Series 1934, No. 23 Issued May 1943

Soil Survey

Knox County Indiana

By
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United States Department of Agriculture

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

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Series 1934, No. 23. Issued———— 1940

SOIL SURVEY OF KNOX COUNTY, INDIANA

By H. P. ULRICH, in Charge, T. M. BUSHNELL, D. R. KUNKEL, and J. S. JAMES, Purdue University Agricultural Experiment Station, and R. R. FINLEY, E. G. FITZPATRICK, and JAMES THORP, Soil Survey Division,[1] Bureau of Chemistry and Soils, United States Department of Agriculture

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

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[1] The Soil Survey Division was transferred to the Bureau of Plant Industry July 1, 1939.

COUNTY SURVEYED

Knox County is in the southwestern part of Indiana, in the pocket formed by the junction of the White and Wabash Rivers (fig. 1). Surrounded on three sides by the Wabash River, the White River, and the West Fork White River, it has the distinction of having more natural water boundaries than any other county in the State. Vincennes, the county seat, is situated on the Wabash River 55 miles south of Terre Haute, 105 miles southwest of Indianapolis, 50 miles north of Evansville, and about 113 miles west and slightly north of Louisville, Ky. The county has an area of 510 square miles, or 326,400 acres.

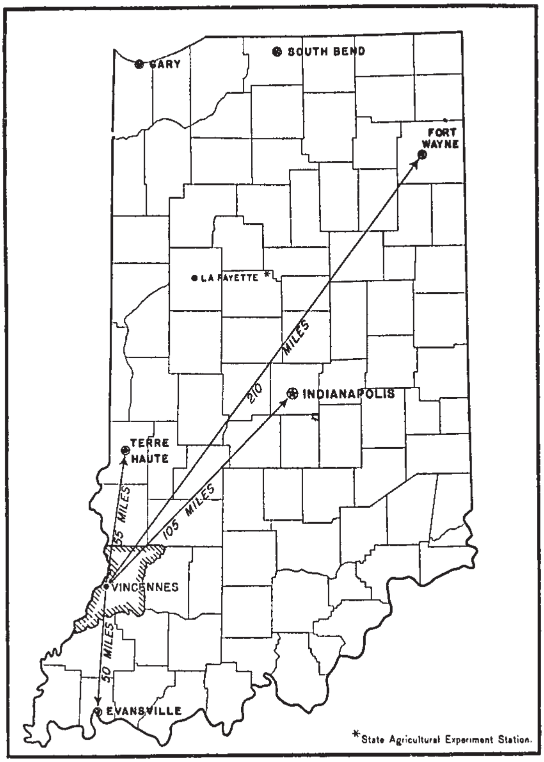

FIGURE 1.—Sketch map showing location of Knox County, Ind.

Physiographically, Knox County lies in the Wabash lowland[2] section of southern Indiana. This section is characterized by (1) the filling in of valleys so that streams develop extensive bottoms out of proportion to their size, and (2) the presence of island hills resembling monadnocks in that they rise above the surrounding bottoms. The present gently rolling relief of the uplands is ascribed by geologists to the invasion of this area by the Illinoian ice sheet, followed by the deposition of wind-blown silts of the post-Sangamon period and subsequent erosion. The thickness of soil material, silt, and glacial drift overlying the rockk ranges from 10 to 50 feet. The unleached part of the glacial material, consisting of clay with some sand and gravel derived from igneous rocks, contains from 10 to 20 percent of limestone fragments. The covering of wind-blown sand and silt ranges from 5 to 40 feet in thickness, the thicker deposits being along the western side of the county. The sand hill and red-clay sections have limy sands and silts from 3 to 8 feet beneath the surface.

[2] MALOTT, CLYDE A. THE PHYSIOGRAPHY OF INDIANA. Handbook of Indiana geology, pt. 2, Ind. Dept. Conserv. Pub. 21: 59–256, illus. 1922.

The county includes three types of relief: (1) Wind-blown sand deposits give the western part of the uplands a dunelike appearance. North of Vincennes this land is rolling and rather highly dissected. The slopes are steep, and the streams occupy narrow V-shaped valleys in their upper courses. Southward toward Decker, the land is gently rolling and almost entirely tillable. (2) The rest of the uplands has, in general, a gently rolling to rolling relief and is moderately dissected by drainage. The broad divides in the vicinity of Freelandville and southward and the divide south of Bruceville include extensive areas of nearly flat land that constitute the remnants of a former peneplain, which once covered the entire county. The valleys are broad and U-shaped, with gently sloping sides. On these divides the existing cycle of erosion has not progressed far enough to provide adequate surface drainage to all areas. Areas of rolling land east of Bruceville, south of Bicknell, and southeast of Monroe City are thoroughly dissected. Erosion is active, and the forested valley slopes are sufficiently steep to be nonagricultural. On a few of the higher hills sandstone rock lies within 5 feet of the surface. (3) The river bottoms are broad extensive filled-in valleys. Small streams cutting down from the hills widen into extensive bottoms where they join the larger streams. The river valleys are divided into the overflow land and the higher terraces that are no longer subject to overflow. The terraces are cut by numerous old channels that sometimes fill with backwater in periods of overflow.

Rising above the river flats in various places are large island hills such as Wolf Hill, Bunker Hill, Chimney Pier Hills, Dicksburg Hills, and Claypole Hills. These hills, underlain by sandstone, have survived the erosive forces of ice and water, which removed the surrounding high land, leaving the hills as island remnants.

The county is drained on three sides by the Wabash and White Rivers. The upland part of the county is very low, and the streams flow in wide U-shaped valleys almost from their headwaters. As the relief is not pronounced, the streams do not cut sharply or deeply, and erosion is not active. Extensive areas of dark-colored bottom land of former drainageways are in many parts of the county. North of Bicknell an ancient channel connects the West Fork White and the Wabash River Valleys by way of Marie Creek. Drainage of the extensive areas of low bottom land has been augmented by many dredged ditches.

The average elevation of Knox County is only 480 feet above sea level. The lowest point is at the junction of the Wabash and White Rivers, where the elevation is 376 feet at low watermark, and the highest elevation is 610 feet. Maximum local differences in elevation do not exceed 90 feet. The elevation[3] at Decker Chapel is 406 feet, Wolf Hill 520 feet, Dicksburg Hills 545 feet, Bicknell (coal mine on State highway) 498 feet, Decker 520 feet, Sandborn (on hill) 528 feet, Chimney Pier Hills 485 feet, the West Fork White River (at Greene County line) 462 feet, and Vincennes (county courthouse) 434 feet. The low watermark of the Wabash River at the northwestern corner of the county (Sullivan-Knox County line) is 410 feet.

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[3] Elevations taken from U. S. Geological Survey topographic sheets and Indiana Handbook of Geology (see footnote 2).

In early times most of the land in this county supported a very fine stand of timber, but all the virgin timber has been removed, and at present the woodland is mainly steeply sloping land. A few scattered areas of prairie land are in the vicinity of Oaktown, Sandborn, and Vincennes. Shaker Prairie, which is west of Oaktown, is the largest. The higher prairie land originally was covered with wild prairie grasses, such as bluejoint turkeyfoot or big bluestem, prairie beardgrass or little bluestem, Indian grass, and other grasses, and the low wet swales supported such coarse grasses as bluejoint, Reed canary grass, and sloughgrasses, and sedges and cattails. Since the land has been under cultivation and has been kept free of fires, bluegrass has become the principal grass. There are a few scattered groves of trees.

The virgin forest in the first bottoms [4] consisted of catalpa, cottonwood, cypress, Kentucky coffeetree (coffee-nut), gum, hackberry, mulberry, oak, sycamore, and walnut. The present growth on the Algiers, Eel, and Genesee soils includes ash, birch, elm, gum, black locust, honeylocust, sugar maple, soft maple, hackberry, poplar, black oak, chestnut oak, pin oak, red oak, white oak, sassafras, shellbark hickory, and sycamore. On the more poorly drained Sharkey and Bartle soils the present stand of trees consists of American linden (or basswood), elm, sweetgum, sugar maple, hackberry, persimmon, sycamore, shellbark hickory, pignut hickory, bur oak, black oak, chestnut oak, red oak, and pin oak. Cypress Swamp is one of the few places in the State where native stands of cypress grow. The virgin vegetation in this swamp consisted of cypress, sweetgum, catalpa, pecan, persimmon, and cane.

The original vegetation of the sand hills consisted of ash, gum, hickory, oak, maple, and poplar, and the present growth on the sandy Princeton soils and on the Elkinsville and Fox soils consists of black oak, chestnut oak, red oak, white oak, pignut hickory, shellbark hickory, poplar, persimmon, sycamore, sugar maple, sweetgum, honeylocust, and walnut. The land locally called red-clay land was formerly covered with ash, poplar, sugar maple, and walnut. The present stand of trees on Princeton silt loam and Iona silt loam consists of ash, elm, basswood, beech, hackberry, shellbark hickory, pignut hickory, tuliptree, sugar maple, walnut, black oak, red oak, white oak, and chestnut oak. The part of Freelandville that is locally called post oak land was originally covered with ash, post oak, persimmon, and gum, and the present vegetation consists mainly of ash, elm, poplar, sugar maple, silver maple, tuliptree, persimmon, pignut hickory, walnut, black oak, red oak, and pin oak.

The grazing of cattle has retarded the reproduction of trees in much of the woodland and confined the growth to less desirable species, such as redbud, ironwood, and sassafras. Where cattle and fire are kept out of the woods, however, reproduction will maintain a stand of desirable trees.

Knox County has an interesting history. About 1680 a French trading post and military station was located at the Indian village that occupied the present site of Vincennes. In 1702 Antoine de la Motte Cadillac came down the river from the newly founded Detroit

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[4] Information on the virgin forest is taken from the following publication: COLLETT, JOHN. GEOLOGY OF KNOX COUNTY. Ind. Geol. Survey Ann. Rpt. (1873) 5: [315]–382, illus. 1874.

with an old priest and stayed here for a time. Vincennes was a fur-trading post from early times and is the oldest continuous white settlement in Indiana. It was founded about 1732 and was named in honor of a French officer, Francis Morgan de Vincennes, who was killed by the Indians in 1736. In 1749 the first mission, or church, was established here, and when the county was organized Vincennes became the county seat. In 1800 it became the first capital of Indiana Territory and remained such until 1813, when the capital was removed to Corydon. Vincennes University, the oldest institution of higher learning west of the Allegheny Mountains, is here.

Antedating the white man and the Indian are the mounds of habitation, worship, and burial of a little-known race of men called mound builders. More than 200 of these mounds are scattered through the county. Two of the most prominent are south of Vincennes. Long after the time of their builders these mounds were used as burial places by the Indians.

Knox County was organized June 30, 1790, by Winthrop Sargent, an agent of the Governor of Virginia, and was named in honor of Henry Knox, the first Secretary of War. This was the first county formed in old Northwest Territory. Originally it covered all of Indiana and large parts of Ohio, Illinois, Michigan, and Wisconsin, extending from the Ohio River north to the Great Lakes. About 1815 the county was laid out with its present boundaries.

The earliest settlers were French traders. Their descendants lived by trapping, hunting, and fishing until the coming of American colonists about 1796. With the organization of the county and the improvement in the government, the city of Vincennes began to grow, and in 1850, according to the Federal census, it numbered 2,070 people. In 1860 the population of the county was reported as 16,056, and it increased steadily to 46,195 in 1920. Between 1920 and 1930 it decreased to 43,813, owing largely to a decline in the bituminous coal-mining industry. In 1930 the rural population comprised 48 percent of the total, or 21,037 people. The density of the rural population was 41 persons to the square mile in that year. Vincennes, with a population in 1930 of 17,564, is the largest city in the county. Bicknell, the second largest city, had a population of 5,212 in 1930, having declined from 7,635 in 1920, owing primarily to disorganization in the coal fields. Important towns are Wheatland, Oaktown, Sandborn, Monroe City, Decker, Edwardsport, Freelandville, Westphalia, Fritchton, and Busseron.

Knox County is served by four railroads, all which pass through Vincennes. They are the main lines of the Baltimore & Ohio Railroad and the Chicago & Eastern Illinois Railway and branch lines of the Pennsylvania Railroad and the Cleveland, Cincinnati, Chicago & St. Louis (Big Four) Railway. The county is also supplied with bus service to Terre Haute, Evansville, Indianapolis, and intermediate points.

United States Highways Nos. 41, 50, and 150 and two State highways connect Vincennes with the principal cities. A complete system of paved and graveled county roads reaches all sections, and a number of earth roads are principally in Harrison Township and through the White River Valley. The 1930 Federal census reported 335 farms on earth roads and 1,905 farms on hard-surfaced and gravel roads.

Some of the earth roads are impassable during certain seasons of the year. Lack of local road-building material, especially gravel, which occurs only in the Wabash Valley, limits the mileage of improved roads.

The county is well supplied with telephones, schools, and churches. Telephone lines connect most of the towns, and many of the farm homes have such service available. According to the Federal census, 1,380 farms, or nearly 59 percent of the total number, reported telephone service in 1930. The county provides an excellent system of consolidated schools in all the townships except the part of Harrison Township that lies outside the Monroe City district. Several one-room schools are scattered through that area.

Although Knox County is dominantly agricultural, a few industries make an important contribution to the wealth and prosperity of the community. Coal mining, the most important industry, is centered in the vicinity of Bicknell, where a number of large shaft mines employ many men. The oil and gas industry has some possibilities of development, as wells have been drilled in various parts of the county and large areas of land have been leased for drilling. Vincennes has a number of important manufacturing plants, which make such products as iron bridges, window glass, boxboard, agricultural machinery, and shoes. In 1937 the Federal census of manufactures reported 38 manufacturing plants in the county which added $4,224,909 to the value of raw materials worth $6,194,968. The plants employed an average of 1,608 wage earners annually and paid a total of $1,652,973 in wages. The important industries related to agricultural activities include a creamery, a cannery, several flour and feed mills, and grain elevators.

CLIMATE

Knox County has hot summers and moderately cold winters. The monthly mean temperatures range from 31.8° F. in January to 79° in July. The average date of the last killing frost is April 14, and the average date of the earliest is October 22, giving an average frost-free period of 191 days. Frost has been recorded as late as May 25 and as early as September 23. Short severe cold snaps frequently occur during the winter, and frequent thunderstorms in summer cause wide fluctuations in temperature. The temperature during the summer is about the optimum for the growth of corn, as the high temperature lasts well into the night. This fact, together with high humidity, makes ideal conditions for the growth of corn.

The average annual precipitation of 45.41 inches is fairly well distributed throughout the year. The spring season usually is moderately wet, and tillage operations are retarded on the wetter soils. During July and August the somewhat lower rainfall, combined with higher temperature, frequently reduces the yield of such crops as corn, oats, and cantaloups. During July 1930, the drought, together with hot dry winds, reduced the yields of cantaloups about one-half, and the corn crop on some areas of the Sharkey and Bartle soils in the Wabash River bottoms and on the sandy soils was a complete failure. Corn yields were reduced on Abington clay loam, the best soil for corn, more than 10 bushels an acre below the normal yields. The light snowfall during winter gives some protection to the wheat crop, but this protection is not dependable, as frequent above-freezing temperatures quickly melt the snow. On the dark soils of depressions, wheat and clover heave severely during some winters, owing to frequent freezing and thawing. During some years late spring freezes bring disaster to the peach crop.

Table 1, compiled from records of the United States Weather Bureau station at Vincennes, gives the essential data regarding the climate of this county.

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

[Elevation, 431 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1936)	Total amount for the wettest year (1927)	Snow, average depth
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	34.2	71	−9	3.68	4.15	4.43	2.9
January	31.8	73	−18	3.95	1.82	5.00	4.1
February	33.4	74	−19	2.55	2.17	1.14	6.1
Winter	33.1	74	−19	10.18	8.14	10.57	13.1
March	44.6	88	4	4.41	2.72	5.21	1.9
April	55.1	94	20	3.90	3.01	5.34	(1)
May	65.8	100	31	4.13	.99	10.10	0
Spring	55.2	100	4	12.44	6.72	20.65	1.9
June	74.4	105	37	4.58	2.02	4.21	0
July	79.0	109	44	3.45	2.63	5.26	0
August	77.0	105	45	3.95	.90	4.82	0
Summer	76.8	109	37	11.98	5.55	14.29	0
September	71.0	106	30	3.96	2.53	5.18	0
October	58.5	95	14	3.60	4.32	1.14	(1)
November	45.2	83	10	3.25	4.66	6.60	.2
Fall	58.2	106	10	10.81	11.51	12.92	.2
Year	55.8	109	−19	45.41	31.92	58.43	15.2

[1] Trace.

AGRICULTURAL HISTORY AND STATISTICS

The early French settlers of this section lived mainly by hunting and fishing. No agriculture was developed until the American colonists began to arrive about 1796 and the Government donated large tracts of land to new settlers. From this time on agriculture developed rapidly.

Land in farms, as reported by the Federal census, ranged from 79.7 percent of the total area of the county in 1880 to 94.7 percent in 1910, at which time the improved acreage, which best reflects the expansion in agriculture, also attained its maximum. Since that time both farm land and land available for crops has decreased slightly. In 1935, 90.7

percent of the area of the county represented farm land, of which 80.7 percent was available for crops. The number of farms increased from 2,125 in 1880 to 2,767 in 1910 and declined to 2,436 in 1935. The average size of farms for those years was 122.4, 111.7, and 121.6 acres, respectively. The average acre value of land was highest ($110.12) in 1920, owing to the rise in prices of farm products during the World War. During the drastic deflation of the next decade the average value dropped to $53. The value of land alone was not reported in 1935, but the average value of land and buildings was $49.92 per acre, compared with $70.36 per acre in 1930, and $6,068 per farm, compared with $8,691 in 1930. Selected farm data are given in table 2.

TABLE 2.—*Land, farm areas, and tenure of farms in Knox County, Ind., in stated years*

Year	Farms	Operated by—			Land in farms			Improved land in farms		
		Owners	Tenants	Managers	Total	Percentage of county area	Per farm	Total	Percentage of farm land	Per farm
	Number	*Percent*	*Percent*	*Percent*	*Acres*	*Percent*	*Acres*	*Acres*	*Percent*	*Acres*
1880	2, 125	72. 1	27. 9	--------	260, 197	79. 7	122. 4	187, 785	72. 2	88. 4
1890	2, 245	69. 0	31. 0	--------	283, 867	87. 0	126. 4	211, 223	74. 4	94. 1
1900	2, 683	60. 0	39. 4	0. 6	305, 966	93. 7	114. 0	249, 603	81. 6	93. 0
1910	2, 767	58. 6	40. 5	. 9	309, 087	94. 7	111. 7	269, 362	87. 1	97. 3
1920	2, 458	57. 1	41. 7	1. 2	299, 751	91. 8	121. 9	261, 428	87. 2	106. 4
1930	2, 359	61. 1	38. 3	. 6	291, 383	89. 3	123. 5	237, 386	81. 5	100. 6
1935	2, 436	58. 3	40. 8	. 9	296, 115	90. 7	121. 6	239, 085	80. 7	98. 1

Agriculture is based on cash-grain farming. The extensive areas of bottom land are devoted to the production of corn and wheat, and here few livestock are raised. Corn has occupied a larger acreage than any other crop since 1889. Its production reached a peak in 1909 but declined after the World War. Although the acreage in wheat has contracted since the World War, it is still very important. Knox County led the State in both acreage and production of winter wheat in 1934. Oats and rye are minor crops.

Hay ranks third in acreage. Clover formerly was the chief hay crop, but, owing to winter-killing and acid soil conditions, it is not grown so extensively at present. Cowpeas and soybeans have been grown since 1912 and supply a large part of the leguminous hay for dairy feed. The acreage in leguminous hay expanded remarkably between 1929 and 1934. Alfalfa is steadily increasing in importance as a hay crop.

Potatoes formerly were an important source of income, although they never occupied a large acreage. In recent years sweetpotatoes have far exceeded potatoes in acreage.

Growing vegetables for sale has assumed a very significant role in the agriculture of the county. The acreage increased from 1,656 acres in 1919 to 6,921 acres in 1934. In value of market vegetables, Knox County ranked second only to Marion County in 1929 when the value in Knox County was $363,176. Tomatoes, cantaloups, and watermelons are the leading market vegetables and were grown on 1,515, 1,188, and 633 acres, respectively, in 1929. Cantaloups were not reported separately in the census of 1935, but the acreages of tomatoes and watermelons increased to 2,209 and 1,363 acres, respectively, in 1934.

Since 1880 orchard fruits have been a growing source of income. The San Jose scale gave the production of apples a severe set-back between 1910 and 1920, and the number of trees declined more than one-half. With the adoption of measures of control, this branch of agriculture has recovered and is again expanding. The oriental fruit moth and the codling moth are the most serious problems in the peach orchards and are most effectively controlled by the propagation of parasites that prey on the moths and by trapping the moths in bait cans suspended in the trees.

The trend of agriculture may be traced in the acreages of the principal crops, presented in table 3.

TABLE 3.—*Acreages of the principal crops in Knox County, Ind., in stated years*

Crop	1879	1889	1899	1909	1919	1929	1934
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Corn	54, 232	58, 016	79, 296	96, 393	78, 578	69, 515	69, 420
Wheat	59, 442	56, 574	71, 382	53, 355	76, 474	51, 798	57, 065
Oats, threshed	2, 603	8, 371	5, 443	7, 769	13, 366	10, 489	7, 257
Oats, cut and fed unthreshed						2, 257	2, 812
Rye	46	416	171	585	2, 076	734	2, 054
Soybeans						4, 262	13, 389
Dry peas			11	3, 181	469	[1] 3, 149	[1] 5, 597
Clover seed						4, 002	
Vegetables for sale					1, 656	3, 663	6, 921
Potatoes		1, 179	573	725	295	288	128
Sweetpotatoes	58	35	105			1, 279	1, 237
Hay	8, 033	23, 061	22, 973	20, 491	24, 627	19, 947	26, 754
Timothy and timothy and clover mixed				11, 982	13, 553	7, 547	7, 251
Clover			11, 912	5, 134	6, 998	5, 952	1, 072
Alfalfa			15	382	1, 206	2, 343	2, 827
Legumes for hay					1, 164	3, 808	14, 362
Other hay			11, 046	2, 993	1, 706	297	1, 242
	Trees	*Trees*	*Trees*	*Trees*	*Trees*	*Trees*	*Trees*
Apples [2]		72, 564	125, 536	73, 523	39, 321	87, 869	105, 868
Peaches [2]		14, 315	46, 504	22, 337	20, 692	147, 701	131, 147

[1] Cowpeas only.
[2] Numbers of trees are for the years 1900, 1930, and 1935, respectively.

Most of the livestock is raised in the general-farming section of the county. In early times, when the marketing of bulky grain crops was difficult and expensive, large numbers of beef cattle were raised and fattened. From 1890 to 1920 about 10,000 head of beef cattle were kept, but since that time the number has declined. Idle concrete silos in the Wabash River bottoms near Vincennes are evidence of the former activity of raising beef cattle in this section. The larger proportion of cattle now are dairy cows on farms around Vincennes and on the hilly land, and the principal breeds are Holstein-Friesian, Jersey, and Guernsey. A few general-purpose cattle and a few herds of purebred Shorthorn and Hereford cattle are raised also. Some feeders are still brought into the county for finishing, but fluctuations in prices of beef cattle and corn, as well as other factors, cause wide variations in the enterprise of fattening cattle. The total number of cattle on farms in 1935 was 18,680.

More swine are raised in this county than in surrounding counties, because of the extensive production of corn on the bottom lands, which should offer possibilities for further expansion of this branch of livestock raising. The number of swine on farms in 1935 was 43,091, a considerable decrease from the number in 1930.

The census of 1935 reports 4,367 horses and 3,456 mules on farms in 1935. Sheep raising, never very important, has declined to insignificance. There were only 2,726 sheep on the farms in 1935. Most farmers keep a flock of chickens, but more chickens are raised in the hilly section than on the bottom lands. The total number in 1935 was 200,103.

The number and value of livestock on farms in census years are given in table 4.

TABLE 4.—*Number and value of livestock in Knox County, Ind., in stated years*

Livestock	1880 [1]	1890 [1]	1900		1910		1920		1930		1935 [1]
	Number	*Number*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*
Cattle	16,075	21,364	20,891	(1)	17,021	$492,337	19,076	$1,020,614	14,894	$763,996	18,680
Horses	6,343	8,306	9,848	(1)	10,730	1,017,040	9,008	857,805	5,277	380,453	4,367
Mules	1,732	1,878	2,537	(1)	3,752	468,760	4,399	561,577	3,687	330,586	3,456
Sheep	9,349	8,559	7,034	(1)	9,929	39,261	3,410	37,958	4,182	30,297	2,726
Swine	38,763	41,253	55,990	(1)	57,643	377,031	58,114	844,884	52,084	518,368	43,091
Poultry	75,591	236,909	148,401	$56,325	190,523	99,381	226,913	196,005	[2] 185,089	[2] 151,773	[2] 200,103
Hives of bees	------	-------	2,096	3,897	1,832	3,948	2,119	7,904	1,520	5,472	-------

[1] Value not reported.
[2] Chickens only.

The value of certain agricultural products, as reported by the Federal census for the years 1909, 1919, and 1929, is shown in table 5.

TABLE 5.—*Value of certain agricultural products in Knox County, Ind., in stated years*

Products	1909	1919	1929
Crops produced:			
Cereals	$2,988,051	$6,017,919	$2,350,759
Other grains and seeds	36,207	55,795	116,820
Hay and forage	266,771	1,021,165	343,559
Vegetables (including potatoes and sweetpotatoes)	210,003	363,436	756,085
Fruits and nuts	48,470	117,075	628,617
All other field crops	117,328	12,683	5,452
Nursery and hothouse products	-----------	-----------	130,535
Forest products cut on farms	-----------	-----------	21,034
Livestock products sold:			
Dairy products	111,577	327,860	411,703
Poultry products	166,080	329,957	376,415

Fruits and vegetables show a very striking increase in value. The development of the production of orchard and small fruits, sweetpotatoes, melons, and tomatoes has provided diversity of crops and income and has helped to develop a prosperous agriculture. The decrease in value of cereals in 1929 was due to the drastic deflation of staple farm crops. Cereal and livestock products, however, have always been the main sources of income. Poultry and dairy products have yielded increasing cash revenue to farmers. The value of forest products cut on farms has shown a marked decline since 1900, when it was $51,702, as practically all of the merchantable timber has been cut.

Table 5 does not show, however, the significance of livestock in farm income. An analysis of the value of products sold, traded, or used in 1929 by the operators' families is as follows:

Crops sold or traded	$2, 208, 834
Livestock sold or traded	1, 177, 050
Livestock products sold or traded	759, 180
Forest products sold	16, 609
Farm products used by operators' families	561, 559
Total	4, 723, 232

The number of cows milked in 1929 was 7,077. The milk production was 3,145,264 gallons, of which 771,182 gallons, valued at $161,948, was sold as whole milk. Most of the rest was disposed of in the form of cream, largely butterfat, of which 484,527 pounds, valued at $213,192, was sold. In 1934, 8,508 cows were milked, producing 2,710,613 gallons of milk.

In 1929, 378,793 chickens, valued at $318,186, were raised. Of this number 146,667, valued at $130,534, were sold alive or dressed. The 1,218,742 dozen eggs produced in 1929 were valued at $341,248. Of this production, 878,146 dozen, valued at $245,881, were sold. In 1934, 410,154 chickens were raised and 842,377 dozen eggs produced.

The use of commercial fertilizers has increased steadily. In 1929, 32.1 percent of the farms reported using $104,108 worth of fertilizers and lime, an average of $137.53 per farm reporting. As failures of clover have become more frequent, liming has become a more general practice, especially on the yellow clay hill lands in the eastern part of the county. Ready-mixed fertilizers are more commonly used, although considerable unmixed fertilizers are applied to the orchards and melon lands and some home mixing is done. The acre applications of fertilizers on various soils and crops, as reported by the farmers, are given in table 6.

TABLE 6.—*Acre applications of the fertilizers used by farmers for the leading crops on the principal soils of Knox County, Ind.*

Soil type	Crop	Acre application	Fertilizer used
		Pounds	
Princeton loamy fine sand; Oaktown loamy fine sand	Sweetpotatoes and cantaloups.	250 to 400	0-12-12,[1] 0-8-32, or 2-16-8.
Abington clay loam; Carlisle silty muck	Corn	100	0-8-32 and extra potash on very chaffy spots.
Ayrshire fine sandy loam; Ayrshire silt loam; Iona silt loam; Iva silt loam; Muren silt loam; Alford silt loam	Wheat	125 to 150	2-12-6, or nitrogen and some complete fertilizer.

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

The many special crops grown require extra hand labor. In the last three decades from 50 to 66 percent of the farms reported hiring extra labor during summer. In 1919, $914,233 was spent in wages on 66 percent of the farms, but in 1929, owing to the decline in the value of farm products, only $602,643 was spent on 51 percent of the farms, or $500.53 per farm reporting. Most of the extra labor is hired from March until after corn shucking in November.

The purchase of $293,078 worth of feed was reported on 64.3 percent of the farms in 1929, or $193.07 per farm reporting.

The farms in Knox County always have been operated mainly by the owners. Tenancy increased from 27.9 percent in 1880 to 40.8 percent in 1935. Most of the farms rent on a share basis, the owner's share ranging from one-third to one-half of the crop. Rentals are higher in the river bottoms, especially in the "pocket," that is, the section near the confluence of the Wabash and White Rivers, where the construction of levees necessitates heavy tax assessments on the farms. On the farms in the bottoms, the owner ordinarily receives one-half of the harvested crop of corn and wheat, either on the farm or delivered to the elevator. The owner pays the taxes and supplies the seed and fertilizer, and the tenant supplies labor and implements. On the hilly land the owner's share is one-third to one-half of the corn and wheat and one-half of the soybeans. Land devoted to orchards and melons is operated mainly by the owners.

The kind and condition of farm buildings differ widely. The better farmsteads with fine modern country homes are in the owner-operated sandy orchard and special crop sections, but the extensive river-bottom farms, with their danger of flood damage and greater percentage of tenant farming, have less expensive farm buildings. On the river-bottom farms, which are largely devoted to cash-grain farming, the number of barns and outbuildings is less. In Decker Township, which is composed almost entirely of overflow bottom and terrace land, the value of improvements is about $8 an acre, whereas in Vincennes and Palmyra Townships the value of improvements is $28 and $22 an acre, respectively. Elsewhere farm buildings are of moderate value.

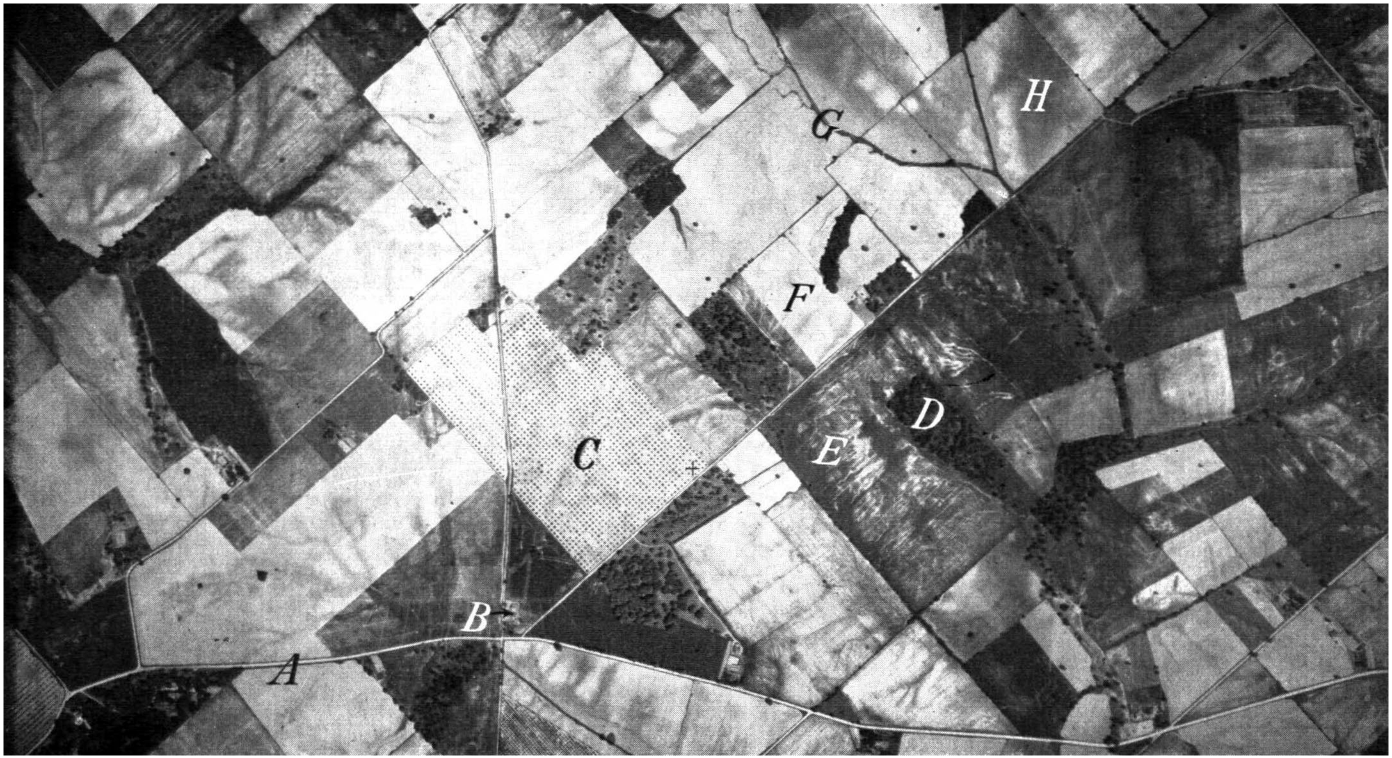
The investment in machinery, according to the Federal census, averaged $583.42 a farm in 1930, a decline from the high point of $734.64 a farm in 1920. The extensive bottom lands make it possible to use power machinery advantageously. The Federal census reported 702 tractors on 670 farms in 1930. Decker and Vincennes Townships rank highest in their machinery investments—$911.13 and $835.39 a farm, respectively, or $5.25 and $7.33 an acre. Townships with the greater proportions of their area in yellow clay hill land tend to have lower investments per acre in machinery.

SOIL-SURVEY METHODS AND DEFINITIONS

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

The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those in road or railroad cuts, are studied. Each excavation exposes a series of distinct soil layers, or horizons, called, collectively, the soil profile. Each horizon of the soil, as well as the parent material beneath the soil, is studied in detail, and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil [5] and its content of lime and salts are determined by simple tests. Drainage, both internal and external, and other external features, such as relief, or lay of the land, are taken into consideration, and the interrelation of soils and vegetation is studied.

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



Vertical aerial view of an area including about 4½ square miles, 1 mile northeast of Fritchton: *A*, Road; *B*, farmstead; *C*, orchard; *D*, woods; *E*, badly eroded pasture; *F*, cultivated field; *G*, stream; and *H*, dark-colored soil.

The soils are classified according to their characteristics, both internal and external, special emphasis being given to those features influencing the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics soils are grouped into mapping units. The three principal ones are (1) series, (2) type, and (3) phase. Areas of land that have no true soil, such as riverwash, gravel pits, and mine dumps, are called (4) miscellaneous land types.

The most important group is the series, which includes soils having the same genetic horizons, similar in their important characteristics and arrangement in the soil profile, and developed from a particular type of parent material. Thus, the series includes soils having essentially the same color, structure, and other important internal characteristics and the same natural drainage conditions and range in relief. The texture of the upper part of the soil, including that commonly plowed, may vary within a series. The soil series are given names of places or geographic features near which they were first found. Thus, Alford, Genesee, and Eel are names of important soil series in this county.

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

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

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

Aerial photographs are used as a base for mapping soils in Indiana. The pictures are taken from an airplane flying at a height of about 13,500 feet, and each picture covers about 4½ square miles. More than 600 pictures, similar to that shown in plate 1, were taken to cover the county. The map showing roads, buildings, streams, soils, and other features was drawn on a sheet of celluloid covering the picture, to separate the map and photographic features. All features mapped were identified on the picture by ground observation, the surveyor covering the ground closely enough either by car or on foot to see at least two sides of every 40-acre field. Soils were studied and identified by observing road cuts and boring with a soil auger. Soil boundaries and other features were then drawn in their correct position and proper relationship to all other features. The field maps were later assembled into larger sheets, from which the final colored map was produced.

SOILS AND CROPS

Knox County has a great diversity of soils and agriculture. Seventy-three soil types and phases and three land types are mapped, but many minor variations in the soils cannot be separated consistently on a map of the scale used in this survey. Eight different soil associations, representing four major types of agricultural use, are outlined on the generalized soil map (fig. 2), and listed in table 7.

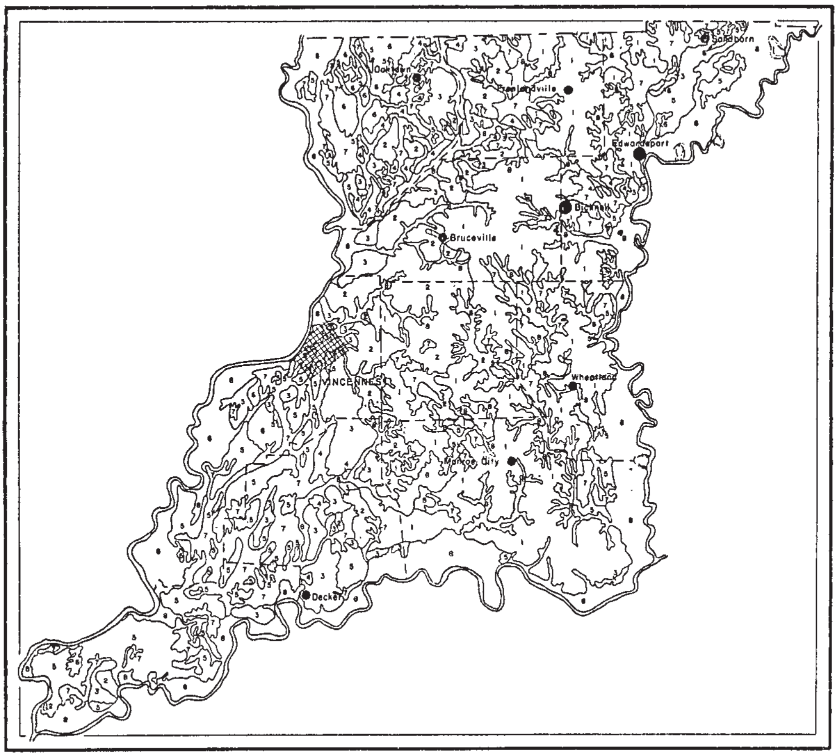


FIGURE 2.—Generalized soil map showing eight different soil associations in Knox County, Ind.: 1, Alford silt loam and associates; 2, Princeton silt loam and associates; 3, sandy Princeton soils and associates; 4, Oaktown and Elkinsville soils and associates; 5, Fox and Homer soils; 6, Warsaw and Buckner soils; 7, Abington, Montgomery, and similar soils; 8, alluvial soils.

TABLE 7.—*Soil associations and use in Knox County, Ind.*

Group No.	Soil association	Use
1	Alford silt loam and associates	General farming.
2	Princeton silt loam and associates	
3	Sandy Princeton soils and associates	Special crops—fruits and vegetables.
4	Oaktown and Elkinsville soils and associates	
5	Fox and Homer soils	Wheat and general farming.
6	Warsaw and Buckner soils	
7	Abington, Montgomery, and similar soils	Corn.
8	Alluvial soils	

Originally, forest covered about 81 percent of Knox County. About 53 percent comprises soils with a low organic-matter content; 28 percent, soils with an intermediate organic-matter content; and the rest, soils that were developed under prairie conditions and therefore are dark-colored and high in organic matter. The light-colored soils, developed under forest, are moderately acid in reaction, except where they are subject to overflow. The soils in group 1 are the most acid, whereas the overflow river bottoms and the soils in the dark swales and depressions are dominantly sweet, that is, very slightly acid or slightly alkaline. Soils in groups 1, 2, 3, 4, 5, and 6 are moderately acid. In this grouping of soils, about 27 percent of the area is strongly acid, 41 percent is sweet, and 32 percent is moderately acid.

The soils in groups 1 and 2 are used for general farming, occupy about 32 percent of the county, and are devoted mainly to corn, wheat, and clover, or to corn, oats or soybeans, wheat, and clover, planted in rotation. Other crops grown include tomatoes, cowpeas, and alfalfa. In western Palmyra Township apples are grown extensively on Princeton silt loam. The soils of groups 1 and 2 are similar in that they are deep silty soils resting on a heterogeneous mass of clay, sand, and gravel, called glacial till, at a depth ranging from 8 to 12 feet. This till generally is limy at a depth ranging from 15 to 20 feet. The soils of group 1 have no lime in their silty subsoils, and they rest on deposits of clay, sand, and gravel at a depth of 7 to 9 feet. The soils of group 2 are underlain by gray limy silt and sand at a depth of 4 to 6 feet, and the till lies deeper, in one place at a depth of about 35 feet.

The utilization of the soils is influenced to a great extent by the relief, or lay of the land. The county includes two major topographic classes of land—rolling land and flat land—and two minor classes—hilly land that is too steep for agriculture and gently sloping or undulating land. The hilly land comprises the steep slopes along the river bluffs and the minor tributary streams. As the slopes erode readily when cleared and cultivated, most of them have been allowed to remain in forest, although some widely scattered areas of steep and rolling land have been seriously eroded as a result of cultivation. The slope phases and eroded phases of the soils generally may be classed as nonagricultural land, as they have little value for growing crops but are well suited to forestry. They comprise about 5 percent of the area of the county. The soils of the other three topographic classes constitute the agricultural land.

Soils with a rolling surface and various degrees of slope have adequate to excessive surface drainage and are dissected by numerous small streams. The slope of the land is such that frequent cultivation and lack of vegetative cover, especially on the clay land, may result in serious sheet and gully erosion. Alford silt loam, the dominant soil with rolling relief, shows this tendency toward erosion by the exposure of the yellow clay subsoil on many hillsides. About 16 percent of the county consists of rolling land.

Soils with a gently sloping or undulating surface have fair surface drainage, owing to the proximity of streams, but somewhat sluggish

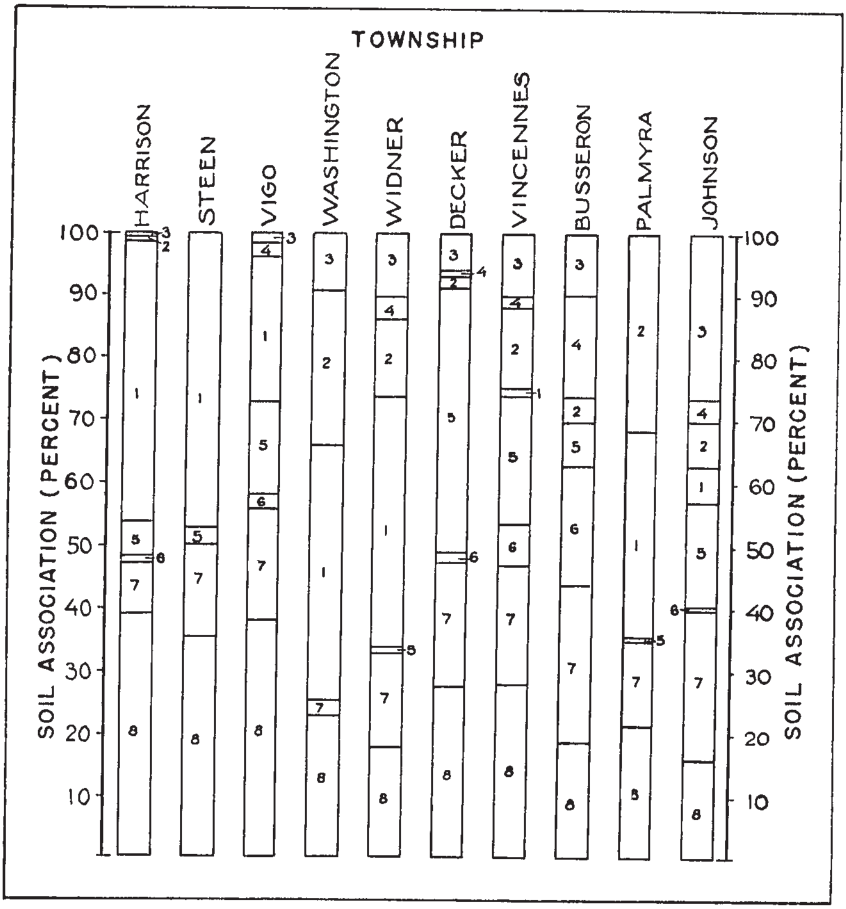


FIGURE 3.—Proportions of each township in Knox County, Ind., included in the following soil associations: 1, Alford silt loam and associates; 2, Princeton silt loam and associates; 3, sandy Princeton soils and associates; 4, Oaktown and Elkinsville soils and associates; 5, Fox and Homer soils; 6, Warsaw and Buckner soils; 7, Abington, Montgomery, and similar soils; 8, alluvial soils.

internal drainage. Muren silt loam is the most extensive soil of this type. The soils are benefited by tile drainage, but crops grow well even without tiling. About 8 percent of the county may be classed as gently sloping or undulating land. This land is easily tilled with machinery.

The flat lands (groups 3 to 8, inclusive) comprise all the river terraces and bottoms, except the areas of sand dune soils, Elkinsville fine sandy loam, and Oaktown loamy fine sand; the poorly drained lower slopes of hills; and the tops of the broad divides, such as in the vicinity of Freelandville and south of Bruceville. This land, especially on the river bottoms, lends itself to the use of power machinery. It comprises about 71 percent of the area of the county. Owing to its flat surface, much of this land is poorly drained. On the river bottoms, especially in the Wabash Valley, drainage is provided by extensive systems of open dredged ditches. On the hill

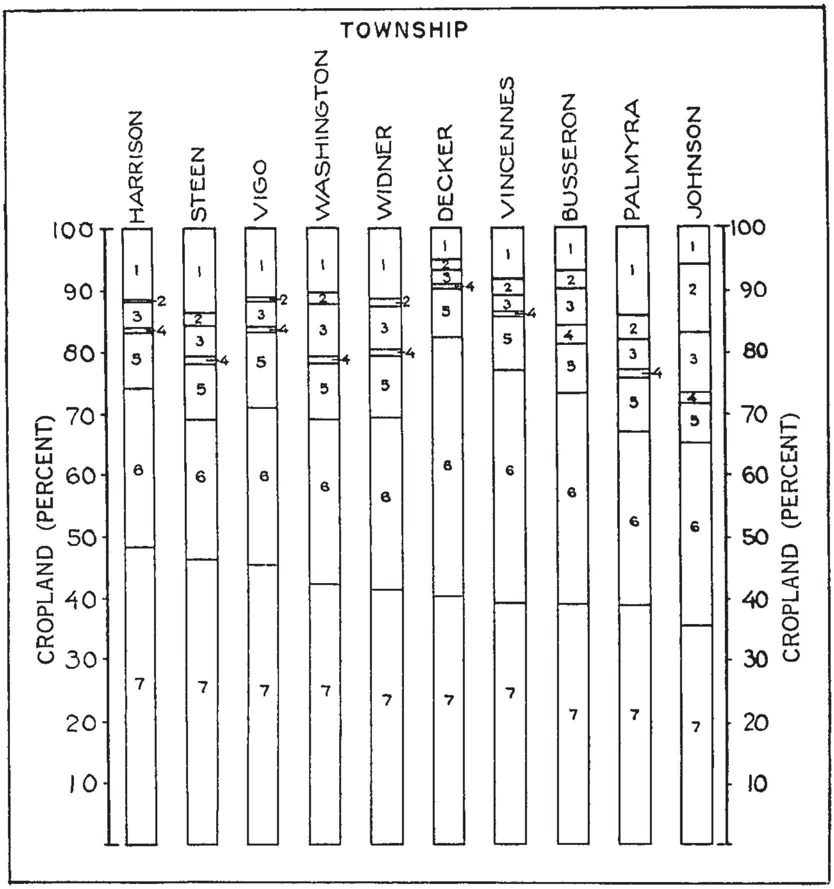


FIGURE 4.—Proportions of cropland in each township in Knox County, Ind., devoted to the following crops: 1, Hay; 2, miscellaneous crops; 3, soybeans and peas; 4, rye; 5, oats; 6, wheat; 7, corn.

land and on those terraces where it is possible to obtain sufficient fall for an outlet, tile drainage is used. Tiling has been successful on much of the flat upland, such as that including the Ayrshire and Iva soils. About 29 percent of the area needs tiling or ditching except where tile has already been laid.

Figure 3 shows the proportions of each township consisting of the eight soil associations, and figure 4 shows the proportions of cropland in each township devoted to the principal crops.

The soils of group 1 occupy from 40 to 47 percent of Steen, Harrison, Washington, and Widner Townships. These townships are among the highest in the production of corn, oats, and hay, but they are among the lowest in the production of wheat. Harrison, Steen, and Vigo Townships lead in the production of corn because nearly 40 percent of their area consists of overflow river-bottom soils (group 8), which are devoted almost entirely to corn. Washington and Widner Townships, although their area of cornland (soil groups 7 and 8) is small, rank fourth and fifth in the percentage of their cropland used for corn. The townships that have the greatest area of soils of group 1 also have the highest percentage of their farm land in rough pasture, forest, and wasteland. These soils are very acid. Clover fails frequently, but alfalfa and sweetclover grow readily on well-drained land after liming.

Washington and Palmyra Townships have the greatest proportion of the soils of group 2. Apple growing is centered largely on the red clay soil (Princeton silt loam) of Palmyra Township. The soils of group 2 in Washington Township are mainly yellow clay soils, which are used for general farming. These soils range from sweet to moderately acid. Clover grows well in some places, but in other places the crop would be benefited by liming. In general, these soils tend to be less acid close to the river bottoms.

For convenience in discussion, the soils and land types of Knox County are placed in the following groups on the bases of use, color, and drainage: (1) Soils of the general-farming districts; (2) soils of the special-crops districts; (3) soils of the wheat- and general-farming districts; (4) dark-colored and very dark colored soils devoted chiefly to corn; (5) light-colored soils of the bottoms devoted chiefly to corn; and (6) miscellaneous land types.

In the following pages the soils of Knox County are described in detail, and their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 8.

Table 8.—*Acreage and proportionate extent of the soils mapped in Knox County, Ind.*

Soil type	Acres	Percent	Soil type	Acres	Percent
Alford silt loam	34,368	10.5	Oaktown loamy fine sand	3,584	1.1
Pike silt loam	4,864	1.5	Elkinsville fine sandy loam	6,272	1.9
Princeton silt loam	14,080	4.3	Elkinsville loam	2,944	.9
Alford silt loam, slope phase	8,192	2.5	Elkinsville silt loam	4,032	1.2
Alford silt loam, eroded phase	768	.2	Buckner sandy loam	5,888	1.8
Pike silt loam, slope phase	1,792	.5	Buckner loam	1,920	.6
Princeton silt loam, slope phase	3,008	.9	Fox loam	2,688	.8
Princeton silt loam, eroded phase	128	(1)	Fox sandy loam	4,096	1.3
Princeton fine sandy loam, slope phase	1,856	.6	Warsaw loam	1,600	.5
Bainbridge silt loam	384	.1	Warsaw sandy loam	1,408	.4
Otwell silt loam	1,216	.4	Vincennes silty clay loam	5,056	1.5
Muren silt loam	15,872	4.9	Vincennes clay loam	5,696	1.7
Iona silt loam	7,296	2.2	Vincennes silt loam	1,600	.5
Iva silt loam	7,040	2.2	Vincennes loam	2,112	.6
Ayrshire silt loam	4,352	1.3	Bartle fine sandy loam	2,304	.7
Ayrshire fine sandy loam	2,880	.9	Bartle loam	2,432	.7
Marion silt loam	960	.3	Bartle silt loam	4,096	1.3
Princeton loamy fine sand	3,840	1.2	Homer loam	2,240	.7
Princeton fine sandy loam	10,624	3.3	Homer sandy loam	768	.2
Princeton loam	3,264	1.0	Markland silt loam	1,088	.3
			McGary silt loam	2,368	.7

[1] Less than 0.1 percent.

TABLE 8.—*Acreage and proportionate extent of the soils mapped in Knox County, Ind.*—Continued.

Soil type	Acres	Percent	Soil type	Acres	Percent
Lyles silty clay loam	1,856	0.6	Genesee silty clay loam	7,168	2.2
Lyles silt loam	4,800	1.5	Genesee silty clay loam, high-bottom phase	704	.2
Lyles loam	4,800	1.5	Genesee loam	3,712	1.1
Ragsdale silt loam	3,520	1.1	Genesee loam, high-bottom phase	320	.1
Ragsdale loam	896	.3	Genesee fine sandy loam	1,920	.6
Montgomery silt loam	7,296	2.2	Eel silt loam	23,040	7.1
Montgomery silty clay loam	2,496	.8	Eel silty clay loam	14,720	4.5
Westland clay loam	5,248	1.6	Eel loam	640	.2
Westland loam	640	.2	Algiers silt loam	7,680	2.4
Ross silty clay loam	5,440	1.7	Algiers loam	512	.2
Ross silt loam	2,112	.6	Algiers fine sandy loam	512	.2
Kings silty clay	2,368	.7	Stendal silt loam	2,176	.7
Sharkey clay	4,352	1.3	Mine dumps	64	(1)
Sharkey clay loam	3,072	.9	Riverwash	576	.2
Abington clay	1,472	.5	Gravel pits	256	.1
Abington clay, mucky phase	1,216	.4			
Abington clay loam	3,264	1.0	Total	326,400	100.0
Carlisle silty muck	768	.2			
Genesee silt loam	13,888	4.3			
Genesee silt loam, high-bottom phase	1,920	.6			

[1] Less than 0.1 percent.

SOILS OF THE GENERAL-FARMING DISTRICTS

The soils of the general-farming districts may be placed in subgroups for convenience in description, on the bases of relief and drainage, as follows: Soils of the rolling areas, soils of the steep areas, soils of the undulating areas, and soils of the poorly drained flats and depressions.

SOILS OF THE ROLLING AREAS

Soils of the rolling areas include Alford silt loam (an extensive soil), Pike silt loam, and Princeton silt loam.

Alford silt loam.—Under conditions of cultivation the dry surface soil of Alford silt loam has a grayish-brown cast and the moist soil is brown or yellowish brown. The surface soil is smooth soft silt loam about 9 inches thick. Although its mellow porous structure aids the rapid absorption of water, the rolling relief allows rapid run-off during rains; and this feature, together with high evaporation during the hot summer, causes crops to suffer from lack of moisture. The subsoil is brownish-yellow friable silty clay loam with a slightly red cast. It breaks readily into irregular angular lumps one-fourth to three fourths of an inch in diameter. It is easily penetrated by roots and does not markedly retard the movement of moisture. The lower part of the subsoil, beginning at a depth of 3 feet, is slightly compact and is mottled with rust brown and gray. Beneath this layer the soil consists of dull-brown, gray, and yellow smooth soft silt loam to an average depth of 100 inches. The material in this layer has a porous open structure, allowing water to move freely through it. Underlying the soft silt loam is a mottled yellowish-brown and gray heterogeneous mass of clay, sand, and gravel, which probably is limy in many places at a depth of 15 to 18 feet. The soil is strongly acid to a depth ranging from 70 to 90 inches, where it generally becomes approximately neutral in reaction.

Alford silt loam is the most extensive soil in the county. It is well drained and occupies moderately rolling relief that is not sufficiently steep to hamper tillage operations seriously. The soil occupies rounded ridge tops separated by shallow stream valleys in many places, and in such areas the hills and valleys may be cultivated as a unit. In other places, such as east of Bruceville, south of Bicknell, and southeast of Monroe City, the land is dissected by numerous streams bordered by steep wooded hillsides. In these places farming is confined largely to irregular fields on the ridge tops.

Erosion is a serious problem on this soil. Owing to the rolling relief and the heavy rains during the fall and winter, it is important that some cover crop be grown during these seasons. Severe sheet and gully erosion have destroyed only a small area in this county, but the less noticeable sheet erosion, by gradually removing the surface soil, has exposed the yellow subsoil on many hillsides. The surface soil is the most important part of the soil for crop production. Sheet erosion has lowered the productivity of many acres of Alford silt loam to the extent of 10 to 15 bushels of corn an acre.

This soil is used primarily for general farming. The common rotations are corn, oats or soybeans, wheat, and clover; or corn, wheat, and clover. Corn yields from 30 to 35 bushels an acre, depending largely on the amount of rainfall during late July and August. Wheat yields from 18 to 22 bushels an acre, and yields of 30 bushels are not uncommon. It is a common practice to fertilize wheat with 125 to 150 pounds of 2–12–6 fertilizer an acre. Clover grows well where the soil has been limed. Many farmers are having trouble getting and keeping good stands of clover because of acid soils, late July drought, which frequently kills young plants, and winter-killing. Oats are not generally grown, because climatic and soil conditions are unfavorable. Wet weather in the spring causes late seeding, and this results in late maturity and reduction of yield by drought. Soybeans or cowpeas are commonly grown as a leguminous hay crop. Alfalfa grows well on this soil, but it requires the application of lime. Alford silt loam is most useful for general farming. Where it is underlain by coal, the mining rights have been valued at $40 to $50 an acre, although this valuation is by no means fixed for the future.

Pike silt loam.—Pike silt loam is similar to Alford silt loam but differs from it in having a light-red deep substratum, which is exposed in many road cuts. It occurs most extensively in Harrison Township southeast of Monroe City. Pike silt loam has better internal drainage than Alford silt loam, as the silty subsoil is underlain by a mixture of red sandy clay and fine gravel. The subsoil above the gravel has a browner appearance because of better drainage. The cropping system is similar to that practiced on Alford silt loam. Alfalfa is well adapted to Pike silt loam because of the open porous subsoil, but liming is necesary to grow this crop. Tillage operations on this soil begin at an earlier date in the spring, as it dries more quickly than Alfor silt loam.

Princeton silt loam.—Princeton silt loam is a rolling well-drained soil and is locally known as red clay land. The 8- to 10-inch surface soil consists of smooth soft brown or grayish-brown silt loam. It is underlain by a reddish-brown or reddish yellow-brown silty clay loam subsoil that is moderately compact but breaks and crumbles readily into small angular fragments. Below a depth of 3 feet the soil consists of light brownish-yellow smooth soft structureless silt loam, which is lime-bearing at a depth of 5 feet. The open porous consistence of the soil promotes ready absorption and retention of moisture. This is a fertile soil and contains adequate supplies of plant nutrients. Roots penetrate easily into the soft well-drained subsoil.

Because of certain favorable qualities, Princeton silt loam is used extensively for growing apples, especially in Palmyra Township, where the areas are largest. The rolling surface assures adequate air drainage. Orchard sites are generally chosen on gently rolling land that allows clean cultivation without serious erosion. Control of moisture is the most serious problem of orcharding on this soil. Clean cultivation and increase of organic matter by green manuring are the methods used to conserve moisture. Surface run-off is high, but it can be reduced by the maintenance of a soil mulch. The control of erosion is highly important in orchards. On the more rolling land where clean cultivation cannot be practiced, alfalfa, soybeans, or grass are used as cover crops for the control of erosion. Alfalfa is more commonly used because it checks sheet erosion more effectively than soybeans do.

The horticultural specialists at Purdue University state that short sod rotations are displacing cultivation and cover crops in many apple orchards. Grass or a mixture of grass and clover is grown for 3 or 4 years, after which the orchard is disked and reseeded. The straw-mulch system of management is used to a considerable extent. A readily available nitrogen fertilizer, such as sodium nitrate or ammonium sulfate, is applied about 3 weeks before blossomtime to aid in fruit setting. Commercial orchardists devote their time exclusively to orcharding and do practically no general farming.

The varieties of apples most commonly grown are Yellow Transparent, Oldenburg (Duchess), Wealthy, Grimes Golden, Jonathan, Delicious, Golden Delicious, Stayman Winesap, Turley, Winesap, and Rome Beauty. Early apples are marketed when harvested, but thousands of bushels of the later varieties are put in cold storage in the several large storage plants around Vincennes.

Where Princeton silt loam is used for general farming, crop rotations are similar to those practiced on the Alford and Pike soils, and crop yields are about the same. This soil is not so acid as Alford silt loam. Some included areas are practically neutral in reaction, so that red clover and sweetclover make fine stands in many fields without liming, but in some places the seeding of red clover on unlimed land fails to obtain a stand. Failure of clover indicates the need of lime, and most areas of this soil would probably be greatly improved by liming. Tomatoes are commonly grown, and yields range from 7 to 10 tons an acre. Land in bearing orchards commands a high price, but its value for general farm crops is somewhat lower.

SOILS OF THE STEEP AREAS

Associated with the rolling soils of the Princeton, Alford, and Pike series are steep slopes at the edges of the river bottoms and along the small tributary streams. These hillsides are too steep to cultivate and are largely wooded. The following soil phases are recognized and mapped: Alford silt loam, slope phase; Alford silt loam, eroded phase; Pike silt loam, slope phase; Princeton silt loam, slope phase; Princeton silt loam, eroded phase; and Princeton fine sandy loam, slope phase. In general the profile characteristics of the slope phases are very much like those of the typical soils, except that the individual horizons in many places are thinner. The eroded phases are similar to the typical soils except that one or more horizons have been partly or entirely removed by sheet or gully erosion. These phases comprise the principal forested areas of the uplands and are most extensive within the rolling districts around Bruceville, south of Bicknell, and southeast of Monroe City.

A considerable proportion of the farm land of Harrison, Washington, Palmyra, Widner, and Steen Townships may be classed as rough pasture, forest land, and wasteland. According to the 1930 census, 15 percent of Harrison Township, 11 percent of Palmyra Township, 10 percent of Washington Township, and 7 percent of Widner Township are in woodland. The woods are confined mainly to steep hillsides but probably 2 percent of the river bottom area also is wooded.

Alford silt loam, slope phase.—The slope phase of Alford silt loam is much like the typical soil except that the several horizons average somewhat thinner. The surface soil is perhaps 6 to 8 inches thick, compared with 9 inches in the typical soil, and the compact horizon occurs at a depth of 24 to 30 inches instead of 36 inches. Practically all the slope phase of Alford silt loam is wooded; otherwise it would be eroded sufficiently to be classed as an eroded phase. Cleared areas are in pasture, and, where a sufficiently dense sod is maintained, erosion is not likely to be serious, although such areas are generally eroded to some extent because clean-tilled crops were grown before they reverted to pasture.

Alford silt loam, eroded phase.—The eroded phase of Alford silt loam originally was similar to the typical soil, but the clearing of forest and attempts at cultivation or overgrazing have led to serious erosion. Sheet wash has removed most of the surface soil, and many small gullies have cut deeply into the subsoil. The chief value of this eroded soil is for the production of forest trees. Common locust (black locust) is especially useful in halting erosion, and this tree has the added advantage that it will fix nitrogen in the soil so that grass will grow. Lespedeza volunteers on this land and also helps to hold the soil and check further erosion.

Pike silt loam, slope phase.—Pike silt loam, slope phase, is characterized by upper soil horizons that are similar to those of the Alford soils and are the same as those of typical Pike silt loam except that they are not so thick. The red substratum is somewhat nearer the surface than in the typical soil, and in some places the silty mantle is less than 3 feet thick. As with the slope phase of Alford silt loam, most of this soil is in forest and some small areas are devoted to pasture. About 50 acres of steep soil occurring on the White River bluffs northeast of Iona, in association with Bainbridge silt loam, are included with this soil in mapping.

Princeton silt loam, slope phase.—The surface soil of Princeton silt loam, slope phase, consists of a 5- to 6-inch layer of smooth soft grayish-brown silt loam. This is underlain by reddish-brown silty clay loam that breaks readily into small angular fragments. At a depth of 2 to 2½ feet the material is light brownish-yellow soft smooth silt loam, which contains lime at a depth ranging from 3 to 5 feet. This soil absorbs and holds water readily, and roots can readily penetrate to considerable depth. Most of this soil is wooded, but some areas support a good sod of pasture grasses. Wherever the land is cleared and cultivated, it is subject to more or less severe sheet and gully erosion.

Princeton silt loam, eroded phase.—The profile characteristics of Princeton silt loam, eroded phase, originally were the same as those of the slope phase, but sheet wash and gullying have removed practically all of the surface soil and in many places much of the lower horizons. The silty clay loam layer has been severely cut by gullies, and in some places the limy silty material is exposed at the bottoms of gullies or even on the surface of the land. Erosion can be checked by building brush dams, planting locust and other forest trees, and encouraging the growth of pasture grasses.

Princeton fine sandy loam, slope phase.—Princeton fine sandy loam, slope phase, consists of brown loose loamy fine sand or fine sandy loam to a depth of 6 to 8 inches. It is underlain by reddish-yellow or light reddish-yellow sandy clay loam. The deeper part of the substratum is friable but has sufficient body to hold moisture well, and at a depth of 4 to 6 feet it generally is moderately calcareous.

Much of Princeton fine sandy loam, slope phase, is in woodland; but cleared and cultivated areas, although steep, are not very seriously affected by erosion, because the sandy surface soil absorbs rain water rapidly and the more or less porous substratum allows it to pass fairly readily. A comparatively small area of this soil is devoted to pasture and a still smaller area to orchards.

SOILS OF THE UNDULATING AREAS

The soils of the undulating areas within the general-farming districts occur on the tops of rounded ridges and on the broad divides; consequently they are easily tilled with machinery. As erosion is not a serious problem, a higher proportion of grain crops may be grown in shorter rotations without material reduction in soil productivity. Surface drainage is fair, as most of these soils occur around the heads of draws on flat divides. In two of the soils, Bainbridge silt loam and Otwell silt loam, internal drainage is well established in spite of the nearly flat surface, owing to a permeable open substratum. The other two soils, Muren silt loam and Iona silt loam, have heavier substrata and therefore somewhat sluggish internal drainage. In some places this condition may be improved by tile drains.

Bainbridge silt loam.—The characteristics of Bainbridge silt loam closely resemble those of Pike silt loam, except that the surface is flat and the underlying material is more sandy and somewhat assorted and stratified at a depth ranging from 7 to 10 feet. In cultivated fields the surface soil is brown mellow silt loam with a slightly red cast. Below a depth of 12 inches is yellowish-brown friable silty clay loam with a slightly red cast. At a depth of 3 to 4 feet the soil material becomes increasingly reddish brown and gritty and is underlain by moderately assorted fine gravel, sand, and silt. The soil material is acid in reaction throughout.

This soil occupies a flat-topped terrace approximately 30 feet above the White River flood plain. Only a small area is mapped. Because of the slight slope, all crops may be grown with little loss from erosion. In yields, the soil is well above the average, owing to the absence of erosion and the system of farming followed. This system includes one or more years of red clover and mixed hay in the rotation under a mixed grain and livestock farming system, resulting in the maintenance of both fertility and yields. Applications of lime are necessary for the successful production of red clover. The soil is probably best suited for growing wheat, yields of which are from 22 to 25 bushels an acre.

Otwell silt loam.—Otwell silt loam is associated with Bainbridge silt loam on flat to gently undulating areas on a rather broad terrace northeast of Iona. It is developed on slightly heavier sandy and silty deposits than the associated Bainbridge silt loam. Internal drainage may be slightly sluggish in areas having heavier, more clayey substrata.

The 12-inch surface soil is grayish-brown yellow silt loam, the lower part of which is slightly lighter in color, owing to a lower content of organic matter. The yellowish-brown silty clay loam subsoil is friable and crumbles readily to small angular particles. Gray and yellow mottlings appear within 3 feet of the surface in some places where the subsoil consists of compact heavy silt and clay. The lower subsoil layer consists of friable assorted sand and silt.

A few small areas, included on the map, have a yellow subsoil with mottling appearing at a depth of 20 inches. In such areas internal drainage is more sluggish and spring seeding may be delayed a few more days.

Mixed grain and livestock farming is followed, the crops grown and yields obtained being similar to those on Bainbridge silt loam. Owing to the slight relief, erosion is not a problem. Inclusion of legumes in the crop rotation has resulted in better than average yields for this soil. Only a small total area is mapped.

Muren silt loam.—Muren silt loam has a 10-inch brownish-gray surface soil, and the subsoil is pale-yellow silty clay loam to a depth of about 20 inches, below which it is more compact and more highly mottled with gray than the associated Alford soil, and moisture movement is retarded to some extent. The parent material consists of highly mottled brown and gray silty loess, which is underlain at a depth of 15 feet or more by calcareous Illinoian glacial till. Owing to poorer internal drainage, this soil cannot be cultivated so early in the spring as Alford silt loam, and yields are not quite so high, but the cropping system is similar. This soil is widely distributed. The larger areas are near Freelandville.

Iona silt loam.—Iona silt loam consists of an 8- to 10-inch brownish-gray friable silt loam surface soil overlying somewhat compact yellow silty clay loam, which extends to a depth of 30 to 36 inches and is more or less mottled with gray in the lower part. In the characteristics just mentioned, the soil resembles Muren silt loam very closely, but at a depth of approximately 4 feet it is underlain by grayish-yellow limy silt loam.

The cropping system on Iona silt loam is very similar to that on Princeton silt loam, with which it is associated. Clover grows more readily than on Muren silt loam. Iona silt loam is more extensive in the area south of Bruceville.

SOILS OF THE POORLY DRAINED FLATS AND DEPRESSIONS

The soils of the poorly drained flats and depressions within the general-farming district are Iva silt loam, Ayrshire silt loam, Ayrshire fine sandy loam, and Marion silt loam. They are locally known by such names as buckshot land, slash land, and gray flats. These soils occupy the broad flat divides between main drainage lines and the flat low-lying areas adjoining stream bottoms. The sandy Ayrshire soils occupy depressions within areas of Princeton loam and Princeton fine sandy loam. Surface drainage is poor because of the flat surface, and in many places internal drainage is retarded by a compact subsoil. These poorly drained soils are greatly improved by tile drainage. Working these soils when they are wet destroys their tilth, as they puddle when wet and bake when dry. Organic matter is deficient.

Crops grown on the Iva and Ayrshire soils consist mainly of corn, wheat, and clover or mixed hay. Corn yields vary considerably with the rainfall. Between 30 and 35 bushels is the usual yield, although in wet seasons the yield may be much lower. Wheat ordinarily yields from 15 to 20 bushels an acre, but yields ranging from 20 to 40 bushels frequently are obtained. Clover requires liming on the Iva soils but not on most areas of the Ayrshire soils. Crop rotations are interrupted occasionally by crop failures.

Iva silt loam.—Iva silt loam is the most extensive soil in this group. It is widely scattered in small areas, the largest being in the vicinity of Freelandville. The 6- to 8-inch surface soil is light gray when dry and brownish gray when moist. Below plow depth the subsoil is mottled light-gray and yellow silty clay loam. In many places it is moderately compact and somewhat impervious to the movement of moisture at a depth of 3 feet. Below a depth of 3 feet the subsoil is dominantly yellow noncalcareous silt loam. Particles of black buckshot gravel are common on the surface. These consist of nearly round very dark-brown or black concretions of iron and manganese compounds, which have been deposited in the soil from solution.

Included with Iva silt loam in mapping are several small areas of a more poorly drained soil. In such areas the surface soil is very light gray silty material and the subsoil is splotched and stained with rusty iron colors and concretions.

Ayrshire silt loam.—Ayrshire silt loam differs from Iva silt loam in having limy silty or sandy substrata at a depth of approximately 4 feet. It resembles Iva silt loam in other soil features. Ayrshire silt loam is most extensively developed on the divide south of Bruceville, but small areas are widely scattered in association with Princeton silt loam and on the lower slopes of hills associated with the Alford and Muren soils.

Ayrshire fine sandy loam.—Ayrshire fine sandy loam occupies small depressions within areas of Princeton fine sandy loam. It differs from Ayrshire silt loam mainly in the sandiness of the surface soil and the subsoil. As mapped, it includes small areas of Ayrshire loam.

Ayrshire fine sandy loam occurs largely in the sandy hill country near the bluffs. Because of its poor drainage it is not well suited to the special crops sometimes planted on it. Orchard fruits are small and knotty, and the trees are not thrifty. Melons return small yields of poor-quality fruit. In the spring, apple and peach buds are frequently frostbitten because of poor air drainage. As Ayrshire fine sandy loam occupies many small depressions in the sand dunes, it is difficult to drain. Grass is the principal crop, but on larger areas corn and wheat are grown.

Marion silt loam.—Marion silt loam is developed in the vicinity of Freelandville on the same type of flat land as is Iva silt loam. The surface soil is gray or somewhat dark gray silt loam 15 inches thick. It is underlain by slightly mottled gray and yellow silty clay loam, into which dark organic matter penetrates along the vertical cleavage lines. The Marion soil generally consists of limy silt at a depth of 5 feet. The soil is acid and does not support clover without liming. Farmers say that this soil is superior to the Iva or Ayrshire soils. The rotation commonly practiced is corn, wheat, and clover where the soil is limed. Sweetclover does well if the soil is limed and inoculated.

SOILS OF THE SPECIAL-CROPS DISTRICTS

The sand-hill areas of Johnson Township, from Decker northward, constitute the outstanding special-crops districts in the county. With about 25 percent of its area composed of sandy Princeton soils, Johnson Township has 11 percent of its cropland classed as "other crops,"[6] which consist largely of melons, sweetpotatoes, and tomatoes. This does not account for the extensive acreage of orchard fruits. This has long been an important melon-growing section, owing to the favorable soil conditions. Melons grow best in a loose sandy soil that dries quickly and warms rapidly. Princeton loamy fine sand and Oaktown loamy fine sand with their loose sandy subsoils furnish sufficient moisture for melons during dry weather. These soils are very deficient in nitrogen and organic matter. Organic matter is important, because an abundant supply aids in reducing damage from drought. Land for melons is generally operated on a 2-year rotation, including melons and a rye green-manure and cover crop the first year, followed by cowpeas or soybeans and a winter cover crop of rye. This rotation places Johnson Township in the lead in the production of cowpeas and soybeans. In the culture of melons the tender young plants are started in hotbeds and transplanted after the danger of frost is past. They are planted in rows about 4 feet apart in each direction so that they can be cultivated constantly in both directions, in order to conserve moisture and control weeds. As the vines become longer they are cultivated in only one direction, and after blossoming, when fruit-setting starts, cultivation ceases. Fertilizing and manuring are common practices. Stable manure and straw manure, where available, are used in addition to green manure, in order to build up the content of humus. Commercial fertilizer, such as 2–12–6, 4–10–6, and 2–16–8, is applied in the hill

[6] Based on county assessor's reports.

at the rate of 400 to 500 pounds an acre, and additional fertilizer may be broadcast.

The Rocky Ford type of cantaloup, of which Hale Best is the most important variety, is grown almost exclusively. Other varieties of this type are Eden Gem, Rust-Resistant Pollock, Salmon-Tinted Pollock, Golden Pollock, and Burrel Gem. Some Tiptop and Hackensack cantaloups are grown for local trade. Varieties of watermelons grown include Cuban Queen, Dixie Bell, Tom Watson, and Kleckley Sweet. Many growers market their fruit under Federal inspection and grades. This is particularly true of the many carloads shipped from Decker to the large eastern markets. In recent years a large percentage of the crop of melons and other fruits is sold direct to buyers who haul the product away from the farm by truck. Yields of cantaloups range from 250 to 400 crates (36 to 45 melons each) an acre on Princeton loamy fine sand, with somewhat lower yields on the other soils suited to melons. Princeton loamy fine sand is highly valued because of this special use.

Sweetpotatoes are widely grown on Oaktown loamy fine sand, Princeton loamy fine sand, Elkinsville fine sandy loam, and Princeton fine sandy loam. They are commonly grown in small patches of less than 10 acres each. Owing to such diseases as wilt and rot, they are grown on the same land only once in every 4 to 6 years. The plants are transplanted in the spring when danger of frost is past, in rows about 3 feet apart. They are given constant cultivation until the vines become too heavy to move easily. Ordinarily they are planted on land that has previously been in melons.

As these soils are low in organic matter and nitrogen, green manure and cover crops are commonly grown. Commercial fertilizers, such as 0-20-20, 4-24-12, 2-16-8, and 0-8-32, are sown in the hill with sweetpotatoes at the rate of 400 to 500 pounds an acre. Varieties grown are chiefly Red Jersey and some Nancy Hall. Yields range from 150 to 200 bushels an acre, but yields of 350 bushels are not uncommon. Many of the sweetpotatoes are stored until winter, in order to realize higher prices. This practice is followed around Decker. The sweetpotatoes are graded and marketed by consignment to commission houses. At planting time sweetpotato buyers contract for a large proportion of the acreage. In 1931 the contract price was $1 a bushel for No. 1 grade and 65 cents for No. 2 grade.

Early tomatoes are grown extensively on the lighter sandy soils because these soils are well suited to early planting and promote quick growth. The crop has a high acre value if the tomatoes ripen in time to command the higher prices of the early-tomato market. At the height of the season several carlots are shipped daily from Decker to large produce markets.

Peaches occupy the largest acreage and probably bring the largest income of any of the special crops. They do equally well on the heavier loam and the lighter sandy soils. The ideal soil for peaches is said to be a loose sand underlain by clay at a depth of 8 to 12 feet, in order to give the greatest moisture movement within the feeding range of the roots. Some of the finest peaches are grown on Princeton loam, which has a heavier subsoil than the lighter textured Princeton loamy fine sand and Oaktown loamy fine sand. Roots and moisture readily penetrate all soils in this group.

One of the principal problems in the culture of peaches is prevention of drought, as drought lowers the yield and reduces the quality and size of the fruit. Clean cultivation, with cover crops and manure to build up the organic content, is the method used to conserve moisture. Rye is used as a winter cover crop on bearing orchards, and soybeans are frequently used as a green-manure crop, particularly before the orchard reaches bearing age. Cover crops are seeded late in summer or early in fall and are plowed under in spring. The orchard is cultivated in spring and early summer, especially after rains. Ammonium sulfate and sodium nitrate are the most common sources of nitrogen, and applications are given in the spring at the rate of 2 to 4 pounds a tree. The horticulture department of Purdue University recommends one-fourth pound for each year in the age of the tree. Superphosphates are frequently used. Where manure is available it is used, because, in addition to supplying plant nutrients, it builds up the organic-matter content of the soil. Ordinarily the fruit is graded and packed at the orchard, and much of the crop is sold by the truckload at the orchards and warehouses. United States graded fruit is shipped from the county by the carload.

Scattered through the sand-hill district are numerous small depressed areas of Ayrshire fine sandy loam associated with the Princeton soils, and Bartle loam and Bartle fine sandy loam associated with the Elkinsville and Oaktown soils. When fruit trees are planted on these areas, they suffer from poor drainage and many of them die. The fruit is of poor quality, and frost damage is frequent. Tile drainage is difficult in many of these areas, because of the lack of good outlets. The larger areas of these soils are used in connection with general farming, especially as meadows.

Late spring freezes frequently cause partial loss and occasionally entire loss of the fruit crop. Peaches are damaged more frequently than apples. Table 9 shows the yearly production in percentage of full crop for the period 1917–38, according to data obtained from the agricultural statistician at Purdue University. The average farm price during the marketing period is shown for some years.

TABLE 9.—*Production and price of apples and peaches in Knox County, Ind., in stated years*

Year	Apples		Peaches		Year	Apples		Peaches	
	Percentage of full crop	Farm price per bushel	Percentage of full crop	Farm price per bushel		Percentage of full crop	Farm price per bushel	Percentage of full crop	Farm price per bushel
	Percent	*Dollars*	*Percent*	*Dollars*		*Percent*	*Dollars*	*Percent*	*Dollars*
1938	50	---------	52	1.20	1927	75	1.80	48	2.35
1937	[1] 107	---------	70	1.19	1926	91	.95	96	1.60
1936	24	---------	0	---------	1925	90	1.45	16	2.30
1935	93	---------	80	.95	1924	78	1.52	15	2.20
1934	36	---------	8	---------	1923	78	---------	64	---------
1933	79	---------	87	---------	1922	79	---------	99	---------
1932	32	---------	4	---------	1921	17	---------	12	---------
1931	95	0.50	[1] 108	.55	1920	40	---------	88	---------
1930	59	1.35	0	2.00	1919	39	---------	27	---------
1929	37	1.70	62	1.66	1918	28	---------	0	---------
1928	57	1.30	75	1.60	1917	48	---------	31	---------

[1] Exceeds the quantity estimated as a full crop.

The special-crops districts consist of soils included in groups 3 and 4,[7] or the sand hills. This is a gently rolling strip of land about 2 miles wide extending along the western edge of the upland adjoining the Wabash River bottoms. The soils, developed on hills of wind-blown sand, are well drained, brown, loose and mellow, and slightly to moderately acid. Peaches, apples, cantaloups, watermelons, sweetpotatoes, and tomatoes are extensively grown. The loose sandy soils of the upland (group 3) are referred to locally as deep sand soils in separating them from the soils of the sand hills on the terraces (group 4). The soils of group 3 are considered superior for melons and other crops because they are less droughty. These soils occupy the higher upland positions and are underlain by gray marly sand at a depth of 5 to 7 feet. The soils of group 4 lack the marly subsoil, but they have seams of clay in the subsoil, which may be responsible for the slightly lower drought resistance claimed by farmers. The different types of the Princeton, Oaktown, and Elkinsville sandy soils resemble one another closely in their soil features and agriculture. The soils of group 3, developed on marly sands, are Princeton loamy fine sand, Princeton fine sandy loam, and Princeton loam, and those in group 4 are Oaktown loamy fine sand and Elkinsville fine sandy loam. The Princeton soils, especially the lighter sands, are used almost entirely in the production of special crops, and more general farming is done on the Elkinsville soils, especially where the sandy subsoil is shallow and rests on clay and gravel at a depth of 5 to 7 feet.

Princeton loamy fine sand.—Princeton loamy fine sand has a loose light-brown loamy fine sand surface soil, with a bright yellowish-brown subsoil below a depth of 10 inches. The subsoil is slightly sticky when wet, but it is essentially a loose loamy fine sand 10 feet or more thick. At an average depth of 6 feet it is more or less limy. Variability in heaviness of the subsoil occurs within short distances in some places. Areas having clayey subsoils generally occupy the windward sides of dunes.

The surface is undulating to rolling, characterized by a series of dunes and troughs, with local flat areas. Following the ate Wisconsin glacial period, the parent material of the Princeton soils was blown by northwest winds from the adjacent valley.

Princeton loamy fine sand is used mainly for the production of special crops, as previously stated. It is considered the best land for melons in the county. It is more drought-resistant than the other sandy soils.

Princeton fine sandy loam.—Princeton fine sandy loam consists of brown friable loamy fine sand or fine sandy loam, 8 to 10 inches thick. It is underlain by bright-brown or light reddish-brown friable fine sandy clay loam or clay. This material extends to an average depth of 3 feet, where it grades into loose reddish-brown fine sand. This material generally is limy at an average depth of 6 feet. This soil differs from Princeton loamy fine sand in that it has a heavier subsoil. As mapped, Princeton fine sandy loam includes areas of soil that have a lighter clayey sand subsoil. These areas are better adapted to growing melons than are areas of the typical soil. Special crops, such as apples, peaches, sweetpotatoes, and early tomatoes, are extensively

[7] See generalized soil map, fig. 2, p. 14.

grown, but a large proportion of the acreage is used for such farm crops as corn, wheat, soybeans, and alfalfa. Yields of corn vary widely, depending on the amount and distribution of the rainfall. This soil is better suited to the more drought-resistant crops.

Princeton loam.—Princeton loam differs primarily from Princeton fine sandy loam in having a less sandy surface soil, and the material of the entire soil mass is heavier in texture. The surface soil, to a depth of 12 inches, consists of grayish-brown or bright-brown friable loam. The dry plow soil may become slightly cloddy, and when wet it is moderately plastic and sticky. The subsoil, to a depth of 30 inches, consists of reddish-brown moderately compact clay loam or sandy clay loam, which crumbles readily into angular particles. At a greater depth the subsoil is more sandy, with yellowish-gray calcareous sand and silt occurring at an average depth of 6 feet. The soil material to a depth of 3 feet is moderately acid.

This soil occupies many slightly depressed areas surrounded by the more sandy Princeton soils and bordering the heavier Princeton silt loam where only small quantities of sand are mixed in the surface soil. The surface is flat to rolling, and drainage is well established, owing to the permeable substratum.

Princeton loam is well suited to peach and apple orchards and it is used to a considerable extent for growing tomatoes and garden crops, although it is probably used more extensively for general farm crops. The crops commonly grown in rotation are corn, wheat, and clover or mixed hay. Alfalfa and soybeans also are grown extensively.

Oaktown loamy fine sand.—Oaktown loamy fine sand is very similar to Princeton loamy fine sand in the character of the upper part of the soil material. The 10-inch surface soil consists of grayish-brown or brown mellow loamy fine sand. This is underlain by yellowish-brown loose fine sand or loamy fine sand, which continues to a depth of approximately 8 feet. The underlying substrata consist of stratified sand, clayey sand, and silt, with some gravel at the greater depths. The soil material is acid to a depth of 4 feet, but the substrata are limy in some places. This soil has a ridge-and-swell, or dune, relief, owing to wind movement of the surface soil; but the underlying material consists of water-laid deposits of silt, sand, and fine gravel. The soil occurs on high terraces adjacent to the Princeton soils of the upland.

Oaktown loamy fine sand is associated with Elkinsville fine sandy loam in the more extensive areas around Oaktown, and it also occurs as isolated dunes in association with Elkinsville loam and the Bartle soils in Maria Creek Valley.

The agricultural practices followed are very similar to those on Princeton loamy fine sand. The soil is used largely for special crops, although farmers report that melons do not yield so well as on Princeton loamy fine sand. Owing to the low organic-matter content and the low moisture-holding capacity, some crops, such as corn and oats, do not grow well on this soil.

Elkinsville fine sandy loam.—Elkinsville fine sandy loam has a brown mellow fine sandy loam surface soil 10 inches thick. This is underlain by friable moderately compact clay loam or sandy clay loam which continues to a depth of 30 inches. The underlying layers consist of loose fine sand and are stratified at a depth of 5 feet or more.

This soil is suited to the growth of a variety of special crops, but it is not so well suited to melons, which are more susceptible to drought. A large proportion of the area is used for general farm crops. Corn yields average about 25 bushels an acre. In general the uses and productivity of this land are similar to those of Princeton fine sandy loam.

SOILS OF THE WHEAT- AND GENERAL-FARMING DISTRICTS

The soils of groups 5 and 6 are used primarily for the production of wheat, but other crops, such as corn, soybeans, cowpeas, alfalfa, and other hay crops also are grown extensively. Decker, Vincennes, and Busseron Townships have a larger proportion of their areas in these groups of soils than the other townships, and they lead in the production of wheat in the order mentioned. These soils in many places occupy small areas surrounded by black clay land or occur as flats with swales of black land cutting through them. Consequently, the agriculture consists of nearly continuous cultivation of corn on the black land with small-grain and general farming on the soils of group 5. This group includes a greater diversity of soils than the other agricultural groups. All these soils are on the terraces and are derived from old assorted and stratified deposits of clay, silt, sand, and gravel.

The soils of group 5 are developed from three kinds of parent materials: (1) Assorted sand and silt deposits, largely in the White River Valley, from which the Elkinsville and Bartle soils are developed; (2) assorted calcareous gravel deposits, occurring almost entirely in the Wabash River Valley, from which the Fox and Homer soils are developed; and gravel, sand, and silts, which were laid down largely in the Wabash River Valley, from which the Vincennes soils are developed; and (3) heavy limy silt and clay deposited almost entirely in the White River Valley, from which the Markland and McGary soils are developed. All these are light-colored soils.

The Prairie soils of group 6 are developed on two kinds of parent materials: (1) High-lime gravels and sand, the parent materials of the Warsaw soils; and (2) low-lime mixed silt, sand, and some gravel, the parent materials of the Buckner soils. These soils are dark, and all are moderately acid in reaction, so that applications of lime are necessary in order to grow red clover. As these soils are developed on river terraces, they are nearly flat with gentle slopes to the lower levels of the associated dark soils of the depressions and the overflow first bottoms.

On the bases of drainage and color the soils of the wheat and general-farming districts fall into two groups: (1) Well-drained soils and (2) poorly and imperfectly drained light-colored soils.

WELL-DRAINED SOILS

The well-drained soils of the wheat- and general-farming districts consist of loams and silt and sandy loams of the Elkinsville, Buckner, Fox, and Warsaw series.

Elkinsville loam.—The surface soil of Elkinsville loam is grayish brown, friable, and easily tilled. It is underlain, at a depth of 10 inches, by a moderately compact subsoil, which ranges from sandy clay loam to silty clay loam. At a depth of 3 feet the materials are more friable and sandy and generally are underlain by stratified and assorted sand and silt at a depth of 5 feet or more. In a few places some fine gravel is mixed with the soil. The entire soil mass is strongly acid. This soil is developed on flat to slightly sloping terraces under generally good drainage conditions, although a slight gray mottling is present below a depth of 3 feet in some of the lower areas. It occurs along the White River Valley and along many of the old stream channels that dissect the upland.

General farm crops, especially wheat and corn, are grown extensively. Liming is necessary for growing clover and alfalfa. As this practice is increasing, the crop rotation followed frequently includes soybeans and red clover for 1 or more years. Corn yields as much as 65 bushels an acre in favorable seasons, but the average is probably about 40 bushels. The yield of wheat is from 20 to 25 bushels. Some truck crops, especially late tomatoes, are grown. Yields of tomatoes are from 8 to 10 tons an acre.

Elkinsville silt loam.—Elkinsville silt loam has a 10-inch grayish-brown surface soil, which rests on a yellowish-brown silty clay loam subsoil mottled in places with gray below a depth of 3 feet. The lower substrata consist of water-laid layers of silt and sand, which may be neutral in reaction, although the material of the entire soil mass is, in general, strongly acid. Small areas of this soil are scattered throughout the White River Valley; the larger ones are at the junction of the White River with the Wabash River.

The agricultural practices and crop yields are very similar to those on Elkinsville loam, except that few truck crops are grown.

Buckner sandy loam.—Buckner sandy loam is the most extensive dark-colored Prairie soil, although its area is not very large—5,888 acres. This soil occupies undulating terraces formed from water-laid sands, silt, and gravel that contain little or no lime (calcium carbonate). The gravel is variably distributed, being abundant in the extreme northwestern part of the county and absent in the vicinity of Sandborn.

The surface soil of Buckner sandy loam, to a depth of 18 inches, consists of very dark brown moderately coherent sandy loam, which gradually becomes lighter brown with depth. When wet the plow soil is slightly sticky and nearly black. The subsoil between depths of 25 and 35 inches is brown or yellowish-brown slightly cemented sandy clay loam or clayey sand. It is underlain by yellowish-brown loose sand, which may contain some gravel at the lower depths. The entire soil material generally is strongly acid to a depth of 6 feet or more, where it becomes neutral and, in places, slightly calcareous.

A system of grain farming is followed, in which corn and wheat are the dominant crops. As the Buckner and Warsaw soils are not very retentive of moisture, the yields of corn depend largely on the distribution of rainfall. The average yield is about 30 bushels an acre. Wheat is more extensively grown than corn, and the yields average about 18 bushels an acre. Oats are grown to a small extent, but they are sown early, in order to escape the drought. Owing to the acid condition of the soil, liming is necessary before growing clover. As liming is not a general practice, soybeans are grown to some extent as a leguminous hay crop. A few farmers are attempting to diversify their farming system by growing special crops, such as watermelons, on the more sandy areas, and apples. Except work animals, little livestock is kept on the Prairie soils.

Buckner loam.—Buckner loam differs from Buckner sandy loam in containing more clay throughout the soil mass. As it occurs in slight depressions, the surface soil is darker and thicker than the associated Buckner sandy loam. The subsoil at a depth of 20 or more inches is yellowish-brown moderately compact clay loam. Below a depth of 3 feet the material consists of yellowish-brown loose sand. Rainfall is not absorbed so quickly as in Buckner sandy loam, and the soil is reported to be a little colder in the spring. Slight rust-brown stains are present in places below a depth of 30 inches, indicating that slightly imperfect drainage may exist in some places. The crops grown and the yields are similar to those on Buckner sandy loam, although farmers report that the soil is a little less productive.

Fox loam.—Fox loam has a brown surface soil, 10 to 12 inches thick, resting on a moderately compact sandy or gravelly clay loam subsoil, which generally contains considerable gravel. After a rain the fields have a slightly reddish-brown color. Below a depth of 10 to 12 inches is bright-brown or slightly reddish-brown friable very compact gravelly clay loam. Below a depth of 3 feet the subsoil becomes more friable and gravelly. A dark sticky clayey gravel layer, ranging from 4 to 10 inches in thickness and neutral in reaction, overlies the limy gray gravel, which occurs at a depth of 3½ to 5 feet. The dark layer forms a very wavy contact with the parent material, as can readily be seen in exposures along roads or in gravel pits.

Fox loam occurs mainly on the Wabash River terraces, although a few areas are northeast of Edwardsport in the White River Valley. The underlying gray limy gravel is used extensively for road material. In some places gravel is very abundant on the surface.

Mixed grain and livestock farming is followed, with dairy products furnishing part of the farm income. A common crop rotation consists of corn, oats or soybeans, wheat, and clover. Owing to excessive internal drainage, especially where the gravel layer is close to the surface, corn yields are likely to be reduced by drought. The average yield is about 35 bushels an acre. Early seeding of oats is necessary to escape the drought. Oats yield 30 to 35 bushels an acre. Wheat is well suited to the Fox soil because it makes its growth in spring when moisture is adequate, and yields 18 to 20 bushels an acre. As red clover is especially susceptible to injury from drought, a considerable acreage of alfalfa is grown. Lime is necessary to sweeten the soil for these crops.

Fox sandy loam.—Fox sandy loam differs from Fox loam largely in the greater content of sand and gravel throughout the soil mass. The brown sandy loam surface soil is underlain, at a depth of 10 inches, by light reddish-brown friable slightly gravelly clay loam, which is less compact and more permeable to moisture. The limy gray gravel is capped by the dark sticky gravelly clay layer as in Fox loam.

This soil occurs in scattered areas throughout the Wabash River Valley on flat to undulating terraces. Because it contains smaller amounts of clay, its moisture-holding capacity is lower and crop

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yields are consequently slightly lower than on Fox loam. Corn yields average about 30 bushels an acre. The agricultural practices and crops grown are similar to those on Fox loam.

Warsaw loam.—The 18-inch surface soil of Warsaw loam is very dark brown loam, which gradually merges into yellowish-brown gravelly clay loam. Below a depth of 30 inches the subsoil becomes more friable and gravelly and grades into a dark-brown clayey gravel layer that is neutral in reaction. This overlies calcareous gravel at a depth of 3 to 5 feet.

The Warsaw soils are similar to the Fox soils in that they are derived from limy gravels deposited on terraces of the Wabash River. They differ from the Fox soils in having been developed under a grass cover rather than under forest, which has resulted in a higher content of organic matter and a dark color of the surface soil. In these characteristics they are similar to the Buckner soils.

The agriculture consists largely of grain and livestock farming. Because of the low moisture-holding capacity, wheat is the dominant crop, yielding from 18 to 20 bushels an acre. Crops grown and yields obtained are similar to those on Buckner loam, but crops are more susceptible to injury from drought than on that soil, especially where gravel is close to the surface.

Warsaw sandy loam.—Warsaw sandy loam is an inextensive soil occupying scattered areas through the Wabash River Valley. It is generally more sandy and gravelly than Warsaw loam. The 20-inch surface soil is dark-brown or very dark brown sandy loam. It is underlain by brown or yellowish-brown light gravelly clay loam, which, because of the small content of clay, has a low moisture-holding capacity. This material, in turn, is underlain by limy gray gravel, at a depth of 3 to 5 feet, with a dark sticky layer capping the gravel. Crop yields are slightly lower than on Warsaw loam.

POORLY AND IMPERFECTLY DRAINED LIGHT-COLORED SOILS

The surface soils of the poorly and imperfectly drained light-colored soils of the terraces are gray or light gray, low in organic matter, and acid in reaction. They have gray and yellow mottled subsoils. The land is flat, and poor drainage is due either to a heavy impervious subsoil or to a high water table. The upper layers sometimes dry out excessively during late summer. Artificial drainage is necessary for the improvement of crop yields on all these soils. Members of this group include Vincennes silty clay loam, Vincennes clay loam, Vincennes silt loam, Vincennes loam, Bartle fine sandy loam, Bartle loam, Bartle silt loam, Homer loam, Homer sandy loam, Markland silt loam, and McGary silt loam.

Vincennes silty clay loam.—Vincennes silty clay loam has a 10- to 12-inch surface layer of dull yellowish-gray material with a dark cast. This material is sticky and plastic when wet. The dull bluish-gray subsoil is highly stained and speckled with rust-brown and some yellow mottlings. It is a tough, tight plastic clay that is impervious to moisture, and it breaks into massive angular lumps. Below a depth of 3 feet the material becomes a little more friable, owing to increasing quantities of gravel. Slightly calcareous clay, sand, and fine gravel are present in places at a depth of about 7 feet.

Vincennes silty clay loam occupies low-lying swales and flats of the Wabash and White River Valleys, where it is subject to occasional overflow. In the Wabash River Valley small quantities of gravel are on the surface and scattered through the soil mass. The reaction generally is moderately to strongly acid, except in a few swales where it is neutral.

A system of grain farming is followed in which corn and wheat are the principal crops, with mixed hay and soybeans occupying smaller acreages. Corn is well suited to this soil because of the adequate supply of moisture and more than average supply of organic matter. Corn yields from 45 to 50 bushels an acre, and wheat from 20 to 25 bushels, but yields as high as 40 bushels are not unusual.

Vincennes clay loam.—Vincennes clay loam is similar to Vincennes silty clay loam in most respects, except that the proportion of gravel is higher; consequently the soil mass is slightly more friable throughout, and under cultivation the slightly dark gray clay loam surface soil crumbles more readily. The subsoil consists of mottled gray, rust-brown, and yellowish-brown compact silty clay. Agricultural practices and crop yields are similar to those on Vincennes silty clay loam, but cultivation is less difficult. Most of this soil occurs in the Wabash River Valley and in the White River Valley below Decker.

Vincennes silt loam.—The surface soil of Vincennes silt loam is brownish-gray silt loam containing numerous pieces of "turkey shot" gravel or concretions. At a depth ranging from 12 to 18 inches this material is underlain by rust-stained brown and gray silty clay, which is compact and heavy to a depth of 3 to 5 feet. The subsoil becomes brown and slightly more friable with depth until the stratified silts and sands are reached at a depth ranging from 4 to 8 feet. The entire soil mass is strongly acid in reaction. This is a cold wet soil, slow to warm in the spring, and it is generally less productive than the heavier soils of the Vincennes series. Although a system of grain farming is followed, the land is better adapted to wheat, other small grains, and hay than to corn.

Vincennes loam.—Vincennes loam differs from the other members of the Vincennes series in its larger proportion of sand and gravel and greater friability throughout the entire soil mass. The 12- to 18-inch surface soil ranges from brownish-gray to slightly dark gray loam. It is underlain to a depth of 3 feet by rust-stained gray moderately compact clay loam, which is more friable in the lower part. Gray gravel containing a low proportion of lime occurs in places at a depth of 7 feet or deeper. The soil is associated in depressed positions with the Buckner and Warsaw soils, in the extreme northwestern part of the county, and elsewhere with the Westland, Fox, and Bartle soils. Corn, wheat, soybeans, and mixed hay are the principal crops grown. As this is a soil of small extent occupying small areas, the agricultural practices are determined largely by those on the associated soils.

Bartle fine sandy loam.—The 10-inch surface soil of Bartle fine sandy loam is brownish-gray mellow fine sandy loam. It is abruptly underlain by a mottled gray and yellow friable sandy clay loam subsoil, which is more compact in the lower part. Between depths of 3 and 4 feet a tough impervious mottled gray claypan layer impedes the movement of moisture. The underlying layers become increasingly sandy and less mottled with depth. At a depth of 8 to 10 feet, low-lime sand and fine gravel occur in places. The entire soil material is acid.

This soil occupies flat terraces and depressions associated with the Elkinsville and Lyles soils. Much of it is mapped in the vicinity of Oaktown and northeast of Decker in an abandoned stream channel. Corn and wheat are the principal crops grown. The average yields are about 35 bushels of corn and 20 bushels of wheat to the acre. Soybeans and mixed hay are grown to some extent for feed.

Bartle loam.—Bartle loam differs from Bartle fine sandy loam in having a more coherent brownish-gray loam surface soil and a more compact and heavier mottled gray and yellow clay loam subsoil to a depth of 3 feet or more. The underlying layers are similar to those underlying Bartle fine sandy loam. A grain system of farming is followed, with slightly higher yields of corn and wheat than on the more sandy members of the Bartle series. This soil is mapped in scattered areas throughout the White River Valley and in broad old channels in the upland.

Bartle silt loam.—Bartle silt loam has a 10-inch brownish-gray or grayish-brown surface soil, underlain by a yellow silty clay loam subsoil mottled with gray. At a depth of 3 feet the material in most places is moderately compact rusty iron-stained gray silty clay or sandy clay, below which the soil material is more friable and yellower. Farmers report that this soil is wetter and more difficult to till than the low-lying black land that surrounds it in many places. It puddles badly if worked when wet, and it dries slowly and becomes very hard. Corn and wheat are the most common crops, and some clover is grown in places where crop rotation is practiced. Clover requires lime, and it suffers from winter-killing. Corn yields from 40 to 45 bushels an acre and wheat from 20 to 25 bushels, and much higher yields are obtained in some years.

Homer loam.—The surface layer of Homer loam is grayish-brown or gray loam containing a small quantity of gravel. At a depth of 10 inches the material becomes mottled gray and yellow friable clay loam, which gradually changes to a more rust-stained, compact, and impervious subsoil. The subsoil at a depth of 3 to 4 feet becomes more friable and at a depth of 5 feet is underlain by gray limy water-laid gravel like that under the Fox soils. Generally, however, this layer contains considerable sand and clay. A thin layer of dark gravelly clay is developed over the limy gravel. In a few areas, where internal drainage is not so sluggish, the surface soil is brown and the subsoil is less compact and mottled.

This soil occupies flat areas between the well-drained Fox soil and the poorly drained Westland soil. It is best suited to small grains and hay, but, owing to its occurrence in small areas, it is farmed in the same way as the associated soils.

Homer sandy loam.—Homer sandy loam is more sandy and friable throughout than Homer loam. The brownish-gray sandy loam surface soil is underlain by mottled gray and yellow light clay loam to a depth of 20 inches, where the material changes to moderately compact, mottled, rust-stained gravelly clay loam. Limy gravel occurs at a depth of 4 feet or more. As this soil occurs in small areas, the agricultural practices are determined by the associated Fox soils.

Markland silt loam.—The 9-inch surface soil of Markland silt loam consists of grayish-brown smooth silt loam. It is underlain by brownish-yellow friable heavy silty clay loam to a depth of 16 inches, grading below into tough waxy silty clay that extends to the limy yellowish-gray clay at an average depth of 3 feet. To a depth of 20 inches the soil mass is moderately acid.

This soil is developed from water-laid clays deposited in protected cover and bends of the White River and its tributaries, probably during the Late Wisconsin glacial period. The organic content of the soil is low, as it was developed under a mixed hardwood forest cover consisting dominantly of beech and maple. Much of it is in small areas associated with the McGary and Montgomery soils. Although external drainage is good, internal drainage is slow.

The agricultural practices are determined largely by the associated soils. On the larger areas, associated with McGary silt loam, a rotation of corn, wheat, and clover is followed, and the small areas, mixed with the Montgomery soils, may be used largely for corn. This soil probably is better adapted to wheat than to corn, yields of wheat averaging about 20 bushels an acre, and yields of corn ranging from 30 to 35 bushels. Clover can generally be grown without the use of lime, and the yields average about 1¼ tons an acre. The soil is well suited to the growth of alfalfa.

McGary silt loam.—When moist the plow soil of McGary silt loam is brownish gray, and when dry it becomes light gray. It puddles and bakes badly if cultivated when wet. The subsurface layer, between depths of 7 and 10 inches, is light gray and contains much less organic matter than the surface layer. At a depth of 10 to 16 inches the subsoil is gray and yellow moderately friable mottled silty clay loam, which grades quickly into very tough heavy slightly mottled yellow clay. Yellowish-gray calcareous clay generally occurs at a depth of less than 3 feet. In some places the parent material consists of more friable heavy silt, which produces a slightly more friable soil.

The flat surface and the heavy subsoil induce very poor internal drainage. In a few areas where surface drainage is good the surface soil is browner and the mottling occurs only in the upper part of the subsoil.

This soil occupies numerous small areas scattered through the Markland and Montgomery soils; consequently the agricultural practices are determined by the associated soils. The soil is best adapted to small grains, especially wheat, and hay. Where it occurs in sufficiently large areas, a corn, wheat, and clover rotation is followed. As the soil is only moderately acid, clover can sometimes be grown without the use of lime.

DARK-COLORED AND VERY DARK-COLORED SOILS DEVOTED CHIEFLY TO CORN

The dark-colored and very dark-colored soils devoted chiefly to corn are members of group 7 (table 7, p. 15). These soils are locally called black clay land, are the strongest soils in the county, and return consistently high yields of corn. As most of them occupy low, depressed, poorly drained areas, many farmers refer to them as wet prairie land. Nearly all areas of them have been artificially drained, in most places by open ditches. The Ross soils are the only naturally well drained soils in the group. As a group the soils are slightly acid or neutral in reaction. Their importance as soils for growing corn is not apparent from figure 4 (p. 17), because they are widely scattered in small irregular-shaped areas, which are cropped in the same manner as the surrounding soils. They are most extensively developed in the bottoms of the Wabash and White Rivers, but they also occur in the bottoms of tributary streams, generally terminating as oval-shaped areas at the sources of the streams.

Owing to the abundant supply of organic matter, nitrogen, other plant nutrients, and available moisture, these soils are best suited to the production of corn, yields of which average 50 or more bushels an acre. Corn is grown continuously, except for short rest periods when wheat, soybeans, oats, or hay are grown. Some farmers practice a short rotation of corn, wheat, and clover. Although the average yield of wheat is about 20 bushels an acre, it is not so certain a crop as corn, because occasionally it is drowned out in low spots by standing water. Red clover also may be damaged in this way. Oats to be most successfully grown should be seeded early, in order to mature before the hot dry weather of midsummer. Soybeans, although of minor importance, are well suited to these soils.

The dark-colored soils have been divided into two general groups based on the degree of darkness, depth of penetration of organic matter, color of the subsoil, and associated soil features, as follows: (1) Dark-colored soils—Lyles silty clay loam, Lyles silt loam, Lyles loam, Ragsdale silt loam, Ragsdale loam, Montgomery silt loam, Montgomery silty clay loam, Westland clay loam, Westland loam, Ross silty clay loam, and Ross silt loam; and (2) very dark-colored soils—Kings silty clay, Sharkey clay, Sharkey clay loam, Abington clay, Abington clay, mucky phase, Abington clay loam, and Carlisle silty muck.

DARK-COLORED SOILS

Lyles silty clay loam.—The plow soil of Lyles silty clay loam is dark-gray or dark brownish-gray granular friable slightly gritty silty clay loam. To a depth of 18 inches the subsoil consists of dark-gray or grayish-black compact gritty silty clay loam that breaks into angular massive lumps. At a greater depth the penetration of organic matter diminishes and the soil material is slightly rust-stained gray sandy clay loam. Succeeding layers are increasingly sandy and more yellow, and calcareous sand occurs at an average depth of 5 feet.

This soil occupies low slightly depressed areas associated with the Elkinsville and Bartle soils on the terraces along the Wabash River and below the Princeton soils on the upland. In some areas adjacent to local stream channels the surface soil is lighter colored, owing to a slight deposition of water-laid silt. The entire soil mass is neutral to slightly acid in reaction, owing to the lime leached from the Princeton soils. The Lyles soils are distinctly more friable and less plastic and sticky than the Montgomery and Westland soils; consequently they are easily tilled. Corn yields range from 50 to 60 bushels an acre.

Lyles silt loam.—Lyles silt loam has a more friable and less sticky and plastic surface layer than Lyles silty clay loam. The dark-gray subsurface layer, which continues to a depth of 20 inches, is less compact and sticky than the surface layer and consists of sandy clay loam. Organic matter decreases with depth, and the subsoil becomes more sandy and more highly mottled with yellow and brown. The entire soil mass is neutral to slightly acid in reaction. Most of this soil is in the vicinity of Oaktown and northeast of Decker in association with the Elkinsville and Bartle soils. The crop adaptations and yields are similar to those on Lyles silty clay loam.

Lyles loam.—The surface layer of Lyles loam ranges in texture from loam to fine sandy loam. Owing to the more open structure, the color may be slightly browner, compared with the corresponding layer of Lyles silt loam. The gray-black subsurface layer, between depths of 8 and 20 inches, ranges in texture from sandy clay loam to loam. The entire soil material is more sandy and friable than in the other members of the Lyles series. Owing to the greater proportion of sand, this soil may be expected to be slightly less productive over a period of years than the heavier members of the series, although yields can be maintained by good agricultural practices. Crops other than corn occupy a larger proportion of the acreage than on the other Lyles soils.

Ragsdale silt loam.—Like Lyles silt loam, Ragsdale silt loam has a dark brownish-gray surface soil and a grayish-black subsurface soil. The penetration of organic matter is to less depth in many places, ranging from 12 to 20 inches. The mottled gray and yellow silty clay loam subsoil in general is more highly oxidized than the subsoil of the Lyles soils. Grayish-yellow calcareous soft uniform silt or very fine sand is present in places at a depth of 3 to 5 feet; in other places the substratum consists of pale-yellow sand.

This soil occurs in oval-shaped areas at the heads of streams in the upland, or on gentle slopes where the depressions are less well developed; and in such locations the shallow surface soil, the more yellow subsoil, and the limy parent material are most likely to occur. The soil is associated mainly with Princeton silt loam and, in places, with the Alford soils. The larger areas are north of the towns of Bicknell and Decker.

Although this soil is best suited to growing corn, much of it, where it occurs in small irregular-shaped areas, is farmed in rotation with the associated soils. Crop adaptations and yields otherwise are similar to those on Lyles silt loam.

Ragsdale loam.—The characteristics of the profile of Ragsdale loam are similar to those of Lyles loam. The loam has a dark brownish-gray highly organic layer underlain by a mottled gray and yellow sandy clay loam subsoil. The soil normally is nonacid in reaction, although a few areas have been included in which the soil is slightly to medium acid. Such included areas are considerably less productive than the typical areas. Only a small total area is mapped, mostly in association with the sandy Princeton soils on the upland. The crop adaptations and yields are similar to those of Lyles loam.

Montgomery silt loam.—The plow soil of Montgomery silt loam is moderately dark gray friable smooth silt loam or light silty clay loam, which becomes more compact and heavier with depth. At a depth of 18 to 20 inches, penetration of organic matter becomes less noticeable, and the subsoil is mottled gray and yellow silty clay. It rests, at a depth of 4 feet or deeper, on grayish-yellow smooth highly calcareous clay.

The Montgomery soils are associated with the McGary and Markland soils in protected coves and along tributaries of the White River, where they have been developed from slack-water calcareous clay deposits. The more extensive areas of Montgomery silt loam occupy abandoned channels and tributaries in the vicinities of Bicknell, Wheatland, and Monroe City. The aggregate area is fairly large. This soil is intimately and intricately mixed with the associated soils. Where Montgomery silt loam is predominant in the association of soils, the land is used largely for corn, but in other places a rotation of corn, wheat, and clover may be followed. In many seasons yields of corn are as high as 80 bushels an acre on well-managed land, and wheat yields average about 25 bushels.

Montgomery silty clay loam.—The surface soil of Montgomery silty clay loam ranges in texture from silty clay loam to clay. As it is tough, heavy, and difficult to till, it is referred to by many as gumbo. Under cultivation it readily breaks down to form a friable soil mulch. The subsoil, which begins at a depth of 18 inches, is mottled gray and yellow smooth waxy clay, which is underlain, at a depth of 4 feet or more, by gray limy clay. The principal areas of this soil occupy protected areas of the valley of the West Fork White River. The agricultural adaptations and yields are similar to those on Montgomery silt loam.

Westland clay loam.—Westland clay loam is extensively developed in the swales all through the Wabash Valley, associated with the Fox and Warsaw soils on the higher benchland and with the darker Abington soils in the lower parts of the swales. The surface soil when dry is moderately dark gray and when wet is dark-gray plastic sticky clay loam. Pebbles are scattered throughout the soil mass, with clean gray limy gravel at a depth of 5 to 7 feet. This gravel is widely used as road-building material. At a depth of 20 to 25 inches the dark surface material grades into mottled gray and yellow heavy clay. In some areas the content of gravel and sand is very small in the surface soil and the texture approaches silty clay loam; in other places the content of gravel and sand is large.

Corn is the dominant crop on the Westland soils, and yields range from 50 to 60 bushels an acre. Yields are not affected very much by drought, although during the drought of 1930, yields were lowered from 5 to 10 bushels an acre. Wheat is grown where the land is not subject to overflow or inundation from backwater. In some winters, such as that in 1928, the crop may heave badly owing to alternate freezing and thawing of the ground. Yields of wheat range from 25 to 35 bushels an acre.

Westland loam.—Westland loam is an inextensive soil occurring in small areas south of Vincennes in the Wabash Valley. The surface soil is dark brownish gray and very friable, owing to the presence of less clay and larger quantities of sand and gravel than in Westland clay loam. It has a similarly mottled gray and yellow subsoil, which likewise is more friable than that of Westland clay loam. It is underlain by limpy gray gravel. The agricultural practices are determined largely by the associated soils.

Ross silty clay loam.—Ross silty clay loam is the principal representative of the well-drained members of the group of dark-colored soils. It has a moderately dark brown friable silty clay loam surface soil, which becomes somewhat more compact with depth. The dark-brown color extends to a depth ranging from 20 to 30 inches, where the material gradually changes to yellowish-brown silty clay loam. No abrupt textural or color changes occur throughout the soil material. The soil is generally neutral to slightly acid in reaction, as it is developed from alluvial deposits along both the White and Wabash Rivers, where it occurs in a high-bottom position subject to only occasional overflow. The largest area lies above the junction of the East Fork and the West Fork White River.

Corn is the principal crop grown, because of the abundant supplies of organic matter, nitrogen, and other plant nutrients in the soil. Yields range from 50 to 60 bushels an acre. As yields are declining slightly and crops are in little danger of loss from overflow, oats, soybeans, wheat, potatoes, and other crops are assuming a more important place in the farming system. Wheat and soybeans each yield from 20 to 30 bushels an acre.

Ross silt loam.—Ross silt loam differs from Ross silty clay loam in having a more friable and easily tilled surface soil, although the subsoil also is more friable and shows more variation in soil character than does the subsoil of Ross silty clay loam. It occupies scattered areas throughout the valleys of both the Wabash and the White Rivers and some positions in the bottom land that are subject to overflow but rarely. The largest areas are in the vicinity of Decker Chapel. In such positions the soil is moderately acid in reaction in places, and the organic matter does not penetrate so deeply as elsewhere. The more friable yellowish-brown subsoil, beginning at a depth of 12 to 15 inches, tends to crumble into angular lumps from one-half to three-fourths of an inch in diameter. Corn is the most important crop grown, and wheat occupies a considerable acreage.

VERY DARK-COLORED SOILS

Kings silty clay.—The surface soil of Kings silty clay is very dark slightly bluish gray tough waxy silty clay, which gives way, at a depth of 10 to 15 inches, to rust-stained gray very plastic sticky impervious clay. At a depth of 5 feet or more, grayish-yellow limy smooth clay occurs in many places in the subsoil.

A few large areas are near Westphalia and Bicknell. This soil is associated with the McGary and Montgomery soils, which are formed from limy slack-water clay deposits. The Kings and Sharkey soils are the most difficult soils in the county to till, owing to their very heavy waxy surface soils. The higher proportion of organic matter in Kings silty clay helps to develop a more granular soil mulch under cultivation, and it is slightly less sticky and plastic throughout than the Sharkey soils.

Sharkey clay.—The surface soil of Sharkey clay is dark bluish-gray clay, very tough, stick, and difficult to plow or cultivate. Moisture conditions should be near the optimum when the land is tilled, as the granular structure is readily destroyed if the soil is wet when worked. When properly cultivated the surface soil develops a loose granular soil mulch. On drying the soil bakes badly, and it is practically impossible to plow it. Below the plow soil, which is from 4 to 6 inches thick, the material consists of bluish-gray very waxy tenacious clay highly stained with rusty-iron splotches. The lower part of the subsoil is slightly more friable than the upper part, and stratified fine gravel and sand are present at a depth of 8 to 10 feet.

The Sharkey soils occur throughout the river bottoms in low positions where they are naturally subject to overflow. A large proportion of the Wabash Valley, however, has been protected from overflow by an extensive system of levees. Some gravel is generally present in those areas mapped in the Wabash Valley. This soil is best suited to growing corn, the yields probably averaging about 30 bushels an acre. In dry years corn is susceptible to drought on this heavy soil. Many farmers plow this soil in the fall, in order that a granular condition may result from freezing and thawing.

Sharkey clay loam.—Sharkey clay loam differs primarily from Sharkey clay in having a little more gravel and sand in the surface soil and throughout the soil mass, resulting in a slightly more friable soil, which breaks up a little more readily under cultivation to form a granular seedbed. The surface soil is slightly dark gray when wet, and when dry it is drab gray. The subsoil is rust-stained bluish-gray clay. This soil is mapped largely in the Wabash Valley, where the parent material contains more gravel. The crop adaptations and yields are similar to those on Sharkey clay.

Abington clay.—Under cultivation the plow soil of Abington clay is very dark gray granular clay that is plastic and sticky when wet. From a depth ranging from 8 to 18 inches to a depth of 25 inches, the subsoil is grayish-black tough plastic impervious clay. Below this depth the material gradually becomes lighter bluish gray gravelly clay mottled slightly with yellow. The substrata, at a depth ranging from 4 to 6 feet, consist of gray limy gravel and sand.

Abington clay is developed entirely in low swales and depressions associated with the Fox, Homer, and Westland soils on the terraces of the Wabash Valley. The soil material is darker and much less plastic and sticky than that of the Sharkey soils, and it contains less rust staining in the subsoil. Corn is the principal crop. Chaffy spots requiring potash occur in places. This highly organic soil is poorly adapted to the growth of wheat, as the content of nitrogen is too high, the growth of straw is rank, and lodging generally occurs. Crops often drown or freeze out.

Abington clay, mucky phase.—Abington clay, mucky phase, has a 6- to 18-inch surface layer of grayish-black soft spongy highly organic material containing from 20 to 50 percent of mineral matter. This layer is underlain by bluish-gray tough clay or clay loam, with limy clay at a depth of 5 feet or more. In some places a thin layer of brown slightly fibrous peaty material overlies the heavy mineral soil. This is one of the better soils of the county for corn, and yields in many years are as much as 100 bushels an acre. Wheat, however, tends to lodge.

Abington clay loam.—The surface soil, in fact, the entire soil mass, of Abington clay loam is more friable than Abington clay, because of the content of gravel and sand. Under cultivation the surface soil crumbles readily to form a granular mulch. The dark-gray clay loam surface soil is underlain by grayish-black tough slightly gravelly clay, in which the organic matter decreases with depth and the soil becomes lighter in color. Limy gravel occurs at a depth of 4 to 6 feet.

This soil is developed in the Wabash Valley in association with the Westland and Fox soils. The crop adaptations and yields are similar to those of Abington clay, but the soil is more easily plowed and cultivated.

Carlisle silty muck.—Carlisle silty muck occupies a few scattered areas, the largest one being in Cypress Swamp. Some areas are, for the most part, forested, undrained, and nonagricultural. The surface soil is a black granular soft spongy mass resembling the surface soil of Abington clay, mucky phase. This black soil extends to a greater depth, contains a higher percentage of organic matter, and contains less mineral clay than the Abington soil. It is underlain by a layer of brown loose soft fibrous peat containing undecomposed wood and plant remains. When dry these layers shrink to a fraction of their original thickness. When dry the soil is light in weight, and when burned it leaves a very small proportion of ash. This soil is neutral in reaction.

Corn is the principal crop on this highly organic or mucky soil, and this crop is grown continuously with high yields ranging from 60 to 80 and occasionally 100 bushels an acre. Corn sometimes turns yellow, firing along the margins of the leaves, when 2 or 3 feet high, owing to a lack of potash. Extra applications of potash are generally applied to these areas. The common fertilizer application is 100 pounds of 0–8–32 an acre. Carlisle muck may be used for special crops, such as celery, onions, and potatoes, when drained, but it is not well suited to small grains.

LIGHT-COLORED SOILS OF THE BOTTOMS DEVOTED CHIEFLY TO CORN

The light-colored soils of the first bottoms (group 8 of table 7, p. 15) are characteristic of the section where corn is most extensively grown. The larger areas are developed in the river bottoms where the land has been protected from overflow by a system of levees, but fairly wide bottoms also border the numerous small tributary streams. Where the danger of overflow is considerable, corn is grown almost exclusively, and even low-lying areas back of levees are overflowed occasionally by backwater sufficient to drown wheat. Where the bottoms are not overflowed, corn occupies about 75 percent of the acreage, wheat about 20 percent, and soybeans about 5 percent. The livestock kept in this section are mainly work animals.

This section supplies ideal conditions for the growth of corn. The soils are rich and easily worked; the growing season is long, with warm days and humid nights; and the large level fields are adapted to the use of machinery. The soils may be considered under two heads, as follows: (1) Well-drained soils, including Genesee silt loam, Genesee silty clay loam, Genesee loam, the associated high-bottom phases, and Genesee fine sandy loam; and (2) imperfectly and poorly drained soils, including Eel silt loam, Eel silty clay loam, Eel loam, Algiers silt loam, Algiers loam, Algiers fine sandy loam, and Stendal silt loam. Practically all of the soils are sweet, being slightly acid to neutral in reaction, except Stendal silt loam, which occupies the bottoms of streams that have their source in the strongly acid yellow clay hill land of Greene and Sullivan Counties. Eel silt loam, which occupies the small bottoms of streams in the hill land, in many places develops slight acidity. The overflow bottom soils differ from the soils of other groups in that definite layers, or horizons, are lacking. Each succeeding flood deposits a layer of silt or sand, giving rise to the local expressions of filled-in land and made land.

WELL-DRAINED SOILS

Genesee silt loam.—The surface soil of Genesee silt loam consists of brown or slightly dark brown friable and in many places slightly gritty silt loam. At a depth of 8 to 15 inches the subsoil gradually becomes lighter brown or yellowish brown and slightly heavier. The entire soil material is neutral to slightly alkaline in reaction. This soil is formed from stratified silts and fine sands, laid down in broad areas in overflow bottom positions of both the Wabash and the White Rivers, where it is associated with the Eel soils in the swales. The land is used largely for the production of corn. This is one of the more extensive soils in the county.

Genesee silt loam, high-bottom phase.—The high-bottom phase of Genesee silt loam has a 10-inch brown or grayish-brown friable silt loam surface soil. The material changes rather abruptly to yellowish-brown friable silty clay loam that crumbles into small angular fragments. Below a depth of 36 inches the material is more friable, owing to the larger proportion of sand. The soil mass, to a depth of 3 feet or more, is medium acid in some of the higher areas, but other areas are neutral in reaction. This soil occupies slightly elevated areas that are intermediate in position between areas of typical Genesee soils and areas of the Elkinsville soils.

As this soil is subject to overflow only during extremely high water, systematic crop rotation is more frequently followed than on typical Genesee silt loam. Wheat, red clover, and alfalfa are grown to a considerable extent. Only a small area is mapped. It is probable that some of the typical Genesee silt loam, which occupies slightly higher positions where it is not subject to such frequent overflow, is very similar to this soil.

Genesee silty clay loam.—The surface soil of Genesee silty clay loam is brown, moderately compact, and heavy, although a small proportion of very fine sand causes it to crumble readily under cultivation and to form a very granular seedbed. The underlying layers consist of moderately compact silty clay loam, which is readily penetrated by roots, and increasing proportions of sand occur below a depth of 3 feet. This soil is developed in low flats and slight depressions generally in back-bottom positions. Owing to its low position, the soil is better suited to growing corn than small grain.

Genesee silty clay loam, high-bottom phase.—Genesee silty clay loam, high-bottom phase, is a moderately compact silty clay loam soil occurring in a few very small areas mainly in the upper Wabash Valley. The 10- to 15-inch brown surface soil grades into a yellowish-brown silty clay loam subsoil. The soil mass generally is approximately neutral in reaction. This soil differs from the typical soil largely in its occurrence at slight elevations above ordinary overflow and the development of slight acidity in some places. Corn is the principal crop grown.

Genesee loam.—The 12- to 18-inch surface soil of Genesee loam consists of brown or slightly dark brown loam in most places, but the texture ranges from heavy loam to fine sandy loam in some places. This material is underlain by yellowish-brown friable loam, with stratified sand and silt at a depth of 40 or more inches. It is neutral to slightly alkaline in reaction.

This soil occupies natural levee positions and areas in the bends of both the Wabash and the White Rivers. The soil lies sufficiently high to lessen the danger of losing crops during floods, as the water usually recedes quickly. Although the productivity of this soil may be slightly lower than that of the other Genesee soils, it is a more desirable soil, owing to its slightly higher position and granular physical condition.

Genesee loam, high-bottom phase.—Genesee loam, high-bottom phase, is very similar to typical Genesee loam in soil characteristics. As it occurs, for the most part, on slight elevations bordering old channels that are now some distance from the main stream, slight acidity may develop in places, but not sufficient to prevent the growth of clover. Corn is the principal crop, although wheat and other crops may be grown, as the danger of loss from overflow is slight. Only a very small area is mapped, mainly in the Wabash Valley.

Genesee fine sandy loam.—Genesee fine sandy loam consists of brown loose mellow fine sandy loam or loamy fine sand that becomes slightly lighter brown with depth. Below a depth of 2 to 3 feet the subsoil becomes more coherent and heavier in places, and at a depth of 3 feet it generally consists of yellowish-gray limy fine sand. A small total area of this soil is mapped on the slightly elevated natural levees bordering the streams and in the bends of the rivers.

Corn and alfalfa are the principal crops. Because of the loose sandy soil material, corn occasionally fires during dry weather. The yields range from 30 to 40 bushels an acre. This soil is well suited to alfalfa because of the abundant supplies of lime and the excellent drainage conditions prevailing, and it is known to many farmers as alfalfa land. The crop loss from overflow is slight and infrequent.

IMPERFECTLY AND POORLY DRAINED SOILS

Eel silt loam.—Eel silt loam is the most extensive poorly drained soil of the overflow bottoms. It has a brownish-gray or grayish-brown silt loam surface soil extending to a depth of 15 to 18 inches, where it grades into mottled gray and yellow silt loam or silty clay loam. Some areas occupying the lower wetter positions have a grayer surface soil and, in places, are highly mottled or rust-stained at a slighter depth. This soil has its source in the silty wash from the Alford, Princeton, and related upland soils, and consists of stratified silt deposits. It ranges in reaction from neutral to slightly acid, depending on the source of the material and to some extent on drainage conditions. Most of this soil is in the long narrow valleys of the many small streams in the upland. A large proportion, especially the wetter areas, is used for pasture. Corn is extensively grown and, to a less extent, wheat and soybeans. In aggregate area, this soil is exceeded only by Alford silt loam.

Eel silty clay loam.—Typically, Eel silty clay loam has a grayish-brown moderately compact silty clay loam surface soil, which grades into mottled gray and yellow silty clay loam at a depth of 15 to 20 inches. Depending on position and internal drainage conditions, the underlying layers may be more highly mottled and rust-stained or they may be better oxidized and less mottled. One variation from the typical soil comprises those areas of the Eel soils that are in swales associated with the Ross soils. In such places the surface soil is slightly dark gray or gray, and it grades at a depth of 18 inches into a mottled subsoil. Eel silty clay loam occupies swales throughout the overflow bottoms of both the Wabash and the White Rivers, in association with the Genesee and Ross soils.

Some areas of Eel silty clay loam occupy the beds of former stream channels where the soil is waterlogged much of the time. The surface soil in such locations is light gray or brownish gray and when dry becomes dull yellowish gray. The subsoil is rust-stained bluish-gray clay. Except for the production of occasional crops of turnips or soybeans, little use is made of these old stream channels.

Although not so extensive as Eel silt loam, Eel silty clay loam has a large total area. It is used mainly for corn, although the young plants frequently drown out in late spring floods. Some of the wetter areas may not dry early enough to plant corn, and frequently soybeans are planted instead. Corn yields in some years are as high as 90 bushels an acre.

Eel loam.—Eel loam is an inextensive soil occupying swales close to the rivers and associated with the more sandy members of the Genesee series. The surface soil consists of grayish-brown loam, which is underlain, at a depth of 15 to 20 inches, by mottled gray and yellow heavy loam or silty clay loam. As mapped, this soil includes several areas with a surface soil of fine sandy loam. The agricultural practices are determined largely by the associated soils, and yields are about the same as on Eel silt loam.

Algiers silt loam.—Algiers silt loam consists of deposits of light-colored alluvium upon dark-colored older soils, such as members of the Montgomery, Lyles, Ragsdale, and Westland series. The surface soil consists of grayish-brown silt loam resting on somewhat yellowish-brown silt loam, which may be slightly mottled at a depth of 20 or more inches. The light-colored silt loam surface deposit ranges in thickness from 6 inches to more than 3 feet and rests on a layer of dark-gray loam or silty clay loam a foot or more thick. Where the silt layer is more than 3½ feet thick, the soil is classed as Eel silt loam. The entire soil mass is generally neutral in reaction.

This soil is developed where small streams carrying yellow silts from the upland flow out over dark-colored sweet black lands in abandoned channels in the upland or on the terraces; consequently the soil in many places lies between the Eel soils and one of the dark-colored soils mentioned above. The most extensive areas of Algiers silt loam are mapped west of Edwardsport. As this soil occupies areas in the larger bottoms, most of which have been artificially drained by ditches, it is almost entirely cropped. Corn is the principal crop, although wheat, soybeans, and clover may be grown in the rotation. This soil is very productive, some farmers considering it equal to the dark-colored soils.

Algiers loam.—Algiers loam has a grayish-brown loam surface soil grading through a slightly lighter colored and, in most places, mottled yellowish-brown loam subsoil into the underlying black clay at an average depth of about 2 feet. Most of this soil occurs on the stream terraces and bottoms bordering the sandy soils of the terraces and uplands in the Wabash Valley. The total area is small. In a few places the light-colored silt has its origin in sediments of the Wabash River.

Algiers loam is used for the same crops as Algiers silt loam, and, although the yields average somewhat less, it is considered a very productive soil.

Algiers fine sandy loam.—The surface soil of Algiers fine sandy loam consists of brown or grayish-brown fine sandy loam. It grades into slightly mottled grayish-brown loam that extends to the underlying dark-colored soil at a depth of 20 to 24 inches. The largest area of this soil is in the Wabash River bottom in the extreme northwestern part of the county. A small quantity of gravel is mixed with the soil material. This soil covers a small total area, mainly west of Decker. Corn and wheat are the principal crops. Yields of corn average about 35 bushels an acre.

Stendal silt loam.—Stendal silt loam differs from Eel silt loam in that it is more poorly drained and is acid in reaction. The surface soil is brownish gray when moist and gray when dry. Immediately below plow depth is the subsoil of mottled gray and yellow silt loam. Some particles of small black gravel (concretions) and rust stains occur in places throughout the soil mass, especially in the more poorly drained places. The entire soil mass is strongly acid, as this soil is derived from silts washed in from acid upland soils.

The larger areas are in the bottoms of small streams northwest of Freelandville, Edwardsport, and Westphalia. This soil is less productive than the other poorly drained soils of the bottoms, owing to its acidity, smaller supply of plant nutrients, and poorer drainage. A large proportion of the land is in pasture. On the cropped land, corn is the principal crop, although wheat, soybeans, and mixed hay are also grown.

MISCELLANEOUS LAND TYPES

Mine dumps.—Throughout the coal-mining section of the county are areas of land occupied by mine refuse, which mark the site of active or abandoned coal mines. A few such areas are near Bicknell. The material consists of waste coal of very poor quality, carbonaceous shale, and rock removed from the mines during the period of operation. These areas are worthless for cultivated crops, but may grow sweetclover in places.

Riverwash.—Areas mapped as riverwash consist of gravel and sand bars in and along the river channels. They are valueless for agriculture, but the material has considerable value for road building. The sand is used to some extent for concrete structures about the farms.

Gravel pits.—A few gravel pits, such as those near Vincennes, are large enough to show separately on the soil map. They have no use other than for the gravel taken from them.

PRODUCTIVITY RATINGS

The soils of Knox County are rated in table 10 according to their productivity for the more important crops of the county. They are listed in the order of their estimated desirability for farming according to their general productivity under common better practices of management, their dominant uses, and prevailing conditions of drainage and overflow. Ratings are given for two general levels of management; one without the use of fertilizers and other amendments, except for plant residues; and the other under good management practices that include the use of commercial fertilizers, lime, barnyard manures, green manures, and legumes in rotation. Actual practices followed on any particular field or farm vary, of course, with the particular soil type, pattern of soil types, or individual preference of the farmer. In evaluating individual soil types, as mapped, the purity of the type is a modifying factor. The descriptions of the individual soils in the preceding pages should be consulted.

The productivity of each soil for each crop is compared to a standard of 100 in the columns headed "Crop productivity index." A rating of 50, for example, indicates that the soil type is one-half as productive for the specified crop as is a soil with a rating of 100. The standard index of 100 represents the approximate acre yield obtained without amendments on the more extensive and better soil types of the regions of the United States in which the crop is most widely grown. Soils given amendments, such as lime, commercial fertilizers, and irrigation, and unusually productive soils of comparatively small extent, may have productivity indexes of more than 100 for some crops. Crop residues and manure produced directly or indirectly by the soils in question are not considered amendments.

The following tabulation sets forth some of the acre yields that have been established as standards of 100. These figures represent the average long-time yields of crops of satisfactory quality.

Crop:		
Corn (grain)	bushels	50
Wheat	do	25
Oats	do	50
Soybeans	do	25
Potatoes	do	200
Apples	do	200
Timothy and clover hay	tons	2
Red clover hay	do	2
Alfalfa hay	do	4
Pasture	cow-acre-days[1]	100

[1] See footnote 7 of table 10, p. 51.

The crop productivity indexes in columns "N" refer to expected yields without special practices to restore, maintain, or increase productivity. Aside from the return of crop residues and the occasional application of manure produced from feed grown on the land, no fertilizers and no lime or other amendments are used, and no special effort is made in the selection and rotation of crops or to return organic matter to the soils. Under such practices, of course, yields will decrease, the rate of decrease varying with the different soil types.

The indexes in columns "F" refer to yields obtained under the current practices of the better-than-average farmers. These practices include the use of optimum amounts of barnyard manure, legumes, commercial fertilizers, longer rotations, green manures, and artificial drainage where needed. The intensity of these practices varies with the soil type. The management of some of the fertile soils of the bottoms by the better farmers is not greatly different, for example, from the management by the other farmers.

Two sets of ratings are given for a considerable number of the soils to indicate their productivity under natural conditions of poor drainage and under conditions of artificial drainage. Likewise, two sets of ratings are given for those soils, subject to overflow, that are artificially protected.

The principal factors determining the productivity of land are climate, soil (this includes a long list of physical, chemical, and biological characteristics), slope, drainage, and management, including the use of amendments. Actually, no one of these factors operates separately from the others, although some one may dominate. The soil type itself is conceived by the modern soil scientist to represent the combined expression of all those forces and factors that, working together, produce the medium in which the plant grows. Crop yields over a long period of years furnish the best available summation of these associated factors and therefore are used where available. In this rating of the soils of Knox County, most of the indexes are based on estimated yields rather than on actually reported yields. This is necessary because of the lack of definite records. Interviews with farmers are the most common source of information upon which the estimated yields or indexes are based. The indexes for vegetables and pasture are generally less exact and less satisfactory than the others, as data regarding these items are particularly scarce and indefinite. No attempt is made to relate the indexes for vegetables to species or to a standard. As a result they are generalized and comparative. It is recognized also that variations in soils as mapped and in management make it impossible to expect that the indexes will apply absolutely to all areas of a given soil type. The indexes represent, therefore, what may be considered a reasonable approximate average yield.

The productivity table as given here does not present the relative roles that the different soil types, because of their extent and the pattern of their distribution, play in the agriculture of the county. The ratings give a characterization to the productivity of individual soil types. They cannot picture the total quantitative production of crops by soil types without the additional knowledge of the acreage of the individual soil types devoted to each of the specified crops.

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TABLE 10.—*Productivity ratings of the soils of Knox County, Ind.*

Soil (soil types and phases) [1]	Condition in respect to drainage and overflow [2]	Crop productivity index [3] for—																							Type of farming or principal crops, with some additional remarks	General classification
		Corn (grain)		Wheat		Oats		Timothy and clover		Red clover		Alfalfa		Soybeans		Potatoes		Vegetables [6]		Apples		Permanent pasture		Forest [8]		
		100=50 bu.		100=25 bu.		100=50 bu.		100=2 tons		100=2 tons		100=4 tons		100=25 bu.		100=200 bu.				100=200 bu.		100=100 cow-acre-days [7]				
		N [4]	F [5]	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F			
Montgomery silty clay loam.	D	80	110	70	90	50	60	80	100	60	70	40	60	90	100	60	70	70	80	---	---	---	---	---	Largely corn; rotation of corn, wheat, and clover; small grains subject to some winter-killing; heavy power equipment required for tillage.	Excellent to good cropland.
	U	50	---	30	---	20	---	70	---	40	---	---	---	70	---	---	---	---	---	---	---	100	---	A		
Montgomery silt loam	D	80	105	80	90	50	60	80	100	60	70	50	60	90	100	50	70	60	70	---	---	---	---	---	Largely corn; rotation of corn, wheat, and clover.	
	U	60	---	30	---	20	---	70	---	50	---	---	---	70	---	20	---	---	---	---	---	100	---	A		
Westland clay loam	D	80	105	70	100	50	60	80	100	60	70	40	60	90	100	60	70	70	80	---	---	---	---	---	Largely corn; rotation of corn, wheat, and clover.	
	U	60	---	30	---	20	---	70	---	40	---	---	---	70	---	---	---	---	---	---	---	100	---	A		
Lyles silty clay loam	D	90	105	60	80	50	60	80	100	60	70	60	70	90	100	50	80	60	70	---	---	---	---	---	Grain farming; largely corn, some wheat, soybeans, and clover.	
	U	50	---	50	---	20	---	70	---	40	---	20	---	60	---	30	---	---	---	---	---	100	---	A		
Genesee silt loam	L	100	110	70	80	80	---	80	100	90	100	80	90	100	---	60	70	90	100	---	---	---	---	---	Largely corn, some soybeans, and wheat. Easily tilled but subject to overflow unless protected.	
	NL	90	---	40	---	20	---	80	---	40	---	20	---	90	---	30	---	60	---	---	---	100	---	A		
Genesee silt loam, high-bottom phase.	NL	90	100	70	80	60	---	100	100	70	80	80	90	90	100	60	70	70	90	---	---	100	---	A	Largely corn, some soybeans, and wheat	
Ross silty clay loam	NL	90	105	80	100	70	---	80	90	80	90	70	90	80	90	60	70	70	80	---	---	100	---	A	Grain farming; corn, some wheat, clover, soybeans, and alfalfa.	
Abington clay loam	D	90	105	30	70	50	60	90	100	50	70	---	---	90	100	---	---	---	---	---	---				do.	
	U	20	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	90	---	A		
Ross silt loam	NL	90	105	80	100	70	---	80	90	80	90	70	80	80	90	60	70	70	80	---	---	100	---	A	Grain farming; corn, some wheat, clovers, soybeans and alfalfa.	
Westland loam	D	80	100	70	100	70	80	80	100	60	70	40	60	90	100	60	70	70	80	---	---	---	---	---	Largely corn; rotation of corn, wheat, and clover. Easily tilled.	
	U	60	---	60	---	20	---	70	---	40	---	---	---	70	---	---	---	---	---	---	---	90	---	A		

Lyles silt loam	D	80	100	80	90	50	60	80	100	60	70	60	70	90	100	50	80	60	70	---	---	---	---	---	Grain farming; largely corn; some wheat, soybeans, and clover.
	U	60	---	60	---	20	---	70	---	50	---	---	---	60	---	30	---	---	---	---	---	100	---	A	
Ragsdale silt loam	D	80	105	80	90	50	60	80	100	60	70	50	60	90	100	50	80	60	70	---	---	---	---	---	Grain farming; largely corn; some wheat, soybeans, and clover.
	U	60	---	60	---	20	---	70	---	50	---	---	---	70	---	30	---	---	---	---	---	100	---	A	
Abington clay	D	90	100	50	70	40	50	90	100	40	60	---	---	90	100	---	---	---	---	---	---	---	---	---	Grain farming; corn, some wheat, clover, soybeans, and alfalfa. Heavy power equipment required for tillage. Short period when soil has optimum moisture content for tillage.
	U	20	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	80	---	A	
Genesee silty clay loam	L	100	110	70	80	20	---	80	100	80	90	80	90	100	---	40	60	80	90	---	---	---	---	---	Largely corn, some soybeans, and wheat.
	NL	90	---	30	---	20	---	80	---	30	---	---	---	80	---	20	---	50	---	---	---	100	---	A	
Genesee silty clay loam, high-bottom phase.	NL	90	100	70	80	50	---	100	---	60	70	70	80	80	90	50	60	60	80	---	---	100	---	A	Largely corn, some soybeans, and wheat.
Genesee loam	L	100	110	70	80	80	---	80	100	80	90	80	90	90	---	60	70	90	100	---	---	---	---	---	Largely corn, some soybeans, and wheat.
	NL	90	---	40	---	30	---	50	---	50	---	50	---	80	---	30	---	60	---	---	---	90	---	A	
Lyles loam	D	80	100	80	90	50	60	80	100	60	70	60	70	80	100	50	80	60	70	---	---	---	---	---	Grain farming; largely corn, some wheat, soybeans, and clover.
	U	60	---	60	---	20	---	70	---	50	---	---	---	60	---	30	---	---	---	---	---	90	---	A	
Ragsdale loam	D	80	100	80	90	50	60	90	100	60	70	60	70	90	100	50	80	60	70	---	---	---	---	---	Grain farming; largely corn, some wheat, soybeans, and clover. Easily tilled.
	U	60	---	40	---	20	---	70	---	50	---	---	---	60	---	30	---	---	---	---	---	90	---	A	
Genesee loam, high-bottom phase.	NL	80	90	50	70	70	---	60	70	70	80	50	80	80	90	60	70	40	50	---	---	90	---	A	Grain farming; largely corn, some wheat, soybeans, and clover.
Abington clay, mucky phase.	D	50	100	---	---	---	---	80	100	---	---	---	---	70	90	30	80	60	90	---	---	---	---	---	Grain farming; corn, some wheat, clover, soybeans, and alfalfa. Crops, especially corn, may suffer from deficiency of potash.
	U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	90	---	B	

[1] The soils are listed in the order of their estimated general productivity for the common crops and desirability for farming. Common use and prevailing drainage conditions, as well as productivity, are important factors in determining the order.

[2] Ratings are given for those soil types and phases that include either areas artificially drained or artificially protected from overflow. The following symbols are used: D, Adequately drained by tiling or ditching; U, undrained; L, land with optimum levee protection from overflow; and NL, land with no protection from overflow.

[3] The soils of Knox County are given indexes that show the approximate average production of each crop in percent of the standard of reference. The standard represents the approximate yield obtained without the application of commercial fertilizers or lime on the more extensive and better soil types of the regions of the United States in which the crop is most widely grown. Many of the ratings are the result of estimates, as yield data are incomplete.

[4] Indexes in column N (no fertilizer) refer to yields obtained from land that is cropped without the use of amendments, except for the return of plant residues.

[5] Indexes in column F (fertilizers) refer to yields obtained by the practices of the better farmers. These practices include the use of commercial fertilizers, lime, barnyard manures, green manures, and legumes in the rotation.

[6] These indexes for vegetables are only generalized and comparative for the soil types of this and adjoining counties, as they do not refer to either standard yields or particular species. Substantiating yield data are too scarce to estimate specific yields by type of vegetable.

[7] Cow-acre-days is a term used to express the carrying capacity of pasture land. As used here it is the product of the number of animal units carried per acre multiplied by the number of days the animals are grazed without injury to the pasture. For example, the soil type able to support 1 animal unit per acre for 360 days of the year rates 360, whereas another soil able to support 1 animal unit on 2 acres for 180 days of the year rates 90. Again, if 4 acres of pasture supports 1 animal unit for 100 days, the rating is 25.

[8] Order of preference is A, B, C. The letters represent very generalized comparisons of the productivity of the soils for trees without direct reference to quantity of production, rate of growth, or species.

NOTE: Absence of an index figure indicates that the soil is not adapted to the crop or that the crop is not commonly grown.

TABLE 10.—*Productivity ratings of the soils of Knox County, Ind.*—Continued

Soil (soil types and phases)	Condition in respect to drainage and overflow	Crop productivity index for—																						Forest	Type of farming or principal crops, with some additional remarks	General classification
		Corn (grain) 100=50 bu.		Wheat 100=25 bu.		Oats 100=50 bu.		Timothy and clover 100=2 tons		Red clover 100=2 tons		Alfalfa 100=4 tons		Soybeans 100=25 bu.		Potatoes 100=200 bu.		Vegetables		Apples 100=200 bu.		Permanent pasture 100=100 cow-acre-days				
		N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F			
Bainbridge silt loam	......	60	90	70	100	50	70	60	80	30	70	10	80	70	90	40	70	..	50	60	70	...	70	A	Grain and livestock; corn, oats, wheat, and clover. Inherently only moderately productive, but level and not erodible.	
Otwell silt loam	......	60	90	70	100	50	70	60	80	30	70	10	80	70	90	40	70	...	50	60	70	..	70	A	do.	
Princeton silt loam	......	60	80	70	90	50	70	50	70	50	70	50	80	70	80	40	60	..	50	80	100	...	70	A	Commercial apple orcharding, grain, and livestock; corn, oats, wheat, and clover. Susceptible to some sheet erosion.	
Iona silt loam	......	70	80	70	90	50	60	50	70	40	80	60	90	70	80	40	70	..	70	50	60	...	80	A	Grain and livestock	
Princeton loam	......	50	70	70	90	50	70	50	70	50	70	60	80	70	80	40	60	50	60	90	100	60	...	A	Apples, peaches, and general farm crops.	
Marion silt loam	D	80	90	60	80	60	70	90	100	80	100	60	70	80	90	50	60	40	50	...	...	-	...	...	Grain and livestock; mainly corn, some soybeans, wheat, and hay.	
	U	70	..	50	-	50	...	80	...	60	-	40	...	80	-	40	...	30	...	...	...	100	...	A		
Eel silty clay loam	L	110	..	50	60	50	...	100	...	80	...	50	...	100	...	40	50	..	70	...	...	-	...	...	Grain farming; corn and soybeans	
	NL	80	..	...	...	...	...	70	...	...	...	...	...	70	...	...	...	..	...	...	...	100	...	...	Subject to considerable overflow with water standing in places for considerable periods of time.	
Algiers silt loam	D	90	105	60	70	60	...	90	...	70	80	30	50	100	...	40	60	...	70	...	...	...	...	...	Grain and livestock; mainly corn, some wheat, soybeans, and hay.	
	U	80	...	50	...	40	...	60	...	50	...	...	...	70	...	...	...	...	...	...	...	100	...			
Muren silt loam	......	60	80	70	90	40	50	50	70	20	60	10	60	70	80	40	60	...	70	40	50	...	70	A	Grain and livestock	
Eel loam	L	100	...	60	70	60	..	90	...	70	..	50	...	100	...	40	50	...	70	...	...		...	...	Grain farming; corn and soybeans	
	NL	90		20	...	40	..	70	...	...	...	...	...	70	...	...	...	...	...	...	...	90	...	A		
Algiers loam	D	90	100	60	70	60	...	80	...	60	70	30	50	90	...	80	60	...	70	...	...	...	...	...	Grain and livestock; mainly corn, some soybeans, wheat, and hay.	
	U	80	...	50	...	40	...	60	...	50	...	...	...	70	...	...	...	...	...	...	...	90	...	A		
Vincennes silty clay loam	D	90	100	80	100	60	70	90	100	40	60	10	30	80	100	40	50	40	60	...	...	70	...	...	Grain; corn, wheat, and soybeans	
	U	80	...	70	...	50	..	80	...	20	...	...	...	70	...	...	...	...	...	...	...	...	...	A		
Vincennes clay loam	D	90	100	80	100	60	70	90	100	40	60	10	30	80	100	...	...	40	...	...	...	70	...	...	Grain; corn, wheat, and soybeans	
	U	80	...	70	...	50	...	80	...	20	...	...	...	70	...	...	...	...	...	...	...	...	...	A		Good to fair cropland.

Elkinsville silt loam	------	65	80	70	80	40	50	50	80	50	80	20	70	70	90	40	70	50	60	30	50	70	---	A	Grain farming; wheat and corn with some clover.
Ayrshire silt loam	D	70	80	70	80	50	60	70	80	50	80	40	50	70	80	40	60	30	40	---	20	---	60	------	Grain and livestock; corn, oats, wheat, and clover.
	U	50	---	50	---	40	---	50	---	40	---	20	---	60	---	---	---	---	---	---	---	---	---	A	
Pike silt loam	------	60	80	70	90	50	60	60	70	30	60	10	80	70	80	40	70	---	50	70	80	---	70	A	Mixed grain and livestock; corn, wheat, clover, and timothy.
Genesee fine sandy loam	L	70	80	40	60	60	---	40	60	30	40	70	80	80	90	50	60	50	60	---	---	---	---	------	Largely corn; some soybeans and wheat.
	NL	70	---	30	---	20	---	40	---	20	---	60	---	60	---	20	---	40	---	---	---	50	---	A	
Alford silt loam	------	60	80	70	90	50	60	50	70	20	70	10	70	70	80	40	70	---	50	60	70	---	70	A	Mixed grain and livestock; corn, oats, wheat, clover, and timothy. Susceptible to severe sheet erosion.
Elkinsville loam	------	60	80	60	80	40	50	40	60	40	70	20	60	60	80	40	70	35	65	40	60	60	---	A	Grain farming; wheat and corn with some clover.
Eel silt loam	L	100	110	60	70	60	---	90	---	70	80	30	50	100	---	40	60	---	70	---	---	---	---	------	Largely corn; some soybeans and wheat. Fertile soil, but areas along stream bottoms are small and tillage operations with machinery are inefficient and costly.
	NL	70	---	40	---	40	---	60	---	---	---	---	---	70	---	---	---	---	---	---	---	100	---	A	
Vincennes loam	D	80	90	60	70	50	60	60	70	40	70	10	40	80	90	50	70	40	80	---	---	60	---	------	Grain; corn, wheat, and soybeans.
	U	70	---	50	---	40	---	50	---	30	---	---	---	70	---	40	---	---	---	---	---	---	---	A	
Fox loam	------	50	65	50	90	50	60	30	50	40	50	30	60	70	80	40	60	40	50	---	40	40	---	A	Cash grain farming; wheat and corn. Moisture-holding capacity relatively low.
Markland silt loam	------	50	70	70	80	30	50	60	80	30	50	30	70	60	70	30	50	40	60	40	50	40	55	A	Grain and livestock; corn, wheat, and clover.
Princeton fine sandy loam.	------	40	60	40	60	20	40	20	40	10	30	50	70	40	60	60	80	50	[9] 100	50	[10] 100	30	---	A-B	Melons and other special crops; alfalfa and soybeans. Moisture-holding capacity low.
Warsaw loam	------	50	65	50	80	50	60	30	50	---	50	---	50	60	80	40	60	40	50	40	40	40	---	B-A	Grain farming; wheat and corn.
Algiers fine sandy loam	D	60	80	50	60	40	50	70	---	30	40	30	50	80	---	40	60	---	70	---	---	80	---	A	Grain and livestock; mainly corn, some soybeans, wheat, and hay.
	U	50	---	40	---	30	---	50	---	---	---	---	---	60	---	---	---	---	---	---	---	---	---	---	
Buckner loam	------	50	80	50	80	50	60	30	50	---	50	---	40	60	80	40	60	40	50	30	30	35	---	B-A	Cash grain farming; wheat and corn; low moisture-holding capacity.
Princeton loamy fine sand.	------	30	50	30	60	10	20	20	40	---	---	50	70	40	50	30	50	60	[9] 100	50	[10] 100	20	---	B	Melons and other special crops; alfalfa and soybeans. Low moisture-holding capacity.

See footnotes at end of table.

TABLE 10.—*Productivity ratings of the soils of Knox County, Ind.*—Continued

Soil (soil types and phases)	Condition in respect to drainage and overflow	Crop productivity index for— Corn (grain) 100=50 bu.		Wheat 100=25 bu.		Oats 100=50 bu.		Timothy and clover 100=2 tons		Red clover 100=2 tons		Alfalfa 100=4 tons		Soybeans 100=25 bu.		Potatoes 100=200 bu.		Vegetables		Apples 100=200 bu.		Permanent pasture 100=100 cow-acre-days		Forest	Type of farming or principal crops, with some additional remarks	General classification
		N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F			
Iva silt loam	D	60	80	60	70	60	70	60	70	40	70	---	40	60	70	40	60	50	60	---	---	---	60		Grain and livestock; corn, wheat, clover, and timothy.	Fair to poor cropland.
	U	40	---	40	---	50	---	50	---	10	---	---	---	50	---	20	---	40	---	---	---	---	---	A		
Fox sandy loam	---	40	60	50	70	50	55	30	40	30	40	30	50	60	70	40	60	40	50	---	40	30	---	A	Cash grain farming; wheat and corn. Low moisture-holding capacity.	
Warsaw sandy loam	---	40	60	50	80	40	55	20	40	---	40	---	50	60	80	40	60	40	50	40	40	30	---	B-A	do.	
Kings silty clay	D	80	90	60	70	20	20	80	90	50	70	20	30	20	30	---	---	---	---	---	---	---	---	---	Grain farming; corn, some wheat, clover, soybeans, and alfalfa. Tillage operations are difficult because of heavy and relatively intractable soil.	
	U	50	---	50	---	---	---	70	---													80	---	A		
Buckner sandy loam	---	50	70	50	80	40	50	20	40	---	50	---	50	60	80	40	60	40	50	40	40	30	---	B-A	Cash grain farming; wheat and corn. Low moisture-holding capacity.	
Vincennes silt loam	D	70	90	60	70	50	60	60	70	40	70	10	40	80	90	50	70	40	50	---	---	60	---	---	Grain farming; corn, wheat, and soybeans.	
	U	60	---	50	---	40	---	50	---	30	---	---	---	70	---	40	---	---	---	---	---	---	---	A		
Bartle silt loam	D	70	90	60	70	50	60	60	70	40	70	10	50	70	80	50	70	40	50	---	---	60	---	---	Grain farming; corn, wheat, and soybeans.	
	U	60	---	50	---	40	---	50	---	30	---	---	---	60	---	40	---	---	---	---	---	---	---	A		
Homer loam	D	50	70	60	70	50	60	50	60	40	50	10	50	60	70	40	50	40	50	---	---	60	---	---	Grain farming and some dairying; corn and wheat.	
	U	40	---	50	---	40	---	40	---	30	---	---	---	50	---	30	---	---	---	---	---	---	---	A		
Elkinsville fine sandy loam.	---	40	60	50	70	20	40	20	40	10	20	20	50	40	50	40	60	50	[9] 90	50	[10] 90	30	---	A-B	Special cash and general farm crops. Low moisture-holding capacity.	
Oaktown loamy fine sand	---	30	50	30	60	10	20	20	40	---	---	50	70	40	50	30	50	55	[9] 95	50	[10] 90	20	---	B	Melons and special crops; alfalfa and soybeans.	
Bartle loam	D	80	90	60	70	50	60	60	70	40	70	10	50	70	80	50	70	40	50	---	---	60	---	---	Grain farming; corn, wheat, and soybeans.	
	U	70	---	50	---	40	---	50	---	30	---	---	---	60	---	40	---	---	---	---	---	---	---	A		
Homer sandy loam	D	50	60	60	70	40	50	40	50	40	45	10	50	60	70	40	50	40	50	---	---	60	---	---	Grain farming and some dairying; corn and wheat.	
	U	40	---	50	---	30	---	30	---	30	---	---	---	50	---	30	---	---	---	---	---	---	---	A		
Stendal silt loam	D	60	70	50	70	50	---	70	---	---	50	---	---	60	---	20	30	50	---	---	---	---	---	---	Grain and livestock; mainly corn, some soybeans, wheat, and hay.	
	U	40	---	30	---	20	---	50	---	---	---	---	---	40	---	---	---	---	---	---	---	60	---	A		

Ayrshire fine sandy loam	D	60	70	50	70	40	60	70	80	40	70	10	50	60	70	30	50	30	40	---	-----	---	---	------	Grain and livestock and some dairying; corn, oats, wheat, and clover.	
	U	30	---	30	---	30	---	50	---	30	---	---	---	50	---	---	---	---	-----	---	-----	---	---	A		
Bartle fine sandy loam	D	60	70	50	60	50	60	50	60	30	40	10	40	60	70	50	60	40	50	---	-----	30	---	------	Grain farming; corn, wheat, and soybeans.	
	U	50	---	40	--	40	--	40	---	20	---	---	---	50	---	40	---	---	-----	---	-----	---	---	A		
McGary silt loam	D	50	70	50	70	40	50	60	70	40	60	10	30	50	60	30	40	30	40	---	-----	50	---	------	Mixed grain and livestock; corn, wheat, and clover.	
	U	40	---	40	---	20	---	50	---	10	---	---	---	40	---	---	---	---	-----	---	-----	---	---	A		
Carlisle silty muck	D	50	100	---	---	---	---	80	100	---	---	---	---	70	90	30	80	70	[11] 100	---	-----	---	---	------	Grain farming; largely corn, some wheat, soybeans, and clover.	
	U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	-----	---	-----	100	---	B		
Sharkey clay loam	D	60	70	60	70	20	20	70	80	20	30	---	---	---	---	---	---	---	-----	---	-----	---	---	------	Grain farming; corn, wheat, clover, soybeans, and alfalfa. Tillage operations are difficult because of comparatively tough and intractable soil.	
	U	20	---	10	---	---	---	---	---	---	---	---	---	---	---	---	---	---	-----	---	-----	80	---	A		
Sharkey clay	D	60	70	60	70	20	20	70	80	20	30	---	---	---	---	---	---	---	-----	---	-----	---	---	------	Grain farming; corn, wheat, clover, soybeans, and alfalfa. Tillage operations are difficult because of comparatively tough and intractable soil.	
	U	20	---	10	---	---	---	60	---	---	---	---	---	---	---	---	---	---	-----	---	-----	80	---	A		
Princeton fine sandy loam, slope phase.	------	---	10	---	10	---	---	20	30	---	---	40	60	---	---	---	20	---	20	---	40	---	20	B	Mixed farm and truck crops	Meadow, pasture, or timberland.
Princeton loam, slope phase.	------	---	10	---	20	---	---	30	40	---	20	40	60	---	---	---	---	---	-----	---	40	---	40	A	Woods and pasture	
Princeton silt loam, slope phase.	------	10	20	10	20	10	20	30	50	---	30	---	30	---	---	---	---	---	-----	---	30	---	50	A	do.	
Pike silt loam, slope phase.	------	10	20	10	20	10	20	30	50	---	20	---	20	---	---	---	---	---	-----	---	20	---	50	A	do.	
Alford silt loam, slope phase.	------	10	20	10	20	10	---	30	50	---	20	---	20	---	---	---	---	---	-----	---	20	---	50	A	do.	
Princeton silt loam, eroded phase.	------	10	20	10	20	---	---	10	30	---	---	---	30	10	---	---	---	---	-----	---	-----	---	30	C	Grain livestock, pasture, and idle land	
Alford silt loam, eroded phase.	------	10	20	10	20	10	20	10	30	---	---	---	30	10	---	---	---	---	-----	---	-----	---	30	C	do.	

[9] Indexes refer primarily to melons.
[10] Indexes refer primarily to peaches.
[11] Index refers primarily to the production of such special crops as celery, carrots, mint, potatoes, and onions.

Economic considerations have played no part in determining the crop indexes, therefore they cannot be interpreted into land values except in a very general way. Relative demands and prices of farm products, distance to market, and other factors influence the value of land.

The brief statements under "Type of farming or principal crops with some additional remarks" are offered to give the reader information about the principal uses of the soil types in the local agriculture.

The column "General classification" summarizes in a simple way the productivity and use capabilities of the various soils, by placing them in a few groups based on their relative suitability for the common crops, pasture, and timber. It is conceivable that changes in farming, shifts in the values of present important crops, newer uses of lands, and different kinds of management may alter this classification. The association of soil types or the particular pattern of distribution that they form on an individual farm or a group of farms may have a very important influence on the use and value of the land of the farms. Such conditions are not covered adequately by this classification to make it equally applicable to all farms in the county. Thus, certain areas of Princeton loamy fine sand give phenomenal economic returns for special cash crops, especially in some years, but are comparatively low in productivity for general farm crops. Similar statements apply to other soils.

Since the productivity of the soil is not the only characteristic that determines its desirability for agriculture, the most productive soils in a given area are not necessarily the most desirable. Other considerations, such as ease of tillage, susceptibility to erosion, freedom from stone, the topography or lay of the land, extent of individual areas, uniformity of areas as to soil profile, drainage, and topography, and the location and association of the areas with other soil areas, are additional characteristics affecting the general desirability of a soil type. Of course, the productivity of a soil is influenced by most of these characteristics, but productivity in itself does not completely determine the desirability of soil types for agricultural use. Accordingly, the soils of Knox County have been listed in table 10 in the order of their general desirability for agricultural use, when such factors, together with common use and management, are considered in addition to productivity. The order of listing, therefore, is a result of judgment rather than of mathematics based on a weighted average of the individual crop indexes.

MORPHOLOGY AND GENESIS OF SOILS

Soil is the product of the forces of weathering and soil development on soil materials deposited or accumulated by geological agencies. The characteristics of the soil at any given point depend on the internal soil climate, native vegetation, composition of the parent material, and the length of time the forces of soil development have acted upon the soil material. Soil climate, in turn, depends on the usual climatic factors of rainfall, temperature, and humidity and locally is greatly modified by relief as it affects drainage, aeration, and run-off.

Knox County lies in the Gray-Brown Podzolic soil region of the United States, which includes most of Indiana. Approximately 80 percent of the soils are light colored, such as are produced under forest conditions, and about 20 percent are dark-colored soils produced under a grassy (prairie) or swamp vegetation. The Prairie soils are confined largely to the bottoms and terraces.

The soils have been differentiated on the basis of certain definite soil characteristics, including texture, structure, color, and reaction; number, arrangement, and thickness of horizons; and composition of the parent material. Topographic, physiographic, and vegetative relationships also are considered.

Table 11 shows the physiographic, parent-material, topographic, drainage, and soil-color relationships of the soils of Knox County.

The soils of Knox County are developed on four principal kinds of parent material and several secondary kinds. First, in the upland, the deep silty materials resting on a heterogeneous mass of clay, sand, and gravel comprise the dominant group. The material consists of uniform, soft, porous, vesicular silt deposits having a mixture of dull-brown, yellow, and gray colors. It covers the Illinoian glacial deposits to an average depth of approximately 100 inches. Geologists consider that this silt mantle was deposited during the Iowan period.

The soils are acid to a depth of 70 to 80 inches, where they generally become neutral in reaction. The silt, lying from 10 to 15 inches above the till, in most places is slightly gritty, suggesting that in some places it may be a fossil A horizon developed prior to deposition of the silt. The upper part of the till contains fewer glacial pebbles, and the slightly different color and structure suggest a fossil B horizon. The material in both these horizons is acid in places, although the till deposits in many places are calcareous at a depth of 12 to 15 feet. Neutralizing values show that this material contains about 10 percent of mixed calcium and magnesium carbonates.

Glacial deposits are supposed to have covered the entire area of the county at one time. Most of the deposits are from 20 to 25 feet in thickness but are very thin in many places, with sandstone outcropping in road cuts and on hillsides. The material of a few hills is known to contain no glacial evidence between the silt mantle and the sandstone rock. The island hills in the river bottoms have sandstone and shale outcropping, with no glacial evidence on some of them.

The second kind of parent material consists of calcareous unstratified deposits of yellowish-gray sands and silts. These materials are in the western part of the county adjoining the Wabash Valley and cover about 16 percent of the area. The materials are assumed to have been carried from the valley by strong northwest winds sweeping across the bottoms. The coarser sands are along the bluffs, and the finer calcareous silts (loess) have been deposited from 3 to 4 miles from the bottoms. Geologists place the age of the sand deposits in the Late Wisconsin glacial period, but the calcareous silt deposition occurred earlier, as shown by the lower position in exposed cuts. The calcareous loess deposits range from several to many feet in thickness, depending on the direction of air currents at the time of deposition and the distance from the river. Deposits close to the river valley are thicker than more distant ones. North of Vincennes a cut was examined that had a 35-foot deposit of silt and sand overlying glacial till. The leached sand and silt have neutralizing values equivalent to 15 and 25 percent calcium carbonate, respectively.

TABLE 11.—*Key to the soils of Knox County, Ind.*[1]

SOILS OF THE UPLANDS AND TERRACES

Parent material	General profile							
	II	III	IV	V	VI	VII	VIII	IX and X
	Brownish-gray soils on flats and mottled gray and yellow subsoils; original surface drainage imperfect and original internal drainage poor	Grayish-brown soils on undulating land, yellow B_2 horizon, mottled B_3 horizon; original surface drainage fair and original internal drainage imperfect	Grayish-brown soils on rolling land and brownish-yellow B horizon; surface and internal drainage good	Brown soils on flat to rolling land, light reddish-brown B horizon, light-red porous substrata; surface and internal drainage good to excessive	Soils on steep nonagricultural slopes; surface drainage excessive and internal drainage fair to good	Eroded soils on slopes; surface drainage excessive and internal drainage fair to good	Moderately dark soils of flats and depressions; surface and internal drainage poor	Very dark soils of depressions and organic soils; surface and internal drainage very poor
Soils of the formerly forested uplands:								
Loess on calcareous Illinoian till; leached about 10 feet.	Iva silt loam	Muren silt loam	Alford silt loam	Pike silt loam	Alford silt loam, slope phase; Pike silt loam, slope phase.	Alford silt loam, eroded phase.	-----	
Calcareous loess and sands; leached 4 to 7 feet.	Ayrshire silt loam; Ayrshire fine sandy loam.	Iona silt loam	Princeton silt loam; Princeton loam; Princeton fine sandy loam; Princeton loamy fine sand.	-----	Princeton silt loam, slope phase; Princeton fine sandy loam, slope phase.	Princeton silt loam, eroded phase.	Ragsdale silt loam; Ragsdale loam.	
Soils of the formerly forested terraces:								
Calcareous gravelly stratified terrace materials; leached 3 to 5 feet.	Homer loam; Homer sandy loam.	-----	-----	Fox loam; Fox sandy loam.	-----	-----	Westland clay loam; Westland loam.	Abington clay; Abington clay, mucky phase; Abington clay loam; Carlisle silty muck.

Calcareous stratified clay; leached 2 to 4 feet.	McGary silt loam	----------	Markland silt loam	----------	----------	----------	Montgomery silt loam; Montgomery silty clay loam.	Kings silty clay.
Noncalcareous stratified clay, silt, sand, and gravel.	Bartle silt loam; Bartle loam; Bartle fine sandy loam.	----------	Otwell silt loam; Elkinsville silt loam; Elkinsville loam; Elkinsville fine sandy loam; Oaktown loamy fine sand.	Bainbridge silt loam.	----------	----------	Vincennes silty clay loam; Vincennes clay loam; Vincennes silt loam; Vincennes loam.[2]	Lyles silty clay loam; Lyles silt loam; Lyles loam; Sharkey clay; Sharkey clay loam.
Soils of former grasslands (Prairie):[3]								
Loess on calcareous Illinoian till; leached about 10 feet.	Marion silt loam	----------	----------	----------	----------	----------	----------	
Calcareous stratified gravelly terrace materials; leached 4 to 5 feet.	----------	----------	----------	Warsaw loam; Warsaw sandy loam.	----------	----------	----------	
Noncalcareous stratified sand, silt, and some clay.	----------	----------	Buckner loam; Buckner sandy loam.	----------	----------	----------	----------	

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

[2] The Vincennes soils are intermediate between group II and group VIII. The loam and silt loam resemble the soils in group II, and the silty clay loam and clay loam more closely resemble the soils in group VIII.

[3] Soils of the former grasslands are darker colored than is indicated under the roman numerals, because of the organic matter accumulated under the influence of grassy vegetation.

TABLE 11.—*Key to the soils of Knox County, Ind.*—Continued

SOILS OF THE BOTTOM LANDS

Parent material	General profile							
	II	III	IV	V	VI	VII	VIII	IX and X
	Brownish-gray soils of low areas; mottled subsoils	Grayish-brown soils of slightly elevated areas; mottled subsoils	Brown soils of elevated areas; brown subsoils					
Neutral or slightly acid alluvial soils.	-----	Algiers silt loam; Algiers loam; Algiers fine sandy loam; Eel silt loam; Eel silty clay loam; Eel loam.	Genesee silt loam; Genesee silty clay loam; Genesee loam; Genesee fine sandy loam; Genesee silt loam, high-bottom phase; Genesee silty clay loam, high-bottom phase; Genesee loam, high-bottom phase; Ross silt loam;[4] Ross silty clay loam.	-----	-----	-----	-----	
Acid alluvial soils -----	Stendal silt loam -----	-----	-----	-----	-----	-----	-----	

[4] Ross soils are darker colored than Genesee soils, owing to accumulations of alluvium from neighboring Prairie soils.

Third, the river terrace deposits consist of stratified gravel, sand, silt, and clay. On this basis the soils are arranged in three groups: (1) Those developed on assorted calcareous gravel and sand; (2) those developed on noncalcareous clay, silt, and sand; and (3) those developed on heavy slack-water clay deposits. All these soils are derived from materials deposited during the recession of the Late Wisconsin ice sheet by the glacial White and Wabash Rivers. The slack-water clay deposits presumably were made in ponded streams during this period.

The more recent alluvial deposits fall into two groups: (1) Neutral or slightly acid sands, silts, and clays; and (2) acid sands, silts, and clays. Soils of the bottoms are dominantly slightly acid or neutral in reaction. They comprise the largest soil group and cover about 28 percent of the county. Bottom soils of small tributary streams in the hill land are dominantly neutral, although some of them are slightly acid. These acid spots, which occur with no apparent regularity, could not be separated consistently on the map. Acid alluvial soils occur mainly in the northeastern part of the county where the streams have their source in the acid Illinoian glacial till deposits of Greene and Sullivan Counties. A few scattered areas have been separated in other parts of the county.

The development of soils in the Gray-Brown Podzolic soil region has produced certain definite characteristic horizons. Virgin Gray-Brown Podzolic soils are covered with a thin layer of partly decomposed plant residues, which is designated as the A_0 horizon. This material generally is neutral or only slightly acid in reaction. The upper mineral soil horizon (A) is subject to frequent percolation of water in a humid climate and has been leached of soluble basic constituents. The finer clay particles have been extracted and carried into the B horizon, which is a zone of concentration. The upper 2 or 3 inches of mineral soil (A_1) under virgin conditions are gray or dark gray, the result of an accumulation of organic matter. The underlying A_2 horizon is brownish gray, owing to leaching by organic acids. At a depth of 8 to 10 inches the brownish-gray A horizon grades rather abruptly into the fine-granular brownish-yellow silty clay loam B_1 horizon, which extends to a depth of 12 to 15 inches. The B horizon is the zone of accumulation for the finer clay particles and the sesquioxides of iron and aluminum. The downward percolating ground water removes the more soluble bases, the alkaline earths, and some of the soluble iron from this horizon. The main B horizon (B_2) is brownish yellow or yellowish brown. It is heavier in texture than the A horizon, and the soil breaks into angular irregular fragments from one-fourth to one-half inch in diameter. This material extends to a depth of 30 to 34 inches, and the lower part gradually becomes more friable and lighter in texture. The C horizon consists of slightly altered parent material. In soils with calcareous parent material the C horizon is assumed to begin at the place where the soil will effervesce with acid. The upper part of the C horizon is leached, to some extent, of the more soluble bases, as it has a lower neutralizing value than the lower part.

Besides the three main horizons, which occur in all well-drained Gray-Brown Podzolic soils, two additional horizons commonly occur in the soils of southern Indiana. The X layer is a moderately compact, more or less impervious layer, which lies at a depth of about 3 feet and is commonly called hardpan or claypan. It is best developed on flat soils with imperfect or poor internal drainage. Horizon X_1 consists of light-gray silt-capped tops of vertical columns. The gray silt penetrates along the vertical cleavage planes. The main part of the X horizon X_2 is mottled gray, yellow, rusty, iron-stained heavy silty clay loam or silty clay, which retards the movement of moisture. This horizon has a concentration of clay particles, and it generally has the maximum acidity (exchange acidity by Hopkins method) and the lowest pH value (by colorimetric method). This horizon is considered to be a natural soil horizon developed by deposition of finer colloidal material extracted from the horizons above. The pH value of this horizon tends to approach 4.5. Above the X horizon the soil material is mottled strongly gray and yellow. The heavy X horizon retards the movement of moisture, with consequent periodic waterlogging and reduction of iron compounds. Soils that have imperfect drainage and well-developed X horizons, or claypans, are known technically as Planosols.[8]

Below the X horizon the soil becomes more friable, lighter in texture, and dominantly yellow. This is the Y horizon, which is less thoroughly leached of bases, and the concentration of colloidal material is less.

The grouping of the soils in table 11 on page 58 is designed to show the interrelationship of relief and drainage to profile development. In the light-colored soils of the uplands there have developed in the flat poorly drained soils certain special soil features that are absent or merely suggested in the well-drained soils. The light-gray soils with very poor internal drainage have light-gray surface and subsurface layers; reduction of iron compounds and segregation, as iron and manganese concretions, blotches, and stains; and an impervious claypan layer (X horizon), developed at a depth of about 3 feet, which contributes to the waterlogged condition of the soil. Soils of this extreme development have been combined on the map with the brownish-gray soils (II of the key, table 11). As drainage conditions improve along drainage lines near the edges of the flats where the adjoining land is somewhat more sloping, a B horizon is developed texturally, structurally, and in color. In the ideal profile (II) the B horizon has about 50 percent each of yellow and gray colors. In soils of group III of the key, surface drainage is fair, as the soil has a slightly sloping surface or occupies a flat area adjacent to stream heads. As a result a normal textural and structural B horizon develops and mottling occurs only below the B horizon at a depth of about 2 feet, owing to a moderately impervious X horizon. Below the X horizon the mottling disappears. In soils of group IV of the key, where drainage is well established both internally and externally, the normal B horizon is developed, mottling is less common, and only an incipient X horizon may be found in some places. Soils with excellent underdrainage (group V of the key) occur in places on flats as well as on rolling land. Generally, they do not have X horizons or show evidence of poor drainage. In the

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[8] BALDWIN, MARK, KELLOGG, CHARLES E., and THORP, JAMES. SOIL CLASSIFICATION. Soils and Men, U. S. Dept. Agr. Yearbook 1938: 979–1001. 1938.

soils of the bottom land, gradation of color alone is used as the basis for distinguishing drainage types.

Well-drained Prairie soils are best developed in the northwestern part of the county. The line between Prairie and forested soils is rather sharply drawn in many places by soil color. In other places the soil has a slightly dark grayish-brown color extending to a depth of about 10 inches, which is the common depth of the A horizon in a forested soil. West of Oaktown the soils have moderately dark grayish-brown A horizons extending to a depth of 18 or 20 inches. Southwest of Vincennes and south of Sandborn the Prairie soils have a faded dark brownish-gray appearance together with less depth of penetration by organic matter, seeming to indicate a tendency to change from the Prairie to the Gray-Brown Podzolic group.

In the group of light-colored soils the first subgroup includes soils having light reddish-brown subsoils with excellent internal drainage. Pike silt loam, Bainbridge silt loam, and the Fox soils are included in this subgroup. Pike silt loam is developed from slightly alkaline brown and yellow silt resting on light-red clayey sand and gravel at an average depth of 8 feet. Following is a description of a profile of this soil, as observed in a grassy woods 1 mile east of Monroe City:

A_1. 0 to 7 inches, grayish-brown smooth silt loam having a slightly reddish brown color when moist. It has a light phylliform structure and is easily crumbled in the fingers. The pH value is 6.2.[9]

A_2. 7 to 10 inches, grayish-brown phylliform silt loam. The pH value is 6.1.

B_1. 10 to 15 inches, reddish yellow-brown silty clay loam that has a fine-crumb structure and is slightly plastic and sticky when wet. The pH value is 5.4.

B_2. 15 to 32 inches, coarse-granular friable reddish yellow-brown silty clay loam, moderately plastic and sticky when wet. The pH value is 5.4.

Y_1. 32 to 38 inches, brown or yellowish-brown silty clay loam. The pH value is 5.6.

Y_2. 38 to 70 inches, smooth soft single-grained brown and yellowish-brown vesicular silt grading into the layer below. The pH value is 5.6.

Y_3. 70 to 80 inches, slightly reddish yellow-brown gritty silty loam. The pH value is 5.8.

Y_4. 80 to 96 inches, reddish yellow-brown loam containing some exotic pebbles. The pH value is 5.8.

Y_5 96 to 110 inches, a layer of reddish-brown or light-red clayey gravel and sand that is slightly plastic and sticky when wet. The underlying material consists of assorted sand and gravel. The pH value is 5.8.

Geologists consider this underlying material to be glacial outwash-plain deposits, and the mantle of soil is thought to have been deposited during the Iowan loessial period. Areas of this soil occur most extensively southeast of Vincennes as far as the White River. The predominant relief is rolling, with rather steep slopes along the streams.

The zone of contact between the silt and the glacial till in many places indicates the development of fossil A and B horizons. In this description the Y_3 horizon is transitional from the uniformly smooth silt horizons to the horizons containing glacial pebbles. As shown by the separations, it has the usual depth of a normal A horizon, 10 inches. It rests on a B-like horizon designated as Y_4, which extends to a depth of 26 inches below the uniformly smooth silt. These horizons are acid in some places, whereas the overlying

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[9] Acidity determination made in field or in laboratory by the Morgan method.

soil horizons are neutral. The B-like horizon in many places has a more pronounced structural and textural B development. This gradation from the loess to the till has been observed in the Alford and Muren soils also.

West of Iona is a small flat plain where a similar soil, Bainbridge silt loam, is developed. The silty upper layers of this soil are thought to have been deposited by water rather than by wind, and the substratum seems to consist of lacustrine sands and silts.

Pike silt loam, slope phase, is mapped along streams where the slopes are too steep to allow farming operations. The same horizons are present in the soil of this phase as in the typical soil, but they are not so thick. Erosion has removed more of the silty loess than on the less sloping areas.

The Fox series includes soils on terraces developed from the weathering of stratified deposits of calcareous gray gravel and sand laid down during the recession of the Late Wisconsin glacier. With the exception of a few areas northeast of Edwardsport, these soils occur only in the Wabash Valley. The main features of the profile are the bright-brown or slightly reddish brown gravelly clay B horizon and the dark neutral highly colloidal clay B_3 horizon at the contact with the calcareous gravel. The Fox soils of Knox County are developed on gravel and sand that contain a smaller proportion of calcareous gravel than do the materials farther north in the Wabash Valley; consequently, the thickness of the profile above calcareous gravel is greater in many places, and the B_3 or dark neutral horizon in many places is thinner and lighter in color. Knox County seems to mark the southern limit of occurrence of the Fox soils in both the White River and the Wabash River bottoms. Two textures have been mapped—Fox loam and Fox sandy loam.

Following is a description of a profile of Fox sandy loam, as observed 3 miles southwest of Vincennes:

A_1. 0 to 7 inches, brown friable sandy loam. The pH value is 5.8.
A_2. 7 to 9 inches, slightly grayish-brown sandy loam. The pH value is 5.8.
B_1. 9 to 17 inches, reddish-brown or bright-brown clayey sand, with some gravel. The pH value is 5.5.
B_2. 17 to 26 inches, reddish-brown moderately compact gravelly clay, which is plastic and sticky when wet. The pH value is 5.7.
B_{21}. 26 to 32 inches, reddish-brown loose friable clayey sand and gravel. The pH value is 5.4.
B_3. 32 to 38 inches, moderately dark reddish-brown sticky highly colloidal gravelly clay. The pH value is 6.8.
C_1. 38 inches +, gray calcareous gravel and sand, with a neutralizing value of 23 percent.

In the group of light-colored soils, the second subgroup includes well-drained soils with grayish-brown surface soils and brownish-yellow subsoils. The soils in this group are Alford silt loam; Alford silt loam, slope phase; Alford silt loam, eroded phase; Princeton silt loam; Princeton silt loam, slope phase; Princeton loam; Princeton fine sandy loam; Princeton fine sandy loam, slope phase; Princeton loamy fine sand; Elkinsville silt loam; Elkinsville loam; Elkinsville fine sandy loam; Oaktown loamy fine sand; and Markland silt loam. These soils represent four kinds of parent material. They have wide differences in their profile developments.

Alford silt loam shows the dominant regional profile of the county. It occupies rolling to gently rolling areas. It has a grayish-brown surface soil, 10 inches thick, and a yellowish-brown or brownish-yellow B horizon. It differs from Pike silt loam principally in the character of the substratum. The underlying glacial till is gray and yellow, and it is heavier in texture and less pervious to moisture than the material underlying Pike silt loam. The horizons below the B horizon have yellow, brown, and gray colors, owing to less perfect internal drainage. The till is a heterogeneous mass of clay, sand, and gravel, and highly weathered fragments of granite and gneiss occur in a few places. Calcareous till is present at a depth ranging from 12 to 15 feet, and the average depth of the till material is about 25 feet overlying sandstone. The till has a neutralizing value equivalent to 10 to 15 percent $CaCO_3$.

Following is a description of a profile of Alford silt loam, as observed in a wooded area 3 miles southwest of Bicknell in Donation 123:

A_0. 1/4 to 1/2 inch, partly decomposed leaf and plant material. The pH value is 7.

A_1. 0 to 2 inches, moderately dark grayish-brown smooth silt loam. The pH value is 6.7.

A_2. 2 to 4 inches, phylliform smooth silt loam, slightly dark grayish brown in color, especially in the lower part. The pH value is 5.8.

A_3. 4 to 9 inches, phylliform brownish-gray smooth silt loam in many places ranging toward light gray in color. The pH value is 5.7.

B_1. 9 to 15 inches, brownish-yellow friable granular light silty clay loam, moderately plastic and sticky when wet. The pH value is 5.7.

B_2. 15 to 41 inches, brownish-yellow silty clay loam with a dull-red tint on the cleavage faces and crushing to a brownish-yellow color. The soil breaks into angular nut-sized fragments. When wet, the soil is moderately plastic and sticky. The pH value is 5.3.

Y_1. 41 to 66 inches, yellowish-brown, slightly mottled with gray, heavy silt loam. The pH value is 5.4.

Y_2. 66 to 86 inches, gray and yellow mottled soft smooth porous vesicular silt. The pH value is 5.6.

Y_3. 86 to 106 inches, gritty silt loam containing a few glacial pebbles and underlain by unconsolidated clay, sand, and gravel. The pH value is 5.6.

The reaction of the Y horizons commonly is found to be neutral (by field tests) at a depth ranging from 70 to 90 inches.

The Princeton soils are similar to Alford silt loam in the upper 3 feet. Princeton silt loam occupies rolling areas, and the sandy types have a dunelike relief. They have brown A horizons and reddish-brown B horizons. They are underlain by gray and yellowish-gray calcareous sand and silt at a depth of 5 to 7 feet. Between the main structural and textural B and C horizons is generally a more friable lighter textured Y horizon, which is nearly neutral in reaction. In Princeton silt loam this Y horizon closely resembles the Y horizon of Alford silt loam except that it has a brighter color. The Princeton soils in many places are neutral in reaction in areas close to the river bluffs. In general, they range from neutral to moderately acid. The lighter textured Princeton soils have less concentration of clay in the B horizon than the silt loam, and Princeton loam has a well-developed sandy clay loam B horizon. As mapped, Princeton fine sandy loam ranges from well-developed sandy clay loam to clayey fine sand in the B horizon, and in dry weather this clayey sand may be rather firmly cemented. Princeton loamy fine sand generally lacks any semblance of a textural B horizon but it has a reddish-brown color—B-horizon development. When dry, the B horizon is compact, owing to slight cementation of the sand.

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Following is a description of a profile representative of Princeton loamy fine sand:

A_1. 0 to 7 inches, brown fine sand or loamy fine sand, which is reddish brown when moist. The pH value is 6.3.
B_1. 7 to 15 inches, reddish yellow-brown loose loamy fine sand. The pH value is 6.3.
B_2. 15 to 36 inches, reddish yellow-brown loamy fine sand, with clayey sand pellets scattered through it. When dry the material is slightly cemented. The pH value is 6.5.
Y_1. 36 to 50 inches, yellowish-brown loose fine sand. The pH value is 7.4.
C_1. 50 to 60 inches, grayish-yellow calcareous loose fine sand, having a neutralizing value of about 7 percent.

The material in this profile is slightly acid to the Y horizon, which is neutral.

Slope phases of the Princeton soils occur as steep hillsides bordering streams. Erosion proceeds more rapidly than soil development on Princeton silt loam, where the land is not covered with trees and grass. The sandy soils, owing to their higher absorption of moisture in the loose A horizon, do not erode so readily as the silt loam. The thickness of the solum is less and the horizons are thinner on these slopes.

The Elkinsville and Oaktown soils have developed through the weathering of noncalcareous or only slightly calcareous water-laid sand, silt, and clay deposits on the river terraces. Oaktown loamy fine sand and Elkinsville fine sandy loam have a dunelike relief, owing to subsequent reworking of the river deposits by wind action. The heavier loam and silt loam soils occupy flat land. Areas of Elkinsville fine sandy loam and Oaktown loamy fine sand are closely associated with the Princeton soils, and, as they have similar relief and occupy similar positions, separation is difficult. The Elkinsville and Oaktown soils are similar to the Princeton soils above the Y horizons. They differ in having yellowish-brown B horizons in Elkinsville silt loam and Elkinsville loam. The Y horizon, below a depth of 70 inches, is composed of alternate clay and fine sandy seams, which in many places are neutral in reaction but are not calcareous.

Markland silt loam has developed through the weathering of heavy calcareous slack-water clay deposits. These sediments were probably deposited in ponded water during the recession of the Late Wisconsin glacier. This soil generally occupies a well-drained rim at the edges of flat terraces. The B horizon differs from that of Alford silt loam in that it is a very plastic and sticky yellowish-brown silty clay. It is directly underlain by a mixture of grayish-yellow calcareous silt and clay, which differs considerably in lime content, although this material in places has a neutralizing value equivalent to 29 percent of calcium carbonate. The silty part of the parent material is similar to that underlying Princeton silt loam. Both the calcareous clay and the calcareous silt may occur in the same general area. Areas of soil with a silty C horizon tend to have a lighter textured B horizon.

The imperfectly and poorly drained light-colored soils have fair to poor drainage and occupy undulating to nearly flat areas on the uplands. They are characterized by grayish-brown A horizons and yellow well-developed granular silty clay loam B horizons. Two soils have been separated in this group—Muren silt loam *in the common* loess group and Iona silt loam in the marl loess group. Iona silt loam is associated with Princeton silt loam on the smoother rounded ridges. It is an ABYC soil with the granular yellow silty clay loam B horizon resting on smooth soft silt, which is calcareous at a depth of approximately 4 feet.

Following is a description of a profile of Iona silt loam, as observed 4½ miles east of Vincennes. This area is a gently undulating low-lying upland plain, with a few high knolls of Princeton silt loam and Alford silt loam projecting above it.

A_1. 0 to 8 inches, grayish-brown smooth silt loam having a few iron and manganese concretions on the surface. The pH value is 5.7.

A_2. 8 to 10 inches, lighter grayish-brown phylliform smooth silt loam. The pH value is 5.4.

B_1. 10 to 16 inches, granular dull brownish-yellow light silty clay loam with some iron concretions scattered through the soil material. The crushed material is dull yellow. The pH value is 5.6.

B_2. 16 to 30 inches, brownish-yellow silty clay loam, which, on crushing, becomes yellow. This material is tough, plastic, and sticky when wet, and it is moderately compact. The pH value is 5.3.

Y_1. 30 to 38 inches, dull-yellow friable light silty clay loam. The pH value is 5.4.

Y_2. 38 to 47 inches, brownish-yellow iron-stained soft silt. The pH value is 6.4.

C_1. 47 inches+, grayish-yellow and brown calcareous soft vesicular silt having a neutralizing value of about 26 percent.

Muren silt loam is derived from smooth soft noncalcareous silt resting on Illinoian till at a depth ranging from 7 to 9 feet. The A and B horizons resemble those of Iona silt loam very closely. Gray mottling occurs at a depth ranging from 18 to 24 inches. In a few places, at a depth of about 3 feet is an X-like horizon, which is moderately compact and highly mottled with gray. It is somewhat impervious to the movement of moisture and doubtless contributes to the sluggish internal drainage. In soils developed on common (noncalcareous) loess the X-like horizon does not attain the heaviness of texture and structure generally present in southern Indiana soils. In most places, this soil has a reaction of pH 5.5 to pH 5.0 to a depth ranging from 70 to 80 inches, where the smooth soft silt is nearly neutral in reaction.

The fourth group includes the poorly drained light-colored upland and terrace soils with yellow and gray subsoils. The characteristics of these soils are due to poor drainage. The land is flat, surface drainage is poor, and internal drainage is retarded somewhat by compactness and heaviness in the lower B and the X horizons. Iron concretions are scattered on the surface and downward through the soil mass. Soils in this group include Iva silt loam, Ayrshire silt loam, Bartle silt loam, Bartle loam, Bartle fine sandy loam, Homer loam, Homer sandy loam, and McGary silt loam.

Iva silt loam is developed on smooth loessial silt deposited on Illinoian till. Internal drainage is impaired by a moderately compact slightly heavier clay layer (X horizon) at a depth of 3 feet. This X layer is not so heavy and impervious as that underlying other flat southern Indiana soils. Following is a description of a profile of Iva silt loam, as observed three-fourths of a mile southwest of Monroe City:

A_1. 0 to 8 inches, smooth brownish-gray silt loam that dries to light gray. Iron concretions are numerous on the surface. The pH value is 5.7.

A_2. 8 to 10 inches, light-gray slightly phylliform smooth silt loam. The pH value is 5.5.

B_1. 10 to 16 inches, mottled gray and yellow fine-granular silty clay loam that is moderately plastic and sticky when wet. The pH value is 5.2.
B_2. 16 to 27 inches, more highly mottled yellow and gray silty clay loam, with a nut structure. The pH value is 5.5.
X_1. 27 to 40 inches, moderately compact mottled gray and yellow silty clay loam. The vertical cleavage planes are coated with light-gray silt. The pH value is 4.6.
Y_1. 40 to 70 inches, mottled gray and yellow light silty clay loam, dominantly yellow. The pH value is 5.6.
Y_2. 70 to 100 inches, mottled gray and yellow smooth soft silt. The pH value is 6.3.
Y_3. 100 to 130 inches, mottled slightly gritty silt loam grading into a heterogeneous mass of clay, sand, and gravel. The pH value is 5.9.

Ayrshire silt loam occupies the broad flat divides in the marl loess region. It ranges in color from grayish brown to light gray with the dominant color brownish gray. The B_1 horizon is mottled gray and yellow granular silty clay loam, and the B_2 horizon is yellow coarsely granular silty clay loam, underlain by smooth soft silt, which is calcareous at a depth of 4 feet.

The Bartle soils are derived from the weathered products of noncalcareous stratified sands, silts, and clays. They occupy river terrace positions associated with the Elkinsville soils. They have grayish-brown A horizons, with mottled yellow and gray B horizons. The salient characteristics of the profile are the mottled B horizon, which, in most places, is moderately compact at a depth of 3 feet. A heavy compact columnar mottled silty clay X horizon occurs in many places at a depth of 36 inches, beneath which the soil material is more friable and less highly mottled. As a rule Bartle loam and Bartle fine sandy loam lack any development of an X horizon, the B horizon grading into the more friable and mottled sandy Y horizon. Poor drainage is due to the low position of these soils and a high water table. Three types are mapped—Bartle silt loam, Bartle loam, and Bartle fine sandy loam.

The Homer soils are developed on stratified deposits of calcareous clay, sand, and gravel. They are poorly drained soils occupying low flat areas, and generally occurring as narrow bands between the Fox soils and the dark-colored soils of the depressions. Two types are mapped—Homer loam and Homer sandy loam. The A horizon is gray or brownish-gray to a depth of 10 inches and, is in most places, covered by iron concretions. It grades into a mottled gray and yellow rusty iron-stained sandy clay loam B horizon. The B horizon is variable in its structural and textural development, depending on drainage. The more poorly drained areas have the least concentration of clay in the B horizon. Below a depth of 30 inches the soil material generally is highly mottled gray compact clay loam with calcareous clayey sand and gravel at a depth of 4 feet. The Homer soils have more clay and sand in the upper C horizons than do the Fox soils.

McGary silt loam is a terrace soil derived from heavy calcareous clay deposits. The A horizon consists of gray silt loam grading into mottled gray and yellow silty clay loam (B_1) below a depth of 12 to 15 inches. The main B horizon (B_2) is very tough waxy yellowish-brown clay. Leaching has removed the carbonates to a depth of 3 to 4 feet.

The Vincennes series includes four soil types—Vincennes silty clay loam, Vincennes silt loam, Vincennes clay loam, and Vincennes loam.

The Vincennes soils differ from the Westland soils in four important particulars, as follows: (1) The color of the surface soil is drab gray, the accumulation of organic matter is less pronounced, as shown by the light color of the upper 20 inches, and the basic and dominant color is gray; (2) at a depth ranging from 8 to 12 inches, the subsoil is highly stained and blotched by rusty iron concretions and stains; (3) the entire soil material is moderately acid; and (4) the substratum consists of clay and silt, with some sand and fine gravel. In the bottoms of the Wabash River, Vincennes clay loam includes lighter colored acid soils of depressions and flats. It is most extensively developed west and northwest of Dicksburg Hills. Gravel is common on the surface and continues downward into the substratum, which consists of an unassorted mass of clay, sand, and gravel. Vincennes silty clay loam is most extensively developed in the White River bottoms northeast of Edwardsport, with some smaller areas in the pocket of the Wabash bottoms. Vincennes silt loam occurs mainly in the pocket.

The alluvial soils, or soils of the first bottoms, are classified on the bases of two main characteristics—reaction and color profile. Owing to deposition at each overflow and lack of time for development, these soils have not advanced very far from the stage of soil-forming materials; that is, they are young soils. The reaction of most of these soils is neutral to alkaline, although moderately acid spots occur in places. In the large river bottoms, sediments are derived mainly from the Early Wisconsin and Late Wisconsin glacial regions where the soils are only moderately acid and are leached of lime to a depth ranging from 3 to 5 feet.

The soils in the bottoms of small streams (largely Eel silt loam) are neutral to slightly acid, ranging from pH 6.4 to pH 7. They are derived from uplands that have been entirely covered by loess. One-third of the upland soils are underlain by calcareous parent material, and in the remaining area the subsoils are neutral below a depth of about 70 inches. The acid alluvial soils are derived mainly from sediments transported from the Illinoian till soils of Greene and Sullivan Counties.

The Genesee soils are well-drained nearly neutral brown alluvial soils. The surface soil in places has a dark cast and the subsoil is yellowish brown. The series is represented by four soil types—Genesee silty clay loam, Genesee silt loam, Genesee loam, and Genesee fine sandy loam. They occur almost entirely along the Wabash and White Rivers. Genesee fine sandy loam and Genesee loam occur as natural levees along the river banks, and the heavier types lie farther from the streams. High-bottom phases of Genesee silt loam, Genesee silty clay loam, and Genesee loam are separated as areas of soil that are not subject to ordinary overflow and the profiles of which resemble those of the more frequently overflowed Genesee soil types. The 10-inch surface soil is brown and grades rather abruptly into an incipient B horizon (as revealed by a better oxidized color, slightly heavier texture, and nut structure). These soils range in reaction from neutral to pH 5.5. The Eel and Algiers soils have imperfectly and poorly drained grayish-brown surface soils and gray and brown mottled subsoils. The Eel series included Eel silty clay loam, Eel silt loam, and Eel loam.

The Algiers soils consist of an overwash of grayish-brown alluvium on black clayey soils. This material ranges from a few inches to more than 3 feet in thickness. Where it is more than 3 feet thick the soil is mapped in the Eel series. The overwash is grayish brown and may be mottled with gray below a depth of 15 or more inches.

Stendal silt loam is most extensively developed in the wide bottoms of Splunge and Maria Creeks, at the point where they enter the county. This soil has a pale yellowish-gray or slightly brownish gray surface soil covered with numerous black iron and manganese concretions. The subsoil is gray, highly mottled with rust-brown splotches or stains. The entire soil mass is strongly acid.

The well-drained dark-colored soils of the terraces and bottoms are dark Prairie soils having excellent drainage, and they include members of the Buckner and Warsaw series. Two textures are separated in each series—sandy loam and loam. Buckner sandy loam is the most extensive soil in this group. The Buckner soils are developed on assorted calcareous clay, sand, and some fine gravel. In the extreme northwestern part of the county there is considerable gravel throughout the soil material. Following is a description of a profile of Buckner sandy loam, as observed 2 miles west of Busseron:

A_1. 0 to 8 inches, dark-brown sandy loam. The pH value is 5.5.
A_2. 8 to 20 inches, very dark brown sandy loam. The pH value is 5.5.
A_3. 20 to 27 inches, moderately dark brown sandy loam. The pH value is 5.6.
B_1. 27 to 31 inches, brown sandy loam, slightly cemented. The pH value is 5.7.
B_2. 31 to 36 inches, brown compact weakly cemented sand, which crushes very easily. The pH value is 5.8.
Y_1. 36 to 46 inches, brown loose sand underlain by reddish-brown loose sand and fine gravel. The pH value is 5.9.

Organic matter causes coherence in the A horizons.

A variation from the above profile, in many places, is one that has a reddish-brown clayey gravelly B horizon and a calcareous fine gravelly and sandy C horizon at a depth of 70 or more inches.

Buckner loam occupies flat areas and very shallow swales. The A horizon is thicker and somewhat darker than that of Buckner sandy loam. The B horizon consists of slightly cemented or coherent sand and clayey gravel. In places a few iron concretions occur, but there is no other evidence of poor drainage. The substratum consists of loose open sand and fine gravel.

The Warsaw soils are comparatively unimportant. They are developed through the weathering of stratified calcareous gravel and sand deposited during the recession of the Late Wisconsin glacier. Warsaw sandy loam has a dark-brown A horizon, similar to that of Buckner sandy loam, and a B horizon of reddish-brown gravelly clay loam. At the contact with calcareous gravel, a dark-gray highly colloidal neutral horizon, or B_3, similar to that in the Fox soils, is developed. All the horizons above the B_3 are strongly acid in reaction. The gravelly substratum, or C horizon, occurs at an average depth of 4 feet and consists of many kinds of rocks, including quartz, granite, gneiss, jasper, basalt, and limestone. The gravel has variable neutralizing values equivalent to about 20 to 30 percent $CaCO_3$. Warsaw loam occupies gravelly terraces that formerly were covered by prairie vegetation.

Ross silt loam and Ross silty clay loam are dark-colored alluvial soils that lie slightly higher than the overflow bottoms. They are generally neutral in reaction, although the lower part of the subsoil may be slightly acid. In Ross silty clay loam the surface soil to a depth of 8 inches is moderately dark gray silty clay loam. This is underlain by a slightly darker gray horizon of silty clay loam, extending to a depth of about 20 inches. The underlying horizons are dominantly yellowish brown, with some penetration of dark organic material on the cleavage faces. Some areas of Ross silt loam are moderately acid in reaction.

The dark-colored imperfectly and poorly drained soils occupy flat or concave low-lying positions, and consequently they catch the leachings from the higher land. Before the land was drained for cultivation these areas were swamps. Except for Marion silt loam, the soils are very dark colored and are almost everywhere neutral in reaction. The soils of the shallower depressions are somewhat less dark colored and not so deep as those of the deeper and therefore wetter depressions.

In describing the dark-colored soils of depressions the organic horizon is designated as the H horizon, the underlying gray and yellow mottled noncalcareous mineral horizon as the M horizon, and the calcareous parent material as the U horizon.

The Westland soils are the most extensive of the poorly drained dark-colored soils. Two types—Westland clay loam and Westland loam—are recognized. They have moderately dark gray H horizons with gray and yellow M horizons and are underlain by calcareous stratified gravel, sand, and clay of the river terraces. Following is a description of a profile of a Westland soil, as observed near Claypole Pond and well represents the soils of this series:

H_1. 0 to 8 inches, dark brownish-gray clay loam. The soil at this place contained no gravel on the surface. The pH value is 6.6.

H_2. 8 to 17 inches, slightly darker gray clay loam with shiny black cleavage faces. The pH value is 6.7.

H_3. 17 to 23 inches, slightly dark brown gritty silty clay loam. The pH value is 6.7.

M_1. 23 to 36 inches, highly iron stained and mottled yellowish-brown silty clay loam. The pH value is 7.2.

M_2. 36 to 70 inches, gravelly yellowish-brown clay loam and clayey sand, probably underlain by a gravelly substratum. The pH value is 7.2.

Three inextensive soils in the uplands have dark-colored surface soils. One of them, Marion silt loam, occurs on nearly flat uplands; and the other two, Ragsdale silt loam and Ragsdale loam, occupy depressions.

Marion silt loam is a strongly to medium acid medium-gray or slightly dark gray soil on the flat divides west of Freelandville. The average color is somewhat darker than that of the Marion soils of Iowa. This soil occurs only in an area several miles wide at the contact between the marl loess and the noncalcareous loess. Drainage conditions are fair to poor. The A horizon consists of slightly dark gray to medium-gray smooth silt loam, ranging in thickness from 12 to 17 inches. The lower part of the horizon is lighter colored than the upper part. Organic matter penetrates the B_1 horizon on the cleavage faces. The B_1 horizon is grayish-yellow nut-structured silty clay loam and extends to a depth of 25 inches. The B_2 horizon is slightly gray on the cleavage faces, but when crushed the material has a solid yellow color. The A and B horizons have an average reaction of approximately pH 5.5, and below the B_2 horizon, at a depth of 34 inches, the soil becomes neutral. The Y and C horizons consist of smooth soft vesicular silt, which is calcareous in places at an average depth of 5 feet. Some mottling of colors is evident in the B and lower horizons.

The Ragsdale soils are dark approximately neutral soils of depressions in the uplands and terraces. They occupy two kinds of positions in the marl-loess region: (1) On slightly sloping ground around drainage lines, and (2) in bulb-shaped or oval depressions at the heads of intermittent drainage lines. Consequently, in mapping, they include two kinds of profiles—ABC and HMU—but the series is defined on characteristics of the HMU profiles. Two types are mapped—Ragsdale silt loam and Ragsdale loam. The ABC type of profile has a 10- to 12-inch surface layer of dark-gray silt loam, overlying a yellow silty clay loam B horizon, which is slightly mottled with gray in places. Calcareous yellow silt lies at a depth of 3 to 4 feet. This profile is more commonly developed in association with Princeton silt loam. The HMU profile has a 12- to 15-inch layer of dark-gray silt loam or loam, overlying mottled gray and yellow silty clay loam. Organic matter penetrates the upper part of the M horizon on the cleavage planes. The calcareous U horizon is generally 4 feet or more below the surface.

The Montgomery soils are moderately dark gray. They occupy depressions on low terraces and are developed from heavy calcareous clay deposits. Because of their low position they receive leachings from the slightly higher McGary and Markland soils. Two types are mapped—Montgomery silt loam and Montgomery silty clay loam. The color profile resembles that of the Westland soils. The texture profile consists of a smooth uniform silt loam or silty clay loam H horizon and a heavy plastic silty clay M horizon.

The Lyles soils occupy depressions along streams in association with the Elkinsville and Princeton soils, where they are subject to occasional overflow. They are slightly acid or neutral soils developed from deposits and leachings of the higher calcareous loess soils as well as from some river deposits in the more open river bottom positions. The soil material is more friable than that of the Montgomery soils, owing to the larger content of sand. The color profile is similar to that of the Westland soils, although the variations in the surface color are greater. In some of the areas where they receive considerable deposition, they become less dark gray. In very wet places they trend toward a very dark color with greater depth of penetration of organic matter. The color generally is slightly darker than that of the Westland soils. Three types are mapped—Lyles silt loam, Lyles silty clay loam, and Lyles loam. A few areas of very fine sandy loam are included with Lyles loam in mapping.

The darker soils, as a group, occupy the lowest parts of depressed areas and consequently contain more clay and organic matter and are more poorly drained. The members of four series are mapped in this group—Abington, Carlisle, Kings, and Sharkey.

The Abington soils are the dominant soils in the group and are associated with Westland and Fox soils on the gravelly river terraces. Two types are mapped—Abington clay and Abington clay loam. Following is a description of a profile of Abington clay loam, as observed near St. Thomas:

H_1. 0 to 7 inches, dark-gray clay loam crushing to very dark brownish gray. Under cultivation a loose soil mulch is readily formed. When wet, the material is plastic and sticky. The pH value is 6.2.

H_2. 7 to 17 inches, very dark-gray clay with shiny black cleavage faces. The pH value is 6.3.
H_3. 17 to 26 inches, slightly iron stained dark-gray very sticky clay. The pH value is 6.2.
M_1. 26 to 38 inches, yellow iron rust stained bluish-gray clay. The pH value is 6.4.
M_2. 38 to 56 inches, drab bluish-gray sticky clay resting on calcareous gray gravel. The pH value is 6.5.

More or less gravel is scattered throughout the soil mass.

Abington clay occupies scattered areas throughout the Wabash River bottoms. Included with Abington clay are a few areas of soil that have the lighter surface color of the Westland soils with the heavy texture of Abington clay. The separation of the Westland soils is complicated by the fact that much of the soil mapped as Westland has the characteristic moderately dark surface soil, but the depth of dark organic layers is rather great and the M horizons are dominantly gray. In separating the soils, surface color was given first consideration and subsoil characteristics were secondary. Probably very poor drainage and nearly permanent saturation, as shown by the bluish-gray color and relatively complete reduction of the iron compounds, should be the dominant characteristics of the Abington soils. The grayish-black color and somewhat higher organic content of the H horizons are generally closely related features. The percent of nitrogen averages considerably higher in the Abington soils than in the Westland soils.

Abington clay, mucky phase, is a highly organic mineral soil resting on stratified calcareous gray gravel and sand deposits at a depth of 4 feet. The surface soil is very dark gray smooth colloidal clay, which becomes loose and granular under cultivation. The dark organic horizons contain considerable mineral matter and in places grade into brown fibrous peat at a depth ranging from 15 to 25 inches. At a depth of 3 to 4 feet the substratum consists of calcareous gray gravel. This soil is neutral in reaction.

Carlisle silty muck consists of very dark brownish-gray smooth highly colloidal organic matter extending to a depth of 30 or more inches, but the surface layer in many places contains some mineral matter. Below a depth of 30 inches the material is brown fibrous peat containing partly decomposed leaves and small branches of trees. The substratum, at a depth of 4 to 6 feet, consists of sand and clay deposits. All acidity tests on organic soils in the county indicate that they are neutral in reaction.

The Sharkey soils are scattered throughout the river bottoms. They are bluish-gray soils with a slight accumulation of organic matter. The surface soil is very sticky, tough, intractable plastic clay or clay loam. Below plow depth the subsoil is bluish-gray, very plastic and sticky clay containing some yellow iron stains. The substratum, at a depth of 10 feet or more, consists of clay, sand, and fine gravel. In the Wabash River bottoms the Sharkey soils have some gravel mixed through the soil mass, but in the White River bottoms these soils are gravel free. Sharkey clay and Sharkey clay loam are mapped in this county. Sharkey clay loam contains more sand and gravel throughout the soil mass than Sharkey clay.

Kings silty clay has a very dark gray surface soil underlain by bluish-gray very plastic sticky clay. It has a higher content of organic matter in the surface soil and is slightly less plastic and sticky than the Sharkey soils. The subsoil resembles that of the Sharkey soils very closely. Kings silty clay is associated with the Montgomery soils on the low terraces and is underlain by grayish-yellow calcareous clay at a depth of 4 to 5 feet.

Although visible physical characteristics are the chief criteria used in classifying soils into types, certain invisible qualities, indicated by chemical tests of composite profile samples of Knox County soils, correlate fairly well with different soil types and individual soil horizons. Except where the surface soils have been modified by cultivation, determination of pH values and tests for readily soluble phosphorus and potash tend to conform to certain definite patterns in each kind of profile, and soil types grouped in the classification generally test similarly and as would be expected from their parent materials, ages, and environments.

As a group, ABC, or high-ground, soils have almost neutral thin surface layers in natural undisturbed situations, higher acidity in the subsurface layers and subsoils, and neutral or alkaline reaction in the unleached parent materials. Acidity reaches a maximum at the greater depths in soils that have weathered for a longer time.

As a group, HMU, or low-ground, soils are nearly neutral throughout; or, if acid in the upper part, they are less acid in the lower part.

Alluvial soils also tend to be practically neutral, except where the sediments have been washed from strongly acid soils of the uplands.

Quick tests for easily soluble phosphorus tend to show a relationship between acidity and a deficiency of phosphorus in the soils.[10] In samples more acid than pH 5.2, all tests show a deficiency of phosphorus. Between pH 5.2 and pH 6.6, tests for available phosphorus show a range from zero to high, but on the average it is low. One notable exception to the trend is in five soils derived from common loess, as all are comparatively high in phosphorus in the acid Y layers. From pH 6.6 to pH 7.8 tests show a range from low to very high. All samples containing carbonates have a pH value above 8 and tests showed extremely high available phosphorus.

Tests for soluble potash do not show very close relationship to other qualities, although they vary somewhat with texture. The maximum soluble potash in many soils is in the B horizon, or zone of accumulated clay. A seam of sand in a subsoil is generally very low in potash compared with the silt or clay layers above and below it. Highly organic or mucky soils also tend to be low in soluble potash, and most of the gray wet soils average lower in potash than comparable better drained soils. In general the upper and more highly weathered layers, especially the A_2 horizon, are lower in both phosphorus and potash than the underlying layers.

Vincennes, Bartle, and other soils of the valleys in many places lack systematic relationship between the tests of their layers for pH value, phosphorus, and potash, probably owing to the fact that they are

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[10] THORNTON, S. F., CONNER, S. D., and FRASER, R. R. THE USE OF RAPID CHEMICAL TESTS ON SOILS AND PLANTS AS AIDS IN DETERMINING FERTILIZER NEEDS. Ind. Agr. Expt. Sta. Cir. 204, 16 pp., illus. 1934. [Rev. 1936.]

products of variable deposition and the time has been too short for environmental factors to produce uniformity in their characteristics.

MANAGEMENT OF THE SOILS OF KNOX COUNTY

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

The purpose of the following discussion is to call attention to the deficiencies of the several soils of the county and to outline in a general way the treatments most needed and most likely to yield satisfactory results. No system of soil management can be satisfactory unless in the long run it 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

Table 12 shows the results of chemical analyses for the important plant nutrients in the different types of soil in Knox County, expressed in pounds of elements in the 6- to 7-inch layer of plowed surface soil of an acre, estimated at 2,000,000 pounds.

TABLE 12.—*Approximate quantities of nitrogen, phosphorus, and potassium in certain soils of Knox County, Ind.*

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

Soil type	Total nitrogen	Total phosphorus [1]	Total potassium	Weak-acid soluble phosphorus [2]	Weak-acid soluble potassium [2]
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Iva silt loam	2,400	700	27,900	35	150
Muren silt loam	2,000	790	28,100	35	150
Alford silt loam	2,200	800	26,700	40	185
Otwell silt loam	2,400	800	27,100	50	190
Pike silt loam	2,400	790	25,900	45	200
Bainbridge silt loam	2,200	780	28,200	60	220
Marion silt loam	3,200	790	32,800	35	120
Ayrshire silt loam	2,600	870	28,300	35	135
Ayrshire fine sandy loam	1,600	610	24,200	50	100
Iona silt loam	2,600	870	32,000	35	170
Princeton silt loam	2,800	870	32,000	45	150
Princeton loam	1,800	740	27,600	50	135
Princeton fine sandy loam	1,400	610	27,000	80	100
Princeton loamy fine sand	1,200	440	21,300	90	235
Ragsdale silt loam	4,000	660	28,600	120	200
Homer loam	2,600	870	26,400	35	135
Homer sandy loam	1,600	790	21,500	55	65

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

TABLE 12.—*Appropriate quantities of nitrogen, phosphorus, and potassium in certain soils of Knox County, Ind.*—Continued

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

Soil type	Total nitrogen	Total phosphorus	Total potassium	Weak-acid soluble phosphorus	Weak-acid soluble potassium
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Fox loam	2, 200	1, 050	26, 400	80	150
Fox sandy loam	1, 600	790	23, 000	60	150
Warsaw loam	2, 600	610	24, 500	60	120
Warsaw sandy loam	2, 600	870	26, 600	50	120
Westland clay loam	3, 200	1, 050	30, 600	130	320
Westland loam	2, 800	570	26, 400	60	250
Abington clay	6, 800	2, 360	28, 100	185	320
Abington clay loam	4, 400	1, 270	23, 900	215	305
Vincennes clay loam	3, 400	1, 095	29, 600	95	310
Vincennes silty clay loam	3, 600	1, 220	35, 300	70	285
Vincennes silt loam	2, 800	870	30, 300	45	150
Vincennes loam	2, 400	790	22, 500	85	135
Bartle silt loam	2, 600	700	27, 200	50	170
Bartle loam	1, 600	610	24, 900	70	100
Bartle fine sandy loam	1, 800	480	21, 400	55	65
Elkinsville silt loam	2, 400	700	24, 000	85	150
Elkinsville loam	2, 200	1, 140	26, 600	270	200
Elkinsville fine sandy loam	1, 400	870	24, 700	215	135
Oaktown loamy fine sand	1, 200	650	23, 900	165	150
Buckner loam	3, 000	1, 220	24, 200	160	235
Buckner sandy loam	2, 400	920	24, 900	130	170
Sharkey clay	4, 000	1, 490	27, 200	155	420
Lyles silty clay loam	6, 800	1, 140	25, 900	115	200
Lyles silt loam	3, 800	870	26, 100	115	170
Lyles loam	3, 200	740	27, 200	95	85
Carlisle silty muck [3]	9, 600	1, 050	16, 950	100	260
McGary silt loam	2, 200	870	25, 600	140	270
Markland silt loam	3, 400	1, 050	33, 100	140	335
Montgomery silty clay loam	3, 800	1, 140	35, 200	225	235
Montgomery silt loam	3, 400	1, 140	26, 200	215	285
Kings silty clay	6, 000	1, 220	35, 500	325	305
Algiers silt loam	2, 400	870	29, 600	130	395
Algiers loam	2, 400	830	26, 600	105	305
Algiers fine sandy loam	1, 700	520	22, 700	130	220
Genesee silty clay loam	3, 900	1, 400	31, 500	70	235
Genesee silt loam	3, 200	1, 070	33, 100	120	215
Genesee loam	3, 000	1, 220	28, 900	200	355
Genesee fine sandy loam	1, 600	960	22, 000	235	185
Genesee silt loam, high-bottom phase	4, 000	1, 350	32, 000	60	185
Genesee loam, high-bottom phase	2, 800	1, 140	32, 300	140	150
Ross silt loam	3, 200	1, 090	32, 300	45	220
Ross silty clay loam	3, 400	1, 040	31, 440	60	250
Eel silty clay loam	4, 200	1, 750	34, 400	190	435
Eel silt loam	4, 200	1, 530	28, 100	140	305
Eel loam	4, 000	790	26, 700	235	335
Stendal silt loam	2, 000	790	25, 600	45	270

[3] Based on 1,500,000 pounds of surface soil to the acre.

The quantity of phosphorus soluble in weak acid is considered by many authorities a very good indication of the relative availability of this element. Where the weak-acid soluble phosphorus runs less than 100 pounds to the acre, phosphates generally are needed for high crop yields. The more intensive the crop, the greater is the need for large quantities of available phosphorus. Everything else being equal, the more of this soluble phosphorus a soil contains, the less apt it is to need phosphates. The deeper a soil is, the less it needs phosphates. Subsoils contain less available phosphorus than surface soils. A soil in which erosion has removed the surface layer and exposed the subsurface layers is apt to need phosphates.

The quantity of potassium soluble in weak acid is considered by some authorities significant of the need for potash. This determination, however, is not so certain an indicator as is the determination for phosphorus. In general, however, the lower the soluble potassium, the greater is the need for potash. Contrary to the instance of phosphorus, however, the potassium of the subsoil is fairly available, and potash is more apt to be needed on flat uneroded land than on sloping eroded soils. Sandy soils and muck soils are more generally in need of potash than clay and loam soils. Poorly drained soils and soils with impervious subsoils generally need potash more than well-aerated deep soils.

The strong-acid soluble phosphorus, the total potassium, and total nitrogen are given as an indication of the plant-nutrient content of the soil. The total amounts of phosphorus and potassium are more valuable as an indication of the origin of the soil than of the need of the soil for these elements, as much of the phosphorus and potassium in soils is very insoluble and extremely slow in availability. Total nitrogen is to a large extent indicative of the nitrogen and organic-matter content of the soil. Soils with a low nitrogen content soon wear out and require additions of this and other elements by growing legumes, adding manure, and applying fertilizer. The darker the soil, the higher it is in organic matter and nitrogen and the longer it may be cropped without the addition of nitrogenous fertilizer.

No one method of soil analysis will definitely indicate the deficiencies of a soil. These chemical data, therefore, are not intended to be the sole guide in determining the needs of the soil. The thickness of the surface soil, the physical character of the subsoil and surface soil, and the previous treatment and management of the soil are all factors of the greatest importance and should be taken into consideration. Pot tests indicate that nitrogen and phosphorus are much less available in subsurface layers and in subsoils than they are in the surface soils. On the other hand, potassium in the subsoil seems to have relatively high availability. Crop growth depends largely on the amount of available plant nutrients in contact with the roots. If the crop roots deeply, it may be able to make good growth on soils of relatively low analysis. If the crop roots shallowly, it may suffer for lack of nutrients, particularly potash, even on a soil of high analysis. The better types of soils and those containing large quantities of plant nutrients will endure exhaustive cropping much longer than the soils of low plant-nutrient content.

The nitrogen, phosphorus, and potassium contents of a soil are not the only chemical indications of high or low fertility. One of the more important factors in soil fertility is the degree of acidity. Soils that are very acid will not produce well, even though plant nutrients are not lacking. Although nitrogen, phosphorus, and potassium are of some value when added to acid soils, they will not produce their full effect where lime is deficient. This is particularly true of phosphorus.

Table 13 shows the percentage of nitrogen and the acidity of the important soils in Knox County.

TABLE 13.—*Nitrogen, acidity, and lime requirement in certain soils of Knox County, Ind.*

Soil type	Depth	Nitrogen	pH	Average depth to neutral material	Indicated ground limestone requirement per acre
	Inches	*Percent*		*Inches*	*Tons*
Iva silt loam	0- 8	0.12	5.7	70	2-4
	8-16	.07	5.3		
	16-36	.07	5.5		
Muren silt loam	0- 8	.10	6.2	70	2-3
	8-18	.07	5.4		
	18-35	.06	5.2		
Alford silt loam	0- 7	.11	6.0	70	2-3
	7-15	.06	5.7		
	15-38	.05	5.3		
Otwell silt loam	0- 6	.12	5.7	70	2-4
	6-18	.06	5.5		
	18-36	.05	4.7		
Pike silt loam	0- 7	.12	6.0	70	2-3
	7-17	.08	5.7		
	17-36	.05	5.4		
Bainbridge silt loam	0- 7	.11	5.8	70	2-3
	7-18	.05	6.0		
	18-45	.04	5.0		
Marion silt loam	0- 8	.16	5.7	60	2-3
	8-25	.11	6.0		
	25-34	.07	6.9		
Ayrshire silt loam	0- 7	.13	5.8	48	2-4
	7-17	.09	5.8		
	17-40	.06	5.5		
Ayrshire fine sandy loam	0- 7	.08	5.8	48	2-3
	7-17	.05	5.4		
	17-36	.04	5.2		
Iona silt loam	0- 8	.13	5.7	48	2-3
	8-17	.10	5.5		
	17-31	.06	5.3		
Princeton silt loam	0- 6	.14	5.9	60	2-3
	6-15	.11	5.8		
	15-32	.06	5.7		
Princeton loam	0- 6	.09	6.4	74	2-3
	6-13	.07	5.8		
	13-32	.06	5.4		
Princeton fine sandy loam	0- 9	.07	5.8	90	2-3
	9-16	.05	5.7		
	16-33	.04	5.5		
Princeton loamy fine sand	0- 7	.06	6.6	50	0-2
	7-15	.04	6.1		
	15-36	.04	6.6		
Ragsdale silt loam	0- 8	.20	6.8	0	0
	8-18	.17	7.4		
	18-32	.10	7.2		
Homer loam	0- 7	.13	5.9	60	2-3
	7-14	.10	5.7		
	14-38	.04	5.2		
Homer sandy loam	0- 7	.08	5.6	60	1-2
	7-15	.06	5.7		
	15-29	.05	5.4		
Fox loam	0- 7	.11	5.8	50	1-3
	7-15	.08	5.7		
	15-37	.04	5.9		
Fox sandy loam	0- 7	.08	5.8	48	1-2
	7-16	.07	5.7		
	16-33	.05	5.5		
Warsaw loam	0- 6	.13	5.8	56	1-3
	6-17	.12	5.7		
	17-45	.06	5.8		
Warsaw sandy loam	0- 7	.13	5.8	65	1-2
	7-20	.11	5.5		
	20-41	.08	5.8		
Westland clay loam	0- 8	.16	6.7	0	0
	8-19	.14	6.7		
	19-42	.06	7.2		
Westland loam	0- 7	.14	5.8	60	2-3
	7-18	.11	6.2		
	18-43	.05	5.5		
Abington clay	0- 6	.34	6.1	42	0-2
	6-16	.19	6.7		
	16-42	.11	6.9		
Abington clay loam	0- 8	.22	6.1	36	0-2
	8-18	.10	6.2		
	18-36	.06	6.4		

TABLE 13.—*Nitrogen, acidity, and lime requirement in certain soils of Knox County, Ind.*—Continued

Soil type	Depth	Nitrogen	pH	Average depth to neutral material	Indicated ground limestone requirement per acre
	Inches	*Percent*		*Inches*	*Tons*
	0- 6	0.18	6.0		
Vincennes clay loam	6-15	.08	6.6	105	2-3
	15-28	.06	6.1		
	0- 5	.23	5.9		
Vincennes silty clay loam	5-10	.18	5.8	86	2-3
	10-36	.09	5.5		
	0- 7	.14	5.8		
Vincennes silt loam	7-20	.10	5.6	76	2-3
	20-36	.10	5.3		
	0- 7	.12	5.9		
Vincennes loam	7-12	.07	5.4	95	2-3
	12-30	.05	5.3		
	0- 7	.13	6.0		
Bartle silt loam	7-16	.08	5.8	80	2-3
	16-33	.06	5.3		
	0- 7	.08	5.8		
Bartle loam	7-17	.05	5.4	75	2-3
	17-37	.05	5.0		
	0- 8	.09	5.8		
Bartle fine sandy loam	8-19	.06	5.6	90	2-3
	19-33	.04	5.4		
	0- 8	.12	6.0		
Elkinsville silt loam	8-17	.07	5.8	70	2-3
	17-37	.05	5.4		
	0- 7	.11	5.6		
Elkinsville loam	7-15	.06	6.6	64	2-3
	15-34	.06	5.7		
	0-10	.07	6.0		
Elkinsville fine sandy loam	10-23	.05	5.6	64	2-3
	23-41	.04	5.5		
	0- 6	.06	5.9		
Oaktown loamy fine sand	6-18	.05	5.8	100	2-3
	18-38	.04	5.8		
	0- 7	.15	5.6		
Buckner loam	7-18	.10	5.7	75	2-3
	18-36	.07	5.8		
	0- 9	.12	5.7		
Buckner sandy loam	9-18	.10	5.6	75	2-3
	18-35	.07	5.6		
	0- 6	.20	6.4		
Sharkey clay	6-15	.18	6.0	50	0-2
	15-33	.10	6.2		
	0- 7	.34	5.8		
Lyles silty clay loam	7-18	.23	6.5	26	0-2
	18-36	.14	7.3		
	0- 7	.19	5.8		
Lyles silt loam	7-18	.10	5.9	40	0-2
	18-38	.06	5.8		
	0- 7	.16	6.2		
Lyles loam	7-33	.10	6.8	33	0-2
	33-44	.06	7.3		
	0- 7	.64	6.0		
Carlisle silty muck	7-17	.90	6.2	52	0-2
	17-43	.34	6.5		
	0- 6	.16	6.5		
McGary silt loam	6-15	.09	6.0	24	0-2
	15-33	.07	7.2		
	0- 8	.17	6.7		
Markland silt loam	8-17	.09	6.7	20	0-2
	17-34	.08	7.0		
	0- 6	.19	6.7		
Montgomery silty clay loam	6-18	.14	7.3	0	0
	18-29	.08	7.5		
	0- 7	.17	6.6		
Montgomery silt loam	7-20	.16	7.2	0	0
	20-32	.09	7.4		
	0- 6	.30	7.4		
Kings silty clay	6-14	.13	7.4	0	0
	14-38	.06	7.6		
	0- 7	.12	7.5		
Algiers silt loam	7-18	.12	7.8	0	0
	18-36	.13	7.2		
	0- 6	.12	7.6		
Algiers loam	6-18	.12	7.6	0	0
	18-36	.07	7.6		

TABLE 13.—*Nitrogen, acidity, and lime requirement in certain soils of Knox County, Ind.*—Continued

Soil type	Depth	Nitrogen	pH	Average depth to neutral material	Indicated ground limestone requirement per acre
	Inches	*Percent*		*Inches*	*Tons*
Algiers fine sandy loam	0- 7	0.08	7.7	0	0
	7-18	.10	7.7		
	18-37	.10	7.8		
Genesee silty clay loam	0- 8	.20	6.8	0	0
	8-18	.11	7.1		
	18-36	.08	6.0		
Genesee silt loam	0- 8	.16	7.3	0	0
	8-18	.12	7.2		
	18-36	.09	7.4		
Genesee loam	0- 8	.15	7.3	0	0
	8-18	.15	7.2		
	18-36	.12	7.3		
Genesee fine sandy loam	0-10	.08	7.0	0	0
	10-18	.05	(1)		
	18-36	.04	(1)		
Genesee silt loam, high-bottom phase	0- 7	.20	6.5	40	0-2
	7-15	.10	5.6		
	15-37	.05	6.0		
Genesee loam, high-bottom phase	0- 8	.14	6.5	40	0-2
	8-18	.08	6.5		
	18-36	.05	6.6		
Ross silt loam	0- 7	.18	6.6	40	0-2
	7-16	.17	6.7		
	16-32	.11	6.3		
Ross silty clay loam	0- 7	.20	6.5	30	0-2
	7-18	.16	6.8		
	18-36	.11	7.0		
Eel silty clay loam	0- 8	.21	6.9	0	0
	8-18	.14	6.7		
	18-36	.10	6.8		
Eel silt loam	0- 8	.21	6.8	0	0
	8-18	.12	7.8		
	18-36	.07	5.9		
Stendal silt loam	0- 6	.10	5.1	80	2-4
	6-18	.10	5.0		
	18-36	.05	4.8		

[1] Calcareous.

The acidity is expressed as the pH value, or intensity of acidity. A soil of pH 7 is neutral and contains just enough lime to neutralize the acidity. If the pH is over 7, it indicates that there is some lime in excess. Soils with a pH value ranging from 6 to 7 are slightly acid, and those ranging from a pH value of 5 to 6 are of medium acidity. If the pH value runs below 5, the soil is strongly to very strongly acid. As a rule, the stronger the acidity, the more a soil needs lime. The acidity is reported for the surface soil (0 to 6 inches), for the subsurface soil, and for the subsoil. It is important to know the reaction, not only of the surface soil, but of the lower layers of the soil as well. Given two soils of the same acidity, the one with the greater acidity in the subsurface layer is in greater need of lime than the other. Furthermore, the more organic matter and nitrogen a soil contains and the greater the depth to which these elements extend, the less will be the need for lime. The slighter the depth of acid soil the less it is apt to need lime. Therefore, in determining how much an acid soil is in need of lime, it is necessary to know the pH value and the amount of nitrogen and organic matter that accompanies it. It is well to remember that sweetclover, alfalfa, and red clover need lime more than do other crops. As it is advisable to grow these better soil-improvement legumes in the rotation, it is in many places desirable to apply lime so that sweetclover or alfalfa will grow. A soil of pH value 7 to 8 is ideal for these legumes. Grain crops do well on slightly acid soils.

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

SOIL MANAGEMENT

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

BETTER DRAINED SILT LOAM SOILS OF THE ROLLING UPLANDS AND TERRACES

The better drained silt loam soils of the rolling uplands and terraces include members of the Alford, Muren, Iona, Pike, Princeton, Otwell, Bainbridge, Elkinsville, and Markland series that are not too rough or too sloping for cultivation. Alford silt loam is by far the most extensive soil of this group and occupies 34,368 acres. Princeton silt loam, with an area of 14,080 acres, ranks next in acreage. Most of the slope phases of the Alford, Pike, and Princeton silt loams are grouped with the eroded phases in the nonarable lands discussed at the end of this section.

The soils of this group have fair to good natural drainage and seldom suffer from a too wet condition, except on the flattest hilltops. Much of this land is subject to excessive surface run-off, owing to the slope and the silty character of the soil; and there is much danger of erosion. All these soils are acid and naturally deficient in phosphorous. Nitrogen and organic matter also are more or less deficient. In most places where the land has been farmed for some time there is also need for more available potash.

DRAINAGE

The more level and the gently sloping areas of the soils in this group would be benefited by tile underdrainage, especially the Muren and Iona silt loams, which occupy the more level hilltops and other flat areas associated with the Alford and Princeton silt loams.

Where the land is sloping, plowing and other tillage operations should extend crosswise of the slopes, in order to lessen surface erosion by heavy rains. In many places terracing of the slopes may be practical as a means of preventing erosion. Control of erosion on the slopes is one of the major problems in the management of these soils,

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and the cropping systems and tillage operations must be planned and carried out with this in view. The surface soil contains the better part of the soil's store of fertility and should be protected against erosion by every practical means. If this cannot be done the land should be taken out of cultivation before it is completely ruined.

LIMING

All these soils, except the Markland, are acid and more or less in need of liming. The amount of lime required should be determined by soil-acidity tests in each particular area. If the farmer himself cannot make the test, he can have it made by the county agricultural agent or by the Purdue University Agricultural Experiment Station at La Fayette. A very acid soil will not respond properly to other needed treatments until it has been limed. Failure of clover to develop satisfactorily indicates a need of lime, although lack of thriftiness in clover may also be due to lack of available phosphorus or a bad physical condition of the soil, owing to lack of organic matter. Ground limestone generally is the most economical form of lime to use. As a rule, the first application should be at least 2 tons to the acre. After that 1 ton to the acre every second round of the crop rotation will keep the soil reasonably sweet. Where alfalfa or sweetclover is to be grown on an acid soil, a heavier application of limestone may be needed.

ORGANIC MATTER AND NITROGEN

All the soils of this group, except some of the Markland areas, are naturally low in organic matter and nitrogen. Constant cropping without adequate returns to the land and more or less soil erosion on sloping areas are steadily reducing supplies of these plant nutrients. In many places the original supply of organic matter has become so low that the soil has lost much of its natural mellowness, and it readily becomes puddled and baked. This condition in a large measure accounts for the more frequent failures of clover crops and the greater difficulty in attaining proper tilth where the land has been cropped for a long time without adequate returns of organic matter. Wherever these evidences of lack of organic matter and nitrogen occur, the only practical remedy is to plow under more organic matter than is used in the processes of cropping. Decomposition is going on constantly and is necessary to maintain the productivity of the soil. Decomposing organic matter must also supply the greater part of the nitrogen required by crops. For this reason, legumes should provide large quantities of the organic matter to be plowed under. First, however, the land must be put into condition to grow clover and other legumes. This involves the application of lime or limestone wherever the soil is acid, and also the application of soluble phosphates, because acid soils are invariably low in available phosphorus. After liming, from 200 to 300 pounds to the acre of superphosphate should be applied.

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

CROP ROTATION

With proper fertilization, and liming and tile drainage where needed, these soils will produce satisfactorily all the ordinary crops adapted to the locality. Considerable areas of Princeton silt loam are occupied by apple orchards, for which purpose this soil seems especially well adapted. For general farming on the soils of this group, every system of cropping should include clover or some other legume to be returned to the land in one form or another, because of the prevailing shortage of nitrogen and organic matter. Corn, wheat, and clover or mixed hay constitute the best short rotation for general use on these soils, especially when the corn can be cut and the ground can be disked and properly prepared for the wheat. In this position in the rotation, wheat needs a high-analysis complete fertilizer, and the quantity applied should be sufficient to help the clover also.

Corn, soybeans, wheat, and clover or mixed hay make an excellent 4-year rotation for these soils. The two legumes in the rotation will build up the supply of nitrogen. The soybean straw should be spread on the wheat in the winter. This will not only help the wheat and lessen winter injury, but it will help to insure a stand of clover. Oats are not well adapted to the climatic conditions of this section of the State and as a rule are not profitable. The soybean is not only worth more as a crop but adds some nitrogen to the soil and improves the land for the crop that follows, which generally should be wheat.

On the better lands, if more corn is needed, especially on livestock farms, the 5-year rotation of corn, corn, soybeans, wheat, and clover may be used satisfactorily where the second corn crop, at least, can be given a good dressing of manure. Where enough livestock is kept to utilize all the grain and roughage in this rotation, enough manure should be produced to make a fair application for each corn crop.

A cover crop of rye for plowing under the following spring should be seeded in September on all the cornland.

Where clover is uncertain, even after liming, in any of these rotations, owing to climatic conditions, it is a good plan to sow a mixture of seeds made up of about 4 pounds of red clover, 3 pounds of alfalfa, 2 pounds of alsike clover, and 1 pound of timothy to the acre. Lespedeza may be used to advantage in pasture mixtures and on thin spots in old pastures that need improvement, especially where the pasture land is acid and liming is not feasible.

Alfalfa and sweetclover may be grown on most of the soils of this group if the soil is properly inoculated and limed to meet the needs of these crops. Alfalfa is preferable for hay, and sweetclover is excellent for pasture and for soil-improvement purposes. Special literature on the cultural requirements of these crops may be obtained from the Purdue University Agricultural Experiment Station.

FERTILIZATION

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

The problem of supplying nitrogen has been discussed in connection with provisions for supplying organic matter. Legumes and manure are the logical and only really practical materials for supplying the bulk of the nitrogen needed by crops, and they should be used extensively for this purpose. A system of livestock farming with plenty of legumes in the crop rotation is, therefore, 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 nitrogen in the fertilizer 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 help the wheat much in the fall. The leguminous residue must first decay, and that does not take place to any considerable extent until the following spring.

Phosphorus is the mineral plant nutrient in which all these soils are most deficient. Soil erosion aggravates this deficiency of phosphorus. The only practical way to increase the supply is through the application of purchased phosphatic fertilizers, and it will prove profitable to supply the entire phosphorus needs of crops in this way. In rotations of ordinary crops producing reasonably heavy yields, it may be considered that 20 pounds of available phosphoric acid to the acre is required each year. It will pay well to apply larger quantities at first, so as to create a little reserve. Enough for the entire rotation may be applied at one time, or the application may be divided according to convenience. Where manure is applied, it may be estimated that each ton supplies about 5 pounds of phosphoric acid; therefore, a correspondingly smaller quantity will be required in the form of commercial fertilizer.

The quantity of potash that should be supplied as fertilizer depends on the general condition of the soil and the quantity of manure used. In building up a run-down soil, rather large quantities of potash fertilizer should be used, at least until such time as considerable quantities of manure can be applied or until the general condition of the soil has improved materially. There is plenty of potassium in these soils for all time if it could be made available at a faster rate. As a rule it becomes available too slowly. Its availability may be materially increased by good farm practices, including proper tillage, tile drainage, the growing of deep-rooted legumes, and the plowing under of liberal quantities of organic matter. The better these practices are carried out and the larger the quantity of manure applied, the less potash fertilizer need be purchased.

On the Purdue-Vincennes experiment field, operated from 1924 to 1934, highly profitable returns were obtained from applications of fertilizer on Iona silt loam. On the average, applications of 225 pounds of 16-percent superphosphate to the acre for wheat and 75 pounds for corn in a corn-wheat-clover rotation produced increases in yields, averaging 3.8 bushels of corn, 2.9 bushels of wheat, and 292 pounds of hay to the acre; 300 pounds of 0–12–6 for wheat and 100 pounds for corn produced average increases of 10 bushels of corn, 3.3 bushels of wheat, and 428 pounds of hay to the acre; and 2–12–6 at the same rate of application, produced average increases of 10.4 bushels of corn, 4.7 bushels of wheat, and 459 pounds of hay to the acre.

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, a part of the manure—possibly 2 tons to the acre—may be applied profitably on wheatland as a top dressing during the 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. The manured cornland, unless the application is very heavy, should also receive about 100 pounds of superphosphate to the acre in the row or hill at planting time. Without manure, corn should be given from 100 to 200 pounds to the acre of a phosphate and potash mixture, at least as good as 0–14–6, or 0–12–12, applied in the hill or row. For hill-planted corn, hill fertilization is most efficient, provided the application is made with a fertilizer attachment that places the fertilizer in two short bands, one on each side of the hill. Wheatland should be given from 200 to 300 pounds to the acre of a high-analysis complete fertilizer, at least as good as 2–12–6. On poor soils or where the wheat is backward in the spring, a top dressing of about 100 pounds to the acre of a good soluble nitrogen fertilizer should be applied soon after growth begins. Such top dressing usually will add from 5 to 7 bushels an acre to the yield. Where corn and wheat are included in the rotation and the ground is properly fertilized, there will be little need of fertilizer for other crops.

LIGHT-COLORED POORLY DRAINED HEAVY-TEXTURED SOILS OF THE UPLANDS AND TERRACES

The group of light-colored poorly drained heavy-textured soils of the uplands and terraces includes the silt loam and heavier soils of the Iva, Ayrshire, Marion, Vincennes, McGary, and Bartle series. Vincennes clay loam is the most extensive member of the group, and Vincennes silty clay loam and Ayrshire silt loam rank next.

DRAINAGE

All the soils of this group were developed under conditions of slow drainage, and for the most part they cannot be farmed satisfactorily without artificial drainage. Furthermore, no other beneficial soil treatment can be fully effective without some especial provision for drainage. Most of these soils have been provided with some tile underdrainage. Where this has not been done, tiling should be a part of the improvement program. Surface drainage should be regulated wherever possible, and rapid run-off from the surface should be prevented as much as possible, because it carries away large quantities of the available plant nutrients that should go into the production of crops. Rain water should be absorbed by the soil, and the surplus should pass away through underdrainage, thereby increasing the capacity of the soil to absorb water and lessen surface erosion. Underdrainage also facilitates soil aeration, which helps to make the plant nutrients in the soil available. A mottled subsoil is an indication of insufficient natural drainage.

Experiments in fields on other soils of similar texture and relief indicate that tile lines laid 30 inches deep and not more than 3 rods apart will produce profitable results. Where the land is flat, great care must be exercised in tiling, in order to obtain an even grade and uniform fall. Grade lines should not be established by guess or rule-of-thumb method. 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 rate of fall may be increased toward the outlet, but it should never be lessened. Checking the current may cause the tile to become choked with silt. It is an excellent plan, before filling the ditches, to cover the tile with a thin layer of straw, weeds, or grass. This prevents silt from washing into the tile at the joints while the ground is settling and insures perfect operation of the drains from the beginning.

LIMING

All the soils of this group, except McGary silt loam, are distinctly acid and need liming. The quantity of lime required should be determined by soil-acidity tests, and what has been said about liming in connection with the better drained silt loam soils of the rolling uplands and terraces applies equally to these soils.

ORGANIC MATTER AND NITROGEN

The soils of this group are similar to the better drained silt loam soils of the rolling uplands and terraces in their organic-matter and nitrogen content, and what has been said concerning those soils applies equally well here, especially to the lighter colored soils. The cropping systems and the soil-management program should provide for the use of legumes, which supply both organic matter and nitrogen. Special green-manure crops and winter cover crops, for plowing under in the spring, should be utilized wherever possible, and all unused crop residues should be plowed under. Manure, of course, should be used to the fullest possible extent in all areas.

CROP ROTATION

With proper attention to drainage, liming where needed, and a reasonable amount of fertilization, the soils of this group are best adapted to the grain and hay crops used in general farming. Good rotations on these soils are: Corn, wheat, and clover; corn, soybeans, wheat, and clover; and corn, corn, soybeans, wheat, and clover. The last rotation especially is recommended. Where corn or soybeans are to follow corn, however, a winter cover crop should always be used, in order to prevent losses of fertility by leaching on the level land and losses of both fertility and soil by erosion on sloping land. For this purpose rye generally is the most practicable crop. It should be seeded in the corn in September, with a complete fertilizer, to hasten fall development, and then plowed under in the spring, in preparation for the next crop. In many places, instead of clover alone for the hay crop, it has proved to be a good plan to sow a mixture of about 4 pounds of red clover, 3 pounds of alfalfa, 2 pounds of alsike clover, and 1 pound of timothy to the acre.

FERTILIZATION

The fertilization of these soils should be similar to that of soils on the rolling uplands except that the light-gray soils of the flat areas may be expected to respond to a somewhat higher proportion of potash in the fertilizer for corn. On Ayrshire silt loam in the Purdue-Vincennes experiment field, a phosphate-potash mixture proved to be more than twice as effective as phosphate alone in increasing corn yields (pl. 2, *A*). With wheat, the phosphate was the most efficient constituent of the fertilizer (pl. 2, *B*). As a general practice for the good of the whole crop rotation, wheat should receive from 200 to 400 pounds per acre of a good complete fertilizer. This will also help the grass and clover seeding, which ordinarily is made on the wheat, and carry through to succeeding crops. The effect of the nitrogen in the fall application of fertilizer on the final yield of grain, however, generally is small unless the application is supplemented by a spring top dressing of nitrogen as suggested in discussing the fertilization of the better drained silt loam soils of the rolling uplands and terraces. Most of the manure should be put on the lighter colored soils. On manured land some phosphate and perhaps a little potash should be placed in the row or hill for corn. Where little or no manure is used, the corn should receive a half-and-half phosphate-potash mixture, such as 0–12–12 or 0–20–20.

DARK-COLORED POORLY DRAINED HEAVY-TEXTURED SOILS OF THE UPLANDS AND TERRACES

The group of dark-colored poorly drained heavy-textured soils of the uplands and terraces includes Ragsdale loam; Ragsdale silt loam; Westland loam; Westland clay loam; Abington clay loam; Abington clay; Abington clay, mucky phase; Montgomery silt loam; Montgomery silty clay loam; Lyles loam; Lyles silt loam; Lyles silty clay loam; Kings silty clay; Sharkey clay; Sharkey clay loam; and Carlisle silty muck. These soils are widely scattered throughout both the Wabash and the White River Valleys and occur largely in terrace areas. The Lyles and Montgomery soils are by far the most important, representing 11,456 and 9,792 acres, respectively.

LIMING

Most of the dark-colored soils are sweet or only slightly acid, but Westland loam is more or less distinctly acid and in need of liming. The Ragsdale, Kings, and Montgomery soils and Westland clay loam generally are sweet, and the other soils of the group vary. Wherever there is doubt regarding acidity, samples of the soil should be tested and any lime requirement provided for according to the suggestions contained in the discussion of the better drained silt loam soils of the rolling uplands and terraces.

ORGANIC MATTER AND NITROGEN

In general, the organic matter and nitrogen supplies of these soils are ample. On the lighter colored soils, all unused crop residues should be plowed under and legumes should be included in the crop rotation wherever possible.

DRAINAGE

Owing to their occurrence in depressions, many of these soils are too wet for farming operations and should be tile drained where it is possible to get a satisfactory outlet. In some places ponds form after heavy rains, and some flooding from the streams takes place. Some areas are so depressed that they are constantly too wet for cultivation.

CROP ROTATION

These soils are well adapted to corn, and this generally should be the principal crop. Where drainage is reasonably good and danger from flooding is slight, rotations including small grains, soybeans, and clover and grass (for hay) may be used and should be considered in the plans of management of these soils.

FERTILIZATION

Most of the dark-colored soils are well supplied with plant nutrients and will produce good crops without fertilizer, but Westland loam shows a rather low supply of available phosphorus. Lyles loam, Lyles silt loam, and Carlisle silty muck show a low supply of available potash. On most areas of these soils the cornland should receive about 100 pounds to the acre of a phosphate-potash mixture, such as 0–14–6 or 0–12–12, in the hill or row. On Carlisle silty muck and per-

Effect of fertilizer on Ayrshire silt loam in the Purdue-Vincennes Experiment Field. The crop rotation was corn, soybeans, wheat, and clover. The basal fertilizer formula was 2–12–6, 100 pounds per acre in the row for corn and 400 pounds for wheat. *A*, Average acre yields of corn: *a*, 32 bushels, using lime alone; *b*, 40 bushels, using lime and phosphorus; *c*, 61 bushels, using lime, phosphate, and potash; *d*, 63 bushels, using lime, phosphate, potash, and nitrogen. *B*, Average acre yields of wheat: *a*, 9.3 bushels, using lime alone; *b*, 19.2 bushels, using lime and phosphorus; *c*, 20 bushels, using lime, phosphate, and potash; *d*, 23 bushels, using lime, phosphate, potash, and nitrogen.

haps also on Lyles loam, the 0–10–20 or a similar fertilizer should be used. Where wheat is grown, the land should generally receive a complete fertilizer, such as 2–12–6, at the rate of about 200 pounds to the acre.

LIGHT-TEXTURED SOILS OF THE UPLANDS AND TERRACES

The light-textured soils of the uplands and terraces include Princeton loamy fine sand, Princeton fine sandy loam, Princeton loam, Ayrshire fine sandy loam, Homer loam, Homer sandy loam, Fox loam, Fox sandy loam, Warsaw loam, Warsaw sandy loam, Bartle loam, Bartle fine sandy loam, Elkinsville loam, Elkinsville fine sandy loam, Oaktown loamy fine sand, Buckner loam, and Buckner sandy loam. These sandy soils are naturally deficient in organic matter, nitrogen, and phosphorus, and most of them are also low in available potassium. An important defect is their inadequate water-holding capacity, which sometimes subjects crops to injury from drought.

LIMING

All these soils are more or less acid. They should be tested for lime requirements and limed accordingly, with due consideration to the crops to be grown. Berries and certain truck crops, such as potatoes, watermelons, and tomatoes, generally do not require liming on these soils, but the common clovers and alfalfa may require liming.

DRAINAGE

The Ayrshire, Homer, and Bartle soils of this group, owing to their low positions with respect to adjoining lands, are naturally poorly drained and often are too wet. Such areas should be provided with tile or other means of carrying away surplus water wherever satisfactory outlets can be obtained. The Princeton, Elkinsville, and Oaktown soils have good to excessive drainage, owing to their elevated positions, and the more sandy members are droughty. Most areas of the Fox, Warsaw, and Buckner soils are overdrained because of their open subsoils.

The only practical means of improving the water-holding capacity of the droughty soils is to increase their content of organic matter by plowing under manure, crop residues, and specially grown green-manure and winter cover crops.

ORGANIC MATTER AND NITROGEN

Chemical analyses of these sandy soils show them to be poor in both organic matter and nitrogen, except the Buckner and Warsaw soils, which have moderate supplies of both constituents. In most places some special provision must be made to build up and maintain organic matter and nitrogen, in order to utilize these soils to the best possible advantage. As much manure as possible, as well as all unused crop materials, should be plowed under. Special green-manure crops and cover crops, such as soybeans, cowpeas, sweetclover, rye, and winter vetch, should be planted wherever possible to produce nitrogenous organic matter for plowing under. What has been said concerning this problem in the improvement of the silt loam soils of the uplands and terraces applies equally well here. In fact, very sandy soils need larger supplies of both organic matter and nitrogen than do the heavier textured soils, because they use up these constituents at a faster rate. Their loose, open, in many places excessively aerated condition favors rapid decomposition and oxidization, or burning out of the soil organic matter. For this reason more than ordinary quantities of organic materials, such as manure, crop residues, and specially grown green-manure crops and cover crops, should be plowed under. The land should never be left bare. When any considerable quantities of nonleguminous crop residues or green manures are to be plowed under, especially on land used for truck crops, it will prove advantageous in most places to broadcast a few hundred pounds to the acre of a high-nitrogen fertilizer to aid the processes of decomposition and at the same time provide additional nitrogen for the crop that is to follow.

CROP ROTATION

The more sandy soils of the Princeton, Elkinsville, and Oaktown series are used extensively for special crops. The best quality melons and sweetpotatoes are produced on these sandy soils, which are used also for early tomatoes. A number of peach orchards are located on the dunelike formations, and apples and other fruits are grown on the less sandy areas. General farming is the rule on the other soils of this group, and most of the common field crops are grown. They are best adapted to winter small grains, soybeans, cowpeas, lespedeza, and, when limed, the deep-rooted legumes. After liming, the Fox and Warsaw soils are especially adapted to alfalfa and sweetclover. As a rule, corn does well only on the lower areas and in those situations where the sandy surface soil is underlain at slight depths by heavier material. Some poorly drained areas of Ayrshire fine sandy loam and the Bartle soils are suitable only for grass.

On the sandier soils, where moisture and nitrogen are limiting factors, maintaining the nitrogen content and the moisture-holding capacity is a problem, particularly where special crops are produced. All these crops require early spring plowing and preparation of the seedbed, and sweetpotatoes come off the ground too late for much fall growth of winter cover crops to take place. Rye generally is used as a winter cover crop and may be seeded in good time after melons and early tomatoes have been gathered. Here, it would seem that winter vetch offers possibilities for mixing with rye if the ground is inoculated for it. Winter barley makes a greater fall growth than rye and should be used more extensively where it can be seeded early, which is necessary because it is not so hardy as rye. Clover does not do well on these droughty soils, and alfalfa requires special preparation of the seedbed and early fall seeding for best results. Bacterial diseases of melons and rots of sweetpotatoes increase the need for rotations that are fairly long and include legumes to help in controlling diseases. Such rotations should include legumes also, to build up supplies of actively decaying organic matter and nitrogen. A 5-year rotation of melons (followed immediately by a rye and vetch cover crop), sweetpotatoes (followed immediately by a rye and vetch cover crop), early tomatoes, and alfalfa for 2 years offers good possibilities for utilization of the light sandy soils to which these special crops are adapted. Success with this rotation will depend largely on the success with the cover crops and the alfalfa. All crops should be fertilized. As overliming must be avoided on account of the tomatoes and sweetpotatoes, it is advisable to limit liming to 300 to 400 pounds per acre of ground limestone drilled with the alfalfa seed each time this crop is sown. The cover crop should be seeded as soon as possible after harvesting the melons and sweetpotatoes, and the alfalfa seeding should be made immediately after the tomato harvest. As a variation from this, sweetclover might be used to plow under, after it is full grown, followed by a rye and vetch cover crop. The suggested 5-year rotation may be lengthened to 6 years by allowing one crop of rye and vetch to mature for seed, reseeding at once by disking the stubble and sowing rye for winter cover. The vetch will reseed itself through natural shattering at harvest time.

For general farming, a rotation of corn, soybeans or cowpeas, wheat, rye or winter barley, legume mixtures including lespedeza, alfalfa, clover, and timothy standing 1 or more years is a very practical one. On soils too acid for the general legume mixture, lespedeza and redtop may be used in its place, either pasturing or combining a seed crop from the volunteer lespedeza after the first year. On sloping land all clover, alfalfa, and lespedeza seedings should have some grass sown with them, in order to help prevent erosion during the fall and winter. Strains of early timothy are especially suited for use with alfalfa, and redtop is a good grass for use with lespedeza on the soils that will not produce alfalfa.

FERTILIZATION

For winter grains, fertilization with 200 to 300 pounds of 2–12–6 at seeding time and a top dressing of 15 to 20 pounds per acre of nitrogen, supplied by such materials as nitrate of soda, cyanamid, or sulfate of ammonia, are recommended. For corn, row or hill applications of phosphate-potash combinations, such as 0–14–6 on the loams and 0–12–12 or a similar mixture on the sandy loams, at 100 pounds per acre are most practical. For melons on the sandy soils, a shovelful of well-rotted manure in the hill is still a popular practice. This may be supplemented by small applications, in the hill, of complete fertilizers such as 3–12–12 or 4–10–6. For early tomatoes, applications of 300 to 500 pounds per acre of 2–12–6 placed along both sides of the row are desirable. For sweetpotatoes, complete fertilizer is used, but no standardized formula has been adopted. The 2–12–6 ratio has been popular. In recent years there has been a tendency to increase the ratio of potash in the fertilizer.

Where alfalfa or sweetclover is to be grown, from 300 to 500 pounds to the acre of a high-grade phosphate-potash mixture should be applied at seeding time. A continuous stand of alfalfa should receive a top dressing of phosphate and potash fertilizer every 2 years.

SOILS OF THE BOTTOM LANDS

The soils of the bottom lands consist of Eel silty clay loam; Eel silt loam; Eel loam; Genesee silty clay loam; Genesee silt loam; Genesee loam; Genesee fine sandy loam; Genesee silt loam, high-bottom phase; Genesee loam, high-bottom phase; Ross silt loam; Ross silty clay loam; Algiers silt loam; Algiers loam; Algiers fine sandy loam; and Stendal silt loam. These soils occupy a large part of the county. They are, therefore, of considerable importance. About one-fourth of the bottoms is occupied by the Eel soils, which have poor natural drainage. Their low position makes tile drainage difficult, if not impossible, and large areas are unfit for grain crops.

The greatest problem in the management of these bottom lands is to provide adequate drainage and prevent damage from flooding. On the high bottoms and wherever flooding is not so frequent as to prohibit cultivation, the heavier types of these soils should be provided with tile underdrainage wherever suitable outlets can be obtained, in order that surplus water may get away more quickly. The large bottoms of the White and Wabash Rivers are, for the most part, protected from sudden overflows by levees, but, in periods of prolonged high water and heavy rains during the cropping season, drainage from the adjoining upland and seepage from the river cause much damage to the crops. This damage cannot be avoided except by costly and extensive pumping systems.

With the obvious risks involved, cropping systems on much of the bottom lands are more or less specialized and irregular. Most of the bottoms that can be cultivated at all are well suited to corn, and this is the major and sometimes the only crop grown. Wherever the drainage is satisfactory and flooding does not prohibit, especially on the Genesee soils, some other crop should be included in the rotation from time to time, so as to provide a change from constant cropping with corn. Soybeans are grown on some of the bottoms. They may be damaged by late spring floods, as is corn, but they have the advantage of coming off the land earlier in the fall. On the high-bottom phases of the Genesee soils and other comparatively high and generally well drained areas, wheat, soybeans, cowpeas, sorghums, Sudan grass, and other crops may be grown to advantage. Some of the higher areas are well adapted to alfalfa, and here and there special crops, like tomatoes, are grown.

With the exception of Genesee fine sandy loam and Stendal silt loam, these soils are fairly well supplied with organic matter, and, with reasonable care in their management, their supply of nitrogen can be maintained satisfactorily. On all light-colored soils, legumes should be grown, wherever they can be fitted into the rotation, for the purpose of supplying both organic matter and nitrogen. Cover crops to be plowed under should be seeded in the corn. Manure and all crop residues should be conserved and worked into the soil.

Much of this land receives rich sediments from periodic overflows, and fertilizer is not needed so much as on the uplands. The poorer areas, however, will respond to applications of manure and fertilizer much the same as the light-colored soils of the uplands and terraces, and similar systems of treatment should be followed.

NONARABLE LANDS

Scattered throughout the uplands are areas of very sloping and broken land, which are classed as nonarable and undesirable for ordinary farming purposes. They are of value only for forest or pasture. The soils included in this classification are the eroded phases of the Alford and Princeton silt loams and much of the slope phases of the Alford, Pike, and Princeton soils. In some places the slope phases of these soils are successfully tilled, but in most places efforts at tillage have resulted eventually in disastrous erosion and gullying.

Generally speaking, the most practical use of these rough and very sloping lands is the production of timber. Areas that have been cleared and proved unfit for farming should be reforested with adapted trees and given protection from livestock.

SUMMARY

Knox County is in a region of well-distributed rainfall with warm humid summers and moderately cold winters. The temperature fluctuates widely during both winter and summer. Climatic conditions are well suited to a diversified and highly specialized agriculture. Corn and wheat are the principal crops in the general-farming districts. The warm, humid summers with the long growing season are well suited to the production of corn. In the special-crops district, fruits and vegetables are the principal crops grown. They include peaches, apples, cantaloups, watermelons, tomatoes, and sweetpotatoes.

The county may be divided into three general topographic regions—the dunelike areas of the western part of the uplands, the gently rolling to rolling uplands, and the river bottoms. The western part of the uplands is covered by deposits of calcareous sands and silts. According to geologists, this material was blown from the Wabash River bottoms by strong northwesterly winds during and just preceding the Late Wisconsin glaciation. The rest of the uplands consists of a moderately rolling plain underlain by Illinoian glacial drift composed of unconsolidated and unassorted clay, sand, and gravel. The glacial till is covered by a loose mass of soft uniform silty material to a depth ranging from 7 to 10 feet, probably deposited during the Iowan loess period. Sandstone rock underlies the entire county, and it outcrops on numerous hillsides where the glacial till is thin and also in some places in the beds of the rivers. In the vicinity of Freelandville, limestone comes to the surface in a few places.

The county lies near the border of the Gray-Brown Podzolic soils region of the United States, which extends eastward to the Atlantic Ocean from the Prairie soil region bordering western Indiana. About 80 percent of the soils are light colored and developed under a hardwood forest. The present stand of trees includes oak, maple, hickory, beech, elm, and gum as the principal species.

The remaining soils of the county were developed under prairie conditions. On the well-drained prairie the principal grasses are bluejoint turkeyfoot or big bluestem, prairie beardgrass or little bluestem, and Indian grass. On the wet prairie or black marshland the coarser grasses and sedges predominated, examples of which are bluejoint and Reed canary grass. The marshland was partly forested.

The soils are dominantly well drained. In the upland section, the well-drained soils are developed along the streams. A few localities are highly dissected, and the streams flow in V-shaped valleys with steep wooded hillsides. On the broader divides and rounder

ridge tops are numerous small areas of flat poorly drained soils. Dark-colored poorly drained soils occupy the stream bottoms and rounded depressions at the heads of drainage lines. In the river bottoms the poorly drained soils are more extensive, and large areas of these soils occupy low positions close to the hills, where an extensive system of open ditches has been constructed, in order to make the soils tillable. The well-drained soils of the bottoms occur as natural levees along the river and as higher terraces.

The light-colored soils have developed under conditions of leaching, which has removed much of the soluble elements. The organic content is low, and the soils are moderately acid in reaction. The dark-colored soils and the overflow river bottoms are sweet and well supplied with organic matter, nitrogen, and other plant nutrients.

The soils of this county may be grouped on the basis of drainage and surface color. The dominant well-drained light-colored soils include members of the Pike, Alford, Muren, Princeton, Iona, Fox, Elkinsville, Oaktown, and Genesee series. These soils have brown or grayish-brown surface soils with yellowish-brown subsoils. The well-drained dark-colored soils include members of the Buckner and Warsaw series. They are Prairie soils having a moderately dark grayish-brown color that extends to a depth of 15 to 20 inches.

The more important poorly drained soils, which are dark-colored and neutral in reaction, occupy shallow swales and depressions. They are extensively developed in the river bottoms and extend to the heads of streams. They are moderately dark gray heavy soils containing abundant supplies of plant nutrients. The principal soils of this group are members of the Abington, Westland, Sharkey, Montgomery, and Lyles series.

The more important poorly drained light-colored soils include members of the Iva, Ayrshire, Vincennes, Bartle, and Eel series. They have gray or brownish-gray surface soils and mottled yellow and gray subsoils. Eel silt loam is extensive and is important because it is the principal soil in the bottoms of the small streams.

Knox County has a diversified agriculture with many important cash crops. The county may be divided into four general farming sections, which are determined largely by soil conditions. (1) In the eastern part of the upland the light-colored silt loam soils are devoted to a system of general farming in which corn, wheat, and mixed hay are the principal crops. (2) The sand hills adjoining the Wabash River bottoms constitute a very important section in which special crops are grown. (3) In the river valleys the sandy and gravelly benchland is used largely for wheat and small grains, but it is rather droughty for corn. (4) The black clay land and the light-colored (brown) overflow land are used almost exclusively for corn.

Corn is the principal farm crop. In the last 50 years it has occupied an average of nearly 40 percent of the cropland. Both the climate and the soil conditions are well adapted to the growth of this crop. The soils best suited to it are overflow bottoms and black clay land. These soils are not leached of plant nutrients to the same extent as those of the general farming region. They have abundant supplies of organic matter, nitrogen, and other plant nutrients for such a strong feeder as corn. The black clay land in many places has accumulated the more soluble bases through leaching from the higher ground. The soils are nearly neutral in reaction; consequently, the organic matter is held in the soil in a relatively insoluble form, and this tends to improve the physical condition of these soils. These characteristics make it possible to grow corn continuously on these soils. In the general farming section, corn is generally grown as one of the crops in a 3- or 4-year rotation, although there are numerous widely scattered areas of black clay land through this section which are more often used for corn.

This county is part of the southwestern winter-wheat producing section of Indiana. The light-colored soils and high lighter textured Prairie soils are extensively used for the production of wheat, particularly the sandy and gravelly soils, which are too droughty for corn. On the low, heavy Prairie soils wheat suffers to a greater extent from winter-killing. Clover, timothy, soybeans, cowpeas, and alfalfa are other extensively grown crops.

The sand hills and the red clay soils constitute the important special-crops section. The light texture and the excellent drainage of the sandy soils makes it possible to cultivate them early in the spring. They warm rapidly and are well suited to the production of early vegetables, such as tomatoes. The deep sandy soils are warm and furnish a constant supply of moisture for the production of fine-quality cantaloups. Watermelons and sweetpotatoes are also important crops, and extensive commercial peach and apple orchards are grown on these soils. Princeton silt loam is extensively used for apple orchards. This soil has an abundance of plant nutrients, and the roots penetrate easily and to a great depth in the soft, well-drained subsoil.

Dairying, poultry raising, and hog raising are the principal livestock activities. Livestock products are consumed to a large extent in local markets. Animal industry has declined in importance in the last 20 years, because the extensive bottom lands have enabled this county to develop into a cash-grain farming area.

U. S. GOVERNMENT PRINTING OFFICE: 1941

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To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at http://www.ascr.usda.gov/complaint_filing_cust.html and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by:

(1) mail: U.S. Department of Agriculture
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410;

(2) fax: (202) 690-7442; or

(3) email: program.intake@usda.gov.

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