

UNIVERSITY OF ILLINOIS  
Agricultural Experiment Station

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SOIL REPORT No. 52

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**FAYETTE COUNTY SOILS**

By E. A. NORTON, R. S. SMITH, E. E. DeTURK, F. C. BAUER,  
AND L. H. SMITH



URBANA, ILLINOIS, MAY, 1932

The Soil Survey of Illinois was organized under the general supervision of Professor Cyril G. Hopkins, with Professor Jeremiah G. Mosier directly in charge of soil classification and mapping. After working in association on this undertaking for eighteen years, Professor Hopkins died and Professor Mosier followed two years later. The work of these two men enters so intimately into the whole project of the Illinois Soil Survey that it is impossible to disassociate their names from the individual county reports. Therefore recognition is hereby accorded Professors Hopkins and Mosier for their contribution to the work resulting in this publication.

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## INTRODUCTORY NOTE

IT IS A MATTER of common observation that soils vary tremendously in their productive power, depending upon their physical condition, their chemical composition, and their biological activities. For any comprehensive plan of soil improvement looking toward the permanent maintenance of our agricultural lands, a definite knowledge of the various existing kinds or types of soil is a first essential. It is the purpose of a soil survey to classify the various kinds of soil of a given area in such a manner as to permit definite characterization for description and for mapping. With the information that such a survey affords, every farmer or landowner of the surveyed area has at hand the basis for a rational system of improvement of his land. At the same time the Experiment Station is furnished an inventory of the soils of the state, upon which intelligently to base plans for those fundamental investigations so necessary for solving the problems of practical soil improvement.

This county soil report is one of a series reporting the results of the soil survey which, when completed, will cover the state of Illinois. Each county report is intended to be as nearly complete in itself as it is practicable to make it, even at the expense of some repetition.

While the authors must assume the responsibility for the presentation of this report, it should be understood that the material for the report represents the contribution of a considerable number of the present and former members of the Agronomy Department working in their respective lines of soil mapping, soil analysis, and experiment field investigation.

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# FAYETTE COUNTY SOILS

By E. A. NORTON, R. S. SMITH, E. E. DeTURK, F. C. BAUER, AND L. H. SMITH<sup>1</sup>

## GEOGRAPHICAL FEATURES OF FAYETTE COUNTY

FAYETTE COUNTY is located in the south-central part of Illinois. It lies within a region of the state characterized by mature, light-colored soils. It comprizes approximately 716 square miles, or 458,092 acres. The population in 1930 was 23,487, more than two-thirds of which was classed as rural. Vandalia is the principal town and the county seat.

The land surface in Fayette county is nearly level, with the exception of the gullied land along streams and a series of knolls and ridges, most of which occur near the west bluff of Kaskaskia river. Natural drainage on the nearly level land is poor, but the rolling land is well drained. The rainfall, temperature, and growing season are favorable for the development of a wide variety of crops. The soils vary from poor and marginal to moderately rich and productive. The type of agriculture practiced is of a mixed nature, with grain and livestock farming predominating. Five railroads intersect the county, and every farm is within eight miles of a shipping center. The auto truck has developed into an important means of both local and long-distance transportation. Milk and other products are hauled daily to the St. Louis market. About 75 miles of concrete highway have been completed in the county. Educational facilities and social life are moderately well developed in rural communities. General agricultural conditions indicate moderate prosperity over the county.

### Climate

The climate of Fayette county is characterized by a wide range in temperature between the extremes of winter and summer and by an abundant rainfall. The average yearly range of temperature is more than 100 degrees. The highest temperature from 1883 to 1930, forty-eight years, as recorded at the U. S. Weather Bureau station at Greenville in Bond county, was 113° in 1901; the lowest was 21° below zero in 1930. The mean summer temperature is 74.1°; the mean annual temperature, 55.0°. The average length of growing season is 185 days, which is ample time to mature all the common crops grown in the region. Early frosts occasionally produce soft corn in years when the spring is wet and planting delayed. The yield of corn is frequently reduced by hot weather and drouths in summer. Winter wheat and legume crops are injured occasionally by freezing and thawing following sudden temperature changes in early spring.

The prevailing wind direction in spring and summer is south; in winter, northwest. Spring winds are usually brisk, those of summer moderate except before thunder showers. A series of strong northwesterly gales, which bring cold waves followed by periods of relative calm, characterize the winter winds.

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Fayette county lies within the region subject to tornadoes, but none resulting in serious destruction are known to have visited the area.

The average annual rainfall, as recorded at the above-mentioned station for the last thirteen years was 35.93 inches. The rainfall during the growing season

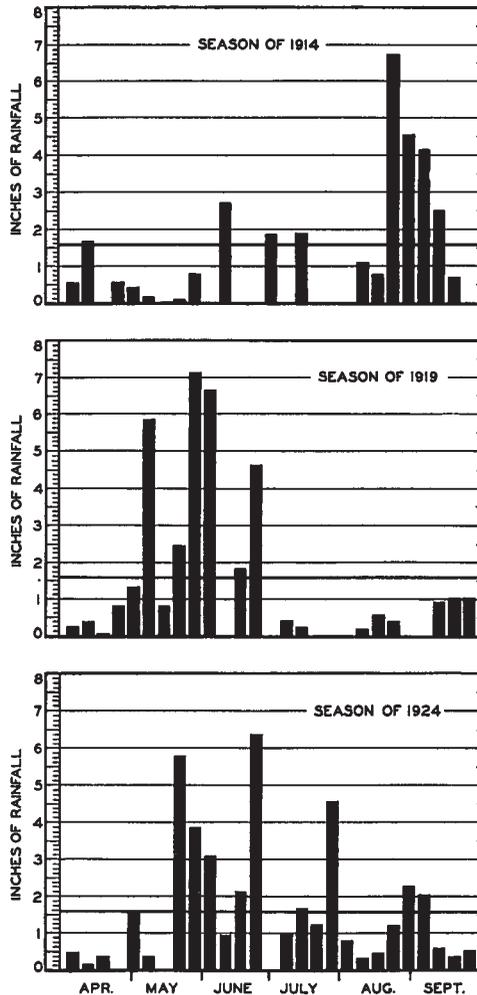


FIG. 1.—DISTRIBUTION OF RAINFALL IN THREE DIFFERENT GROWING SEASONS

The diagram shows inches of rainfall each week in an unfavorable crop season, 1914; in a medium crop season, 1919; and in a favorable crop season, 1924. The heavy horizontal line indicates the average weekly rainfall from April to September for the last 13 years.

thru this same period has averaged about 21 inches. The wettest year on record, 1929, had a total rainfall of 47.16 inches; the driest year on record, 1925, had a total rainfall of 26.15 inches. Some of the yearly precipitation falls as snow in the winter months. Sleet storms are not uncommon, and they have caused considerable damage to wheat, clover, and grasses which remain on the land in the

winter. Occasionally hail storms occur in late spring and summer, but damage from them is usually local.

The annual precipitation in Fayette county is fairly well distributed thru the seasons, so that drouths would scarcely be expected, but observation indicates that drouths do occur. Census figures show that in the past twenty years two crops out of five, on an average, are good, two are fair, and one is poor. The way in which crop yields are related to rainfall is suggested by the three years 1914, 1919, and 1924. The shortage of moisture in the 1914 growing season (Fig. 1) was reflected in poor crops. In the 1919 growing season, which was characterized by a relatively dry early spring, plenty of moisture in early summer, and a very dry late summer, average crop yields were produced, the plants having made sufficient growth from the moisture supplied by the early summer rainfall. The 1924 growing season, one of high yields, had a moderate spring rainfall and a well-distributed summer rainfall.

Drouthy conditions, however, are only partly correlated with rainfall; other important factors are humidity, evaporation, rate and distribution of rainfall, and drainage. The reason that periods of excessive and deficient soil moisture occur more frequently in Fayette county than in counties farther north lies in the character of the soils. The nearly level upland soils of the county are of such nature that they become quickly saturated with water during rainy periods and dry out rapidly during rainless periods. The rolling upland soils are like the level upland soils in being low in organic matter, but differ from them markedly in having a loose, open subsoil which permits the ready downward movement of water during rainy periods, thus preventing a water-logged condition. Because of their low organic-matter content, however, these rolling upland soils are not very effective in retaining moisture.

### Physiography and Drainage

The general elevation of Fayette county is about 600 feet above sea level. The altitude of a few towns in the county is as follows: Farina, 586 feet above sea level; Ramsey, 618; St. Elmo, 614; St. Peter, 593; Shobonier, 526; Vandalia, 512. Kaskaskia river bottom land lies at an elevation of about 450 feet, giving a maximum relief in the county of somewhat more than 150 feet. The upland area is nearly level except for numerous knolls and ridges which rise from 20 to 100 feet above the surrounding territory and produce rolling topography. Erosion has created some rolling and rough land in areas adjacent to streams. The southeastern part of the county is nearly level, the western part more rolling, and the northern part nearly level except where broken by the rolling and rough land near the streams.

Natural drainage in Fayette county is not very well developed because of the presence of such a large area of nearly level land into which streams have not made much progress in working headward. Stream courses ramify the entire area of the county, but because of the level topography and slowly pervious substrata, effective drainage is limited to the immediate vicinity of their channels.

The undulating to rolling land along streams and the knolls and ridges are naturally well drained. On the more rolling land erosion from run-off is serious when the soil is cultivated. The bottom-land soils are well drained but flood

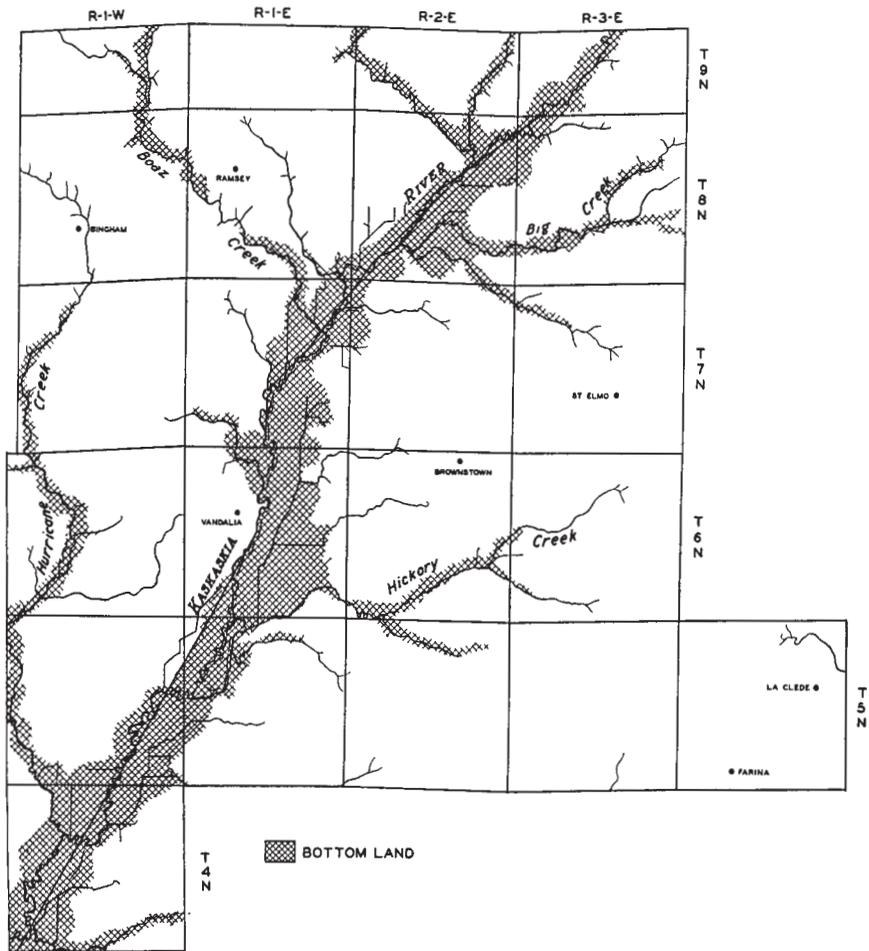


FIG. 2.—DRAINAGE MAP OF FAYETTE COUNTY SHOWING STREAM COURSES AND BOTTOM LAND

frequently. Attempts have been made to dredge Kaskaskia river and protect its bottom land from overflow, but the project has never been completed. However, certain local areas are leveed and protected from overflow.

The principal drainage outlet is Kaskaskia river, which flows diagonally across the county from northeast to southwest. The southeastern township is drained by Dismal creek, which is a tributary of Little Wabash river (Fig. 2).

### Social Development

The first white settler in the region now known as Fayette county was Guy Beck, who came from Kentucky in the spring of 1815. The county was organized in 1821 and named in honor of General Lafayette. The state capitol was established at Vandalia in 1819, and it remained there until moved to Springfield in 1840. Many of the projects in the early development of the Northwest Territory were conceived in Vandalia. Considerable mail and freight destined for the early settlers in the Great Plains region to the west passed over the old Cumberland trail, which runs diagonally across the county.

The Illinois Central Railroad was completed thru the county in 1855. The population of the county grew steadily after its founding until about the year 1900, after which the rate of growth diminished. Since 1910 there has been some decline (Fig. 3). Most of the decline has been in rural districts from which many young people have migrated to the towns and cities. As a result of this population movement, a number of formerly prosperous rural settlements have entirely disintegrated.

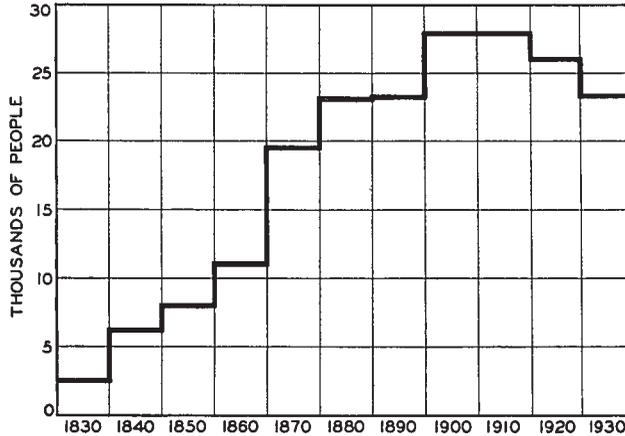


FIG. 3.—GROWTH IN POPULATION OF FAYETTE COUNTY

The population grew steadily until 1900, when it reached its maximum. Since 1910 there has been a notable decrease.

### Agricultural Production

The early agriculture in Fayette county was confined to small fields which had been cleared along the edge of the timber and consisted of raising food for the local inhabitants and enough grain and hay to winter the livestock. Cereals, vegetables, and hay were the chief crops. Most of the land remained in grass and served as pasture for livestock. After 1860 the crop acreage was expanded rapidly (Fig. 4) and surplus grain and livestock were marketed. Up to 1900 the number of farms in the county increased in direct proportion with the population. Since that time, the number has declined. The size of the farms has, however, continually increased. Farm tenantry has remained at about 33 percent for the past thirty years.

The following figures, from "Illinois Crop and Livestock Statistics," show the yields of the principal crops grown in Fayette county in 1930. It should be noted that this year was very dry and the yields for the most part were abnormally low.

Crops	Acreage	Production	Yield per acre
Corn.....	85,600	1,284,000 bu.	15 bu.
Rye.....	1,820	16,380 bu.	9 bu.
Winter wheat.....	24,100	385,600 bu.	16 bu.
Barley.....	90	1,710 bu.	19 bu.
Soybeans (threshed).....	2,000	20,000 bu.	10 bu.
Oats.....	51,300	1,231,200 bu.	24 bu.
Tame hay.....	67,200	53,760 tons	.8 ton
Broom corn.....	270	91,800 lbs.	340 lbs.

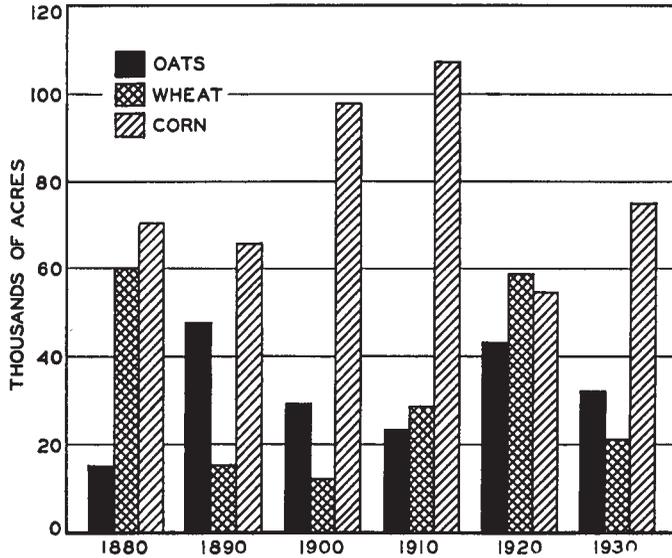


FIG. 4.—ACREAGE OF CORN, OATS, AND WHEAT IN FAYETTE COUNTY

The diagram shows the relative acreage devoted to the three principal grain crops at periodic intervals since 1880. (Figures from U. S. Census, except those for 1930, which are taken from "Illinois Crop and Livestock Statistics.")

Figures for a single year, however, are not so representative of conditions as average yields over a period of years. The U. S. Department of Agriculture gives the following average yields for the ten-year period 1921 to 1930: corn, 25.6

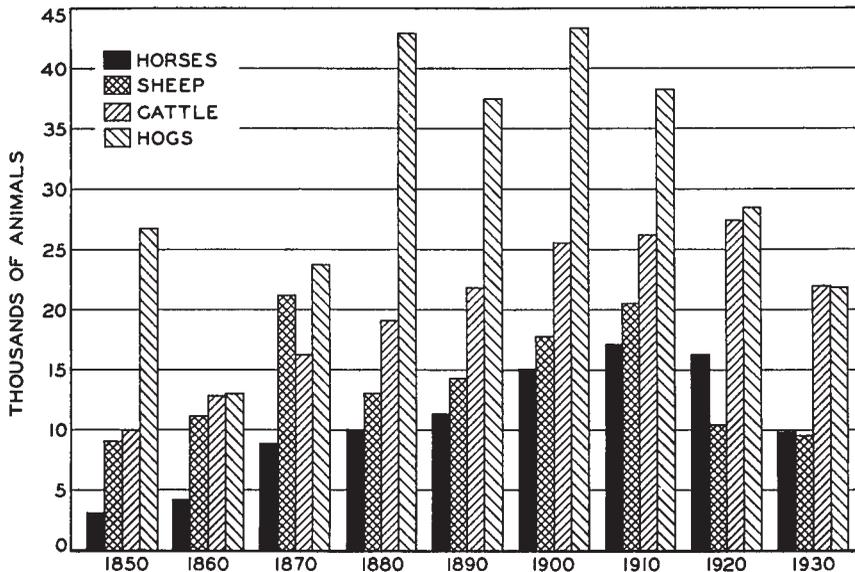


FIG. 5.—NUMBER OF HORSES, SHEEP, CATTLE, AND HOGS IN FAYETTE COUNTY

The diagram shows the relative numbers of the principal classes of livestock at periodic intervals since 1850. (Figures from U. S. Census, except those for 1930, which are taken from "Illinois Crop and Livestock Statistics.")

bushels; winter wheat, 12.8 bushels; oats, 19.6 bushels; tame hay, 1.09 tons. A four-year average for spring wheat is given as 13.1 bushels. These yields are below the all-state average. The predominance of the acreage given over to corn and nonlegume hays indicates that more diversification of crops might well be practiced. While at least 20 percent of the cultivated land should be in legumes every year, Census figures show that only about 7 percent was so occupied in 1929. A good crop rotation might well include a legume every three or four years.

Fruit and vegetable crops are not of great commercial importance in Fayette county. A few orchards have been developed, some of which have proved profitable. Peaches and apples are the principal orchard fruits grown. There is some

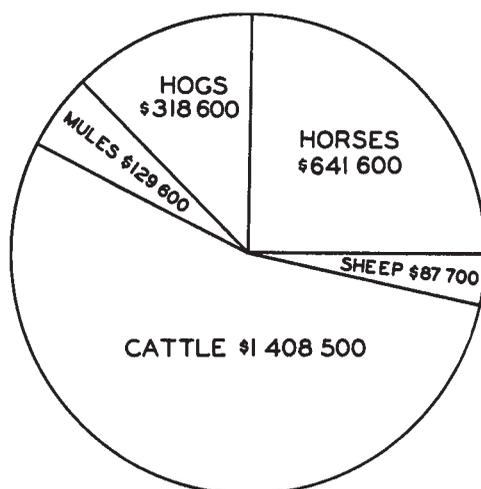


FIG. 6.—RELATIVE VALUE OF THE MORE IMPORTANT CLASSES OF FARM ANIMALS IN FAYETTE COUNTY, 1930

(Data from "Illinois Crop and Livestock Statistics," Circular 409, Illinois Department of Agriculture; U. S. Department of Agriculture cooperating.)

small-fruit acreage, chiefly strawberries. These enterprises, when carefully managed, have proved successful. Practically all the vegetables raised are consumed locally or sold at roadside markets.

The livestock industry has been an important part of the agriculture in Fayette county. The number of animals on farms reached its maximum about 1900, the number increasing up to that time with increasing human population. Since then the number has declined, particularly the number of hogs, sheep, and cattle (Fig. 5). The number of dairy cattle has increased steadily, and dairying and poultry have become the most profitable branches of the livestock industry. The total value of livestock, not including poultry, on all farms in 1930 was \$2,586,000, according to the figures given in "Illinois Crop and Livestock Statistics." More than half this total value was made up of cattle (Fig. 6). The 1925 Census places the value of poultry in Fayette county at more than \$450,000, or about one-fifth the value of all livestock at that time.

## FORMATION OF FAYETTE COUNTY SOILS

### Origin of Soil Materials

The materials which now form the mineral portion of the soils of Fayette county were deposited by ice, water, and wind on the underlying bed rock during the Glacial epoch. The climate during that period was much colder than at present. Snow and ice accumulated in vast amounts in regions to the north until the pressure was so great that the mass pushed outward from its centers. The ice advanced chiefly southward, aided by further accumulation of snow and ice at its margin, until conditions became such that no further advance was made.

In moving across the country from the far north, the ice gathered up all sorts and sizes of material, including clay, sand, gravel, boulders, and even immense masses of rock. Some of these materials were carried hundreds of miles and rubbed against surface rock and against each other until largely ground into powder. The greater part of the material carried, however, was derived from the old bed-rock surface and was deposited within fifty miles or less of its origin. When the ice sheet, or glacier, reached the limit of its advance, the rock debris carried by it usually accumulated along its front in a broad, undulating ridge, or moraine, and as the ice mass slowly melted back the material was deposited somewhat irregularly over the surface previously covered by the ice. The advance and retreat of an ice sheet were not continuous movements; frequent oscillations of the mass took place and the action was complex in character. Each advance and retreat leveled off ridges and hills and filled in valleys. The mixture of materials deposited by the glacier is known as boulder clay or glacial drift.

There were at least four great periods during which ice sheets moved down from the north. Some periods comprized two or more distinct movements, each of which covered a part of North America, altho the same parts were not covered during each advance. The movements of these individual ice sheets were separated by long periods of time, during which the climate was similar to that now existing and the country was clothed with vegetation. At least two of these glaciers covered Fayette county. Remnants of the deposit left by an early advance have been found in several places in the county. The Illinoian glaciation, coming later, completely covered the area and buried or destroyed the deposits left by the earlier invasion. The deposits left by the Illinoian glacier were a heterogeneous, gravelly, clay mass varying in thickness from 20 to more than 100 feet. The original, rough, broken, and eroded rock surface was leveled off to a relatively flat plain. The knolls and ridges which are found over the county today were made at this time by accumulations of glacial debris.

Associated with the withdrawal of an ice sheet and the exposure of the deposited material to the weathering forces was the accumulation of a silty, wind-blown material, known as loess, on top of the drift. The loess was derived largely from the sediment carried by the immense volumes of water which flowed from the melting ice sheet. This sediment-laden water filled the drainage channels and during flood stages overflowed the adjacent lowlands. Following each flood stage, the water would recede and the sediment which had been deposited would dry and be picked up by the wind and blown over and redeposited on the upland

as dust. Undoubtedly some fine material was also left by the ice itself on the drift surface following glacial recession and more accumulated as weathering broke down the larger rock particles. This weathered material was also blown about by the wind when dry and, together with the fine material from the lowlands, collected as a blanket on the upland, particularly on the southwest side of ridges and other obstructions. Most of the loess was derived from the major stream bottoms, such as that of Mississippi river, but since Fayette county is some distance from a major stream it did not receive a very thick blanket of this material. The thickness of the loess over the county, where it has not been eroded away, varies from 2 to 12 feet, the average being about 3 feet. Not all of this loess came at the same time, however, as each glacial advance and retreat was accompanied by a loess accumulation. Most of the loess covering Fayette county was deposited during two periods; the earlier, known as the Sangamon Interglacial period, which followed the Illinoian ice, and the more recent, known as the Peorian Interglacial period, which followed one of the later ice advances. This later ice advance did not reach Fayette county, but the major streams carried immense volumes of water and sediment from its melting. This sediment was deposited in the bottoms and later blown over and accumulated as a shallow deposit on the uplands. Enough time elapsed between the deposition of the drift and the oncoming of the loess so that a soil was formed from the drift. Altho this drift-derived soil was buried by the deposition of loess, it exerted an influence on the formation of the characteristics of the present soil, as will be explained later.

Erosion has been continuously active since the Glacial period. Enough time has elapsed since the recession of the Illinoian ice so that drainage has worked headward, establishing definite channels thru the county. The area surrounding these drainage channels has again become rough and hilly. The process of tearing down the upland is yet in its early development, only a small part of the upland having been attacked. The width of the Kaskaskia river bottom land indicates, however, an enormous removal of material. Most of the minor stream courses are as yet V-type gullies, which indicate that topographical development is in its earlier stages. The destruction of the uplands in Fayette county has been slow because of the unusually flat topography. However, a considerable amount of potential farm land in Fayette county has already been destroyed by gullying, and more is being destroyed each year.

### Soil Development

The various kinds of soil material, whether deposited directly from the glacier, by wind, or by water, all began immediately after their deposition to undergo change as a result of the action of weathering forces. When first laid down, each deposit of soil material was rather uniform from top to bottom and over the area of the county. It was of an open, porous nature, gray to pale yellowish gray in color, high in carbonates, and well supplied with the raw mineral elements of plant food. Altho this material was sweet and potentially productive, it was incapable of growing crops. It had yet to be made into soil by the operation of the weathering forces. The manner in which these forces operated determined the character of the soil produced.

The simpler forms of vegetation first began to grow on these deposits; these were followed by the higher plants as conditions for their growth became favorable. As time went on, the weathering forces began to leave their imprint on the soil material, and soil characteristics began to appear. Soil is not formed all at once, but attains its characteristics gradually, its development passing thru stages corresponding to youth, maturity, and old age. Its development, therefore, may be likened to the growth or life cycle thru which animals and plants pass. The upland soils in Fayette county have reached maturity and are entering the old-



FIG. 7.—STUDYING THE SOIL PROFILE

One of the very pronounced characteristics observed in most soils is that they are composed of more or less distinct layers, or strata, often spoken of in soil literature as "horizons." The vertical section of the soil showing the arrangement of these horizons from the surface down is called the "soil profile."

age stage. Bottom lands and those areas receiving deposits of sediment or those being eroded have youthful soils because the material has just recently been either deposited or uncovered.

All the soil material in Fayette county originally contained an abundance of lime and was sweet, or alkaline, in reaction. Gradual leaching of lime from the soils has made them sour or acid in reaction. Oxidation, produced by the exposure of the material to the oxygen of the air, is the first weathering process to attack the soil material following its deposition. Solution and leaching of the carbonates follows as a second downward wave of weathering, thus allowing an acid condition to develop because of the loss of lime.

Further attack on the soil material by weathering forces such as freezing and thawing, and wetting and drying, serves to break down the larger particles into smaller particles. Carbonic and other acids in the ground water increase its solvent action on the minerals. Some of the material released by decomposition goes into solution and passes out with the drainage water, some is taken

up by plant roots, and some accumulates in place. The breaking down of the larger particles into smaller makes many so small that they are readily moved in solution or suspension in the soil water. Under conditions of poor subsurface drainage, these fine particles accumulate in the subsoil, fill in the spaces between the larger particles, and initiate the formation of a layer slowly pervious to water. This clay pan layer grows both in thickness and in imperviousness by further accumulation of fine clay particles in place. The rapid chemical decomposition of new soil material makes an abundance of plant food available and the soil is able to support a luxuriant vegetative growth.

The conditions in Fayette county were more favorable for the development of a grass vegetation at first, but as streams extended into the region and drainage improved, forest vegetation began to encroach over the area. The grass vegetation with its enormous quantity of surface roots, together with a high lime and moisture content in the soil, resulted in the accumulation of organic matter and the development of dark color in the surface soil. As weathering continued, the soil became acid and somewhat impoverished, vegetative growth became less vigorous, and organic-matter destruction overtook accumulation, reducing the once dark brown to black surface soil to a gray. In timbered areas, the surface soil is of still lighter color because conditions in timber are not favorable for the accumulation or preservation of organic matter.

The gradual development of soil from soil material is very complex, and the above described processes indicate only a few of the outstanding changes which take place. One of the most pronounced and universal effects of the weathering of soil material is the production of layers, or horizons, in the soil, each horizon having definite characteristics. From a practical standpoint, the various horizons constituting the soil profile can be designated as surface, subsurface, and subsoil.

## THE SOIL MAP

### Basis of Soil Classification

In a soil survey the type is the unit of classification. Each soil type has definite characteristics upon which its separation from other types is based. These characteristics are inherent in the different horizons which constitute the soil profile. Among them may be mentioned color, texture, structure, and composition, both physical and chemical. Very useful and easily observed indicators of soil character are topography and the kind and character of the vegetation. Knowledge of the geological origin and formation of the soil material of the region being mapped often makes possible an understanding of soil conditions not otherwise acquired.

One of the troublesome problems of the soil surveyor results from the fact that areas are frequently encountered in which type characters are not distinctly developed or in which characteristics show considerable variation. When these variations are considered to have sufficient significance, and the areas involved are sufficiently large, type separations are made. Because of the almost infinite variability occurring in soils, one of the exacting tasks of the soil surveyor is to determine the degree of variation allowable for any given type.

### Naming the Soil Types

In the Illinois soil survey a system of nomenclature has been used which is intended to make the type name convey some idea of the nature of the soil. Thus the name "Yellow-Gray Silt Loam On Tight Clay" carries in itself a somewhat definite description of the type. It should not be assumed, however, that this system of nomenclature makes it possible to devise type names which are always adequately descriptive, for mature soils are made up of several horizons and it is

TABLE 1.—SOIL TYPES OF FAYETTE COUNTY, ILLINOIS

Soil type No.	Name of type	Area in square miles	Area in acres	Percent of total area
1	Deep Gray Silt Loam On Tight Clay . . . . .	16.18	10 355	2.27
2	Gray Silt Loam On Tight Clay . . . . .	154.98	99 187	21.66
3	Gray Silt Loam On Orange-Mottled Tight Clay . . . . .	86.03	55 059	12.02
4	Yellowish Gray Silt Loam On Orange-Mottled Tight Clay . . . . .	2.59	1 658	0.36
8	Eroded Gravelly Loam . . . . .	88.80	56 832	12.41
11	Light Gray Silt Loam On Tight Clay . . . . .	.35	224	0.05
12	Yellow-Gray Silt Loam On Tight Clay . . . . .	65.53	41 939	9.16
13	Yellow-Gray Silt Loam On Compact Medium-Plastic Clay . . . . .	89.09	57 018	12.45
14	Reddish Yellow-Gray Silt Loam . . . . .	7.92	5 069	1.10
15	Reddish Yellow Silt Loam . . . . .	1.21	774	0.17
47	Grayish Black Silt Loam On Clay . . . . .	7.30	4 672	1.02
48	Grayish Drab Silt Loam On Clay . . . . .	8.64	5 530	1.21
70	Drab Clay Loam . . . . .	11.04	7 066	1.54
72	Mixed Loam . . . . .	66.11	42 310	9.24
75	Mixed Fine Sandy Loam . . . . .	1.39	890	0.19
92	Sand . . . . .	1.02	653	0.14
100	Peaty Loam . . . . .	.07	44	0.01
108	Deep Gray Silt Loam (Overflow) . . . . .	55.82	35 725	7.79
112	Brown-Gray Silt Loam On Tight Clay . . . . .	12.60	8 064	1.76
113	Brown-Gray Silt Loam On Reddish Brown Tight Clay . . . . .	9.46	6 054	1.32
120	Slick Spots . . . . .	21.87	13 997	3.05
127	Grayish Brown Silt Loam . . . . .	4.94	3 161	0.69
128	Grayish Light Brown Silt Loam . . . . .	2.46	1 574	0.34
	Water . . . . .	.37	237	0.05
	Total . . . . .	715.77	458 092	100.00

impossible to describe each horizon in the type name. The type name "Yellow-Gray Silt Loam On Tight Clay" indicates only the color and texture of the surface soil and texture and consistence of the subsoil.

To assist in designating soil types, a number is assigned to each type. These numbers are not only a convenience in referring to the respective types, but they are especially useful in designating very small areas on the map and as a check in reading the map colors.

The accompanying colored soil map, shown in three sections, gives the location and boundary of each soil type in Fayette county and indicates the position of streams, roads, railroads, and towns. Table 1 lists the various soil types, gives the area of each in square miles and acres, and shows the percentage each constitutes of the total area as recorded on the soil map.

## DESCRIPTION OF SOIL TYPES

Based on the principles explained above, the soils of Fayette county have been differentiated into twenty-three soil types. A brief description of the outstanding characteristics of each type, together with a few suggestions for its practical management, are given in the following pages.

It should be clearly understood in this connection that soil types, not fields nor areas of land, must henceforth serve as the principal basis for working out soil management programs. Take, for example, the matter of the management of an upland type developed on a flat surface in Fayette county; the under-drainage is so different from that of an upland soil developed on a slope that it entirely alters the management program. In the improvement of the former the first consideration is to remove the excess water; the first consideration in the latter is to retard the rate of surface run-off and so reduce erosion.

Besides a knowledge of the soil type or types with which one has to deal, it is essential in soil-improvement programs to know what cropping and management practices have been followed in the past and what type of farming it is desired to follow in the future.

Publications of the Illinois Station that will aid in the management and improvement of soils in Fayette county are: Circular 346, "Test Your Soil for Acidity"; Bulletin 337, "A Field Test for Available Phosphorus in Soils"; and Circular 290, "Saving Soil by Use of Mangum Terraces."

### Deep Gray Silt Loam On Tight Clay (1)

Deep Gray Silt Loam On Tight Clay occurs in depressions at the base of long slopes and at the heads of drainage in the upland. It occupies 16.18 square miles, or 2.27 percent of the total area of the county. The soil material from which this type was developed has been deposited as sediment from the run-off of adjoining higher lands. Most of the area of the type still receives some of the silty wash brought down by sheet erosion. It is seldom covered by flood waters except for a short period following heavy rains. It lies on nearly level land which does not have enough slope to remove excess surface water very rapidly. Both surface drainage and underdrainage are poor. The type was originally covered with a growth of grass, brush, and swamp oak trees.

The surface soil of this type varies from 6 to 10 inches in thickness, depending upon the rate of recent deposition. It is a gray, friable silt loam containing numerous small, hard, rounded black pellets. The subsurface is lighter in color than the surface but of the same texture. The lower subsurface soil is gray and ashy. The subsoil begins at a depth of 22 to 28 inches and varies from a thin, moderately compact and plastic clay loam to a thick, pale yellowish gray, very compact and plastic clay. The lower subsoil below 36 to 40 inches is friable. Some sand and gravel are scattered thruout the soil. Slick spots, or "scalds," are common on this type. The reader is referred to a discussion of these under the type Slick Spots (120), page 25.

*Management.*—In the improvement of this soil drainage must first be provided, both to prevent the run-off from the adjoining higher land from spread-

ing over it and to remove the excess surface water after heavy rains. An open ditch constructed at the base of the sloping upland lying above an area of this soil type, and leading to a good outlet, combined with shallow surface ditches and short strings of tile thruout the area, should adequately drain this soil. If tile are used they must be placed above the subsoil to be effective.

The second step in the improvement of this type is to provide fresh organic matter at regular intervals. This can be done by applying animal manure or by growing and plowing under legumes, preferably sweet clover. The soil is acid, and sweet clover will not grow until limestone has been applied. A clover crop should be grown and turned under every third or fourth year to maintain the organic-matter content and to provide nitrogen for grain crops.

Following the correction of the organic-matter and nitrogen deficiencies, the land should be tested for available phosphorus, and a phosphate fertilizer applied if needed. If a liberal application of animal manure is not available, a trial application of a potassium fertilizer should be made.

This type, when properly managed, should return fair crop yields: It will not grow alfalfa successfully, but corn, soybeans, cowpeas, and grasses for seed or hay should return moderate yields.

### Gray Silt Loam On Tight Clay (2)

Gray Silt Loam On Tight Clay is found on the poorly drained, nearly level prairie upland thruout the county. It comprizes 154.98 square miles, or about one-fifth of the area of the county. It is characterized by an almost impervious subsoil and is cold and wet in the spring and often drouthy in the summer. It is difficult to drain, not only because of the impervious subsoil and the consequent impossibility of underdrainage, but also because of its flatness and the lack of a good outlet for the water.

The surface soil is 6 to 8 inches thick and is a friable gray silt loam containing numerous small, hard, rounded black pellets. The subsurface is lighter in color than the surface and of the same texture. The lower subsurface is an ashy, light gray silt loam. The subsoil begins at 18 to 22 inches, and is a tough, plastic, pale yellowish gray clay. A few pale red or orange-colored spots frequently occur near the top of the subsoil. Some sand and a few pebbles occur below 36 to 42 inches, but the material remains very sticky and compact to a depth of five feet or more. This type contains many slick spots, or "scalds," which are too small to be shown on the map. Description of these spots and recommendations for their management are given on pages 25 and 26.

*Management.*—This type is naturally very poorly drained. Because of the practical impossibility of securing adequate drainage and because of the presence of so many unproductive slick spots, it is questionable just how far to proceed in treatment to increase crop production. As tile will not draw, open surface ditches must be depended upon to remove excess water. Unless there is sufficient slope and a good outlet even these are not effective. The soil is low in organic matter and is strongly acid. Animal or green manure must be plowed under in considerable quantity to correct the organic-matter and nitrogen deficiencies. Sweet clover is the best green-manure crop to use, and its growth requires the application of 4 or 5 tons of limestone to the acre. Following the addition of limestone

and the plowing down of leguminous organic matter, a trial application of a potassium fertilizer is suggested. The results from the University of Illinois experiment fields located on this soil type indicate that only a moderate return can be expected under the most favorable conditions (see discussion of Odin and Newton fields, pages 35 and 38). Alfalfa usually fails on this soil, and corn is not well adapted to it. The growing of redtop for seed, without soil treatment, has been the most profitable general practice in recent years. Applications of limestone have increased redtop yields.

### Gray Silt Loam On Orange-Mottled Tight Clay (3)

Gray Silt Loam On Orange-Mottled Tight Clay occurs on the undulating to gently rolling prairie land, around the heads of stream drainage, and on low ridges. It has fair surface drainage but poor underdrainage. Slick spots, or "scalds," occur in association with this type but are not so numerous as in Gray Silt Loam On Tight Clay, described above. This type occupies 86.03 square miles, or about 12 percent of the total area of the county.

The surface soil is 5 to 7 inches thick, and is a friable gray silt loam. The upper subsurface is yellowish gray. The lower subsurface is a light gray, ashy silt loam containing numerous orange or reddish spots. The subsoil begins at 14 to 18 inches and is a compact, plastic, yellowish gray clay containing numerous orange spots. The lower subsoil, below 28 to 30 inches, is less compact than the upper subsoil and contains some sand and small gravel. It is splotched with yellowish brown.

*Management.*—This type, even tho it occurs on gently sloping land, is not well drained. Precaution must be taken to keep excess surface water off the land during wet seasons. Open surface ditches at frequent intervals will accomplish this if a proper outlet is established. Tile cannot be used successfully because the water cannot get into the tile thru the tight subsoil. Following the correction of drainage, organic-matter deficiencies should be taken care of, as suggested in the management discussion of Type 2, Gray Silt Loam On Tight Clay. The results from the Ewing field, Series 100 and 200 of which are located on this soil type, indicate the advisability of using a potassium fertilizer. Fair crop yields can be expected under proper management, but the impervious nature of the subsoil limits the return in all but very favorable years.

### Yellowish Gray Silt Loam On Orange-Mottled Tight Clay (4)

Yellowish Gray Silt Loam On Orange-Mottled Tight Clay occurs on rolling prairie land and is found scattered thruout the county on low knolls and ridges. Most of the area of this type was originally covered with a growth of brush and scattering trees, such as the locust and wild cherry. It has good surface drainage and fair underdrainage. It occupies only 2.59 square miles in the county.

The surface soil is 4 to 6 inches thick, and is a light brownish gray, friable silt loam. The upper subsurface is a pale yellow, friable silt loam. The lower subsurface is a friable, reddish yellow silt loam splotched with red. The subsoil begins at 11 to 14 inches and is a medium-compact, plastic, yellow clay splotched

with red. The lower subsoil below 20 to 22 inches is a grayish yellow, moderately compact clay loam. Below 30 to 32 inches the material is friable and somewhat sandy.

*Management.*—If this type is to be cultivated precaution must be taken to prevent erosion. Vegetation should be kept on the land during the winter and early spring months whenever possible. The steeper slopes should be terraced. This type is acid and low in organic matter. Limestone should be applied, and a legume, preferably sweet clover, grown and turned under. The soil should be tested for available phosphorus and if the test indicates the need, a phosphate fertilizer should be added, particularly if wheat is to be grown. After proper treatment this land will grow alfalfa successfully, and it is also adapted to orcharding and the growing of small fruits and vegetables. Winter wheat usually yields well, but the yield of corn is often cut by summer drouth.

### **Eroded Gravelly Loam (8)**

Eroded Gravelly Loam occurs on the steep gullied hillsides which lie adjacent to bottom lands and on the steeper part of knolls and ridges. The entire area of this type is subject to serious and destructive erosion. Most of it has never been cleared of timber. Wherever it was cleared, erosion soon destroyed the land for cultivation. A few outcrops of rock occur near the base of the slope in some areas of this type. This type occupies 88.80 square miles, or about one-eighth of the total area of the county.

Eroded Gravelly Loam has little or no true soil development because the surface is removed as fast as the soil forms. The material is a sandy, gravelly clay mass, and the steeper slopes, where erosion has exposed the unleached glacial drift, are sweet.

*Management.*—Eroded Gravelly Loam should not be cultivated. Some of the less steep slopes can be used for orcharding or pasture land. A vegetative cover should be kept on the surface at all times. Most of the area of this type should be kept in timber, or, if cleared, replanted with trees or used for permanent pasture.

### **Light Gray Silt Loam On Tight Clay (11)**

Light Gray Silt Loam On Tight Clay occupies the very flat, exceptionally poorly drained areas in the upland timber. This type is the poorest soil in the county but fortunately it includes only 224 acres. The land is now, or was formerly, covered by post-oak and hickory timber.

The surface soil is 2 to 4 inches thick, and is a light gray silt loam containing numerous hard, rounded, black pellets. When cultivated, some of the very light gray subsurface is mixed with the surface, making a very light appearing soil. The upper subsurface down to about 15 inches is a very light gray silt loam. The lower subsurface is an ashy, white silt loam. The subsoil begins at 20 to 24 inches and is a very compact and highly plastic pale yellowish gray clay almost impervious to water.

*Management.*—It is practically impossible to drain this soil, and because of the drainage handicap it is doubtful whether any sort of treatment involving a money outlay should be attempted at this time. The land can best be kept

in meadow or grass, such as redbud, and used for pasture or hay. A University experiment field is located on this soil type at Sparta, Illinois, and the reader who may be interested in the results is referred to Bulletin 362 of this Station, where this work is described.

### **Yellow-Gray Silt Loam On Tight Clay (12)**

Yellow-Gray Silt Loam On Tight Clay occurs on nearly level to very gently sloping land which is now, or was formerly, timbered. Both the surface drainage and underdrainage of this type are naturally poor but not so bad as in Light Gray Silt Loam On Tight Clay. Numerous small slick spots, or "scalds," occur in association with this type, and in many respects it resembles Gray Silt Loam On Tight Clay. It occupies 65.53 square miles, or about 9 percent of the total area of the county.

The surface soil of this type is 4 to 5 inches thick and is a yellowish gray, friable silt loam. The subsurface is lighter in color than the surface and becomes white and ashy below 15 inches. Numerous hard, black, rounded pellets occur in the surface and subsurface. The subsoil begins at 17 to 20 inches and is a very compact, plastic, pale yellowish gray clay, becoming somewhat more friable below 36 to 42 inches. Some sand and pebbles occur at this depth.

*Management.*—Most of the areas of this type lie in close proximity to good drainage outlets, and for this reason surface drainage can usually be obtained by using deep, open, surface ditches and furrows. Where a good drainage outlet is available, this type can be managed so as to produce fair crop yields. The same suggestions given for the treatment of Gray Silt Loam On Tight Clay (page 16) apply to this type, except that more emphasis should be placed on increasing and maintaining the organic-matter content. Experiments on the Raleigh Experiment Field are of interest in this connection (see page 40).

### **Yellow-Gray Silt Loam On Compact Medium-Plastic Clay (13)**

Yellow-Gray Silt Loam On Compact Medium-Plastic Clay is found on the gently rolling upland that is now, or was formerly, timbered. It occurs for the most part between the flat prairie upland and the steep gullied land along streams. It has fair to good surface drainage and fair underdrainage. It occupies about 89 square miles, or one-eighth of the total area of the county.

The surface soil is 5 to 7 inches thick, and is a friable, grayish yellow silt loam. The upper subsurface soil is grayish yellow and the lower subsurface soil is somewhat ashy and light gray in color. The subsoil begins at 14 to 17 inches and is a grayish yellow, medium-compact and plastic clay loam. Below 32 to 36 inches the subsoil becomes more friable. Some sand and gravel occur below 30 inches.

*Management.*—Altho this soil has fair to good surface drainage, some artificial means must be provided to insure adequate subsurface drainage. Shallow open surface ditches are the most practical, but tile will aid if placed not over 3 to 4 rods apart and as close as possible to the surface. The more rolling areas of this type should not be left without a protective vegetative cover in the winter and spring months as sheet erosion will do considerable harm. The organic-

matter content should be increased by the addition of animal or green manure. After the acidity is corrected by limestone, sweet clover grows very well on this soil. Some legume should be plowed under every three or four years to maintain the organic-matter supply. Trial applications of both a phosphorus and a potassium fertilizer are suggested. Results from the Enfield experimental field indicate that returns can be expected from the use of both the above mentioned fertilizers after drainage and organic matter deficiencies are corrected. This soil type is adapted to a great variety of crops, including alfalfa, wheat, orchards, small fruits, and vegetable crops. It responds well to good farming and under proper management should produce satisfactory crops. (See account of Enfield experiments, page 42.)

#### **Reddish Yellow-Gray Silt Loam (14)**

Reddish Yellow-Gray Silt Loam occurs on the rolling upland that is now, or was formerly, timbered. This type is found on the knolls and high ridges. It has excellent surface drainage and good underdrainage, but is subject to destructive sheet erosion when cultivated. It occupies about 8 square miles.

The surface soil is 4 to 5 inches thick and is a light brownish yellow, friable silt loam. The subsurface is lighter colored and more yellowish than the surface and has a reddish cast. The subsoil begins at 10 to 14 inches and is a loose, open, reddish yellow silt loam. It is slightly compacted when dry. Below 30 inches the subsoil is a grayish yellow, very friable silt loam.

*Management.*—Provision must be made to protect areas of this type from erosion when cultivated. Terraces should be constructed to provide this protection. Vegetation should always be kept on the land during the winter and early spring months. The soil is acid and is low in organic matter. It should be limed and a legume grown and turned under. The addition of a phosphate fertilizer should give a good return, particularly if wheat and legumes are grown. Alfalfa will grow well on this land following liming. The yield of corn is often cut by summer drouth. This soil is adapted to the growing of orchard, small fruit, and vegetable crops.

#### **Reddish Yellow Silt Loam (15)**

Reddish Yellow Silt Loam occurs on the very rolling and exceptionally well-drained upland that is now, or was formerly, timbered. It is similar in character to Reddish Yellow-Gray Silt Loam, described above. It differs from it chiefly in having a shallower profile, in being less compact, and having a more reddish color. Also it occurs on more-rolling land. Only 1.21 square miles of this type are found within Fayette county.

*Management.*—For the management of this type the reader is referred to the suggestions given under the type Reddish Yellow-Gray Silt Loam. It is doubtful whether this soil can be included in a regular rotation where cultivation is frequently needed because of the severe erosion to which it is subject. However, it is well adapted to alfalfa following proper treatment and to orchards and small fruit crops.

### Grayish Black Silt Loam On Clay (47)

Grayish Black Silt Loam On Clay occurs in depressional areas in the upland prairie. These areas were covered with water or were swampy until artificially drained. Most of them are found in the region to the southwest of Vandalia. This soil type is youthful because its development was retarded during the time it was covered by water. It occupies 7.30 square miles, or practically one percent of the total area of the county.

The surface soil is 8 to 10 inches thick and is a grayish black, silty clay loam. It is sticky when wet and somewhat difficult to cultivate. The subsurface is a dark drab, plastic, clay loam. The subsoil begins at 16 to 18 inches and is a grayish drab, plastic clay. Below 28 to 30 inches the subsoil becomes friable and gray in color.

*Management.*—Altho natural drainage in this type is lacking, it can be well drained artificially by tile and surface ditches if a good outlet can be established. Tile should be placed at intervals of 5 to 6 rods. An open ditch constructed thru the center of the area will provide a good outlet. If good drainage can be established, this soil can be made one of the most productive in Fayette county. Care must be observed in cultivating it because of the plastic nature of the surface. Frequent additions of fresh organic matter are necessary if a favorable physical condition is to be maintained. Barnyard manure or green manure, preferably sweet clover, should be used for this purpose. The soil is not very acid and will usually grow red clover without lime. A small application of lime is usually needed to grow sweet clover. Trial applications of both a phosphorus and a potassium fertilizer are suggested if this soil is to be regularly cropped. This type is a good corn soil and for this reason is particularly valuable since it is located in a region the soils of which are generally not adapted to corn production.

### Grayish Drab Silt Loam On Clay (48)

Grayish Drab Silt Loam On Clay is found in association with Grayish Black Silt Loam On Clay but occurs on somewhat higher land and has somewhat better drainage. It is not naturally well drained but can be drained easily by artificial means. This type shows more soil development than the preceding one. It occupies 8.64 square miles, or 1.21 percent of the total area of the county.

The surface soil is 7 to 9 inches thick and is a friable, grayish drab silt loam. The subsurface is gray, becoming somewhat ashy near the base. The subsoil begins at 17 to 21 inches and is a pale yellowish gray, compact and plastic clay. The lower subsoil, below 28 to 30 inches, is gray and more friable. Brownish black irregularly shaped pellets occur thruout this soil.

*Management.*—The management recommendations suggested for Type 47, Grayish Black Silt Loam On Clay, apply also to this type. More difficulty is encountered, however, in obtaining underdrainage because the subsoil is more compact. This soil is more acid and not so productive as Type 47. Except during very favorable clover years, an application of limestone is necessary before satisfactory crops of red clover can be expected. Under proper management this is a productive soil.

### Drab Clay Loam (70)

Drab Clay Loam is found in the Kaskaskia river bottom land, in level, somewhat swampy areas. The soil material was deposited from the sediment that settled out of standing or very slowly moving water. The areas are subject to frequent overflow and undoubtedly existed as shallow lakes until recently. The type occupies practically 11 square miles, or about 1½ percent of the total area of the county.

The surface soil varies in thickness from 4 to 12 inches and is a plastic drab clay loam. The subsurface is grayish drab in color and very plastic. There is little or no soil development below 20 inches. As the depth increases the material becomes lighter in color but retains its tough, plastic nature. Below 30 inches it is gray plastic clay splotched with pale yellow.

*Management.*—The plastic nature of this soil makes it undesirable for farming. If an outlet can be established, open surface ditches will drain this soil satisfactorily except in wet years. Tile will not draw. Fresh organic matter must be added frequently in order to keep the soil in sufficiently good physical condition for cultivation. This type will raise good corn if well farmed and if the crop can be planted early enough in the season.

### Mixed Loam (72)

Mixed Loam is mapped on the overflow land along small streams in the northern part of the county along the larger streams. It occupies about 66 square miles, or over 9 percent of the total area of Fayette county. This type is subject to overflow after each heavy rain so that it frequently receives a fresh deposit of sediment brought down from surrounding higher land or upstream area. The flood water soon drains away so that the soil can be cultivated.

Because of its youth this soil shows no development. The material in the surface horizon is silty, usually grayish yellow to yellowish gray in color, and in some places contains some sand and gravel. The surface is darker than the material below it. At 20 to 24 inches the material becomes yellowish gray in color and somewhat more silty than the surface.

*Management.*—Altho Mixed Loam is subject to frequent overflow, most of the floods come in early spring or late fall, giving enough time to mature a crop of corn, soybeans, or cowpeas. Small grain crops are frequently drowned out, as are also clovers and grass for hay. Surface ditches and tile can be used to drain the land in order to get a crop planted in early spring. The soil is slightly acid, and if wheat or clovers are to be grown it should receive an application of limestone. Corn usually makes a crop on this soil.

### Mixed Fine Sandy Loam (75)

Mixed Fine Sandy Loam occurs along the base of some of the steeper bluffs along Kaskaskia river and also at the base of some of the steeper knolls and ridges in the western part of the county. This soil is subject to overflow from adjacent higher land during heavy rains, but there is sufficient slope so that the flood waters drain away quickly. There is only 1.39 square miles of this type in the county.

The surface soil varies from 6 to 18 inches in thickness and is grayish yellow, friable and sandy. The subsurface is similar to the surface but is somewhat lighter in color and less sandy. This type has no true subsoil development. The material below 20 inches is yellowish gray in color, sandy to silty in texture, and friable.

*Management.*—The recommendations suggested for Mixed Loam apply also to this soil. The frequent overflows to which it is subject are more beneficial than harmful because they continually renew the soil material. This soil is productive and is desirable for general farming purposes.

#### Sand (92)

Sand occurs on low knolls or ridges in the Kaskaskia river bottom. The material from which this soil was derived was deposited out of moving water during floods. The areas are found on slightly higher ground adjacent to present or old stream channels. Only 1.02 square miles of this soil occur in Fayette county.

The surface soil is 4 to 7 inches thick, reddish yellow in color, and of a medium sandy texture. The subsurface is more reddish than the surface and not so sandy. The subsoil begins at 12 to 16 inches and is a reddish yellow, slightly compacted, fine sandy to silt loam. At 30 to 34 inches the material is a loose, yellow, fine sandy loam.

*Management.*—This soil has excellent drainage. It is subject to overflow but the water does not remain on these knolls and ridges long. It is slightly acid and is low in organic matter and nitrogen. Following the application of limestone, it will grow excellent alfalfa, sweet clover, or other legumes. Animal manure or legume crops should be turned under to increase the nitrogen and organic-matter content if cereal crops are to be grown.

#### Peaty Loam (100)

Two small areas of Peaty Loam occur in Fayette county, one in Sections 1 and 2 and the other in Section 9, Township 5 North, Range 1 West (Seminary township). They occupy together only 44 acres. The soil material consists of an organic layer which varies in thickness from 20 to 36 inches. This organic material is underlain by a gray plastic clay.

*Management.*—These two areas of Peaty Loam in Fayette county are covered with water during wet seasons. When dry they are well adapted to the growing of vegetable crops such as celery and onions. If corn is to be grown, the soil should receive an application of some potassium fertilizer. Continued cultivation of this soil will soon destroy the organic material and leave the plastic clay subsoil mixed with more or less organic material as a surface soil.

#### Deep Gray Silt Loam (108)

Deep Gray Silt Loam is the predominating bottom-land soil type along the larger streams in Fayette county. It occupies altogether about 55 square miles, or nearly 8 percent of the total area of the county. The material forming this soil is largely silt brought down in the flood waters from surrounding upland and upstream areas. The soil is kept under high moisture conditions most of the

year, as these bottom lands are flat, poorly drained, and often swampy. The soil is youthful because it is continually receiving new deposits from every overflow.

The surface soil varies from 6 to 10 inches in thickness and is a friable gray silt loam containing numerous small, hard, round pellets. The subsurface is lighter in color than the surface but of the same texture. The subsoil is not developed. The material below 20 to 24 inches is a pale yellowish gray, friable silt loam containing numerous soft brownish black splotches and some sand and small pebbles. Those areas that are slightly higher than the surrounding bottom land and which seldom overflow have a light gray subsurface soil and a thin, pale yellowish gray, compact and plastic subsoil.

*Management.*—Drainage and protection from overflow must be provided if this soil is to be regularly cropped. Surface ditches can be used to drain the land if an outlet can be established. Tile will also work. The soil is somewhat acid and in need of organic matter. If it can be drained and does not overflow too often, limestone should be applied and sweet clover grown and turned under. Corn and late summer crops are grown on this soil because winter crops are usually drowned out. It does not dry out soon enough to plant early spring crops. Overflows seldom come between corn planting and harvesting time. Only about half the area of this land in Fayette county is cropped; the remainder is either used for pasture or remains idle.

#### **Brown-Gray Silt Loam On Tight Clay (112)**

Brown-Gray Silt Loam On Tight Clay occurs on the nearly level prairie upland in the northwestern part of the county. It comprizes 12.60 square miles, or 1.76 percent of the total area of the county. It resembles Type 2, Gray Silt Loam On Tight Clay, but differs from it chiefly in having a darker colored surface soil and in being younger in development. This type is cold and wet in the spring and often drouthy in the summer. It is difficult to drain, not only because of the almost impervious subsoil and practical impossibility of underdrainage, but because of its flat topography and the lack of a good drainage outlet. It is a more productive soil than Gray Silt Loam On Tight Clay.

The surface soil is 6 to 8 inches thick and is a friable, brownish gray silt loam containing numerous small, hard, rounded, black pellets. The subsurface is light brownish gray and of the same texture as the surface. The lower subsurface is an ashy, light gray silt loam, containing numerous, small, hard, black pellets. The subsoil begins at 18 to 22 inches, and is a tough, plastic, grayish yellow clay, splotched with reddish brown. Below 32 to 34 inches the subsoil is more friable and is lighter in color. Some sand and a few pebbles occur below 40 inches. This type contains many slick spots, or "scalds," too small to be shown on the map. For their description and management the reader is referred to the discussion of Slick Spots (120) on pages 25 and 26.

*Management.*—Adequate drainage must be provided before this soil can be farmed with any degree of success. Tile will not draw, and open surface ditches placed not over 3 to 4 rods apart are the only means of drainage. Unless there is sufficient slope and a good outlet, even open surface ditches are not effective.

The soil is low in organic matter and is strongly acid except in the slick spots. Animal or green manure must be plowed under in considerable quantity to correct the organic-matter and nitrogen deficiencies. Sweet clover is the best green-manure crop to use but its growth requires the application of considerable limestone. Following the addition of organic matter, a trial application of a potassium fertilizer is suggested. The results from the Carlinville experiment field (see page 43), which is located on this type, indicate that fair yields can be expected under proper treatment. Alfalfa cannot be successfully grown on this soil, but the other legumes do well.

### **Brown-Gray Silt Loam On Reddish Brown Tight Clay (113)**

Brown-Gray Silt Loam On Reddish Brown Tight Clay occurs in conjunction with Type 122, Brown-Gray Silt Loam On Tight Clay, in the northwestern part of the county and occupies 9.46 square miles, or 1.32 percent of the total area of the county. It is found on gently rolling prairie upland, principally around the heads of stream drainage and on the undulating ridges. It has fair surface drainage but poor underdrainage. Slick spots or "scalds" occur in association with this type but are not so numerous as in the preceding type.

The surface soil is 4 to 7 inches thick and is a friable, brownish gray silt loam. The upper subsurface is a yellowish gray silt loam. The lower subsurface is a light gray, friable silt loam mottled with orange or red. The upper subsoil, which begins at 15 to 18 inches, is a very compact and plastic clay, drabish gray in color, mottled with orange or red. The lower subsoil below 24 to 26 inches is a light yellowish gray clay loam. The material below 30 inches is friable.

*Management.*—Drainage is the most important consideration in the successful management of this type. Even tho it occurs on sloping land, the soil remains wet well into late spring. All the excess surface water should be removed by means of open surface ditches placed at frequent intervals. Tile cannot be successfully used. Similar treatment is suggested for this soil as has been suggested for Type 112, Brown-Gray Silt Loam On Tight Clay, described above, but it should respond more quickly and produce higher yields than that type does.

### **Slick Spots (120)**

Slick Spots, commonly known as "scalds," occur thruout the upland in Fayette county and are characterized by their unproductiveness. They are most extensively developed east of Kaskaskia river and occur in conjunction with all soil types developed on flat to gently undulating topography. Only 4.94 square miles are mapped in Fayette county, but their total area, considering the numerous spots which are too small to place on the map, is probably about 5 percent of the area of the county. Slick Spots can be identified in the field by their lighter colored surface soil and their differing moisture conditions from that of the surrounding land. Most of the bad mud holes in the roads during wet seasons develop on Slick Spots. When plowing is being done, the hard, compact subsoil tends to throw the plow out of the ground. Once dry, as in late summer, these Slick Spots do not absorb water readily and are always drier than the surrounding soil, but upon becoming thoroly soaked they tend to remain saturated and

offer little resistance to pressure. When the surface soil over a Slick Spot is removed, the subsoil can be recognized by its light greenish gray or pale yellowish gray color. When dry, the subsoil is very hard and stands out in distinct prisms.

Slick Spots develop where the leaching of materials, chemically known as bases, from the layer of loess above is interrupted by the presence of a slowly pervious layer formed in the old weathered drift below. These bases are thrown out of solution and, as the water evaporates, they accumulate in the soil, thus bringing about an alkaline or sweet condition. This accumulation of bases produces an excess of soluble salts which has given the soil an extremely poor physical condition and created an unbalanced plant-food situation.

The surface soil, when present, is 3 to 8 inches thick, friable, light gray in color, and silt loam in texture. The subsurface is often absent but when present is a thin, ashy, white silt loam. The subsoil, which begins at depths varying from 6 to 24 inches, is a sticky clay when wet but very tough and hard when dry, and of a light greenish gray or pale yellowish gray color. The lower subsoil below 36 to 44 inches is friable. Small rounded gray pellets of lime are usually found scattered in the subsoil.

*Management.*—Lack of sufficient moisture is one of the causes of poor crops on Slick Spots. Corn suffers more from this deficiency than does small grain. In treating Slick Spots, drainage must be provided so that water will not accumulate in the soil above the 30-inch depth. This can only be done by deep open surface ditches. Where drainage cannot be provided, no attempt at treatment is suggested. If the surface soil is acid, as it usually is, enough limestone should be applied to enable sweet clover to grow. The sweet clover may be allowed to reseed itself for several years and then be plowed under. Practical experience has shown that the beneficial effect of an application of animal manure lasts only one year on these Slick Spots; better returns from the manure are obtained if it is applied to other soil types. No further treatment can be suggested at this time. Crop yields on these spots vary from nothing in unfavorable years to a small yield in a season when the moisture is just right. Yields of small grain are almost always better than those of corn.

#### **Grayish Brown Silt Loam (127)**

The dark-colored, nearly level, gently undulating area of land located about 5 miles east of Ramsey, and known locally as "Nichols Prairie," is mapped as Grayish Brown Silt Loam. This soil is unusual to Fayette county because it is darker colored, better drained, and has a higher productive level than the other upland soils. A sandy, gravelly sub-stratum, which occurs at 6 to 9 feet below the surface, explains its good drainage. This type occupies almost five square miles.

The surface soil is 6 to 9 inches thick and is a friable, grayish brown silt loam. The subsurface is yellowish brown with a gray cast. The subsoil begins at 16 to 18 inches and is a slightly compact and plastic, brownish yellow clay loam. The lower subsoil is a grayish yellow, friable silt loam. A sandy, gravelly substratum lies at 6 to 9 feet below the surface.

*Management.*—In favorable years this soil will grow red clover without treatment, but it should have an application of limestone if red clover is to be regu-

larly grown. Sweet clover will not grow without limestone. Tests should be conducted for available phosphorus, and some form of phosphate fertilizer applied if needed. Regular additions of fresh organic matter should be made. Tile placed 6 to 8 rods apart will give adequate drainage. Under good management this land should produce consistently good yields of the common grain crops.

### Grayish Light Brown Silt Loam (128)

Grayish Light Brown Silt Loam has been mapped on the rolling, well-drained knolls which have been only lightly timbered. This soil is found on the ridges which have a northeast-southwest direction just west of and parallel to Kaskaskia river. This type occupies only about  $2\frac{1}{2}$  square miles.

The surface soil is 3 to 6 inches thick and is a friable silt loam, yellowish brown with a grayish cast. The subsurface is likewise friable and yellowish in color. The subsoil begins at 9 to 13 inches and is a slightly compacted, nonplastic, silty clay loam. Its color is deep yellow with a reddish cast. The lower subsoil is yellow and very friable. Sandy, gravelly material is found within 5 feet of the surface.

*Management.*—If this soil is to be regularly cultivated, provision must be made to stop sheet erosion. This can be done either by terracing or by keeping vegetation on the land during the winter and early spring months. This soil is medium-acid, but upon liming will grow good alfalfa and clover. It will also grow fair small grain crops but is too drouthy for consistently good corn yields. It is well adapted to small fruit and orchard crops. If legumes and small grains are to be grown, the soil should be tested for acidity as well as available phosphorus and a phosphate fertilizer applied if needed.

## CHEMICAL COMPOSITION OF FAYETTE COUNTY SOILS

In the Illinois soil survey the soil types are sampled in the manner described below and subjected to chemical analysis in order to obtain knowledge of their important plant-food elements. Samples are taken, usually in sets of three, to represent different strata in the top 40 inches of soil, namely:

1. An upper stratum extending from the surface to a depth of  $6\frac{2}{3}$  inches. This stratum, over the surface of an acre of the common kinds of soil, includes approximately 2 million pounds of dry soil.
2. A middle stratum extending from  $6\frac{2}{3}$  to 20 inches, and including approximately 4 million pounds of dry soil to the acre.
3. A lower stratum extending from 20 to 40 inches, and including approximately 6 million pounds of dry soil to the acre.

By this system of sampling three zones for plant feeding are represented separately. It is in the upper, or surface layer, that the farmer is more particularly interested, for it includes the soil that is ordinarily turned with the plow and is the part with which the farm manure, limestone, phosphate, or other fertilizing material is incorporated. Furthermore it is the only stratum which can be greatly changed in composition as a result of adding fertilizing materials.

For convenience in making application of the chemical analyses, the results presented in Tables 2, 3, and 4 are given in terms of pounds per acre. It is a simple matter to convert these figures to a percentage basis in case one desires

to consider the information in that form. In comparing the composition of the different strata, it must be kept in mind that different quantities of soil are represented, as explained above. The figures for the middle and lower strata must therefore be divided by two and three respectively before being compared with each other or with the figures for the upper stratum.

The data in Tables 2, 3, and 4 are based upon samples collected from the corresponding soil types in counties neighboring Fayette.

### Nitrogen and Organic Matter Generally Deficient

The soils of Fayette county are generally low in their content of both nitrogen and organic matter, the only exception being Type 47, Grayish Black Silt Loam On Clay.

The amount of organic matter in a soil can be measured by the amount of organic carbon present, for organic carbon constitutes about 50 percent of the organic matter. With the exception of Type 47, noted above, the organic carbon in these soils ranges in the surface layer from 18,070 to 37,830 pounds an acre. The nitrogen content runs parallel to that of organic carbon and ordinarily is about one-tenth as high. This relation is explained by the fact that nearly all of the soil nitrogen (usually more than 99 percent) is contained in the organic matter as a part of it. The ratio of nitrogen to carbon does vary to some extent, being wider in the less mature soils as, for example, in Type 47, in which the ratio is 1 to 13.5. As soils become more and more mature, the organic matter

TABLE 2.—FAYETTE COUNTY SOILS: PLANT-FOOD ELEMENTS IN THE UPPER SAMPLING STRATUM: ABOUT 0 TO 6 $\frac{1}{4}$  INCHES  
Average pounds per acre in 2 million pounds of soil

Soil type No.	Soil type	Total organic carbon	Total nitrogen	Total phosphorus	Total sulfur	Total potassium	Total magnesium	Total calcium
1	Deep Gray Silt Loam On Tight Clay	25 980	2 770	780	440	24 740	4 740	5 550
2	Gray Silt Loam On Tight Clay...	26 640	2 490	760	580	24 190	5 060	5 840
3	Gray Silt Loam On Orange-Mottled Tight Clay.....	26 140	2 690	810	470	25 170	4 420	4 490
4	Yellowish Gray Silt Loam On Orange-Mottled Tight Clay...	35 060	3 460	800	790	27 090	5 430	4 690
11	Light Gray Silt Loam On Tight Clay	18 070	2 050	630	470	21 720	4 150	4 770
12	Yellow-Gray Silt Loam On Tight Clay.....	22 420	1 950	730	550	25 290	3 610	4 440
13	Yellow-Gray Silt Loam On Compact Medium-Plastic Clay....	21 620	2 100	580	460	28 290	5 330	3 490
14	Reddish Yellow-Gray Silt Loam..	21 480	2 240	840	590	35 350	4 380	3 400
47	Grayish Black Silt Loam On Clay	61 740	4 550	1 230	740	30 880	9 370	14 290
48	Grayish Drab Silt Loam On Clay	33 010	3 070	730	550	29 820	5 140	9 530
112	Brown-Gray Silt Loam On Tight Clay.....	33 590	2 810	750	530	31 790	5 590	7 790
113	Brown-Gray Silt Loam On Reddish Brown Tight Clay...	26 000	2 520	680	...	...	2 300	6 960
120-A	Slick Spot.....	21 880	2 110	600	760	25 410	4 290	7 330
120-B	Slick Spot.....	24 990	2 420	730	560	24 660	4 300	8 120
120-C	Slick Spot.....	25 630	2 330	590	650	25 840	4 360	7 330
127	Grayish Brown Silt Loam.....	37 830	3 420	890	500	32 990	7 530	8 690

NOTE. The data given here are based upon analyses of samples collected in neighboring counties. No analyses are reported for Types 8, 15, 70, 72, 75, and 108 because of the heterogeneous character of the soil. Analyses for Types 92, 100, and 128 are omitted because of the very small area in Fayette county occupied by these types.

decays, and both the carbon and nitrogen are converted to inorganic forms and leached away. The loss of carbon, however, is more rapid than the nitrogen loss, with the result of a narrowing of the nitrogen-carbon ratio with age. One of the important biological processes associated with the decay of soil organic matter is the change of the organic nitrogen into nitrate-nitrogen, the form in which it is most readily used by crops.

A study of Tables 3 and 4 shows two striking changes in the organic-carbon and nitrogen relations in the deeper layers of the soil. In the first place, both the nitrogen and carbon contents decrease rapidly with increasing depth. This change is noticeable in the second stratum and is still more marked in the lower. It may be associated with the loss of the dark color of the soil with increasing depth, as the organic matter is largely responsible for the dark color of surface soils. It will also be observed in these tables that the carbon-nitrogen ratio (obtained by dividing the carbon by the nitrogen) also becomes narrower with increasing depth, and that this narrowing of the ratio is more pronounced in the more mature soils. These relations are explained by the fact that the organic matter in the deeper levels is older, and is replenished with fresh vegetable matter to a less extent than is that nearer the surface. The extremes are represented by Type 47, one of the less mature types, in which the ratios for the surface, middle, and lower strata are 1 to 13.5, 1 to 13.7, and 1 to 12.1, respectively, and Type 11, one of the more mature types, in which the respective ratios are 1 to 8.8, 1 to 6, and 1 to 4.2.

TABLE 3.—FAYETTE COUNTY SOILS: PLANT-FOOD ELEMENTS IN THE MIDDLE SAMPLING STRATUM: ABOUT 6¾ TO 20 INCHES  
Average pounds per acre in 4 million pounds of soil

Soil type No.	Soil type	Total organic carbon	Total nitrogen	Total phosphorus	Total sulfur	Total potassium	Total magnesium	Total calcium
1	Deep Gray Silt Loam On Tight Clay . . . . .	34 840	3 820	1 330	680	50 630	9 820	8 060
2	Gray Silt Loam On Tight Clay	25 760	3 030	1 150	800	51 820	9 060	9 300
3	Gray Silt Loam On Orange-Mottled Tight Clay . . . . .	24 110	3 160	1 260	670	54 570	10 840	8 780
4	Yellowish Gray Silt Loam On Orange-Mottled Tight Clay	35 820	4 250	1 330	1 020	58 110	15 950	7 420
11	Light Gray Silt Loam On Tight Clay . . . . .	11 730	1 950	1 040	580	41 460	10 740	8 240
12	Yellow-Gray Silt Loam On Tight Clay . . . . .	16 050	2 070	1 230	790	53 380	9 040	6 920
13	Yellow-Gray Silt Loam On Compact Medium-Plastic Clay . . . . .	15 650	2 000	1 190	660	62 550	13 020	5 920
14	Reddish Yellow-Gray Silt Loam	16 810	2 310	1 570	1 170	73 950	13 670	11 750
47	Grayish Black Silt Loam On Clay	85 180	6 200	1 960	1 240	63 020	20 500	26 760
48	Grayish Drab Silt Loam On Clay	35 730	3 680	1 330	960	62 640	11 860	20 210
112	Brown-Gray Silt Loam On Tight Clay . . . . .	42 330	3 650	1 200	690	65 660	13 750	15 520
113	Brown-Gray Silt Loam On Reddish Brown Tight Clay	36 400	3 360	1 480	...	...	12 960	12 720
120-A	Slick Spot . . . . .	24 250	2 610	1 140	940	51 980	16 740	17 690
120-B	Slick Spot . . . . .	28 220	2 840	1 350	640	55 930	17 380	22 230
120-C	Slick Spot . . . . .	26 490	2 570	1 030	700	56 100	12 050	15 170
127	Grayish Brown Silt Loam . . . . .	56 710	4 520	1 570	830	67 110	18 530	16 570

See footnote, Table 2.

### Phosphorus and Sulfur Associated With Organic Matter

Two other essential elements for plant growth are associated to some extent with the soil organic matter. These are phosphorus and sulfur. Since only one-fourth to one-third of the total quantity of phosphorus in the soil is combined with the organic matter, a close parallelism is found only in soils which are much higher in their organic-matter content than the Fayette county types. The types highest in nitrogen and organic matter in the surface soil are found to be relatively high in phosphorus and sulfur, but this relation is not maintained below the surface stratum.

While the common farm crops take as much sulfur as phosphorus from the soil, sulfur deficiencies do not ordinarily develop because of the atmospheric supply. The sulfur dioxide which escapes into the air in the burning of wood and coal is brought to the earth dissolved in rain water, the amount added ranging in different parts of the state from one to three or more pounds of sulfur an acre a month.

### Potassium Content Uniform

The potassium content of Fayette county soils shows relatively less variation from type to type than any other element studied. The average amount in the surface soil is approximately 27,500 pounds an acre, and the entire range thru all the types in the county is from a minimum of 21,720 pounds up to 35,350 pounds an acre. The potassium concentration in the soil at different depths like-

TABLE 4.—FAYETTE COUNTY SOILS: PLANT-FOOD ELEMENTS IN THE LOWER SAMPLING STRATUM: ABOUT 20 TO 40 INCHES  
Average pounds per acre in 6 million pounds of soil

Soil type No.	Soil type	Total organic carbon	Total nitrogen	Total phosphorus	Total sulfur	Total potassium	Total magnesium	Total calcium
1	Deep Gray Silt Loam On Tight Clay . . . . .	27 150	3 780	1 580	780	77 750	25 080	17 030
2	Gray Silt Loam On Tight Clay	19 890	3 110	1 880	940	78 410	24 060	20 000
3	Gray Silt Loam On Orange-Mottled Tight Clay . . . . .	24 280	3 630	2 010	1 070	80 830	24 390	16 020
4	Yellowish Gray Silt Loam On Orange-Mottled Tight Clay	25 840	3 420	1 810	1 490	93 480	33 460	17 430
11	Light Gray Silt Loam On Tight Clay . . . . .	7 220	1 710	1 690	580	59 360	21 580	9 870
12	Yellow-Gray Silt Loam On Tight Clay . . . . .	11 620	2 020	1 680	810	83 290	27 640	14 720
13	Yellow-Gray Silt Loam On Compact Medium-Plastic Clay . .	12 760	1 880	1 660	820	90 340	19 170	11 900
14	Reddish Yellow-Gray Silt Loam	18 330	2 740	2 590	1 620	100 960	28 100	21 480
47	Grayish Black Silt Loam On Clay	39 900	3 300	2 580	930	99 630	43 180	39 480
48	Grayish Drab Silt Loam On Clay	24 240	2 840	2 030	1 190	89 440	28 240	22 080
112	Brown-Gray Silt Loam On Tight Clay . . . . .	31 850	3 270	2 460	750	96 680	42 390	27 780
113	Brown-Gray Silt Loam On Reddish Brown Tight Clay	30 600	3 960	2 220	...	...	33 360	28 500
120-A	Slick Spot . . . . .	19 300	1 980	2 550	730	90 740	34 520	37 290
120-B	Slick Spot . . . . .	19 890	2 520	2 840	800	90 460	34 240	47 730
120-C	Slick Spot . . . . .	23 100	2 730	2 240	660	82 410	37 200	45 750
127	Grayish Brown Silt Loam . . . .	30 300	3 180	2 300	820	100 020	44 840	30 950

See footnote, Table 2.

wise shows very little variation, averaging 28,960 pounds an acre in the middle stratum and 29,200 pounds in the lower, when the figures are converted to the basis of 2 million pounds an acre.

### Wide Variations in Calcium and Magnesium

The variations in the calcium and magnesium content of Fayette county soils are greater than those in the organic matter. These two elements, particularly calcium, are of special interest because of the relation which they bear to the lime requirement of soils.

Aside from the calcium which may be in solution in the soil water, soil calcium exists primarily in three forms—calcium-aluminum silicates, replaceable calcium, and calcium carbonates. *Calcium-aluminum silicates* are complex soil minerals which decompose but slowly and furnish but scant amounts of soluble calcium for plant growth. This is the form which predominates in those soils that are highly acid. Calcium may be deficient as a plant-food element in such soils, so that the supplying of this element in available form may be one of the benefits of liming. Calcium also occurs in association with the soil colloids (the finest of the clay particles), by which it is absorbed; this is known as *replaceable calcium*, and is much more easily obtainable by growing plants than the mineral form above mentioned. It is found more abundantly in the soils which are nonacid or only slightly acid. Soils are occasionally found that grow sweet clover luxuriantly because of the abundance of replaceable calcium which they contain, even tho in reaction they may be actually acid. *Calcium carbonate*, the form contained in limestone, is the third form of calcium in soils. It occurs only in alkaline (sweet) soils. Of the three forms of calcium this is the most readily dissolved in the soil water and removed by drainage, thereby tending to accumulate at lower and lower depths as leaching proceeds. In Fayette county this process has continued to such an extent that all the calcium carbonate has been removed from the surface soils and even to depths beyond 40 inches in practically all soils except the slick spots. In the formation of slick spots, conditions have been such as to prevent excessive leaching of bases, and in these areas the acidity of the surface stratum gives way to a highly impervious alkaline stratum at varying but comparatively shallow depths.

After the carbonates have disappeared, there continues a gradual release of the replaceable calcium and magnesium, which are continually being carried down by the soil water. As this process continues, either greater reabsorption of magnesium than of calcium occurs in the lower strata, or the calcium minerals are more readily decomposed with consequent greater leaching loss of this element, with the result that the ratio of magnesium to calcium increases with increasing depth. This changing ratio is more pronounced in mature soil types. For example, in Type 11, one of the more mature types in the county, the ratios of magnesium to calcium in the upper, middle and lower strata, respectively, are .87, 1.30, and 2.17. These ratios may readily be computed from Tables 2, 3, and 4. Thus in the surface soil there is only about seven-eighths as much magnesium as calcium, in the middle stratum there is about one and a third times as much, while in the lower stratum, 20 to 40 inches, the magnesium is more than double the calcium. Type 47 illustrates the condition in a less mature soil in which

the weathering and leaching have not been sufficient to accentuate so greatly these changes in the magnesium-calcium ratio. Consequently in this type the ratios of magnesium to calcium increase to a much less extent with increasing depth. These ratios in the three respective strata of Type 47 are .66, .77, and 1.09.

It is apparent from these observations that some of the processes involved in soil development are reflected in the chemical properties of the soil itself, and these may, in turn, be related to agricultural use and fertility requirements.

#### Local Tests for Soil Acidity Often Required

It is often impracticable to attempt to obtain an average quantitative measure of the calcium-carbonate content or of the acidity of a given soil type because, while some samples will contain calcium in the form of carbonate (few such areas, except slick spots, occur in this county), others will not only contain no calcium carbonate but may actually have a lime requirement due to the soil acidity. We thus have what may be considered positive and negative values ranging, perhaps widely, on the opposite sides of the zero or neutral point. The numerical average of such values could have no significance whatever, since such an average would not necessarily even approach the condition actually existing in a given farm or field. It is for this reason that the tables contain no figures purporting to represent either the lime requirement or the limestone present in the different soil types.

The qualitative field tests made during the process of the soil survey are much more numerous than the chemical analyses made in the laboratory, and give a general idea of the predominating condition in the various types as to acidity or alkalinity. These tests therefore furnish the basis for some general recommendations which are given in the descriptions of the soil types on pages 15 to 27. To have a sound basis for the application of limestone, the owner or operator of a farm will usually find it desirable to determine individually the lime requirements of his different fields. Circular 346 of this Station, "Test Your Soil for Acidity," should be read in this connection.

#### Character of Chemical Combination Related to Availability

It has been seen that a given plant-food element exists in the soil in various forms, or chemical combinations. Thus the soil phosphorus is partly organic and partly in several different inorganic or mineral combinations. These differ from each other in the rates at which they become available to growing crops, and also soil conditions differ in permitting them to become available. Again, calcium has been observed to be present sometimes as *calcium carbonate*, which is quickly available in the soil, but in many soils calcium is more abundant as *replaceable calcium*, a form which is less active but yet more or less available; or it may exist also as *calcium-alumino-silicate* minerals which are decomposed very slowly. Statements of similar import might be made concerning nitrogen, sulfur, and other elements. Moreover, the proportions in which the different forms of a given element occur vary in different soils.

In the light of these facts, it becomes apparent that a knowledge of merely the total amounts of these various elements present in a soil cannot be a very definite guide as to the need for their applications in the forms of fertilizers.

### Service of Chemical Investigations in Soil Improvement

The chemical investigations carried out in connection with the soil survey, of which the analyses here reported are a part, are of value chiefly in two ways. In the first place, they reveal at once outstanding deficiencies or other chemical characteristics which alone would affect soil productivity to a marked extent, or point the way to corrective measures. It should be borne in mind, however, that fairly wide departures from the usual composition are necessary before the chemical analysis alone can be followed as a guide in practice without supplementary information from other sources. It is probable that the results of chemical soil analyses are frequently misused by attempting to interpret small differences in the amount of a certain plant-food element as indicative of similar differences in the fertilizer need. For example, differences of 100 or 200 pounds of phosphorus per acre in soils containing 1,000 pounds or thereabout in the surface soil should not be considered as indicating a corresponding difference in response to phosphate fertilization. Again, 100 pounds to the acre of active nitrogen added by plowing down a clover crop may be of more importance to the succeeding crop than a difference in soil composition of 1,000 pounds an acre of nitrogen. An example of the direct use of the results of chemical investigations is the discovery of the marked shortage of potassium in peat soils and consequently the need for potassium fertilizers.

The second use of chemical methods is in the more detailed study of soils. The processes of soil development leave their imprint upon the soil both in its physical conformation and also in its chemical characteristics. Likewise every operation in the handling of the soil and every application of fertilizer or liming material disturbs its equilibrium, setting up new reactions, which are in turn reflected in variations in crop adaptability, producing capacity, and agricultural usefulness. Chemistry is a most important tool in tracing and characterizing such changes, and chemical investigations are undertaken with the aim of aiding not only in the classification of soils but also in making possible more accurate prediction of their agricultural value, fertility needs, and response to different methods of management.

### FIELD EXPERIMENTS ON SOIL TYPES SIMILAR TO THOSE IN FAYETTE COUNTY

The University of Illinois has conducted altogether about fifty soil experiment fields in different sections of the state and on various soil types. Altho some of these fields have been discontinued, many of them are still in operation. It is the present purpose to report the results from certain of these fields located on soil types described in the accompanying soil report. For further discussion of these fields reference is made to Bulletin 362, "Response of Illinois Soils to Systems of Soil Treatment," and Bulletin 370, "Crop Yields From Soil Experiment Fields in 1930."

A few general explanations at this point, which apply to all the fields, will relieve the necessity of numerous repetitions in the following pages.

**Size and Arrangement of Fields.** The soil experiment fields vary in size from less than two acres up to forty acres or more. They are laid off in series

of plots, the plots commonly being either one-fifth or one-tenth acre in area. Each series is occupied by one kind of crop. Usually there are several series so that a crop rotation can be carried on with each crop represented every year.

**Farming Systems.** On most of the fields the treatment provides for two distinct systems of farming, livestock farming and grain farming.

*In the livestock system,* stable manure is used to furnish organic matter and nitrogen. The amount applied to a plot is based upon the amount that can be produced from crops raised on that plot.

*In the grain system* no animal manure is used. The organic matter and nitrogen are applied in the form of plant manures, including the plant residues produced, such as cornstalks, straw from wheat, oats, clover, etc., along with leguminous catch crops plowed under. It was the plan in this latter system to remove from the land, in the main, only the grain and seed produced, except in the case of alfalfa, that crop being harvested for hay the same as in the livestock system but certain modifications have been introduced in recent years, as explained in the descriptions of the respective fields.

**Crop Rotations.** Crops which are of interest in the respective localities are grown in definite rotations. The most common rotation used is wheat, corn, oats, and clover; and often these crops are accompanied by alfalfa growing on a fifth series. In the grain system a legume catch crop, usually sweet clover, is included, which is seeded in the young wheat in the spring and plowed under in the following spring in preparation for corn. If the red clover crop fails, soybeans are substituted.

**Soil Treatment.** The treatment applied to the plots at the beginning was usually standardized according to a rather definite system. With advancing experience, however, new problems arose calling for new experiments, so that on most of the fields plots have been divided and a portion given over to new systems of treatment, at the same time maintaining the original system essentially unchanged from the beginning.

Following is a brief explanation of this standard system of treatment.

*Animal Manures.*—Animal manures, consisting of excreta from animals, with stable litter, are spread upon the respective plots in amounts proportionate to previous crop yields, the applications being made in the preparation for corn.

*Plant Manures.*—Crop residues produced on the land, such as stalks, straw, and chaff, are returned to the soil, and in addition a green-manure crop of sweet clover is seeded in small grains to be plowed under in preparation for corn. (On plots where limestone is lacking the sweet clover seldom survives.) This practice is designated as the *residues system*.

*Mineral Manures.*—Limestone has usually been applied at the rate of 4 tons an acre as an initial application, and 2 tons an acre every four years thereafter until a considerable excess has accumulated in the soil. Rock phosphate has been applied at the rate of one ton an acre at the beginning, followed by an annual acre-rate of 500 pounds applied once in the rotation until a considerable excess has accumulated. Potassium has been applied usually in the form of 200 pounds of kainit a year. When kainit was not available, owing to conditions brought on by the World War, potassium carbonate was used.

**Explanation of Symbols Used.** In the presentation of the data much use is made of the following symbols:

- 0 = Untreated land or check plots
- M = Manure (animal)
- R = Residues (from crops, and includes legumes used as green manure)
- L = Limestone
- P = Phosphorus, in the form of rock phosphate unless otherwise designated, (sP = superphosphate, bP = bone meal, rP = rock phosphate, slP = slag phosphate)
- K = Potassium (usually in the form of kainit)
- () = Parentheses enclosing figures, signifying tons of hay, as distinguished from bushels of seed

#### ODIN FIELD

The Odin soil experiment field, located in Marion county near Odin, is one of the oldest of the outlying University experiment fields. It was established in 1902. Gray Silt Loam On Tight Clay, of which more than 150 square miles are mapped in Fayette county, is the prevailing type on the Odin field, and the system of plots made up of Series 100 to 400 lies almost wholly on this soil type.

These series are divided into two sections differing from each other with respect to underdrainage. Plots 6 to 10 inclusive are provided with a system of tile, while the corresponding plots numbering 1 to 5 inclusive are not tiled. During the period from 1907 to 1919 the northeast half of each plot was subjected to subsoil plowing in preparing the land for corn.

The rotation chiefly practiced on these series has been corn, legumes (cowpeas or soybeans), wheat, and clover. Until 1922 the clover was alsike, soybeans being substituted if the clover failed. Since that time sweet clover has been used instead of alsike. A part of the time cowpeas were seeded in the corn at the last cultivation.

Crop residues and cover crops have been regularly plowed down on the residues plots. The return of the wheat straw was discontinued in 1922.

In 1902 slaked lime, at the rate of 475 pounds an acre, was applied to the limed plots, and in 1903 an additional 2 tons was applied to these plots. No more lime was added until 1908, after which it was applied regularly at the annual rate of 500 pounds of limestone an acre to the northwest halves and 1,000 pounds an acre to the southeast halves. In 1922 these applications were temporarily discontinued until further need for lime should appear.

Phosphorus has been used in the form of steamed bone meal and applied at the rate of 200 pounds an acre a year until 1923, when the total amount of bone meal was evened up on all the phosphorus plots to 4,800 pounds an acre and the application temporarily discontinued. Potassium was applied at the annual rate of 100 pounds an acre of potassium sulfate until 1923. At that time enough potassium was applied to each of the potassium plots to even up the total application to 2,500 pounds. Since 1923 the usual application (100 pounds an acre a year) has been made to the southwest halves of these plots, and no potassium has been applied to the other halves.

Table 5 summarizes the crop yields for the time since the plots have been under their full fertilizer treatments. The results from the tiled land and from the land not tiled are shown separately.

The natural productiveness of this land can be judged by the value of the crops produced. The untreated land for the four-year rotation ending in 1930

TABLE 5.—ODIN FIELD: SERIES 100, 200, 300, and 400, SUMMARY OF CROP YIELDS  
Average annual yields 1903-1930—bushels per acre

Serial plot No.	Soil treatment	Corn 28 crops	Soy-beans <sup>1</sup> 32 crops	Wheat 27 crops	Oats 2 crops	Alsike clover 5 crops	Sweet clover 8 crops	Sweet clover- redtop 1 crop	
								Sweet clover	Red- top
Land not tile-drained									
1	O.....	20.3	7.9	9.1	5.9	.12	.06	0	2.31
2	R.....	21.4	8.8	9.2	8.9	.31	.07	0	3.41
3	RL.....	24.9	10.3	18.0	14.8	.40	1.58	.19	4.50
4	RLbP.....	24.8	10.1	23.1	15.1	.40	1.19	.21	3.37
5	RLbPK.....	39.8	14.2	25.9	17.0	.62	2.39	.25	5.14
	Average.....	26.2	10.3	17.1	12.3	.37	1.06	.13	3.71
Land tile-drained									
6	O.....	15.8	6.4	7.0	6.3	.26	0	0	1.46
7	R.....	19.9	7.9	10.1	11.0	.37	.20	.27	2.91
8	RL.....	25.2	10.3	18.4	27.0	.72	1.54	.10	3.53
9	RLbP.....	26.8	10.8	24.7	30.4	.69	1.40	.03	4.06
10	RLbPK.....	37.4	14.1	26.2	28.4	.66	2.22	.29	3.94
	Average.....	25.0	9.9	17.3	20.6	.54	1.07	.14	3.18

<sup>1</sup>Twenty-six crops of soybeans and 6 crops of cowpeas, some hay and some seed, all combined and evaluated as soybeans.

produced crops estimated to have been worth \$4.74 an acre a year at the prices then current.

No stable manure is used in these experiments, organic matter being supplied by plowing down crop residues and legumes used as green manure. Without the aid of limestone, however, this residues treatment has had little effect. Resi-



FIG. 8.—WHEAT ON THE ODIN FIELD

At the left is a check plot, receiving no soil treatment, where the average yield of wheat for 27 crops has been 8.1 bushels an acre. At the right, thru the use of limestone and crop residues, this yield was more than doubled. By adding bone meal to this treatment, another increase was produced, bringing the yield up to 23.9 bushels.

dues with limestone have produced notable increases in yields, amounting in money value during the last crop rotation to an average of \$5.60 an acre a year.

The phosphorus in these experiments has always been supplied in the form of bone meal. Wheat shows a marked benefit from phosphorus, about 5 bushels an acre increase, but the response by the other crops has been so low on the whole as to render unprofitable the use of this material. It is possible that a lack of potassium is a limiting factor here.

Potassium has proved rather generally beneficial, especially for corn, where the increase from its use has averaged more than 10 bushels an acre annually.

So far as these fertility tests show, the results on the whole point to the necessity of using limestone with organic manures in improving this soil. The organic manure has been supplied in these experiments by crop residues and legumes, but on the farm all available stable manure should be utilized. After building up the soil with limestone and organic matter, the use of a potassium fertilizer should be given consideration, especially in the absence of animal manure.

### Results of Tile-Drainage Experiments

A large problem in the cultivation of this soil is its poor physical condition. Therefore, the results of the tiling and subsoiling should be of much interest. As already explained, each soil treatment in the above series is duplicated on tilled and untilled land. In order to measure the effect of the tiling, the yields of all plots for each kind of crop are averaged for the tilled and untilled land respectively in the results shown in Table 5.

Compared in this manner it is found that oats are the only crop that shows any marked response to tiling, the yield being increased about 67 percent. Considering the fact, however, that oats even at their best are not an important crop on this soil, tiling cannot be said to have solved the drainage problem for this land.

### Experiments in Subsoiling

In order to learn whether something could be done by subsoil plowing to overcome the unfavorable subsoil condition in this kind of land, an experiment was started in 1907 and continued for thirteen years. In this experiment one-half of each plot in the above series in both tilled and untilled sections was plowed and subsoiled, with a few exceptions, in the late fall. The effect on crop yields was measured only in the corn, this crop being harvested by half-plots. The yields are given in Table 6, the figures representing the general averages for the entire thirteen-year period for corresponding tilled and untilled plots.

The results show only insignificant differences in yield between subsoiled

TABLE 6.—ODIN FIELD: EXPERIMENTS IN SUBSOILING  
Yields of corn in bushels per acre

	None	Residues	Residues limestone	Residues limestone phosphorus	Residues limestone phosphorus potassium
Subsoiled.....	17.7	20.0	24.3	26.3	38.4
Not subsoiled.....	19.9	22.3	24.7	25.0	41.3

plots and plots not subsoiled. Indeed these differences are so small that they may be regarded as being within the experimental error, and the only conclusion warranted is that the expensive practice of subsoiling has produced no significant effect upon the yield of corn in this investigation.

For a more detailed account of this experiment in subsoiling, the reader is referred to Bulletin 258 of this Station, "Experiments with Subsoiling, Deep Tilling, and Subsoil Dynamiting."

#### NEWTON FIELD

A 30-acre experiment field has been maintained by the University at Newton in Jasper county since 1912. The soil type has been mapped as Gray Silt Loam On Tight Clay, tho the field is not altogether uniform, as is shown by variations in the crop yields. The land is almost level. A system of tile was installed, but owing to the impervious nature of the subsoil the tile did not materially improve the drainage until the scheme was devised of using the tiles as sewers to carry away the surplus water conducted to them thru a system of ditches and catch basins.

The field is laid off into twelve series of plots and these series now make up three separate combinations, or plot systems. Only one of these combinations, consisting of Series 100 to 400, will be considered here. On these four series a rotation of corn, mixed hay, wheat, and oats is at present being practiced. Soybeans were formerly grown instead of mixed hay. Cowpeas have been seeded in the corn and sweet clover in the wheat as catch crops to help supply organic matter and nitrogen on the residues plots. In 1920 the use of the cowpea crop was discontinued, as was also the return of wheat straw in 1922.

The limestone used on these series has been of the dolomitic form ground sufficiently fine to pass a 10-mesh sieve. The usual large initial amount of limestone was not applied here. Up to 1922 the different series had received 5 to 6 tons an acre, when the regular applications were suspended until further need for lime should become apparent.

Table 7 gives a summary of the crop yields obtained, including the years that the various complete soil treatments have been in effect.

TABLE 7.—NEWTON FIELD: SERIES 100, 200, 300, 400, SUMMARY OF CROP YIELDS  
Average annual yields 1913-1930—bushels or (tons) per acre

Serial plot No.	Soil treatment	Corn	Soybeans	Wheat	Oats	Mixed hay	Stubble clover
		<i>23 crops</i>	<i>17 crops</i>	<i>19 crops</i>	<i>4 crops</i>	<i>4 crops</i>	<i>2 crops</i>
1	0.....	9.6	(.61)	.8	9.3	(.56)	(0)
2	M.....	15.2	(.83)	1.9	19.8	(.74)	(0)
3	ML.....	25.6	(1.17)	12.0	28.4	(1.45)	(.59)
4	MLP.....	25.1	(1.25)	16.8	30.2	(1.87)	(.88)
5	0.....	10.0	(.58)	1.6	12.3	(.51)	(0)
6	R.....	10.0	(.55)	1.8	12.9	(.56)	(0)
7	RL.....	16.4	(.90)	9.1	24.4	(1.23)	(.34)
8	RLP.....	16.6	(.99)	14.9	26.3	(1.42)	(.52)
9	RLPK.....	21.7	(1.10)	19.3	24.6	(1.82)	(.83)
10	0.....	6.8	(.54)	.9	11.3	(.66)	(0)

The results of these experiments are characteristic of those of other fields located on this soil type. They demonstrate once more the absolute necessity of liming as the foundation for soil improvement. Without lime, legumes fail completely and the use of manure alone is practically ineffective. Phosphorus in combination with lime and organic manure has, as usual, materially benefited the wheat but, in the manner used in these experiments, the rock phosphate has not paid for itself. Increases in the yields of all crops excepting oats have followed the use of a potassium fertilizer; the money value of this increase is now sufficient to return some profit on the investment.

Altho the above results show very large percentage increases for proper soil treatment, particularly for liming, yet with the best yields obtained the total production is not very high. The rather simple cropping system serves the purpose of bringing out the possibilities of improving this soil; more profitable systems of farming, in which other products are included in the farm output, can doubtless be developed by thoughtful planning.

#### EWING FIELD

As representing the soil type Gray Silt Loam On Orange-Mottled Tight Clay, experimental results from a portion of the Ewing field are presented.

The Ewing field is located in Franklin county about a mile northeast of Ewing. It was established in 1910. This land is nearly level, the drainage is very poor, and the soil is strongly acid. Series 100 to 400 constitute a plot system farmed under a rotation of wheat, corn, oats, and clover, but as Series 300 and 400 lie mainly on another soil type results from them will not enter into the present discussion.

The handling of the crops and the soil treatments have been in the main according to the somewhat standard plan described on pages 33 to 35. Until 1920 cowpeas were seeded in the corn as a catch crop on the residues plots. From 1921 to 1925 sweet clover served as the regular legume crop, but since that time a mixture of clover, alfalfa, and timothy has been used. In 1922 the limestone applications were discontinued after they had reached a total of  $8\frac{1}{2}$  to 10 tons an acre on the different series. No more limestone will be applied until the need for it appears. The return of the wheat straw as a residue was also discontinued at that time. In 1923 the total rock phosphate applications were evened up on all phosphorus plots to 8,500 pounds an acre, and no more will be applied for an indefinite period.

A summary of the results from these two series for the years the plots have been under their complete treatments is presented in Table 8.

The extremely poor yields on the untreated land are characteristic of this soil. About 2 bushels of wheat an acre has been the average production on the check plots. The use of manure alone has increased the crop yields somewhat, but not sufficiently to put this kind of farming on a profitable basis. Residues alone are practically without effect.

Limestone used either with manure or with residues has produced a very decided increase in yields, the large increase with residues being due mainly to the successful growth of legumes following the application of limestone.

TABLE 8.—EWING FIELD: SERIES 100 AND 200, SUMMARY OF CROP YIELDS  
Average annual yields 1911-1930—bushels or (tons) per acre

Serial plot No.	Soil treatment	Corn	Oats	Wheat	Clover	Sweet clover	Mixed hay	Soy-beans
		10 crops	10 crops	9 crops	1 crop	2 crops	2 crops	4 crops
1	0.....	12.9	8.4	2.1	(.20)	0	(.31)	(.46)
2	M.....	27.1	14.2	5.2	(.24)	0	(.39)	(.54)
3	ML.....	49.6	30.6	17.9	(.40)	2.23	(1.64)	(1.08)
4	MLP.....	50.1	32.8	22.9	(.81)	2.25	(2.06)	(1.23)
5	0.....	12.2	9.0	2.0	0	0	(.40)	(.34)
6	R.....	12.3	9.2	1.8	0	0	(.48)	(.36)
7	RL.....	29.8	27.0	17.2	.50	2.46	(1.36)	(.86)
8	RLP.....	27.6	27.9	19.5	1.08	2.07	(1.33)	(.93)
9	RLPK.....	47.6	35.4	28.0	.75	2.09	(1.80)	(1.11)
10	0.....	16.7	9.9	3.3	(0)	0	(.45)	(.56)

The returns from rock phosphate used either with manure and limestone or with residues and limestone have not been sufficient to cover the cost of material.

Potassium fertilizer as used in these experiments has had a very beneficial effect on all the grain crops. In fact, within the last few years the corn crop under the residues system has evidenced acute need for potassium. Thus the average yield of corn for the last three crops grown on these series has been, under the lime, residues, and phosphorus treatment 12.2 bushels an acre, while on the adjoining plot where potassium is included in the treatment the yield has been 50.6 bushels an acre. One year the yield without potassium was 5 bushels an acre while with potassium it was 52.3 bushels.

Taking into account the cost of materials, it would appear that the manure-limestone combination has been the most efficient treatment on the Ewing field. But unfortunately manure is not abundant. The next-best system is the residues, limestone, phosphate, potash combination. The recommendation for improving land of this type is therefore to apply limestone, use all available farm manure, plow under sweet clover, and return unused crop residues to the soil. Then to this basal program, add potassium and phosphorus as the need for these materials develops.

#### RALEIGH FIELD

As representing the soil type Yellow-Gray Silt Loam On Tight Clay, the results from a portion of the University experiment field located at Raleigh in Saline county are presented here. Series 200 and 300, which lie on this soil type, form a part of a plot system kept under a crop rotation of wheat, corn, oats, and clover. When clover fails, soybeans are substituted.

The general management and soil treatments are as described on pages 33 to 35. In 1922 the practice of returning the wheat straw in the residues system was discontinued. In the same year the regular applications of limestone were suspended until such time as lime might again appear to be needed. In 1923 the rock phosphate was evened up on all phosphate plots to a total application of  $4\frac{1}{4}$  tons an acre, and the applications were discontinued for an indefinite period. The results in terms of average annual yields of the respective kinds of crops are summarized in Table 9.

TABLE 9.—RALEIGH FIELD: SERIES 200 AND 300, SUMMARY OF CROP YIELDS  
Average annual yields 1911-1930—bushels or (tons) per acre

Serial plot No.	Soil treatment	Wheat	Corn	Oats	Clover <sup>1</sup>	Soy-beans
		5 crops	10 crops	11 crops	3 crops	6 crops
1	0.....	2.2	11.4	11.1	(.09)	4.8
2	M.....	4.5	23.4	15.9	(.04)	8.3
3	ML.....	12.8	40.0	25.6	(.79)	12.9
4	MLP.....	14.6	41.9	25.5	(.81)	14.2
5	0.....	2.6	12.1	10.1	( 0 )	4.6
6	R.....	3.9	16.4	12.9	( 0 )	5.1
7	RL.....	10.0	34.8	23.2	(.28)	10.0
8	RLP.....	11.5	40.0	26.1	(.35)	11.2
9	RLPK.....	14.5	47.3	26.4	(.86)	12.1
10	0.....	4.5	19.7	13.7	(.04)	8.3

<sup>1</sup>One crop red clover and two crops alfalfa-clover-timothy mixture.

A study of these data brings out the following comments concerning the effects of the various treatments on the Raleigh field:

1. The untreated plots are conspicuous in their low yields. The average yield of wheat on untreated land is 3.1 bushels an acre.

2. All the different kinds of grain crops show some response to the application of stable manure, altho the beneficial effect is not sufficient to make farming profitable.

3. Crop residues used alone have been of very little effect.



FIG. 9.—CORN ON THE RALEIGH FIELD

At the right no treatment has been applied; at the left, limestone, and phosphate have been applied, the major effect being produced by the limestone and manure.

4. Limestone, in combination either with manure or with crop residues, stands out as the most prominent agency in soil improvement.

5. The application of rock phosphate has had little effect, so that on the whole the use of this material in the manner of these experiments has been attended by a financial loss.

6. Potassium in the form of kainit has increased the yields of all crops, particularly those of corn, wheat, and clover. At current prices the value of the increase is just about offset by the cost of the kainit applied.

Regarding the cropping system employed on this field, it may be said that altho it serves for experimental purposes in determining the needs of the soil, for farming practice it doubtless could be improved either by substituting a more profitable crop for the oats or by rearranging the crop sequence and omitting the oats.

#### ENFIELD FIELD

As representing the soil type Yellow-Gray Silt Loam On Compact Medium-Plastic Clay, results from experiments on certain plots of the Enfield field are introduced. This field is located in White county about a mile east of Enfield and has been in operation since 1912. The somewhat standard rotation and soil-treatment methods described on pages 33 to 35 were established on Series 100, 200, 300, and 400. In addition cowpeas or soybeans were seeded in the corn at the last cultivation for use as residues on the residues plots. These methods were followed until 1920, when the use of the peas and beans was discontinued. In 1922 the use of limestone was discontinued until the need for it should become apparent. The return of wheat straw was also discontinued at that time. In 1923 the phosphate applications were evened up to 4 tons an acre, and no more will be applied for an indefinite period.

On account of some variation in soil type, only Series 100 will be considered for the present purpose.

The crops grown have been wheat, corn, oats, soybeans, sweet clover, and mixed hay. The average annual yields for the various soil treatments are given in Table 10.

TABLE 10.—ENFIELD FIELD: SERIES 100, SUMMARY OF CROP YIELDS  
Average annual yields 1915-1930—bushels or (tons) per acre

Serial plot No.	Soil treatment	Wheat	Corn	Oats	Soybeans	Sweet clover	Mixed hay
		<i>4 crops</i>	<i>4 crops</i>	<i>4 crops</i>	<i>1 crop</i>	<i>1 crop</i>	<i>2 crops</i>
1	O.....	4.8	13.8	11.8	(.99)	0	(.07)
2	M.....	8.0	25.6	18.2	(1.14)	0	(.45)
3	ML.....	16.1	33.9	33.6	(1.62)	.75	(2.01)
4	MLP.....	20.5	36.1	34.7	(1.96)	.75	(2.23)
5	O.....	7.4	14.6	10.8	(.50)	0	(.27)
6	R.....	8.0	18.6	10.7	(.50)	0	(.22)
7	RL.....	18.7	28.5	28.7	(1.35)	.50	(1.55)
8	RLP.....	21.6	30.7	32.5	(1.56)	.58	(1.75)
9	RLPK.....	26.3	39.0	39.0	(1.50)	.67	(2.23)
10	O.....	9.7	20.8	12.0	(1.22)	0	(.30)

According to these data there is considerable response to stable manure even where used alone. There is, however, very little response to residues where used without supplementary treatment. Limestone is highly effective used either with manure or with residues.

Rock phosphate has produced some increases in nearly all crops in both manure and residues systems, but these gains are scarcely sufficient in either system to render the use of this material remunerative. Kainit has made a fairly good record, particularly in the corn and hay yields. The response to kainit has been increasing in these later years of the experiments.

#### CARLINVILLE FIELD

The major series of plots on the Carlinville experiment field located in Macoupin county near Carlinville may be taken to represent the soil type Brown-Gray Silt Loam On Tight Clay. Altho a careful examination reveals the presence of two other soil types, these are so similar in their general characteristics to Brown-Gray Silt Loam On Tight Clay that experimental results should not be materially affected.

The soil treatments and cropping practices on Series 100 to 400, which constitute the major series, have, with a few modifications, conformed to the general plan described on page 33. In the earlier years a rotation of corn, oats, clover or soybeans, and wheat was practiced, but in 1924 this rotation was changed to corn, oats with Hubam clover seeding, wheat, and hay. This hay is a mixture of clover and alfalfa, the last growth of which is plowed down as a green manure on the residues plots. In 1921 the return of oat straw was discontinued. The following year the return of wheat straw was also discontinued. The regular application of limestone was discontinued in 1923 after 8½ to 10 tons an acre had been applied to these plots. Rock phosphate was also discontinued after adding enough to each phosphate plot to make the total amount applied 4 tons an acre. In 1930 the phosphate applications were resumed by adding 400 pounds an acre to the wheat ground.

TABLE 11.—CARLINVILLE FIELD: SERIES 100, 200, 300, AND 400,  
SUMMARY OF CROP YIELDS  
Average annual yields 1911-1930—bushels or (tons) per acre

Serial plot No.	Soil treatment	Corn	Oats	Wheat	Clover <sup>1</sup>	Clover-alfalfa	Sweet clover <sup>2</sup>	Soy-beans <sup>2</sup>
		20 crops	21 crops	15 crops	4 crops	5 crops	4 crops	4 crops
1	0.....	28.5	30.9	16.8	(1.68)	(1.35)	1.23	15.8
2	M.....	39.0	40.6	22.3	(2.15)	(1.89)	1.41	18.3
3	ML.....	47.5	47.5	29.0	(2.66)	(3.68)	1.90	21.4
4	MLP.....	48.2	47.2	29.5	(2.32)	(4.18)	2.05	21.5
5	0.....	30.5	33.8	19.1	(1.80)	(1.85)	2.71	16.3
6	R.....	34.3	36.3	18.1	(1.82)	(1.83)	2.49	17.6
7	RL.....	42.0	44.9	25.3	(2.29)	(3.03)	2.51	22.8
8	RLP.....	44.7	45.8	28.1	(2.35)	(3.48)	2.03	23.9
9	RLPK.....	49.4	46.0	28.8	(2.22)	(3.94)	1.88	23.0
10	0.....	32.0	34.0	16.5	(1.59)	(1.86)	1.59	15.8

<sup>1</sup>Some seed evaluated as hay. <sup>2</sup>Some hay evaluated as seed.

Table 11 gives the average annual yields of the several kinds of crops for the years since the complete soil treatments have been in effect.

Looking over these data one may observe first the rather moderate productiveness of the untreated land as indicated by the yields on the check plots. Twenty crops of corn, for example, have yielded on the average about 30 bushels an acre, and the average production of wheat was around 17 bushels. The average acre-value of all crops produced in the last rotation period ending in 1930 was \$17.71 an acre a year (see Bulletin 370).

The value of animal manure on this land is well demonstrated in the increases in yields on the manure plots. Used alone, this material has produced during the last rotation increases in crop yields worth \$6.29 an acre a year.

Crop residues without supplementary treatment have been practically without effect. Thirty-eight cents represents the value of the increases ascribed to the residues treatment and this does not cover the cost, which is estimated at 75 cents an acre.

Limestone has been used with pronounced effect both in the livestock and the grain systems. All crops show more or less benefit from its use. The money value of the additional yields for the last rotation period amounts to \$8.85 as used with manure and \$7.13 as used with crop residues.

Rock phosphate, as applied in these experiments, has not been profitable. The small gains in yield, as measured by acre-value of crop increase, are scarcely significant. In fact, these values, \$1.77 and \$1.76 in the livestock and grain systems respectively, are too small to cover the expense of application with the cost of rock phosphate figured at \$15 a ton.

Potash has been used only in combination with residues, limestone, and rock phosphate. In the earlier years of the experiments there was little response to the potassium treatment and the kainit used as the potassium fertilizer was applied at a financial loss. But as the work progressed, a need for potassium gradually developed, so that during the last rotation period kainit not only returned its cost but also some profit. This behavior with respect to an increasing potassium requirement is in accordance with experience on several of the experiment fields. The beneficial effect appears mainly in the improved corn crops.

The most profitable of the eight different treatment systems compared, as measured by the effects produced during the last crop rotation, have been manure with limestone as a livestock system and residues with limestone as a grain system. Taking into account cost of treatment, the former has produced crop increases having a net value of \$11.57 an acre a year; the latter, \$5.94 an acre a year.

It should be remembered in this connection that response to soil-treatment systems is subject to change as time goes on, so that in the future other treatment systems may supplant those of the present as being most profitable.

## Soil Reports Published

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24 Adams, 1922	50 Macoupin, 1931
25 Livingston, 1923	51 Fulton, 1931
26 Grundy, 1924	52 Fayette, 1932



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