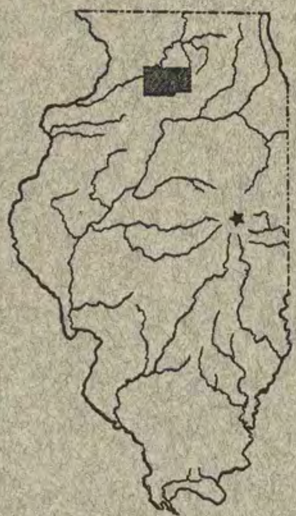
UNIVERSITY OF ILLINOIS

Agricultural Experiment Station

SOIL REPORT No. 37

LEE COUNTY SOILS

By R. S. SMITH, O. I. ELLIS, E. E. DeTURK, F. C. BAUER, and L. H. SMITH



URBANA, ILLINOIS, JUNE, 1927

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.

* Engaged in Soils Extension as well as in Soil Experiment Fields.

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. There is presented in the form of an Appendix a general discussion of the important principles of soil fertility, in order to help the farmer and landowner to understand the significance of the data furnished by the soil survey and to make intelligent application of the same in the maintenance and improvement of the land. In many cases it will be of advantage to study the Appendix in advance of the soil report proper.

Data from experiment fields representing the more extensive types of soil, and furnishing valuable information regarding effective practices in soil management, are embodied in the form of a Supplement. This Supplement should be referred to in connection with the descriptions of the respective soil types found in the body of the report.

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. In this connection special recognition is due the late Professor J. G. Mosier, under whose direction the soil survey of Lee county was conducted.

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SUPPLEMENT

LEE COUNTY SOILS

By R. S. SMITH, O. I. ELLIS, E. E. DeTURK, F. C. BAUER, and L. H. SMITH[1]

LOCATION AND CLIMATE OF LEE COUNTY

Lee county is located in the northwestern part of Illinois. Dixon, the county seat, is about 100 miles west of Chicago. Lee county is of average size, consisting approximately of 723 square miles, two-thirds of which is in the upland.

The climate of Lee county is typical of the general region in which it lies. It is characterized by a wide range between the extremes of winter and summer, and by the abundant, well-distributed rainfall. The greatest range in temperature in any one year from 1892 to 1924 was 126 degrees in 1905. The highest temperature recorded was 108° in 1901; the lowest, 26° below zero in 1905. The average date of the last killing frost in spring is April 28; the earliest in fall is October 11. The average length of the growing season, therefore, is 165 days.

The average rainfall as recorded at Dixon from 1892 to 1924 was 32.29 inches. The average rainfall by months for this period was as follows: January, 1.61 inches; February, 1.35; March, 2.64; April, 2.57; May, 4.31; June, 3.70; July, 3.82; August, 3.29; September, 3.56; October, 2.37; November, 1.62; December, 1.45.

AGRICULTURAL PRODUCTION

Grain, livestock, dairying, and mixed grain and livestock farming characterize the agriculture of the county. The mixed system of farming is most extensively practiced. In this system the chief sources of income are dairy products, beef cattle, and hogs, with a supplementary income from the sale of surplus grain and hay.

The livestock industry has been increasing in importance during the past few years, particularly in the corn-belt section in the eastern part of the county. A contributing cause for this is the danger of injury to the corn from early frosts. It apparently is more profitable to feed the crop than it is to attempt to harvest and sell the grain. The dairy industry is predominant near the towns of Dixon, Amboy, Nachusa, and Harmon. Very few creameries have been constructed in the farming communities. The milk is hauled to the central condensing plants. In the extreme eastern and southeastern parts of the county grain farming is followed. In the section south and west of Amboy, known as the Green river swamp, diversified grain farming and mixed livestock feeding are the chief systems. Often on a single farm, corn, oats, wheat, rye, and barley are grown. Alfalfa, sweet clover, and red clover give good returns, altho it is necessary to apply limestone on most of the soils to insure a good catch of the legumes.

Since the acreage of rough and broken land is not large, a very small percentage of natural grazing land occurs. In some cases, the rough and broken land is partially utilized for cultivated crops, thus further reducing the acreage

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which might well be used for pasture. Fruit and vegetables are grown only for home consumption.

According to the Fourteenth Census of the United States, there were 2,593 farms in the county in 1919. The average size was 167 acres, 151.5 of which were improved. The following table shows the acreage and yield of the more important crops for the year 1919, as given by the above-mentioned Census.

Crops	*Acreage*	*Production*	*Yield per acre*
Corn	141,639	5,412,822 bu.	38.2 bu.
Oats	86,921	2,554,104 bu.	29.3 bu.
Wheat	26,391	503,293 bu.	19.1 bu.
Rye	11,887	167,743 bu.	14.1 bu.
Barley	7,609	179,806 bu.	23.6 bu.
Timothy	37,346	53,906 tons	1.44 tons
Timothy and clover	11,582	14,360 tons	1.23 tons
Clover	22,111	32,753 tons	1.48 tons
Alfalfa	2,672	4,515 tons	1.72 tons
Silage crops	7,058	56,192 tons	7.94 tons
Corn for forage	6,501	16,989 tons	2.59 tons

It should be borne in mind that the above figures represent the yields of only a single season.

The U. S. Department of Agriculture furnishes the following acre-yields for the ten-year period 1911-1920: corn, 41.0 bushels; oats, 42.3 bushels; tame hay, 1.3 tons; winter wheat, 20.4 bushels. Thus it appears that the census year, 1919, was an unfavorable one for corn and oats.

The following figures taken from the 1920 Census show the character of the livestock interests in Lee county. The total value of livestock was $7,434,370 in 1919.

Animals and Animal Products	*Number*	*Value*
Horses	18,959	$1,793,915
Mules	559	62,004
Beef cattle	29,145	1,963,830
Dairy cattle	21,493	1,659,640
Swine	61,034	1,461,841
Sheep	11,512	160,507
Poultry	319,522	334,633
Eggs and chickens	....	430,219
Dairy products	....	1,111,160

Rock and acid phosphate, mixed fertilizers, and limestone have been used rather extensively thruout the county. The use of limestone has increased rapidly during the past few years.

SOIL FORMATION

GLACIATION

One of the most important periods in the geological history of the county, from the standpoint of soil formation, was the Glacial period, during which and immediately following, the material that later formed the mineral portion of the soils was being deposited. At that time, snow and ice accumulated in the region of Labrador and to the west of Hudson Bay to such an amount that the mass pushed outward from these centers, chiefly southward, until a point was reached where the ice melted as rapidly as it advanced. In moving across the country from the far north, the ice gathered up all sorts and sizes of material, including clay, silt, sand, gravel, boulders, and even immense masses of rock. Some of these materials were carried for hundreds of miles and rubbed against surface rocks and against each other until largely ground into powder. When the limit of advance of the ice sheet was reached, the rock material carried by the ice accumulated along the front of the glacier in a broad, undulating ridge or moraine. When the ice melted more rapidly than the glacier advanced, the terminus of the glacier receded, and the material was deposited somewhat irregularly over the area previously covered. The mixture of materials deposited by the glacier is known as boulder clay, till, glacial drift, or simply drift. The average depth of this deposit over the state of Illinois is estimated as 115 feet.

Lee county is situated in a region of vigorous glacial and stream action. The bed rock is buried so deeply over most of the county that it has no influence on the character of the soil. An exception is found in the northwest corner of the county, west of Rock river, where the thickness of the glacial drift does not exceed three feet over much of the area. Relatively shallow drift also occurs to the north of Franklin Grove and Ashton.

At least two, and possibly three, glaciers advanced across the area now included in Lee county. The first of these was the Illinoisan, which covered the entire county. A sufficiently long period of time elapsed after the retreat of the Illinoisan ice sheet for a thick soil to be formed before the next glacial invasion. This soil is known as the Sangamon soil. It was buried by the next glacier, regarding the identity of which there is considerable question. Some believe it was the Iowan, as indicated on the accompanying soil map; some that it was a lobe of the Illinoisan. Following the retreat of this glacier or ice lobe, as the case may be, the third and last ice invasion took place. This last invasion is known as the early Wisconsin. It covered about one-half of the county and during its advances and retreats it constructed numerous moraines, two of which cross the eastern and southeastern parts of Lee county in a northeast-southwest direction. The main morainal ridge which closely follows the outer border of the swamp region of Lee and Bureau counties is known as the outer belt of the Bloomington moraine. This ridge is from 75 to 100 feet higher than the adjacent flat areas to the north and west. The inner ridge crosses the southeast corner of the county.

CHANGES IN THE RIVER SYSTEMS

The extensive swamp and sand areas in Lee county, together with other features, indicate that there have been great changes in the river systems in this region since Preglacial times. The Preglacial course of Rock river was south from Rockford in Winnebago county thru Rochelle in Ogle county and then in a general southwesterly direction to Illinois river in Bureau county. During the Glacial period the Preglacial Rock river was diverted to its present course at its junction with Kishwaukee river in southeastern Winnebago county. This new course was cut thru sandstone and limestone and the conditions were such that no extensive terraces were constructed, such as were formed along the Preglacial course.

Other extensive changes in the drainage systems of the region have occurred, the net result of all the changes being the deep alluvial fills such as occur in the Inlet swamp northeast of Amboy and in the Green river basin.

PHYSIOGRAPHY AND DRAINAGE

The topographic features of Lee county present considerable variation because of the changes which have taken place in its drainage systems. The county constitutes an undulating to rolling plain which becomes rough and hilly as the north-central and northwestern parts of the county are approached. This plain is bisected by the Green river drainage basin, part of which marks the course of the Preglacial Rock river. This drainage basin, locally known as the Green river and Inlet swamp basins, varies in topography from flat to undulating.

Rock river, Green river, and Bureau creek, with their tributaries, form the main drainage systems of the county. Of these, Green river is of chief importance. The channel of this stream has been deepened and straightened, thus providing satisfactory drainage for the swampy condition which formely existed thruout the area now effectively drained by this stream. The accompanying drainage map shows clearly the drainage lines of the county.

The following altitudes of a few places will give some idea of the general elevation of Lee county: Amboy, 753; Ashton, 817; Dixon, 725; Franklin Grove, 810; Nachusa, 790; Paw Paw, 928; Sublette, 924.

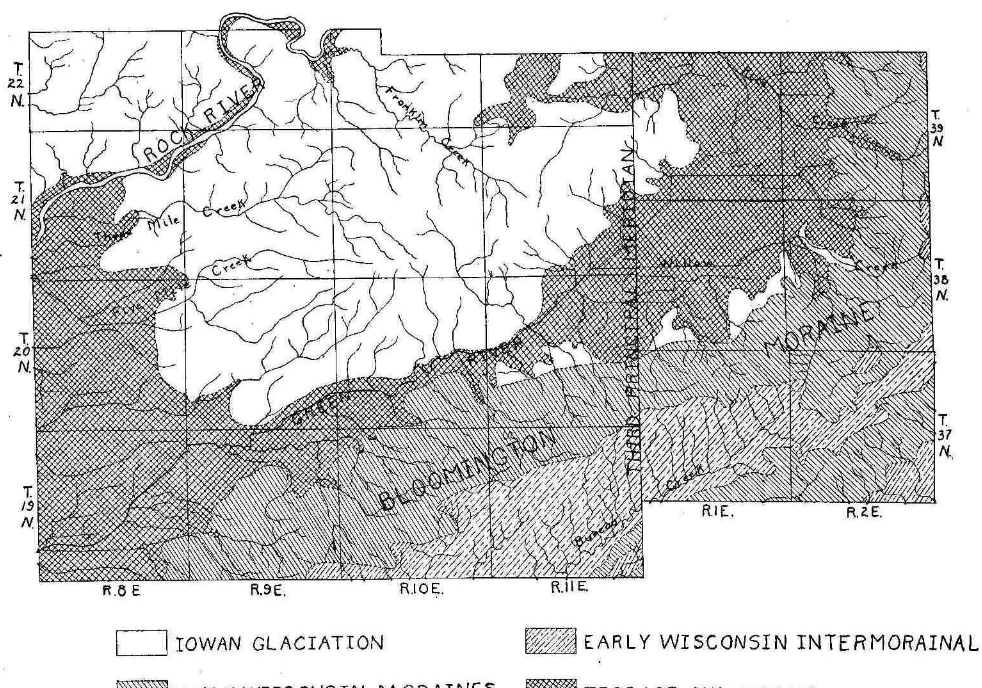

FIG. 1.—DRAINAGE MAP OF LEE COUNTY SHOWING STREAM COURSES, GLACIATIONS, AND TERRACE AND SWAMP AREAS

SOIL DEVELOPMENT

During the time which has elapsed since the last ice invasion, weathering and other processes have been active, resulting in the formation of the soils of the county as we know them today. When first deposited, the general composition of any soil material, particularly loess, is rather uniform. With the passing of time, however, various physical, chemical, and biological agencies of weathering form soil out of the parent material by some or all of the following processes: the leaching of certain elements, the accumulation of others; the chemical reduction of certain compounds, the oxidation of others; the translocation of the finer soil particles, and the arrangement of them into zones or horizons; and the accumulation of organic matter from the growth and decay of vegetable material. One of the very pronounced characteristics observed in most soils is that they are composed of more or less distinct strata, called horizons. As explained somewhat more fully in the Appendix, these horizons are named, from the surface down: A, the layer of extraction; B, the layer of concentration or accumulation; and C, the layer of less-altered material, or the layer in which weathering has had less effect. The development of horizons in a soil is an indication of its age.

Since the upland prairie of this region has been occupied, probably continuously, by grass vegetation, relatively large amounts of organic matter have accumulated, resulting in the formation of productive dark-colored soils. The areas adjacent to streams, which have been occupied by timber, are light-colored because of the relative deficiency of the surface soil in organic matter. The bottom-land soils are made up, for the most part, of alluvial material brought down from the uplands of the immediate vicinity. These soils are to be regarded as relatively young or immature and therefore have not developed horizons as have the mature soils of the upland.

SOIL GROUPS

The soils of Lee county are divided into the following groups:

Upland Prairie Soils, including the dark-colored upland soils.

Upland Timber Soils, including the light-colored upland soils.

Terrace Soils, including alluvial deposits now above overflow.

Swamp and Bottom-Land Soils, including the overflow lands or flood plains along streams, the swamps, and the poorly drained lowlands.

Residual Soils, including rock outcrop areas, and soils formed in place thru weathering of rocks.

Table 1 gives the area of each soil type in Lee county and its percentage of the total area. It will be observed that 61.23 percent of the county consists of upland prairie, 5.44 percent of upland timber, 26.22 percent of terrace, 6.49 percent of swamp and bottom-land soils, and .14 percent of residual soils.

The accompanying map, appearing in three sections, shows the location and boundary lines of the various types.

For explanation concerning the classification of soils and interpretation of the maps and tables, the reader is referred to the first part of the Appendix to this Report.

TABLE 1.—SOIL TYPES OF LEE COUNTY, ILLINOIS

Soil type No.	Name of type	Area in square miles	Area in acres	Percent of total area
	Upland Prairie Soils (700, 900, 1100)			
726, 926, 1126	Brown Silt Loam	350.89	224 571	48.49
726.5	Brown Silt Loam On Limestone	1.54	986	.21
760, 960, 1160	Brown Sandy Loam	42.79	27 384	5.91
760.5	Brown Sandy Loam On Limestone	.07	45	.01
728	Brown-Gray Silt Loam On Tight Clay	5.64	3 610	.77
768	Brown-Gray Sandy Loam On Tight Clay	3.96	2 534	.54
725, 925, 1125	Black Silt Loam	30.14	19 290	4.16
781, 981	Dune Sand	8.15	5 215	1.12
790	Gravelly Loam	.18	116	.02
		443.36	283 751	61.23
	Upland Timber Soils (700, 900, 1100)			
734, 934, 1134	Yellow-Gray Silt Loam	25.31	16 198	3.49
735, 935, 1135	Yellow Silt Loam	4.34	2 778	.59
764, 964	Yellow-Gray Sandy Loam	6.83	4 372	.94
765	Yellow Sandy Loam	.76	486	.14
734.5	Yellow-Gray Silt Loam On Limestone	.56	358	.08
735.5	Yellow Silt Loam On Limestone	1.43	915	.20
		39.23	25 107	5.44
	Terrace Soils (1500)			
1527	Brown Silt Loam Over Gravel	52.51	33 607	7.26
1525	Black Silt Loam	54.89	35 130	7.58
1561	Black Sandy Loam	34.37	21 996	4.75
1566	Brown Sandy Loam Over Gravel	30.12	19 276	4.16
1520	Black Clay Loam	1.52	973	.21
1536	Yellow-Gray Silt Loam Over Gravel	2.45	1 569	.33
1567	Yellow-Gray Sandy Loam Over Gravel	2.33	1 491	.32
1528	Brown-Gray Silt Loam On Tight Clay	.59	378	.08
1568	Brown-Gray Sandy Loam On Tight Clay	3.31	2 118	.46
1581	Dune Sand	7.45	4 768	1.03
1562	Gray Sandy Loam	.27	173	.04
		189.81	121 479	26.22
	Late Swamp and Bottom-Land Soils (1400)			
1450	Black Mixed Loam	25.27	16 172	3.49
1454	Mixed Loam	18.93	12 115	2.62
1401	Deep Peat	2.57	1 645	.36
1402	Medium Peat On Clay	.15	96	.02
		46.92	30 028	6.49

TABLE 1.—SOIL TYPES OF LEE COUNTY, ILLINOIS—*Concluded*

Soil type No.	Name of type	Area in square miles	Area in acres	Percent of total area
	Residual Soils (000)			
083	Sand	.65	416	.09
099	Sandstone Outcrop	.06	38	.01
098	Stony Loam	.15	96	.02
099	Limestone Outcrop	.15	96	.02
		1.01	646	.14
	Miscellaneous			
	Water	3.08	1 972	.43
	Quarries	.27	172	.04
	Gravel pits	.08	51	.01
		3.43	2 195	.48
	Total	723.76	463 206	100.00

INVOICE OF THE ELEMENTS OF PLANT FOOD IN LEE COUNTY SOILS

In order to obtain a knowledge of its chemical composition, each soil type is sampled in the manner described below and subjected to chemical analysis for its important plant-food elements. For this purpose samples are taken usually in sets of three to represent different strata in the top 40 inches of soil; namely, an upper stratum (0 to 6⅔ inches), a middle stratum (6⅔ to 20 inches), and a lower stratum (20 to 40 inches). These sampling strata correspond approximately in the common kinds of soil to 2 million pounds per acre of dry soil in the upper stratum, and to two times and three times this quantity in the middle and lower strata, respectively. This, of course, is a purely arbitrary division of the soil section, very useful in arriving at a knowledge of the quantity and distribution of the elements of plant food in the soil, but it should be borne in mind that these strata seldom coincide with the natural strata as they actually exist in the soil and which are referred to in describing the soil types as horizons A, B, and C. By this system of sampling we have represented separately three zones for plant feeding. The upper, or surface layer, includes at least as much soil as is ordinarily turned with the plow, and this is the part with which the farm manure, limestone, phosphate, or other fertilizing materials are incorporated.

The chemical analysis of a soil, obtained by the methods here employed, gives the invoice of the total stock of the several plant-food materials actually present in the soil strata sampled and analyzed. It should be understood, however, that the rate of liberation from their insoluble forms, a matter of at least equal importance, is governed by many factors, and is therefore not necessarily proportional to the total amounts present.

For convenience in making application of the chemical analyses, the results as presented here have been translated from the percentage basis and are given in the accompanying tables in terms of pounds per acre. In this, the assumption is made that for ordinary types a stratum of dry soil of the area of an acre and 6⅔ inches thick weighs 2 million pounds. It is understood, of course, that this value is only an approximation, but it is believed that with this understanding, it will suffice for the purpose intended. It is, of course, a simple matter to convert these figures back to the percentage basis in case one desires to consider the information in that form.

With respect to the presence of limestone and acidity in different strata, no attempt is made to include in the tabulated results figures purporting to represent their averages for the respective types, because of the extreme variations frequently found within a given soil type. In examining each soil type in the field, however, numerous qualitative tests are made which furnish general information regarding the soil reaction, and in the discussion of the individual soil types which follow, recommendations based upon these tests are given concerning the lime requirement of the respective types. Such recommendations cannot be made specific in all cases because local variations exist, and because the lime requirement may change from time to time, especially under cropping and soil treatment. Therefore it is often desirable to determine the lime requirement for a given field and in this connection the reader is referred to the section in the Appendix dealing with the application of limestone (page 38).

THE UPPER SAMPLING STRATUM

In Table 2 are reported the amounts of organic carbon, nitrogen, phosphorus, sulfur, potassium, magnesium, and calcium in 2 million pounds of the surface soil of each type in Lee county.

In connection with this table attention is called to the variation among the soil types with respect to their content of the different plant-food elements. It will be seen from the analyses that variations in the organic-carbon content of the different soils are accompanied by a parallel variation in the nitrogen content. The organic-carbon content, which serves as a measure of the total organic matter present, is usually from 10 to 12 times that of the total nitrogen. This relationship is explained by the well-established facts that all soil organic matter contains nitrogen, and that most of the soil nitrogen (usually 98 percent or more) is present in a state of organic combination. This close relationship is also maintained in the middle and lower sampling strata.

The range in content of organic matter and nitrogen is very wide. The upland prairie soils are for the most part relatively high in these constituents. The upland timber soils are generally fairly low, altho there is some overlapping of organic matter in the two groups of soil types. The upland timber soils range from 13,140 pounds of organic carbon an acre in Yellow Silt Loam On Limestone up to 38,260 pounds in Yellow-Gray Silt Loam, with an average of 24,140 pounds. The upland prairie soils, ranging from 23,130 to 123,940 pounds, average 56,410 pounds, or more than twice the amount found in the former group. One type, Dune Sand, is omitted from the average for upland prairie soils as given above. This type, as is usually the case with very sandy soils, is very deficient in organic matter and nitrogen, the organic carbon amounting to only

15,780 pounds an acre in the surface stratum. While most soils should receive regular additions of organic materials in the form of green or animal manures and crop residues in order to maintain an adequate supply of organic matter in actively decomposing condition, the frequent use of such materials is particularly necessary in the management of Dune Sand and similar types. The porous, open character of these sandy soils permits the rapid oxidation of organic matter, so that it disappears from the soil much more rapidly than from the heavier types. Dune Sand is in fact but little more than the skeleton of a soil and cannot readily be brought up to, and maintained in, a state of productiveness without first getting an accumulation of organic matter in it, and continuing with frequent subsequent additions. The soil is usually acid and hence limestone and legume green manures constitute the first and most important steps in converting it into a productive soil.

Black Silt Loam contains the largest amount of organic carbon of any soil in the county, except Deep Peat, which is made up largely of organic matter. The organic carbon of Black Silt Loam amounts to 123,940 pounds an acre, with a corresponding nitrogen content of 16,440 pounds. While such soils as this will withstand more abuse by the practice of continuous cropping and are not so greatly in need of additions of organic materials as are soils containing 20,000 to 30,000 pounds of organic carbon, yet the use of manure and the systematic growing of legumes for pasture and plowing down serve to renew the active organic material in the soil in a way which is reflected in increases of crop yields.

Other elements are not so closely associated with each other as are organic matter and nitrogen. There is some degree of correlation, however, between sulfur, another element used by growing plants, and organic carbon. This is because a considerable, tho varying, proportion of the sulfur in the soil exists in the organic form, that is, as a constituent of the organic matter. Most of the Lee county soils are fairly well supplied with sulfur. It ranges, in the surface soil, from a minimum of 240 pounds an acre in the residual Sand up to 4,890 pounds in Deep Peat. Excluding Deep Peat, the sulfur content of Lee county soils averages approximately half that of phosphorus. The sulfur available to crops is affected not only by the soil supply, but also by that brought down from the atmosphere by rain. Sulfur dioxid escapes into the air in the gaseous products from the burning of all kinds of fuel, particularly coal. The gaseous sulfur dioxid is soluble in water and consequently it is dissolved out of the air by rain and brought to the earth. In regions of large coal consumption, the amount of sulfur thus added to the soil is relatively large. At Urbana, during the eight-year period from 1917 to 1924 there has been added to the soil by the rainfall 3.5 pounds of sulfur an acre a month as an average. Similar observations have been made in other localities for shorter periods. At Spring Valley, in Bureau county, the rainfall during six summer months in 1921 brought down 34.5 pounds of sulfur an acre, or an average monthly precipitation of 5.75 pounds. The maximum for a single month was 8.77 pounds, in June. At Toledo, Cumberland county, from April to November, 1922, the average precipitation was 3 pounds an acre a month. The precipitation at the various points in the state in a single month has varied from a minimum of .74 of a pound to

10.22 pounds an acre. These figures will afford some idea of the amounts of sulfur added by rain and also of the wide variation in these amounts under different conditions. On the whole these facts would indicate that the sulfur added from the atmosphere supplements that contained in the soil, so that there appears to be little or no need for sulfur fertilizers in Lee county. In order to determine definitely the response of crops to applications of sulfur fertilizers, experiments with gypsum have been started at five experimental fields, namely, Raleigh, Toledo, Carthage, Hartsburg, and Dixon.

The upland timber soils are, on the whole, more deficient in total phosphorus than either the upland prairie or the terrace soils, altho one of the poorest types in the county in this respect is Dune Sand in the prairie, with an average phosphorus content of 540 pounds.

One type, Black Silt Loam, is outstanding in the county for its high phosphorus content. As found in the upland prairie group, the surface soil of this type contains 3,630 pounds of phosphorus in an acre, while the samples collected in the terrace contained 3,250 pounds. This soil type not only exhibits an unusually high phosphorus content, but is high in organic matter, nitrogen, calcium, and magnesium as well, and is fairly well supplied with sulfur. As to extent, this type covers, in the upland and terrace regions combined, 85 square miles, or 11.74 percent of the area of the county.

Potassium is deficient in Deep Peat, as is usually the case with this soil type, the total amount in the upper 6⅔ inches of soil being only 4,430 pounds an acre. The sandy types in Lee county are considerably lower in potassium content than is generally the case.

Residual Sand has only 6,880 pounds of potassium an acre; Dune Sand, Terrace, 13,020 pounds; and the other sands and sandy loams vary around the 20,000-pound level. Sand soils carry a large proportion of their potassium content in the coarse sand grains. The relatively small total surface exposed in the case of the coarse particles greatly lowers the solubility and availability of the potassium in sand soils. This is partly offset, however, by the greater depth of the feeding zone for crop roots in sandy soils as compared with the heavier types. The other types are normal in content of potassium.

The variation in the calcium and magnesium content in the soils of this county is wide. Nearly all the sand and sandy loam types are markedly low in both calcium and magnesium, containing, generally, less than 4,000 pounds in the surface 6⅔ inches. The soils of finer texture are fairly well supplied with both of these elements.

THE MIDDLE AND LOWER SAMPLING STRATA

In Tables 3 and 4 are recorded the amounts of the plant-food elements in the middle and lower sampling strata. In comparing these strata with the upper stratum, or with each other, it is necessary to bear in mind that the data as given for the middle and lower sampling strata are on the basis of 4 million and 6 million pounds of soil, and should therefore be divided by two and three respectively before being compared with each other or with the data for the upper stratum, which is on a basis of 2 million pounds.

TABLE 2.—PLANT-FOOD ELEMENTS IN THE SOILS OF LEE COUNTY, ILLINOIS
UPPER SAMPLING STRATUM: ABOUT 0 TO 6⅔ 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
	Upland Prairie Soils (700, 900, 1100)							
726, 926, 1126	Brown Silt Loam	62 520	5 550	1 350	1 050	32 020	8 020	10 280
726.5	Brown Silt Loam On Limestone	46 760	3 780	1 060	900	32 000	5 800	7 060
760, 960	Brown Sandy Loam	23 130	2 490	900	630	22 690	3 510	3 710
760.5	Brown Sandy Loam On Limestone	33 760	2 860	1 280	620	23 440	4 600	2 920
728	Brown-Gray Silt Loam On Tight Clay	48 360	4 040	1 100	720	25 430	3 870	4 340
768	Brown-Gray Sandy Loam On Tight Clay[1]	......	......	......	......	......	......	......
725	Black Silt Loam	123 940	16 440	3 630	1 980	42 570	12 410	13 930
781	Dune Sand	15 780	1 160	540	400	18 240	1 240	3 460
790	Gravelly Loam[1]	......	......	......	......	......	......	......
	Upland Timber Soils (700, 900, 1100)							
734, 934	Yellow-Gray Silt Loam	38 260	2 480	960	660	37 210	5 990	9 540
735	Yellow Silt Loam	29 040	2 500	860	460	37 420	5 780	7 820
764	Yellow-Gray Sandy Loam	25 900	2 560	740	480	27 060	3 040	5 640
765	Yellow Sandy Loam	16 680	1 160	840	360	21 400	2 800	4 620
734.5	Yellow-Gray Silt Loam On Limestone	21 820	1 640	640	320	30 140	4 200	6 400
735.5	Yellow Silt Loam On Limestone	13 140	2 940	840	500	34 500	4 900	8 360
	Terrace Soils (1500)							
1527	Brown Silt Loam Over Gravel	49 300	4 000	1 590	780	35 190	7 650	4 690
1525	Black Silt Loam	75 510	6 970	3 250	1 020	30 710	12 210	17 930
1561	Black Sandy Loam	88 260	7 900	1 240	1 120	21 180	3 800	9 960
1566	Brown Sandy Loam Over Gravel	30 060	3 240	950	640	19 110	4 300	4 180
1520	Black Clay Loam	95 640	8 780	2 320	1 420	31 140	14 880	22 800
1536	Yellow-Gray Silt Loam Over Gravel	31 940	2 820	2 120	620	36 760	6 780	6 780
1567	Yellow-Gray Sandy Loam Over Gravel	23 320	1 800	1 120	420	22 800	4 100	3 320
1528	Brown-Gray Silt Loam On Tight Clay	47 740	4 060	1 260	680	25 900	4 900	8 740
1568	Brown-Gray Sandy Loam On Tight Clay	71 700	6 300	1 460	940	22 900	3 880	3 080
1581	Dune Sand	12 840	940	740	280	13 020	1 580	2 400
1562	Gray Sandy Loam	35 240	2 940	1 000	620	17 780	3 940	2 220
	Late Swamp and Bottom-Land Soils (1400)							
1450	Black Mixed Loam[2]	......	......	......	......	......	......	......
1454	Mixed Loam[2]	......	......	......	......	......	......	......
1401	Deep Peat[3]	403 510	44 360	1 910	4 890	4 430	4 180	26 930
1402	Medium Peat On Clay[3]	282 370	22 700	2 180	2 850	9 090	6 470	23 530
	Residual Soils (000)							
083	Sand	14 140	600	480	240	6 880	160	1 900
098	Stony Loam	66 540	6 380	1 500	1 380	39 580	60 180	90 540

LIMESTONE AND SOIL ACIDITY.—In connection with these tabulated data it should be explained that the figures for limestone content and soil acidity are omitted not because of any lack of importance of these factors, but rather because of the peculiar difficulty of presenting in the form of general numerical averages reliable information concerning the limestone requirement for a given soil type. A general statement, however, will be found concerning the lime requirement of the respective soil types in connection with the discussions which follow.

[1]No samples were obtained.
[2]Analytical results are not included for Mixed Loam and Black Mixed Loam because of the heterogeneity of these types.
[3]Amounts reported are for 1 million pounds of Deep Peat and Medium Peat On Clay.

TABLE 3.—PLANT-FOOD ELEMENTS IN THE SOILS OF LEE COUNTY, ILLINOIS
MIDDLE SAMPLING STRATUM: ABOUT 6⅔ 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
	Upland Prairie Soils (700, 900, 1100)							
726, 926, 1126	Brown Silt Loam	58 310	5 920	2 030	1 390	61 580	18 410	18 590
726.5	Brown Silt Loam On Limestone	54 560	4 480	1 840	1 520	68 160	14 480	11 920
760, 960	Brown Sandy Loam	51 570	3 490	1 750	930	50 710	10 200	7 760
760.5	Brown Sandy Loam On Limestone	35 720	3 160	1 720	920	42 880	10 160	5 120
728	Brown-Gray Silt Loam On Tight Clay	31 820	3 020	1 540	620	57 540	11 300	8 920
768	Brown-Gray Sandy Loam On Tight Clay[1]	......	......	......	......	......	......	......
725	Black Silt Loam	94 000	8 760	3 300	1 620	62 700	25 240	36 800
781	Dune Sand	26 480	1 880	1 120	840	36 680	2 000	6 440
790	Gravelly Loam[1]	......	......	......	......	......	......	......
	Upland Timber Soils (700, 900, 1100)							
734, 934	Yellow-Gray Silt Loam	49 740	2 620	1 480	980	72 040	18 280	16 780
735	Yellow Silt Loam	21 960	2 280	1 960	640	85 920	24 440	16 680
764	Yellow-Gray Sandy Loam	19 440	1 800	1 120	680	55 720	9 240	11 000
765	Yellow Sandy Loam	13 640	1 120	1 280	360	47 640	7 200	10 440
734.5	Yellow-Gray Silt Loam On Limestone	17 800	1 520	1 200	560	57 920	10 280	11 400
735.5	Yellow Silt Loam On Limestone	24 840	3 000	1 960	720	71 520	13 440	18 720
	Terrace Soils (1500)							
1527	Brown Silt Loam Over Gravel	57 800	5 100	2 420	1 220	72 860	18 460	11 140
1525	Black Silt Loam	76 240	6 330	2 830	940	65 240	25 310	34 560
1561	Black Sandy Loam	54 920	4 520	1 160	880	41 240	5 680	11 160
1566	Brown Sandy Loam Over Gravel	51 140	4 040	2 080	940	44 600	11 520	7 240
1520	Black Clay Loam	84 480	7 960	3 560	1 640	65 040	38 000	58 440
1536	Yellow-Gray Silt Loam Over Gravel	29 000	2 800	3 240	720	74 000	16 600	15 040
1567	Yellow-Gray Sandy Loam Over Gravel	18 000	1 240	2 200	600	44 120	9 480	3 400
1528	Brown-Gray Silt Loam On Tight Clay	40 240	3 800	2 200	920	51 520	15 480	4 480
1568	Brown-Gray Sandy Loam On Tight Clay	28 160	2 600	3 640	880	49 760	7 600	5 840
1581	Dune Sand	14 400	560	1 040	320	32 080	3 720	4 920
1562	Gray Sandy Loam	21 360	2 160	2 040	800	41 400	11 080	2 040
	Late Swamp and Bottom-Land Soils (1400)							
1450	Black Mixed Loam[2]	......	......	......	......	......	......	......
1454	Mixed Loam[2]	......	......	......	......	......	......	......
1401	Deep Peat[3]	779 780	86 020	3 060	8 320	9 020	9 800	58 600
1402	Medium Peat On Clay[3]	219 100	18 640	2 060	2 620	30 440	17 120	35 840
	Residual Soils (000)							
083	Sand	11 560	560	1 600	360	11 520	680	200
098	Stony Loam[1]	......	......	......	......	......	......	......

LIMESTONE AND SOIL ACIDITY.—See note in Table 2.

[1]No samples were obtained.
[2]Analytical results are not included for Mixed Loam and Black Mixed Loams because of the heterogeneity of these two types.
[3]Amounts reported are for 2 million pounds of Deep Peat and Medium Peat On Clay.

TABLE 4.—PLANT-FOOD ELEMENTS IN THE SOILS OF LEE COUNTY, ILLINOIS
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
	Upland Prairie Soils (700, 900, 1100)							
726, 926, 1126	Brown Silt Loam	47 860	3 300	2 630	1 160	102 300	45 570	48 350
726.5	Brown Silt Loam On Limestone	......	......	......	......	......	......	......
760, 960	Brown Sandy Loam	28 540	2 760	1 660	1 080	91 800	32 500	34 460
760.5	Brown Sandy Loam On Limestone	......	......	......	......	......	......	......
728	Brown-Gray Silt Loam On Tight Clay	24 330	2 520	2 010	720	78 760	21 540	16 500
768	Brown-Gray Sandy Loam On Tight Clay[1]	......	......	......	......	......	......	......
725	Black Silt Loam	45 300	3 810	4 260	1 080	108 300	40 110	44 910
781	Dune Sand	24 720	2 340	1 140	900	69 720	10 740	10 980
790	Gravelly Loam[1]	......	......	......	......	......	......	......
	Upland Timber Soils (700, 900, 1100)							
734, 934	Yellow-Gray Silt Loam	25 800	2 550	2 910	1 440	118 320	51 480	108 090
735	Yellow Silt Loam	27 780	3 180	3 540	480	146 520	48 480	123 000
764	Yellow-Gray Sandy Loam	15 000	1 380	1 980	780	68 040	16 500	13 700
765	Yellow Sandy Loam	15 060	1 140	2 220	1 140	53 640	11 580	11 160
734.5	Yellow-Gray Silt Loam On Limestone	......	......	......	......	......	......	......
735.5	Yellow Silt Loam On Limestone	......	......	......	......	......	......	......
	Terrace Soils (1500)							
1527	Brown Silt Loam Over Gravel	31 020	3 030	2 580	1 200	92 460	31 250	26 340
1525	Black Silt Loam	46 380	3 760	4 180	1 020	91 510	37 920	37 180
1561	Black Sandy Loam	16 740	1 440	1 140	600	55 560	8 520	13 860
1566	Brown Sandy Loam Over Gravel	26 730	2 040	3 810	1 290	62 880	17 460	7 860
1520	Black Clay Loam	66 120	5 940	4 620	1 680	93 420	75 240	216 960
1536	Yellow-Gray Silt Loam Over Gravel	24 600	1 920	3 240	720	88 380	22 380	29 520
1567	Yellow-Gray Sandy Loam Over Gravel	17 400	1 260	3 300	1 020	49 620	12 360	6 480
1528	Brown-Gray Silt Loam On Tight Clay	24 180	2 400	2 640	840	52 620	17 880	3 280
1568	Brown-Gray Sandy Loam On Tight Clay	30 540	3 000	4 380	600	70 920	17 880	10 440
1581	Dune Sand	16 380	420	1 440	780	45 660	5 100	8 580
1562	Gray Sandy Loam	17 580	1 440	3 180	1 020	45 900	10 980	4 860
	Late Swamp and Bottom-Land Soils (1400)							
1450	Black Mixed Loam[2]	......	......	......	......	......	......	......
1454	Mixed Loam[2]	......	......	......	......	......	......	......
1401	Deep Peat[3]	1 247 880	125 610	3 180	16 290	15 000	16 740	84 060
1402	Medium Peat On Clay	166 500	10 260	3 180	3 600	109 380	124 140	198 300
	Residual Soils (000)							
083	Sand	14 700	1 080	1 860	720	27 240	2 220	1 500
098	Stony Loam[1]	......	......	......	......	......	......	......

LIMESTONE AND SOIL ACIDITY.—See note in Table 2.

[1]No samples were obtained.
[2]Analytical results are not included for Mixed Loam or Black Mixed Loam because of the heterogeneity of these types.
[3]Amounts reported are for 3 million pounds of Deep Peat.

Considering the data in this way and comparing the three strata with each other, it will be noted that some of the elements exhibit no consistent change in amount, either upward or downward, with increasing depth. This is true particularly of potassium. Others exhibit more or less marked variation in amount at the different levels. Furthermore, these variations as a rule go in certain general directions, and by a careful study of them it is frequently possible to obtain clues as to the age or stage of maturity of the various soils and the nature of the processes going on in soil formation.

From this point of view it will be seen in comparing the three strata with each other that with the exception of Deep Peat all the soil types diminish rather rapidly in organic matter and nitrogen with increasing depth, and that this diminution is especially noticeable even in the middle stratum. The sulfur content decreases with increasing depth in nearly all cases. This is to be expected since a portion of the sulfur exists in combination with the soil organic matter, which is more abundant in the upper strata, and since inorganic forms of sulfur are not tenaciously retained by the soil against the leaching action of ground water. Phosphorus, on the other hand, is not removed from the soil by leaching. It is converted by growing plants into organic forms and tends to accumulate in the surface soil in these forms in plant residues at the expense of the underlying strata. It is the second stratum (6⅔ to 20 inches) which furnishes most of the phosphorus thus moved upward. Consequently, in nearly all of the soil types in Lee county the surface soil contains a larger proportionate amount of phosphorus than the middle stratum, and in the majority of cases more than the lower stratum.

Two important basic elements, calcium and magnesium, have undergone some shifting in the different levels, as exhibited by analyses of upland types. The calcium content, on the whole, is much higher than that of magnesium in the surface soil, indicating a more abundant supply of calcium in the soil-forming materials. The calcium content diminishes in the middle stratum as compared with the upper. This is accompanied by an increase in the magnesium content in both the middle and lower strata. These two elements are unequally removed from the soil by leaching, the calcium being dissolved and carried downward to a greater extent than magnesium. As they are carried downward in solution, magnesium is more readily reabsorbed by the soil mass than calcium, thus forcing the latter out into the solution to be carried farther down. Consequently, while magnesium tends to accumulate in the middle and lower strata, the liberated calcium, which is thus carried farther down than magnesium, may accumulate at still greater depths or may be washed away entirely. These movements of calcium and magnesium, as indicated by the analyses of the different strata, constitute one factor in estimating the relative maturity of the various soil types.

It is frequently of interest to know the total supply of a plant-food element accessible to the growing crops. While it is not possible to obtain this information exactly, especially for the deeper rooted crops, it seems probable that practically the entire feeding range of the roots of most of our common field crops is included in the upper 40 inches of soil. By adding together for a given soil type the corresponding figures in Tables 2, 3, and 4, the total amounts of the respective plant-food elements to a depth of 40 inches may be ascertained.

Considered in this manner the tables reveal that there is not only a wide diversity among the different soils with respect to a given plant-food element, but that there is also a great variation with respect to the relative abundance of the various elements within a given soil type as measured by crop requirements. For example, in the most extensive soil type in the county, Brown Silt Loam, Upland, we find that the total quantity of nitrogen in an acre to a depth of 40 inches amounts to 14,770 pounds. This is about the amount of nitrogen contained in the same number of bushels of corn. The amount of phosphorus, 6,010 pounds, contained in an acre of the same soil is equivalent to that in 36,000 bushels of corn, while the amount of potassium, 195,900 pounds, is equivalent to that contained in approximately one million bushels of corn. In marked contrast to this soil, with respect to nitrogen, is the Yellow-Gray Silt Loam, an important upland timber soil type, which contains in the 40-inch stratum approximately 7,650 pounds an acre of nitrogen, an amount equal to that in 7,650 bushels of corn. The phosphorus content is nearly as high as in Brown Silt Loam, namely, 5,350 pounds in an acre, which is equivalent to that contained in 31,470 bushels of corn. The potassium content of Yellow-Gray Silt Loam amounts to 227,570 pounds.

With respect to calcium it is not feasible to make such comparisons in soil types which differ within themselves as to the presence or absence of native calcium carbonate (limestone). In such soils the average calcium content cannot be taken as representative of the type. For example, one sample of Yellow-Gray Silt Loam was acid in the lower stratum (20 to 40 inches), the carbonates having been leached to a greater depth than 40 inches. Another sample of the same type contained carbonates in this stratum, and consequently was non-acid. The acid sample contained 31,380 pounds an acre of calcium in this same stratum while the other had more than three times as much, or 108,090 pounds. These differences are thus much greater than the average variations between different soil types.

These considerations are not intended to imply that it is possible to predict how long it might be before a certain soil would become exhausted under a given system of cropping. Neither do the figures necessarily indicate the immediate procedure to be followed in the improvement of a soil, for factors other than the amount of plant-food elements present enter into consideration. Much depends upon the nature of the crops to be grown, as to their utilization of plant-food materials, and much depends upon the condition of the plant-food substances themselves, as to their availability. Finally, in planning the detailed procedure for the improvement of a soil, there enter for consideration all the economic factors involved in any fertilizer treatment. Such figures do, however, furnish an inventory of the total stocks of the plant-food elements that can possibly be drawn upon, and in this way contribute fundamental information for the intelligent planning, in a broad way, of systems of soil management for conserving and improving the fertility of the land.

DESCRIPTION OF SOIL TYPES

UPLAND PRAIRIE SOILS

The upland prairie soils of Lee county occupy 443.36 square miles, or 61.23 percent of the area of the county. They are fairly uniformly distributed over the entire county with the exception of the southwest portion, which is occupied by swamp and terrace formations.

These soils vary in color from black to light brown or grayish brown in the surface, and in texture from silts to sands. The subsoils of this group vary in compactness and in other characters as will be noted in the type descriptions to follow.

The dark color of the prairie soils is due to the accumulation of organic matter, which is derived very largely from the fibrous roots of the prairie grasses. The network of grass roots was protected from rapid and complete decay, thru the partial exclusion of oxygen by the covering of fine soil and mat of vegetative material consisting of old grass stems and leaves. This mat of stems and leaves was destroyed in part by prairie fires and by decay; but it was constantly renewed, and while it added but little organic matter to the soil directly, the decay of the prairie grass roots was retarded considerably by it.

Brown Silt Loam (726, 926, 1126)

Brown Silt Loam, Upland, is well distributed over the county. It occupies a total of about 351 square miles, or practically one-half of the area of the county. On the Bloomington moraine south of the Green river swamp and also on the upland north and west of Amboy, this type is spotted with sandy areas. The topography of the type varies from undulating to rolling, the latter condition occurring in the morainic area. Drainage is well developed thruout the greater portion of the Brown Silt Loam area. Some depressions occur in which artificial drainage must be provided to remove the excess water rapidly. In the morainic areas some of the slopes are subject to erosion, so that the organic-matter content is somewhat lower than the average for the type. Thruout the Brown Silt Loam area numerous knolls of sandy loam occur. Many of these are small in size, while others are sufficiently large to be shown on the map. On the moraines the surface soil is usually shallower than it is on the intermorainal areas.

The A_1 horizon, which has an average depth of about 8 inches, is a light to medium brown silt loam. The A_2 horizon, extending to a depth of about 18 inches, varies from a light yellowish brown to a brownish yellow silt loam. The B horizon is a uniform, slightly compact, yellow silt loam with gray joint mottling. The C horizon, below 30 inches, is a friable, yellow silt loam, spotted with bright yellow or red iron concretions.

In the morainic areas glacial till occurs 22 to 36 inches below the surface on the more rolling topography, altho usually on the moraine the glacial drift is found below 40 inches. The drift is a gravelly yellow silt loam.

Management.—The reader is asked to turn to page 49, where he will find the results of the soil experiment field located in Lee county near Dixon. The soil of this field is not representative of all the soil in Lee county which is mapped as Brown Silt Loam; it is similar, however, to a large percentage of the better drained portions of the type. It will be noted that manure has given excellent returns on this field and that the use of limestone has paid a fairly good profit. The use of rock phosphate has resulted in crop increases just about sufficient to pay for the application of half a ton of this material per acre once in four years. The reader is referred to page 41 for a further discussion of the phosphate problem.

Present knowledge regarding the management of this soil, while not complete, indicates clearly the need for fresh organic matter and, on a considerable portion of the type, an application of limestone. The amount of limestone needed varies and should be determined for each field. The clovers or other legumes should be regularly grown to supply fresh organic matter and nitrogen. At the same time this is being done, trials may well be made of the various phosphates, particularly rock phosphate and acid phosphate. It should be borne in mind in making these trials that, of the grain crops, wheat responds best to phosphate.

Brown Silt Loam On Limestone (726.5)

Brown Silt Loam On Limestone occurs in small, scattered areas thruout the dark-colored soil region in the north-central and northwestern part of the county.

The A_1 horizon is approximately 7 inches in depth and is a brown silt loam. The A_2 horizon is a somewhat compact, brownish yellow, silty clay loam. This stratum gradually becomes heavier with increasing depth and passes into a heavy reddish yellow clay which occurs as a stratum 2 to 3 inches in thickness just above the more or less weathered limestone. The average depth to the limestone is about 16 inches.

Management.—Brown Silt Loam On Limestone, as a type, is not suited to cropping. The underlying bed rock comes so near the surface that the soil is drouthy. It is now, for the most part, kept in permanent pasture, and this practice should be continued. Numerous outcrops occur, some of which are quarried and the stone crushed with portable crushers for agricultural use.

Brown Sandy Loam (760, 960, 1160)

Brown Sandy Loam comprizes 42.79 square miles, or 5.91 percent of the area of the county. Areas of this type occur adjacent to the Green river basin and in the northern part of the county east of Rock river. This type was formed by the blowing of sand out of the sandy swamp and terrace areas of the county onto the upland. South of the Green river swamp there has been little mixing of the wind-blown sand with the upland silty material, while north of the swamps there has been much mixing of the sand with the silts. No abrupt change occurs in this latter region between the sands and silts, while south of the swamps the sands have been piled over and upon the silts with little mixing. The topography of the type varies from undulating to rolling and the natural drainage is good.

The A_1 horizon, which is about 8 inches in depth, is a brown sandy loam. The A_2 horizon, extending from 8 to 18 inches, varies from a light brown to a yellowish brown sandy loam. The B horizon, about 14 inches in thickness, is a slightly compact, yellow, sandy silt loam. The C horizon varies from a yellow silt loam, sandy phase, to a yellow sand. In the morainic area glacial till sometimes occurs at a depth varying from 36 to 45 inches below the surface.

Management.—Brown Sandy Loam, as it is mapped, varies within rather wide limits in sand content. A considerable portion of the type is too sandy to produce satisfactory yields of the grain crops when farmed by the usual methods, and consequently much of it is now left in pasture.

A moderate application of limestone, 2 to 3 tons an acre, should be added to this soil as the first step in raising its level of production. In addition to being slightly acid, this soil is low in nitrogen and organic matter. The character of the soil indicates that this deficiency should be met by the use of short rotations, which will provide for the frequent additions of fresh organic matter in the form of clover, preferably sweet clover. The above plan takes into account the leachy nature of this soil and the impossibility of economically maintaining its organic-matter and nitrogen contents at as high a level as is possible with finer textured soils. It is also suggested that trial be made of acid phosphate for wheat, and of one of the potash salts for corn. Alfalfa can be grown satisfactorily on most, or perhaps all, of this land following the application of limestone.

Brown Sandy Loam On Limestone (760.5)

Brown Sandy Loam On Limestone is of little importance in Lee county because of its very limited area, 45 acres, and its low agricultural value. It is similar, in all respects, to Brown Silt Loam On Limestone with the exception of texture.

Management.—This type should be left in permanent pasture, as its drouthy nature makes it unfit for cropping.

Brown-Gray Silt Loam On Tight Clay (728)

Brown-Gray Silt Loam On Tight Clay is irregularly distributed over the upland. It is frequently found in the low undrained areas of Brown Sandy Loam. It is flat in topography and poorly drained because of its flatness and also because of the presence of the highly plastic "tight clay" subsoil. The type occupies only 5.64 square miles, or less than one percent of the area of the county.

The A_1 horizon, which is 7 to 10 inches in thickness, is usually a grayish brown silt loam, containing an appreciable amount of sand since the areas are either located in or near the sandy soils. The A_2 horizon, which varies from 9 to 10 inches in thickness, is a brownish gray or yellowish gray to a gray or almost white silt loam. The gray layer passes abruptly into the B horizon. The latter is a compact, strongly mottled, yellowish gray clay, containing many red iron concretions. This stratum is highly impervious to the penetration of water. At about 28 inches in depth, the C horizon occurs. It is a friable, mottled, drabbish yellow or yellow silt loam.

Management.—Most of the areas of Brown-Gray Silt Loam On Tight Clay are medium acid in reaction and require an application of about 3 tons of limestone an acre to grow sweet clover. It is well to determine the need for limestone before deciding to make an application on this type, unless it is known definitely that limestone is needed, for there are some areas that contain sufficient lime material. Help can be secured from the farm adviser or from the Agricultural Experiment Station in this matter. In addition to taking care of the need for limestone, the growing and turning down of leguminous crops, and provision for the removal of excess water by surface drainage should be given consideration in the management of this soil.

Brown-Gray Sandy Loam On Tight Clay (768)

Brown-Gray Sandy Loam On Tight Clay, Upland, occupies slightly less than four square miles. In topography and drainage it is similar to Brown-Gray Silt Loam On Tight Clay.

The A_1 horizon, which has an average depth of about 8 inches, is a grayish brown sandy loam. The A_2 horizon, extending to about 20 inches in depth, is a yellowish gray to gray sandy loam. This horizon passes abruptly into the B horizon, which is a highly impervious, plastic, compact, gray sandy clay stratum containing many red iron concretions. The thickness of this layer varies from 8 to 10 inches. The material underlying this compact layer varies from a gray sand to a yellow sand streaked with some gray clayey sand.

Management.—For suggestions regarding the management of this type, the reader is referred to the discussion of the preceding type, Brown-Gray Silt Loam On Tight Clay (728).

Black Silt Loam (725, 925, 1125)

Black Silt Loam, as it occurs in the upland, is closely associated with Brown Silt Loam, and usually occupies the depressions and the low areas along small streams and draws. The topography is flat and the natural drainage is not well established. The areas of this type are small but are well distributed over the upland. The type comprizes in total 30.14 square miles, or more than 4 percent of the area of the county.

The A_1 horizon, which averages about 7 inches in thickness, is a black silt loam. The A_2 horizon, which extends to about 16 or 17 inches in depth, varies from a black silty clay loam to a plastic, drab clay loam. The B horizon is a plastic, fairly compact, mottled, black clay loam which gradually changes into a plastic, drab to yellowish drab, clay loam in the lower part.

Management.—Black Silt Loam is a rich soil, well supplied with lime and suited to the growth of any of the general farm crops. Portions of the type are so poorly drained that they are not farmed and even where regular cropping is carried on, the underdrainage frequently needs improvement. Provision must be made for adding fresh organic matter, even tho this soil has a high organic-carbon content. No fertilizer treatment is advised at the present time.

Dune Sand (781, 981)

Dune Sand, Upland, occurs principally in the sandy areas bordering the swamps and terraces. Its total area in the county includes a little over 8 square miles. Its presence in the upland is due to wind action upon the sandy material, blowing it into ridges. The sand dunes are scattered over most of the sandy area and vary from a few feet to 60 or 75 feet in height above the adjacent plain. Wind erosion has formed blowouts in many of these sand dunes, some of which cover a large portion of the surface of the dune. The topography varies from billowy to rolling.

The A_1 horizon, which is about 2 or 3 inches in depth where there has been some accumulation of organic matter, is a brown loamy sand. There is no horizon development below the thin A_1 or surface horizon, the material being incoherent yellow sand.

Management.—Since there is very little organic matter in the sand, this must be increased by the growth of legumes before other crops can be satisfactorily grown. An application of limestone should be made to insure a catch of legumes. Reforestation also aids the abeyance of wind erosion. The reader is referred to page 62, where the results from the Oquawka experiment field will be found, for further suggestions regarding the management of this type.

Gravelly Loam (790)

Gravelly Loam is an unimportant type appearing in the morainal areas in the southeastern part of the county. It represents the gravel outcrops on the crests of the moraine. It has very little agricultural value. Some of the gravel, altho not of good quality, is being used for road building. This type should be kept in permanent pasture or it may be used for small fruit production when conveniently situated for this purpose.

UPLAND TIMBER SOILS

The upland timber soils occur as irregular zones along streams and on or near somewhat steep morainal slopes. They are characterized by a yellowish gray color, which is due to their low organic-matter content. The deficiency of organic matter has been caused by the long-continued growth of forest trees. After the forests invaded the prairies, two effects were produced: the shade of the trees prevented the growth of prairie grasses, the roots of which are mainly responsible for the large organic content in prairie soils; and the trees themselves added very little organic matter to the soil, for the leaves and branches either decayed completely or were burned by forest fires. Furthermore, the organic matter that had been produced by the prairie grasses became gradually dissipated during the occupation of the land by the trees. As a result the organic-matter content of the upland timber soils has been reduced until it is decidedly lower than that of the adjacent prairie land. Several generations of trees were necessary to produce the present condition of the soil. The upland timber soils of Lee county occupy 5.44 percent of the area of the county.

Yellow-Gray Silt Loam (734, 934, 1134)

Yellow-Gray Silt Loam occupies 25.31 square miles, or 3.49 percent of the area of the county. It occurs as light-colored soil near the streams, most of it being situated along Rock river and its tributaries. Several isolated areas occur on the moraine in the southeast part of the county. The topography of the type varies from undulating to rolling. The natural drainage of this type is, in the main, good.

The A_1 horizon, which is about 6 inches in depth, is a brownish yellow to a grayish yellow silt loam. The A_2 horizon is about 10 or 11 inches in thickness. It is a mottled yellow silt loam. The B horizon, which is about 12 inches thick, is a slightly mottled, slightly plastic, compact, yellow silt loam. The C horizon is a friable, yellow silt loam, mottled with gray, and contains many reddish brown iron concretions.

Management.—Yellow-Gray Silt Loam is now used rather extensively for pasture, particularly the rolling portions of the type. In the morainic portion of the type the slopes which have been sufficiently eroded show the presence of carbonates. This condition can be taken advantage of for growing legumes without limestone. On the more nearly flat areas no carbonates occur within 40 inches of the surface and limestone must be used for alfalfa or sweet clover and usually for red clover.

This soil is low in organic matter and for this reason runs together and packs badly with heavy rains. This difficulty can be gradually overcome by providing for the return of organic matter, preferably legumes, at frequent intervals. The portions of this type which are topographically suitable for regular cropping are productive when good farming methods are practiced. In addition to the use of limestone and legumes, as above suggested, it is advised that a thoro trial be made of both rock and acid phosphate. The most approved method of using rock phosphate is well known. Acid phosphate should be applied for wheat after plowing and before working down the seed bed, at the rate of about 300 pounds an acre. No definite statements are made as to which of these phosphates is likely to prove superior on Yellow-Gray Silt Loam because there is no experiment field located on this type, as it occurs in Lee county, from which conclusions may be drawn.

Yellow Silt Loam (735, 935, 1135)

Yellow Silt Loam occurs as hilly and eroded land in the form of an inner timber belt adjacent to streams, and also on other slopes where erosion has gone on for a considerable period of time. It occupies only a small part of the area of the county, the total area of the type being less than four and a half square miles.

The A_1 horizon, which varies from 0 to 3 inches in thickness, depending on the rate of erosion, is a brownish yellow to yellow silt loam. Erosion has removed most of the upper horizons, and the B horizon, or subsoil, occurs either immediately at the surface or just below it. It is a slightly plastic, compact, silty clay, golden yellow in color.

Management.—The most difficult problem in the management of Yellow Silt Loam is to control general surface washing and gullying. If the land is cropped at all, a rotation should be adopted which provides for some sort of vegetation on the ground as much of the time as is possible, and for a minimum of cultivated crops. When the land is tilled, care must be taken in plowing and cultivating the slopes not to encourage the starting of gullies. Every effort should be made to maintain and increase the organic-matter content of the soil. It would be well to reforest some of the areas near the river and thus stop the continual erosion by that method. An application of limestone for growing legumes is recommended.

Yellow-Gray Sandy Loam (764, 964)

Yellow-Gray Sandy Loam occurs in the northern part of the county and in the sandy areas adjacent to the swamp region. It covers 6.83 square miles, or a little less than 1 percent of the area of the county. Its topography varies from undulating to rolling. Drainage is fairly good in most of the areas.

The A_1 horizon, which is about 5 inches in depth, is a grayish yellow sandy loam. The A_2 horizon, extending to about 17 inches in depth, is a yellow sandy loam. The B horizon is a slightly compact, yellow, sandy clay loam. Below 30 inches a coarse-grained, yellow, sandy silt loam occurs, frequently passing into glacial till of a gravelly textured material at 36 to 38 inches below the surface.

Management.—The management requirements of this type are practically the same as for Yellow-Gray Silt Loam. An application of limestone at the rate of 2 to 3 tons an acre is recommended for the growing of legumes. Wind erosion is somewhat troublesome on this soil and special methods should be used to control it, such as keeping vegetation on the land during as large a portion of the year as possible and using tillage methods which leave the surface somewhat rough.

Yellow Sandy Loam (765)

Yellow Sandy Loam occupies only .76 square mile, or .14 percent of the area of the county. It is found in the region of the outcrops of St. Peter's sandstone along Rock river. The topography of the type is rolling, with some rather short steep slopes.

The A_1 horizon varies in thickness from 0 to 3 inches, depending on the amount of accumulation of organic matter, and is a grayish yellow sandy loam. The A_2 horizon, extending to about 15 inches in depth, is a yellow sandy loam. The B horizon, which is about 8 inches thick, is a slightly compact, yellow, sandy, silt loam. The C horizon is a reddish yellow, sandy clay loam becoming a fairly sticky, residual sandy clay just above the sandstone. The depth to the sandstone varies from 25 to 45 inches.

Management.—This type should be devoted exclusively to timber. It is now generally bearing a fair growth of jack oak, red oak, and hickory.

Yellow-Gray Silt Loam On Limestone (734.5)

Yellow-Gray Silt Loam On Limestone is one of the minor types in Lee county. It comprizes only 358 acres and occurs as isolated areas in the northwestern part of the county. It is undulating in topography. If the limestone is near the surface, the areas are practically non-agricultural, except for pasture. This type changes abruptly into the eroded Yellow Silt Loam On Limestone. Often upon breaking up the soil, dark spots appear on the surface. These spots occur where the underlying limestone is sufficiently near the surface to keep the surface soil supplied with carbonates, thus retaining the dark-colored organic compounds.

The A_1 horizon, which is about 5 inches in depth, is a grayish yellow silt loam. The A_2 horizon, extending to 18 inches in depth, is a yellow silt loam. The B horizon is a compact, yellow silt loam, becoming slightly reddish just above the limestone. Often a heavy, red, residual clay, 2 to 3 inches in thickness, occurs directly above the rock. The average depth to the limestone rock is 22 to 24 inches.

Management.—Much of this type is best suited for pasture because of the nearness of the limestone to the surface. The areas which are suitable for cultivation require the same management as that advised for Yellow-Gray Silt Loam with the exception that less limestone is required.

Yellow Silt Loam On Limestone (735.5)

Yellow Silt Loam On Limestone occupies only 1.43 square miles, or 915 acres. It is found in the northwestern part of the county where erosion has removed most of the surface soil.

The A_1 horizon is a brownish yellow to grayish yellow silt loam, averaging about 3 or 4 inches in depth, depending upon the depth of accumulated organic matter. The A_2 horizon, which is about 10 inches in thickness, is a yellow silt loam. The B horizon is a plastic, compact, yellow silt loam, mottled with gray and containing many red iron concretions. The depth to the underlying limestone varies from 8 to 30 inches.

Management.—This type is, very largely, suitable only for pasture or timber.

TERRACE SOILS

Terrace soils are formed on terraces or old fills. The terraces owe their formation to the deposition of material of overloaded streams which became greatly enlarged and flooded the valleys during the melting of the glaciers. Sometimes these valleys were filled almost to the level of the upland. Later the streams cut down thru the fills and developed new bottom lands. The lowest and most recently formed bottom land is called first bottom. The higher land, no longer flooded, or very rarely so, is designated as second bottom, or terrace.

Brown Silt Loam Over Gravel (1527)

Brown Silt Loam Over Gravel is one of the most widely distributed terrace types in Lee county. The largest areas of the type occur in the Inlet swamp region in the northeastern part of the county. It occupies 52.51 square miles, or 7.26 percent of the area of the county. The areas of the type which occur in the Green river basin contain an appreciable amount of sand. The topography of the type is flat to undulating. Drainage is well established.

The A_1 horizon, which is about 8 inches in depth, is a light brown to brown silt loam. The A_2 horizon, extending to about 18 inches in depth, is a yellowish brown silt loam. The B horizon, which is about 14 inches thick, varies from a friable, yellow silt loam to a slightly plastic, yellow, silty clay loam with slight mottling. Below 32 inches, the material varies from a friable, yellow, sandy silt loam to a sandy loam with terrace gravel and sand occurring from 38 to 45 inches below the surface.

Management.—Brown Silt Loam Over Gravel shows considerable variation in lime requirement. For this reason it is advised that the assistance of the farm adviser or the Experiment Station be secured in determining whether any limestone is needed, and if so, how much. The reader is referred to the discussion of the management of Brown Silt Loam, Upland, (page 16) for further suggestions regarding the management of this terrace type.

Black Silt Loam (1525)

Black Silt Loam, Terrace, occupies 54.89 square miles, or 7.58 percent of the area of the county. It is closely associated with Brown Silt Loam, Terrace, but occupies lower-lying areas. In the southwestern part of the county the type is more or less sandy in texture, owing to the wind blowing some of the sandy material upon the silty areas. The topography is flat.

The A_1 horizon, which is about 6 inches thick, is a black silt loam. The A_2 horizon, extending to about 18 inches in depth, is a plastic, black clay loam or silty clay loam. The B horizon, which is 10 to 12 inches in thickness, is a plastic, slightly compact, drabbish black to black clay loam, with an appreciable amount of sand present in the areas that occur in the western part of the county. The C horizon varies from a partially friable, yellow, silty clay loam to a drab clay loam, containing yellow and red iron concretions.

Management.—Black Silt Loam, Terrace, is rich in organic matter, much of which, however, is probably resistant to decay because it is in an advanced stage of decomposition. The chief requirements in the management of this type are the improvement of the underdrainage and the control of the harmful effects of the alkaline condition associated with poor drainage.

The installation of good underdrainage may be expected to decrease gradually the amount of alkali in the soil, tho the decrease to a point where there is no longer alkali toxicity is slow. Treatment with potash salts, either potassium sulfate, or potassium chlorid, at the rate of about 100 pounds an acre, will counteract the bad effects of the alkali. Straw and strawy manure are also good materials to apply to alkali soils. This soil produces good alfalfa and sweet clover.

Black Sandy Loam (1561)

Black Sandy Loam occurs fairly well distributed thruout the swamp area of Lee county and covers an area of 34.37 square miles, or 4.75 percent of the area of the county. Its topography is flat. This type was developed under conditions of poor drainage.

The A_1 horizon, which is about 10 to 12 inches in depth, is predominantly a black sandy loam. It varies in texture from a peaty loam to a sandy loam. The A_2 horizon extends to about 30 inches in depth and it ranges from a black sandy loam to black sand. The B horizon is a slightly compact, drabbish yellow, clay loam or sandy clay loam containing red iron concretions.

Management.—Black Sandy Loam, Terrace, as it occurs in Lee county, is very generally alkaline and in need of better drainage. Much has already been done in improving the drainage conditions. In laying tile in this soil, great care must be used in making the joints as the fine sand particles, many of which are rounded, cause trouble by clogging the drains. For further suggestions regarding the management of this type, the reader is referred to the recommendations made for Black Silt Loam, Terrace, page 24.

Brown Sandy Loam Over Gravel (1566)

Brown Sandy Loam Over Gravel is one of the predominating soil types of the Green river basin. It occupies 30.12 square miles, or 4.16 percent of the area of the county. Its topography varies from undulating to slightly rolling, the rolling topography being represented by the sand dunes. The areas are slightly higher than the adjacent Black Sandy Loam.

The A_1 horizon, which is about 8 inches in depth, is a brown sandy loam. The A_2 horizon, extending to about 20 inches in depth, is a brownish yellow to yellow sandy loam. The B horizon is a medium to coarse-grained yellow sandy loam. Very little sandy gravel occurs within 60 inches of the surface.

Management.—Brown Sandy Loam Over Gravel, as it is mapped, shows considerable variation both in character of the soil and in productivity. The better portions of the type are productive when well farmed and present no unusual problems of management. The poorer areas are very sandy and are subject to drouth and to drifting by the wind. The drainage of this type has been fairly well taken care of by open ditches and tile.

No very specific recommendation can be made for the use of limestone because of the great variability in lime requirement. The higher, coarser-textured areas are uniformly acid and need 2 to 3 tons of limestone an acre to grow alfalfa or sweet clover. These higher areas are in particular need of nitrogenous organic matter and will grow good corn following the turning down of a green-manure crop of sweet clover in the spring. Alfalfa may be grown successfully on this land, tho particular care must be used in getting a stand.

Black Clay Loam (1520)

Black Clay Loam occurs in the Inlet swamp in the eastern part of the county and occupies 1.52 square miles. It is flat in topography and is on the same level as the Black Silt Loam. The transition between these two types is gradual.

The A_1 horizon, which is about 6 inches in depth, is a black clay loam. The A_2 horizon, extending to 12 inches in depth, is a heavy, plastic, black clay loam, gradually changing into a plastic, slightly compact, drab clay loam subsoil which extends to about 22 inches in depth. The B horizon is a plastic, drab clay loam splotched with yellow streaks and containing numerous red iron concretions.

Management.—Black Clay Loam, Terrace, is a productive soil, does not need limestone, and rarely shows an alkaline condition. It requires only good farming, including some improvement in underdrainage and regular additions of nitrogenous organic matter, to produce good crops.

Yellow-Gray Silt Loam Over Gravel (1536)

Yellow-Gray Silt Loam Over Gravel is found along Rock river. It occupies only 2.45 square miles, or .33 percent of the area of the county. Its topography is slightly undulating. The natural drainage of the type is good, owing to the gravelly and sandy subsoil.

The A_1 horizon, which is about 6 inches in depth, varies from a grayish yellow to a brownish yellow silt loam. The A_2 horizon, extending to about 18 inches in depth, is a grayish yellow silt loam, becoming strongly mottled below 12 inches. The B horizon, which is about 10 inches thick, is a compact, strongly mottled, yellow silt loam. It rests on a yellowish gray sandy loam with some fine gravel occurring 40 to 50 inches below the surface.

Management.—Yellow-Gray Silt Loam Over Gravel is well drained and productive if well farmed. It is somewhat acid and is low in nitrogen and organic matter. About 2 tons of limestone an acre will permit the growth of sweet clover and alfalfa. It is an excellent alfalfa soil, and if this crop is grown, it is suggested that an application of ½ to 1 ton an acre of rock phosphate, or 500 pounds of acid phosphate, be made and well worked into the soil at the time of seeding.

Yellow-Gray Sandy Loam Over Gravel (1567)

Yellow-Gray Sandy Loam Over Gravel occurs in small areas along Rock river and in the Green river terrace southwest of Amboy. It covers an area of 2.33 square miles, or .32 percent of the area of the county. In topography it varies from undulating to rolling, owing in part to the presence of sand dunes.

The A_1 horizon is about 4 or 5 inches in depth and is a grayish yellow sandy loam. The A_2 horizon, which is about 12 inches in thickness, is a slightly mottled, yellow sandy loam. The B horizon, which is 6 or 7 inches thick, is a slightly compact, slightly mottled, yellow, clayey sandy loam. Below this depth yellow sand occurs.

Management.—Yellow-Gray Sandy Loam Over Gravel is a less productive soil than Yellow-Gray Silt Loam Over Gravel. It needs the same treatment as suggested for the latter type with particular attention being given to its nitrogen and organic-matter deficiencies.

Brown-Gray Silt Loam On Tight Clay (1528)

Brown-Gray Silt Loam On Tight Clay, Terrace, occurs in small areas thruout the terraces of both the Green river basin and Inlet swamp. It occupies only .59 square mile in the county. Often these areas are of a more or less sandy texture, owing to the close association with sandy soils. The topography is flat and the natural drainage is poor.

The A_1 horizon, to a depth of 6 inches, is a grayish brown to brown silt loam, with an appreciable amount of sand. The A_2 horizon is a stratum of gray silt extending to 20 inches in depth. The B horizon, which is about 10 inches in thickness, is a highly plastic, compact, tight clay, yellowish gray to gray in color. Below 30 inches a gray to drabbish gray clay loam occurs. This is plastic but not tight.

Management.—Brown-Gray Silt Loam On Tight Clay, Terrace, has the same management requirements as the corresponding upland type to which the reader is referred for suggestions, page 18.

Brown-Gray Sandy Loam On Tight Clay (1568)

Brown-Gray Sandy Loam On Tight Clay, Terrace, occurs as scattering areas in the Green river swamp, usually in connection with the sand dunes. It occupies 3.31 square miles, or .46 percent of the area of the county. Its topography is flat and its natural drainage is poor. Seepage waters from the sand dunes keep some of the areas well saturated.

The A_1 horizon, which is 4 to 8 inches in depth, is a brown sandy loam with a gray cast, particularly after it dries following a rain. The A_2 horizon, which is about 10 inches in thickness, is a yellowish gray to gray sandy loam. The B horizon, which is 6 or 8 inches in thickness, is a gray, sandy, highly impervious clay. Below this depth yellowish gray sand occurs.

Management.—Brown-Gray Sandy Loam On Tight Clay is strongly acid, requiring 3 to 4 tons of limestone an acre. Otherwise its management requirements are the same as those for the corresponding upland type, suggestions for which are found on page 19.

Dune Sand (1581)

Dune Sand, Terrace, is widely distributed thruout the Green river swamp and Inlet swamp. The dunes vary from 2 or 3 feet to 50 or 60 feet in height. They cover all told, 7.45 square miles, or 1.03 percent of the area of the county. The topography varies from billowy to rolling.

The A_1 horizon is a brownish yellow, loamy sand where there has been a little organic-matter accumulation. At a depth of 3 or 4 inches this changes into a yellow sand which extends to a considerable depth below 40 inches.

Management.—The management of Dune Sand, Terrace, differs in no essential from the management of Dune Sand, Upland. A discussion of the management of the latter type will be found on page 20.

Gray Sandy Loam (1562)

Gray Sandy Loam occupies 173 acres in Lee county and is located in the northwest corner of Reynolds township, Township 39 North, Range 1 East. The area is so situated that it receives much seepage water. This fact probably accounts for the formation of this type.

The A_1 horizon, which is about 6 inches in depth, is a brownish gray to yellowish gray sandy loam. The A_2 horizon, extending to a depth of about 14 inches, is a yellowish gray to gray sandy loam. The B horizon is a compact, impervious, sandy clay loam subsoil, varying from yellowish gray to yellow in color. Below an average depth of 32 inches a yellow sand occurs which is usually water logged even during the periods of drouth.

Management.—Gray Sandy Loam, Terrace, fortunately occupies a very small area in Lee county. Its management is the same as that required for Brown-Gray Silt Loam On Tight Clay, see page 19.

LATE SWAMP AND BOTTOM-LAND SOILS

In the group designated as Swamp and Bottom-Land Soils are included the bottom lands or flood plains along streams, the swamps, the poorly drained lowlands, and peats and mucks, whether on upland or terraces. Much of the soil is of alluvial formation and is subject to overflow.

Black Mixed Loam (1450)

Black Mixed Loam occurs as low swampy areas along streams and the poorly drained depressions in the uplands and terraces. It occupies a total area of 25.27 square miles.

The A_1 horizon varies from 7 to 8 inches in depth. It is brown to black in color and varies in texture from sandy loam to silt loam. Below this depth the color becomes drabbish black or drab, with the proportion of drab becoming greater with increasing depth. Considerable variation occurs in the texture of both the subsurface and the subsoil.

Management.—Black Mixed Loam is a productive soil when well drained; however, drainage is so poor over much of the type that it is left in pasture and meadow. The chief difficulty in draining this land is in getting outlets.

Mixed Loam (1454)

Mixed Loam occurs as first bottom along Rock river, Green river, and several small streams in the county. It occupies 18.93 square miles, or 2.62 percent of the area of the county. This type cannot be adequately described because of its variations. It is mapped as Mixed Loam because it is made up of a mixture of several types which occur in areas too small to be mapped separately.

The surface varies in color from brown to yellowish gray and in texture from a silt loam to a clay loam. The material below the 8- or 9-inch surface horizon also varies in texture, but usually has a yellowish gray color.

Management.—Mixed Loam is subject to overflow and the deposition of new material maintains a supply of the elements of plant food. Good farming is the only requirement in the management of this type.

Deep Peat (1401)

Deep Peat is found in scattering areas thruout the swamp and upland, totaling 2.57 square miles. The largest area is located in Sections 1 and 12, Township 37 North, Range 2 East.

The soil is a brown to black, well-decomposed peat to a depth of several feet, with the exception that near the borders of the areas a clay to sandy clay subsoil occurs from 35 to 40 inches below the surface.

Management.—The Deep Peat in Lee county is, for the most part, not sufficiently alkaline to injure crops. Drainage has been provided in most of the areas by means of open ditches. It is advisable to apply about 100 pounds per acre of one of the potash salts for corn.

Medium Peat On Clay (1402)

Medium Peat On Clay is found in a few small scattered areas thruout the county. The largest area is located in Wyoming township (Section 12, Township 37 North, Range 2 East). This area covers about 96 acres. It is fairly well drained and the depth to clay is fairly uniform over the area. The soil is about the same in texture and color as the Deep Peat with the exception that at 18 to 20 inches in depth the drab clay subsoil occurs and extends to below the 40-inch depth. This type requires the same management as Deep Peat.

RESIDUAL SOILS

Residual soils are formed from the residue left in place thru the weathering of the bed rock and the accumulation of organic matter. These soils are found along Rock river and its tributaries. A few isolated areas are found in the vicinity of Ashton and Lee Center. The residual soils are formed from both limestone and sandstone.

Sand (083)

Residual Sand occurs in the vicinity of Grand de Tour, where a fold in the underlying rock has occurred and caused the sandstone to outcrop. This fold is known as the LaSalle anticline. Thru weathering, the sandstone has disintegrated into a white sand which supports very little vegetative growth. No soil horizons have been developed. Often broken pieces of sandstone are found mixed with the sand. This formation is non-agricultural in value. Very little pasture is obtainable on it for grazing purposes.

Sandstone Outcrop (099)

Sandstone Outcrop occurs along the Rock river bluffs, in the vicinity of Grand de Tour, where the river makes its picturesque bend. It is non-agricultural, and the only value of the formation lies in its scenic beauty. The type occupies an area of 38 acres in the county.

Stony Loam (098)

Stony Loam occurs on the slopes of the eroded areas in the northern part of the county. Stones ranging up to 8 or 10 inches in diameter are numerous enough to interfere with cultivation. This type occupies only .15 square mile, or .02 percent of the county. It is of little agricultural value.

Limestone Outcrop (099)

Limestone Outcrop is found in abundance along Rock river and its small tributaries. Most of the outcrops occur as vertical exposures varying from 5 or 6 feet to 60 or 70 feet in thickness. There are no shipping quarries in Lee county. There are, however, numerous quarry sites in the northwestern and north-central parts of the county. Many of these outcrops are suitable for development as a source of agricultural limestone. Information regarding position, character, and composition of these outcrops may be secured from the State Geological Survey, Urbana, or from the Agricultural Experiment Station.

APPENDIX

EXPLANATIONS FOR INTERPRETING THE SOIL SURVEY

CLASSIFICATION OF SOILS

In order to interpret the soil map intelligently, the reader must understand something of the method of soil classification upon which the survey is based. Without going far into details the following paragraphs are intended to furnish a brief explanation of the general plan of classification used.

The soil type is the unit of classification. Each type has definite characteristics upon which its separation from other types is based. These characteristics are inherent in the strata, or "horizons," which constitute the soil profile in all mature soils. Among them may be mentioned color, structure, texture, and chemical composition. Other items, such as native vegetation (whether timber or prairie), topography, and geological origin and formation, may assist in the differentiation of types, altho they are not fundamental to it.

Since some of the terms used in designating the factors which are taken into account in establishing soil types are technical in nature, the following definitions are introduced:

Horizon. A layer or stratum of soil which differs discernibly from those adjacent in color, texture, structure, chemical composition, or a combination of these characteristics, is called an horizon. In describing a matured soil, three horizons designated as A, B, and C are usually considered.

A designates the upper horizon and, as developed under the conditions of a humid, temperate climate, represents the layer of extraction or eluviation; that is to say, material in solution or in suspension has passed out of this zone thru the processes of weathering.

B represents the layer of concentration or illuviation; that is, the layer developed as a result of the accumulation of material thru the downward movement of water from the A horizon.

C designates the layer lying below the B horizon and in which the material has been less affected by the weathering processes.

Frequently differences within these strata or zones are discernible, in which case they are subdivided and described under such designations as A_1, and A_2, B_1, and B_2, etc.

Soil Profile. The soil section as a whole is spoken of as the soil profile.

Depth and Thickness. The horizons or layers which make up the soil profile vary in depth and thickness. These variations are distinguishing features in the separation of soils into types.

Physical Composition. The physical composition, sometimes referred to as "texture," is a most important feature in characterizing a soil. The texture depends upon the relative proportions of the following physical constituents: clay, silt, fine sand, sand, gravel, stones, and organic material.

Structure. The term "structure" has reference to the aggregation of particles within the soil mass and carries such qualifying terms as open, granular, compact, columnar, laminated.

Organic-Matter Content. The organic matter of soil is derived largely from plant tissue and it exists in a more or less advanced stage of decomposition. Organic matter forms the predominating constituent in certain soils of swampy formation.

Color. Color is determined to a large extent by the proportion of organic matter, but at the same time it is modified by the mineral constituents, especially by iron compounds.

Reaction. The term "reaction" refers to the chemical state of the soil with respect to acid or alkaline condition. It also involves the idea of degree, as strongly acid or strongly alkaline.

Carbonate Content. The carbonate content has reference to the calcium carbonate (limestone) present, which in some cases may be associated with magnesium or other carbonates. The depth at which carbonates are found may become a very important factor in determining the soil type.

Topography. Topography has reference to the lay of the land, as level, rolling, hilly, etc.

Native Vegetation. The vegetation or plant growth before being disturbed by man, as prairie grasses and forest trees, is a feature frequently recognized in differentiating soil types.

Geological Origin. Geological origin involves the idea of character of rock materials composing the soil as well as the method of formation of the soil material.

Not infrequently areas are encountered in which type characters are not distinctly developed or in which they show considerable variation. When these variations are considered to have sufficient significance, type separations are made whenever the areas involved are sufficiently large. 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 which is allowable for any given type.

Classifying Soil Types.—In the system of classification used, the types fall first into four general groups based upon their geological relationships; namely, upland, terrace, swamp and bottom land, and residual. These groups may be subdivided into prairie soils and timber soils, altho as a matter of fact this subdivision is applied in the main only to the upland group. These terms are all explained in the foregoing part of this Report in connection with the description of the particular soil types.

Naming and Numbering Soil Types.—In the Illinois soil survey a system of nomenclature is 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" carries in itself a more or less 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 adequately descriptive, because the profile of mature soils is usually made up of three or more horizons and it is impossible to describe each horizon in the type name. The color and texture of the surface soil are usually included in the type name and when material such as sand, gravel, or rock lies at a depth of less than 30 inches, the fact is indicated by the word "On," and when its depth exceeds 30 inches, by the word "Over"; for example, Brown Silt Loam On Gravel, and Brown Silt Loam Over Gravel.

As a further step in systematizing the listing of the soils of Illinois, recognition is given to the location of the types with respect to the geological areas in which they occur. According to a geological survey made many years ago, the state has been divided into seventeen areas with respect to geological formation and, for the purposes of the soil survey, each of these areas has been assigned an index number. The names of the areas together with their general location and their corresponding index numbers are given in the following list.

000 *Residual,* soils formed in place thru disintegration of rocks, and also rock outcrop
100 *Unglaciated,* including three areas, the largest being in the south end of the state
200 *Illinoisan moraines,* including the moraines of the Illinoisan glaciations
300 *Lower Illinoisan glaciation,* formerly considered as covering nearly the south third of the state
400 *Middle Illinoisan glaciation,* covering about a dozen counties in the west-central part of the state
500 *Upper Illinoisan glaciation,* covering about fourteen counties northwest of the middle Illinoisan glaciation
600 *Pre-Iowan glaciation,* now believed to be part of the upper Illinoisan
700 *Iowan glaciation,* lying in the central northern end of the state

800 *Deep loess areas,* including a zone a few miles wide along the Wabash, Illinois, and Mississippi rivers
900 *Early Wisconsin moraines,* including the moraines of the early Wisconsin glaciation
1000 *Late Wisconsin moraines,* including the moraines of the late Wisconsin glaciation
1100 *Early Wisconsin glaciation,* covering the greater part of the northeast quarter of the state
1200 *Late Wisconsin glaciation,* lying in the northeast corner of the state
1300 *Old river-bottom and swamp lands,* formed by material derived from the Illinoisan or older glaciations
1400 *Late river-bottom and swamp lands,* formed by material derived from the Wisconsin and Iowan glaciations
1500 *Terraces,* bench or second bottom lands, and gravel outwash plains
1600 *Lacustrine deposits,* formed by Lake Chicago, the enlarged Glacial Lake Michigan

Further information regarding these geological areas is given in connection with the general map mentioned above and published in Bulletin 123 (1908).

Another set of index numbers is assigned to the classes of soils as based upon physical composition. The following list contains the names of these classes with their corresponding index numbers.

Index Number Limits	Class Names
0 to 9	Peats
10 to 12	Peaty loams
13 to 14	Mucks
15 to 19	Clays
20 to 24	Clay loams
25 to 49	Silt loams
50 to 59	Loams
60 to 79	Sandy loams
80 to 89	Sands
90 to 94	Gravelly loams
95 to 97	Gravels
98	Stony loams
99	Rock outcrop

As a convenient means of designating types and their location with respect to the geological areas of the state, each type is given a number made up of a combination of the index numbers explained above. This number indicates the type and the geological area in which it occurs. The geological area is always indicated by the digits of the order of hundreds while the balance of the number designates the type. To illustrate: the number 1126 means Brown Silt Loam in the early Wisconsin glaciation, 434 means Yellow-Gray Silt Loam of the middle Illinoisan glaciation. These numbers are especially useful in designating very small areas on the map and as a check in reading the colors.

A complete list of the soil types occurring in each county, along with their corresponding type numbers and the area covered by each type, will be found in the respective county soil reports in connection with the maps.

SOIL SURVEY METHODS

Mapping of Soil Types.—In conducting the soil survey, the county constitutes the unit of working area. The field work is done by parties of two to four men each. The field season extends from early in April to Thanksgiving. During the winter months the men are engaged in preparing a copy of the soil map to be sent to the lithographer, a copy for the use of the county farm adviser until the printed map is available, and a third copy for use in the office in order to preserve the original official map in good condition.

An accurate base map for field use is necessary for soil mapping. These maps are prepared on a scale of one inch to the mile, the official data of the original or subsequent land survey being used as the basis in their construction. Each surveyor is provided with one of these base maps, which he carries with him in the field; and the soil type boundaries, together with the streams, roads, railroads, canals, town sites, and rock and gravel quarries are placed in their proper location upon the map while the mapper is on the area. With the rapid development of road improvement during the past few years, it is almost inevitable that some recently established roads will not appear on the published soil map. Similarly, changes in other artificial features will occasionally occur in the interim between the preparation of the map and its publication. The detail or minimum size of areas which are shown on the map varies somewhat, but in general a soil type if less than five acres in extent is not shown.

A soil auger is carried by each man with which he can examine the soil to a depth of 40 inches. An extension for making the auger 80 inches long is taken by each party, so that the deeper subsoil may be studied. Each man carries a compass to aid in keeping directions. Distances along roads are measured by a speedometer or other measuring device, while distances in the field away from the roads are measured by pacing.

Sampling for Analysis.—After all the soil types of a county have been located and mapped, samples representative of the different types are collected for chemical analysis. The samples for this purpose are usually taken in three depths; namely, 0 to 6⅔ inches, 6⅔ to 20 inches, and 20 to 40 inches, as explained in connection with the discussion of the analytical data beginning on page 7.

PRINCIPLES OF SOIL FERTILITY

Probably no agricultural fact is more generally known by farmers and landowners than that soils differ in productive power. A fact of equal importance, not so generally recognized, is that they also differ in other characteristics such as response to fertilizer treatment and to management.

The soil is a dynamic, ever-changing, exceedingly complex substance made up of organic and inorganic materials and teeming with life in the form of microorganisms. Because of these characteristics, the soil cannot be considered as a reservoir into which a given quantity of an element or elements of plant food can be poured with the assurance that it will respond with a given increase in crop yield. In a similar manner it cannot be expected to respond with perfect uniformity to a given set of management standards. To be productive a soil must be in such condition physically with respect to structure and moisture as to encourage root development; and in such condition chemically that injurious substances are not present in harmful amounts, that a sufficient supply of the elements of plant food become available or usable during the growing season, and that lime materials are present in sufficient abundance favorable for the growth of the higher plants and of the beneficial microorganisms. Good soil management under humid conditions involves the adoption of those tillage, cropping, and fertilizer treatment methods which will result in profitable and permanent crop production on the soil type concerned.

The following paragraphs are intended to state in a brief way some of the principles of soil management and treatment which are fundamental to profitable and continued productivity.

CROP REQUIREMENTS WITH RESPECT TO PLANT-FOOD MATERIALS

Ten of the chemical elements are known to be essential for the growth of the higher plants. These are *carbon, hydrogen, oxygen, nitrogen, phosphorus, sulfur, potassium, calcium, magnesium,* and *iron.* Other elements are absorbed from the soil by growing plants, including manganese, silicon, sodium, aluminum, chlorin, and boron. It is probable that these latter elements are present in plants for the most part, not because they are required, but because they are dissolved in the soil water and the plant has no means of preventing their entrance. There is some evidence, however, which indicates that certain of these elements, notably manganese, silicon, and boron, may be either essential but required in only minute quantities, or very beneficial to plant growth under certain conditions, even tho not essential. Thus, for example, manganese has produced marked increases in crop yields on heavily limed soils. Sodium also has been found capable of partially replacing potassium in case of a shortage of the latter element.

Table 5 shows the requirements of some of our most common field crops with respect to seven important plant-food elements furnished by the soil. The figures show the weight in pounds of the various elements contained in a bushel or in a ton, as the case may be. From these data the amount of an element removed from an acre of land by a crop of a given yield can easily be computed.

TABLE 5.—PLANT-FOOD ELEMENTS IN COMMON FARM CROPS[1]

Produce		Nitrogen	Phosphorus	Sulfur	Potassium	Magnesium	Calcium	Iron
Kind	Amount							
		lbs.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*
Wheat, grain...	1 bu.	1.42	.24	.10	.26	.08	.02	.01
Wheat straw...	1 ton	10.00	1.60	2.80	18.00	1.60	3.80	.60
Corn, grain....	1 bu.	1.00	.17	.08	.19	.07	.01	.01
Corn stover....	1 ton	16.00	2.00	2.42	17.33	3.33	7.00	1.60
Corn cobs.....	1 ton	4.00	.....	.....	4.00	.....	.....	.....
Oats, grain.....	1 bu.	.66	.11	.06	.16	.04	.02	.01
Oats straw.....	1 ton	12.40	2.00	4.14	20.80	2.80	6.00	1.12
Clover seed....	1 bu.	1.75	.50	.....	.75	.25	.13	.....
Clover hay....	1 ton	40.00	5.00	3.28	30.00	7.75	29.25	1.00
Soybean seed ..	1 bu.	3.22	.39	.27	1.26	.15	.14	.....
Soybean hay...	1 ton	43.40	4.74	5.18	35.48	13.84	27.56	.....
Alfalfa hay....	1 ton	52.08	4.76	5.96	16.64	8.00	22.26	.....

[1]These data are brought together from various sources. Some allowance must be made for the exactness of the figures because samples representing the same kind of crop or the same kind of material frequently exhibit considerable variation.

PLANT-FOOD SUPPLY

Of the elements of plant food, three (carbon, oxygen, and hydrogen) are secured from air and water, and the others from the soil. Nitrogen, one of the elements obtained from the soil by all plants, may also be secured from the air by the class of plants known as legumes, in case the amount liberated from the soil is insufficient; but even these plants, which include only the clovers, peas, beans, and vetches among our common agricultural plants, are dependent upon the soil for the other six elements (phosphorus, potassium, magnesium, calcium, iron, and sulfur), and they also utilize the soil nitrogen so far as it becomes soluble and available during their period of growth.

The vast difference with respect to the supply of these essential plant-food elements in different soils is well brought out in the data of the Illinois soil survey. For example, it has been found that the nitrogen in the surface 6⅔ inches, which represents the plowed stratum, varies in amount from 180 pounds per acre to more than 35,000 pounds. In like manner the phosphorus content varies from about 320 to 4,900 pounds, and the potassium ranges from 1,530 to about 58,000 pounds. Similar variations are found in all of the other essential plant-food elements of the soil.

With these facts in mind it is easy to understand how a deficiency of one of these elements of plant food may become a limiting factor of crop production. When an element becomes so reduced in quantity as to become a limiting factor of production, then we must look for some outside source of supply. Table 6

TABLE 6.—PLANT-FOOD ELEMENTS IN MANURE, ROUGH FEEDS, AND FERTILIZERS[1]

Material	Pounds of plant food per ton of material		
	Nitrogen	Phosphorus	Potassium
Fresh farm manure	10	2	8
Corn stover	16	2	17
Oat straw	12	2	21
Wheat straw	10	2	18
Clover hay	40	5	30
Cowpea hay	43	5	33
Alfalfa hay	50	4	24
Sweet clover (water-free basis)[2]	80	8	28
Dried blood	280	.....	.....
Sodium nitrate	310	.....	.....
Ammonium sulfate	400	.....	.....
Raw bone meal	80	180	.....
Steamed bone meal	20	250	.....
Raw rock phosphate	.....	250	.....
Acid phosphate	.....	125	.....
Potassium chlorid	.....	.....	850
Potassium sulfate	.....	.....	850
Kainit	.....	.....	200
Wood ashes[3] (unleached)	.....	10	100

[1]See footnote to Table 5.
[2]Young second-year growth ready to plow under as green manure.
[3]Wood ashes also contain about 1,000 pounds of lime (calcium carbonate) per ton.

is presented for the purpose of furnishing information regarding the quantity of some of the more important plant-food elements contained in materials most commonly used as sources of supply.

LIBERATION OF PLANT FOOD

The chemical analysis of the soil gives the invoice of plant-food elements actually present in the soil strata sampled and analyzed, but the rate of liberation is governed by many factors, some of which may be controlled by the farmer, while others are largely beyond his control. Chief among the important controllable factors which influence the liberation of plant food are the choice of crops to be grown, the use of limestone, and the incorporation of organic matter. Tillage, especially plowing, also has a considerable effect in this connection.

Feeding Power of Plants.—Different species of plants exhibit a very great diversity in their ability to obtain plant food directly from the insoluble minerals of the soil. As a class, the legumes—especially such biennial and perennial legumes as red clover, sweet clover, and alfalfa—are endowed with unusual power to assimilate from mineral sources such elements as calcium and phosphorus, converting them into available forms for the crops that follow. For this reason it is especially advantageous to employ such legumes in connection with the application of limestone and rock phosphate. Thru their growth and subsequent decay large quantities of the mineral elements are liberated for the benefit of the cereal crops which follow in the rotation. Moreover, as an effect of the deep-rooting habit of these legumes, mineral plant-food elements are brought up and rendered available from the vast reservoirs of the lower subsoil.

Effect of Limestone.—Limestone corrects the acidity of the soil and supplies calcium, thus encouraging the development not only of the nitrogen-gathering bacteria which live in the nodules on the roots of clover, cowpeas, and other legumes, but also the nitrifying bacteria, which have power to transform the unavailable organic nitrogen into available nitrate nitrogen. At the same time, the products of this decomposition have power to dissolve the minerals contained in the soil, such as potassium and magnesium compounds.

Organic Matter and Biological Action.—Organic matter may be supplied thru animal manures, consisting of the excreta of animals and usually accompanied by more or less stable litter; and by plant manures, including green-manure crops and cover crops plowed under, and also crop residues such as stalks, straw, and chaff. The rate of decay of organic matter depends largely upon its age, condition, and origin, and it may be hastened by tillage. The chemical analysis shows correctly the total organic carbon, which constitutes, as a rule, but little more than half the organic matter; so that 20,000 pounds of organic carbon in the plowed soil of an acre corresponds to nearly 20 tons of organic matter. But this organic matter consists largely of the old organic residues that have accumulated during the past centuries because they were resistant to decay, and 2 tons of clover or cowpeas plowed under may have greater power to liberate plant-food materials than 20 tons of old, inactive organic matter. The history of the individual farm or field must be depended upon for information concerning recent additions of active organic matter, whether in applications of farm manure, in legume crops, or in sods of old pastures.

The condition of the organic matter of the soil is indicated to some extent by the ratio of carbon to nitrogen. Fresh organic matter recently incorporated with the soil contains a very much higher proportion of carbon to nitrogen than do the old resistant organic residues of the soil. The proportion of carbon to nitrogen is higher in the surface soil than in the corresponding subsoil, and in general this ratio is wider in highly productive soils well charged with active organic matter than in very old, worn soils badly in need of active organic matter.

The organic matter furnishes food for bacteria, and as it decays certain decomposition products are formed, including much carbonic acid, some nitrous acid, and various organic acids, and these acting upon the soil have the power to dissolve the essential mineral plant foods, thus furnishing available phosphates, nitrates, and other salts of potassium, magnesium, calcium, etc., for the use of the growing crop.

Effect of Tillage.—Tillage, or cultivation, also hastens the liberation of plant-food elements by permitting the air to enter the soil. It should be remembered, however, that tillage is wholly destructive, in that it adds nothing whatever to the soil, but always leaves it poorer, so far as plant-food materials are concerned. Tillage should be practiced so far as is necessary to prepare a suitable seed bed for root development and also for the purpose of killing weeds, but more than this is unnecessary and unprofitable; and it is much better actually to enrich the soil by proper applications of limestone, organic matter, and other fertilizing materials, and thus promote soil conditions favorable for vigorous plant growth, than to depend upon excessive cultivation to accomplish the same object at the expense of the soil.

PERMANENT SOIL IMPROVEMENT

According to the kind of soil involved, any comprehensive plan contemplating a permanent system of agriculture will need to take into account some of the following considerations.

The Application of Limestone

The Function of Limestone.—In considering the application of limestone to land it should be understood that this material functions in several different ways, and that a beneficial result may therefore be attributable to quite diverse causes. Limestone provides calcium, of which certain crops are strong feeders. It corrects acidity of the soil, thus making for some crops a much more favorable environment as well as establishing conditions absolutely required for some of the beneficial legume bacteria. It accelerates nitrification and nitrogen fixation. It promotes sanitation of the soil by inhibiting the growth of certain fungous diseases, such as corn-root rot. Experience indicates that it modifies either directly or indirectly the physical structure of fine-textured soils, frequently to their great improvement. Thus, working in one or more of these different ways, limestone often becomes the key to the improvement of worn lands.

How to Ascertain the Need for Limestone.—One of the most reliable indications as to whether a soil needs limestone is the character of the growth of certain legumes, particularly sweet clover and alfalfa. These crops do not thrive in acid soils. Their successful growth, therefore, indicates the lack of sufficient acidity in the soil to be harmful. In case of their failure to grow the soil should be tested for acidity as described below. A very valuable test for ascertaining the need of a soil for limestone is found in the potassium thiocyanate test for soil acidity. It is desirable to make the test for carbonates along with the acidity test. Limestone is calcium carbonate, while dolomite is the combined carbonates of calcium and magnesium. The natural occurrence of these carbonates in the soil is sufficient assurance that no limestone is needed, and the acidity test will be negative. On lands which have been treated with limestone, however, the surface soil may give a positive test for carbonates, owing to the presence of undecomposed pieces of limestone, and at the same time a positive test for acidity may be secured. Such a result means either that insufficient limestone has been added to neutralize the acidity, or that it has not been in the soil long enough to entirely correct the acidity. In making these tests, it is desirable to examine samples of soil from different depths, since carbonates may be present, even in abundance, below a surface stratum that is acid. Following are the directions for making the tests:

The Potassium Thiocyanate Test for Acidity. This test is made with a 4-percent solution of potassium thiocyanate in alcohol—4 grams of potassium thiocyanate in 100 cubic centimeters of 95-percent alcohol.[1] When a small quantity of soil shaken up in a test tube with this solution gives a red color the soil is acid and limestone should be applied. If the solution remains colorless the soil is not acid. An excess of water interferes with the reaction. The sample when tested, therefore, should be at least as dry as when the soil is in good tillable condition. For a prompt reaction the temperature of the soil and solution should be not lower than that of comfortable working conditions (60° to 75° Fahrenheit).

The Hydrochloric Acid Test for Carbonates. Take a small representative sample of soil and pour upon it a few drops of hydrochloric (muriatic) acid, prepared by diluting the concentrated acid with an equal volume of water. The presence of limestone or some other carbonates will be shown by the appearance of gas bubbles within 2 or 3 minutes, producing foaming or effervescence. The absence of carbonates in a soil is not in itself evidence that the soil is acid or that limestone should be applied, but it indicates that the confirmatory potassium thiocyanate test should be carried out.

Amounts to Apply.—Acid soils should be treated with limestone whenever such application is at all practicable. The initial application varies with the degree of acidity and will usually range from 2 to 6 tons an acre. The larger amounts will be needed on strongly acid soils, particularly on land being prepared for alfalfa. When sufficient limestone has been used to establish conditions favorable to the growth of legumes, no further applications are necessary until the acidity again develops to such an extent as to interfere with the best growth of these crops. This will ordinarily be at intervals of several years. In the case of an inadequate supply of magnesium in the soil, the occasional use of magnesian (dolomitic) limestone would serve to correct this deficiency. Otherwise, so far as present knowledge indicates, either form of limestone—

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[1] Since undenatured alcohol is difficult to obtain, some of the denatured alcohols have been tested for making this solution. Completely denatured alcohol made over U. S. Formulas No. 1 and No. 4, have been found satisfactory. Some commercial firms are also offering other preparations which are satisfactory.

high-calcium or magnesian—will be equally effective, depending upon the purity and fineness of the respective stones.

Fineness of Material.—The fineness to which limestone is ground is an important consideration in its use for soil improvement. Experiments indicate that a considerable range in this regard is permissible. Very fine grinding insures ready solubility, and thus promptness in action; but the finer the grinding the greater is the expense involved. A grinding, therefore, that furnishes not too large a proportion of coarser particles along with the finer, similar to that of the by-product material on the market, is to be recommended. Altho the exact proportions of coarse and fine material cannot be prescribed, it may be said that a limestone crushed so that the coarsest fragments will pass thru a screen of 4 to 10 meshes to the inch is satisfactory if the total product is used.

The Nitrogen Problem

Nitrogen presents the greatest practical soil problem in American agriculture. Four important reasons for this are: its increasing deficiency in most soils; its cost when purchased on the open market; its removal in large amounts by crops; and its loss from soils thru leaching. Nitrogen usually costs from four to five times as much per pound as phosphorus. A 100-bushel crop of corn requires 150 pounds of nitrogen for its growth, but only 23 pounds of phosphorus. The loss of nitrogen from soils may vary from a few pounds to over one hundred pounds per acre, depending upon the treatment of the soil, the distribution of rainfall, and the protection afforded by growing crops.

An inexhaustible supply of nitrogen is present in the air. Above each acre of the earth's surface there are about sixty-nine million pounds of atmospheric nitrogen. The nitrogen above one square mile weighs twenty million tons, an amount sufficient to supply the entire world for four or five decades. This large supply of nitrogen in the air is the one to which the world must eventually turn.

There are two methods of collecting the inert nitrogen gas of the air and combining it into compounds that will furnish products for plant growth. These are the chemical and the biological fixation of the atmospheric nitrogen. Farmers have at their command one of these methods. By growing inoculated legumes, nitrogen may be obtained from the air, and by plowing under more than the roots of these legumes, nitrogen may be added to the soil.

Inasmuch as legumes are worth growing for purposes other than the fixation of atmospheric nitrogen, a considerable portion of the nitrogen thus gained may be considered a by-product. Because of that fact, it is questionable whether the chemical fixation of nitrogen will ever be able to replace the simple method of obtaining atmospheric nitrogen by growing inoculated legumes in the production of our great grain and forage crops.

It may well be kept in mind that the following amounts of nitrogen are required for the produce named:

1 bushel of oats (grain and straw) requires 1 pound of nitrogen.
1 bushel of corn (grain and stalks) requires 1½ pounds of nitrogen.
1 bushel of wheat (grain and straw) requires 2 pounds of nitrogen.
1 ton of timothy contains 24 pounds of nitrogen.
1 ton of clover contains 40 pounds of nitrogen.

1 ton of cowpea hay contains 43 pounds of nitrogen.
1 ton of alfalfa contains 50 pounds of nitrogen.
1 ton of average manure contains 10 pounds of nitrogen.
1 ton of young sweet clover, at about the stage of growth when it is plowed under as green manure, contains, on water-free basis, 80 pounds of nitrogen.

The roots of clover contain about half as much nitrogen as the tops, and the roots of cowpeas contain about one-tenth as much as the tops. Soils of moderate productive power will furnish as much nitrogen to clover (and two or three times as much to cowpeas) as will be left in the roots and stubble. In grain crops, such as wheat, corn, and oats, about two-thirds of the nitrogen is contained in the grain and one-third in the straw or stalks.

The Phosphorus Problem

The element phosphorus is an indispensable constituent of every living cell. It is intimately connected with the life processes of both plants and animals, the nuclear material of the cells being especially rich in this element.

The phosphorus content of the soil is dependent upon the origin of the soil. The removal of phosphorus by continuous cropping slowly reduces the amount of this element in the soil available for crop use, unless its addition is provided for by natural means, such as overflow, or by agricultural practices, such as the addition of phosphatic fertilizers and rotations in which deep-rooting, leguminous crops are frequently grown.

It should be borne in mind in connection with the application of phosphate, or of any other fertilizing material, to the soil, that no benefit can result until the need for it has become a limiting factor in plant growth. For example, if there is already present in the soil sufficient available phosphorus to produce a forty-bushel crop, and the nitrogen supply or the moisture supply is sufficient for only forty bushels, or less, then extra phosphorus added to the soil cannot increase the yield beyond this forty-bushel limit.

There are several different materials containing phosphorus which are applied to land as fertilizer. The more important of these are bone meal, acid phosphate, natural raw rock phosphate, and basic slag. Obviously that carrier of phosphorus which gives the most economical returns, as considered from all standpoints, is the most suitable one to use. Altho this matter has been the subject of much discussion and investigation the question still remains unsettled. Probably there is no single carrier of phosphorus that will prove to be the most economical one to use under all circumstances because so much depends upon soil conditions, crops grown, length of haul, and market conditions.

Bone meal, prepared from the bones of animals, appears on the market in two different forms, raw and steamed. Raw bone meal contains, besides the phosphorus, a considerable percentage of nitrogen which adds a useless expense if the material is purchased only for the sake of the phosphorus. As a source of phosphorus, steamed bone meal is preferable to raw bone meal. Steamed bone meal is prepared by extracting most of the nitrogenous and fatty matter from the bones, thus producing a more nearly pure form of calcium phosphate containing about 10 to 12 percent of the element phosphorus.

Acid phosphate is produced by treating rock phosphate with sulfuric acid. The two are mixed in about equal amounts; the product therefore contains about one-half as much phosphorus as the rock phosphate itself. Besides phosphorus, acid phosphate also contains sulfur, which is likewise an element of plant food. The phosphorus in acid phosphate is more readily available for absorption by plants than that of raw rock phosphate. Acid phosphate of good quality should contain 6 percent or more of the element phosphorus.

Rock phosphate, sometimes called floats, is a mineral substance found in vast deposits in certain regions. The phosphorus in this mineral exists chemically as tri-calcium phosphate, and a good grade of the rock should contain 12½ percent, or more, of the element phosphorus. The rock should be ground to a powder, fine enough to pass thru a 100-mesh sieve, or even finer.

The relative cheapness of raw rock phosphate, as compared with the treated or acidulated material, makes it possible to apply for equal money expenditure considerably more phosphorus per acre in this form than in the form of acid phosphate, the ratio being, under the market conditions of the past several years, about 4 to 1. That is to say, under these market conditions, a dollar will purchase about four times as much of the element phosphorus in the form of rock phosphate as in the form of acid phosphate, which is an important consideration if one is interested in building up a phosphorus reserve in the soil. As explained above, more very carefully conducted comparisons on various soil types under various cropping systems are needed before definite statements can be given as to which form of phosphate is most economical to use under any given set of conditions.

Basic slag, known also as Thomas phosphate, is another carrier of phosphorus that might be mentioned because of its considerable usage in Europe and eastern United States. Basic slag phosphate is a by-product in the manufacture of steel. It contains a considerable proportion of basic material and therefore it tends to influence the soil reaction.

Rock phosphate may be applied at any time during a rotation, but it is applied to the best advantage either preceding a crop of clover, which plant seems to possess an unusual power for assimilating the phosphorus from raw phosphate, or else at a time when it can be plowed under with some form of organic matter such as animal manure or green manure, the decay of which serves to liberate the phosphorus from its insoluble condition in the rock. It is important that the finely ground rock phosphate be intimately mixed with the organic material as it is plowed under.

In using acid phosphate or bone meal in a cropping system which includes wheat, it is a common practice to apply the material in the preparation of the wheat ground. It may be advantageous, however, to divide the total amount to be used and apply a portion to the other crops of the rotation, particularly to corn and to clover.

The Potassium Problem

Our most common soils, which are silt loams and clay loams, are well stocked with potassium. altho it exists largely in a slowly soluble form. Such soils as sands and peats, however, are likely to be low in this element. On such soils this deficiency may be remedied by the application of some potassium salt, such as potassium sulfate, potassium chlorid, kainit, or other potassium compound, and in many instances this is done at great profit.

From all the facts at hand it seems, so far as our great areas of common soils are concerned, that, with a few exceptions, the potassium problem is not one of addition but of liberation. The Rothamsted records, which represent the oldest soil experiment fields in the world, show that for many years other soluble salts have had practically the same power as potassium salts to increase crop yields in the absence of sufficient decaying organic matter. Whether this action relates to supplying or liberating potassium for its own sake, or to the power of the soluble salt to increase the availability of phosphorus or other elements, is not known, but where much potassium is removed, as in the entire crops at Rothamsted, with no return of organic residues, probably the soluble salt functions in both ways.

Further evidence on this matter is furnished by the Illinois experiment field at Fairfield, where potassium sulfate has been compared with kainit both with and without the addition of organic matter in the form of stable manure. Both sulfate and kainit produced a substantial increase in the yield of corn, but the cheaper salt—kainit—was just as effective as the potassium sulfate, and returned some financial profit. Manure alone gave an increase similar to that produced by the potassium salts, but the salts added to the manure gave very little increase over that produced by the manure alone. This is explained in part, perhaps, by the fact that the potassium removed in the crops is mostly returned in manure properly cared for, and perhaps in larger part by the fact that decaying organic matter helps to liberate and hold in solution other plant-food elements, especially phosphorus.

In laboratory experiments at the Illinois Experiment Station, it has been shown that potassium salts and most other soluble salts increase the solubility of the phosphorus in soil and in rock phosphate; also that the addition of glucose with rock phosphate in pot-culture experiments increases the availability of the phosphorus, as measured by plant growth, altho the glucose consists only of carbon, hydrogen, and oxygen, and thus contains no limiting element of plant food.

In considering the conservation of potassium on the farm it should be remembered that in average livestock farming the animals destroy two-thirds of the organic matter and retain one-fourth of the nitrogen and phosphorus from the food they consume, but that they retain less than one-tenth of the potassium; so that the actual loss of potassium in the products sold from the farm, either in grain farming or in livestock farming, is negligible on land containing 25,000 pounds or more of potassium in the surface 6⅔ inches.

The Calcium and Magnesium Problem

When measured by crop removals of the plant-food elements, calcium is often more limited in Illinois soils than is potassium, while magnesium may be occasionally. In the case of calcium, however, the deficiency is likely to develop more rapidly and become much more marked because this element is leached out of the soil in drainage water to a far greater extent than is either magnesium or potassium.

The annual loss of limestone from the soil depends, of course, upon a number of factors aside from those which have to do with climatic conditions. Among these factors may be mentioned the character of the soil, the kind of limestone, its condition of fineness, the amount present, and the sort of farming practiced. Because of this variation in the loss of lime materials from the soil, it is impossible to prescribe a fixed practice in their renewal that will apply universally. The tests for acidity and carbonates described above, together with the behavior of such lime-loving legumes as alfalfa and sweet clover, will serve as general indicators for the frequency of applying limestone and the amount to use on a given field.

Limestone has a direct value on some soils for the plant food which it supplies, in addition to its value in correcting soil acidity and in improving the physical condition of the soil. Ordinary limestone (abundant in the southern and western parts of Illinois) contains nearly 800 pounds of calcium per ton; while a good grade of dolomitic limestone (the more common limestone of northern Illinois) contains about 400 pounds of calcium and 300 pounds of magnesium per ton. Both of these elements are furnished in readily available form in ground dolomitic limestone.

The Sulfur Question

In considering the relation of sulfur in a permanent system of soil fertility it is important to understand something of the cycle of transformations that this element undergoes in nature. Briefly stated this is as follows:

Sulfur exists in the soil in both organic and inorganic forms, the former being gradually converted to the latter form thru bacterial action. In this inorganic form sulfur is taken up by plants which in their physiological processes change it once more into an organic form as a constituent of protein. When these plant proteins are consumed by animals, the sulfur becomes a part of the animal protein. When these plant and animal proteins are decomposed, either thru bacterial action, or thru combustion, as in the burning of coal, the sulfur passes into the atmosphere or into the soil solution in the form of sulfur dioxid gas. This gas unites with oxygen and water to form sulfuric acid, which is readily washed back into the soil by the rain, thus completing the cycle, from soil—to plants and animals—to air—to soil.

In this way sulfur becomes largely a self-renewing element of the soil, altho there is a considerable loss from the soil by leaching. Observations taken at the Illinois Agricultural Experiment Station show that 40 pounds of sulfur per acre are brought into the soil thru the annual rainfall. With a fair stock of sulfur, such as exists in our common types of soil, and with an annual return, which of itself would more than suffice for the needs of maximum crops, the maintenance of an adequate sulfur supply presents little reason at present for serious concern. There are regions, however, where the natural stock of sulfur in the soil is not nearly so high and where the amount returned thru rainfall is small. Under such circumstances sulfur soon becomes a limiting element of crop production, and it will be necessary sooner or later to introduce this substance from some outside source. Investigation is now under way to determine to what extent this situation may apply under Illinois conditions.

Physical Improvement of Soils

In the management of most soil types, one very important matter, aside from proper fertilization, tillage, and drainage, is to keep the soil in good physical condition, or good tilth. The constituent most important for this purpose is organic matter. Organic matter in producing good tilth helps to control washing of soil on rolling land, raises the temperature of drained soil, increases the moisture-holding capacity of the soil, slightly retards capillary rise and consequently loss of moisture by surface evaporation, and helps to overcome the tendency of some soils to run together badly.

The physical effect of organic matter is to produce a granulation or mellowness, by cementing the fine soil particles into crumbs or grains about as large as grains of sand, which produces a condition very favorable for tillage, percolation of rainfall, and the development of plant roots.

Organic matter is undergoing destruction during a large part of the year and the nitrates produced in its decomposition are used for plant growth. Altho this decomposition is necessary, it nevertheless reduces the amount of organic matter, and provision must therefore be made for maintaining the supply. The practical way to do this is to turn under the farm manure, straw, cornstalks, weeds, and all or part of the legumes produced on the farm. The amount of legumes needed depends upon the character of the soil. There are farms, especially grain farms, in nearly every community where all legumes could be turned under for several years to good advantage.

Manure should be spread upon the land as soon as possible after it is produced, for if it is allowed to lie in the barnyard several months as is so often the case, from one-third to two-thirds of the organic matter will be lost.

Straw and cornstalks should be turned under, and not burned. There is considerable evidence indicating that on some soils undecomposed straw applied in excessive amount may be detrimental. Probably the best practice is to apply the straw as a constituent of well-rotted stable manure. Perhaps no form of organic matter acts more beneficially in producing good tilth than cornstalks. It is true, they decay rather slowly, but it is also true that their durability in the soil is exactly what is needed in the production of good tilth. Furthermore, the nitrogen in a ton of cornstalks is one and one-half times that of a ton of manure, and a ton of dry cornstalks incorporated in the soil will ultimately furnish as much humus as four tons of average farm manure. When burned, however, both the humus-making material and the nitrogen are lost to the soil.

It is a common practice in the corn belt to pasture the cornstalks during the winter and often rather late in the spring after the frost is out of the ground. This trampling by stock sometimes puts the soil in bad condition for working. It becomes partially puddled and will be cloddy as a result. If tramped too late in the spring, the natural agencies of freezing and thawing and wetting and drying, with the aid of ordinary tillage, fail to produce good tilth before the crop is planted. Whether the crop be corn or oats, it necessarily suffers and if the season is dry, much damage may be done. If the field is put in corn, a poor stand is likely to result, and if put in oats, the soil is so compact as to be unfavorable for their growth. Sometimes the soil is worked when too wet. This also produces a partial puddling which is unfavorable to physical, chemical, and biological processes. The effect becomes worse if cropping has reduced the organic matter below the amount necessary to maintain good tilth.

Systems of Crop Rotations

In a program of permanent soil improvement one should adopt at the outset a good rotation of crops, including, for the reasons discussed above, a liberal use of legumes. No one can say in advance for every particular case what will prove to be the best rotation of crops, because of variation in farms and farmers and in prices for produce. As a general principle the shorter rotations, with the frequent introduction of leguminous crops, are the better adapted for building up poor soils.

Following are a few suggested rotations which may serve as models or outlines to be modified according to special circumstances.

Six-Year Rotations

First year —Corn
Second year —Corn
Third year —Wheat or oats (with clover, or clover and grass)
Fourth year —Clover, or clover and grass
Fifth year —Wheat (with clover), or grass and clover
Sixth year —Clover, or clover and grass

Of course there should be as many fields as there are years in the rotation. In grain farming, with small grain grown the third and fifth years, most of the unsalable products should be returned to the soil, and the clover may be clipped and left on the land or returned after threshing out the seed (only the clover seed being sold the fourth and sixth years); or, in livestock farming, the field may be used three years for timothy and clover pasture and meadow if desired. The system may be reduced to a five-year rotation by cutting out either the second or the sixth year, and to a four-year system by omitting the fifth and sixth years, as indicated below.

Five-Year Rotations

First year —Corn
Second year —Wheat or oats (with clover, or clover and grass)
Third year —Clover, or clover and grass
Fourth year —Wheat (with clover), or clover and grass
Fifth year —Clover, or clover and grass

First year —Corn
Second year —Corn
Third year —Wheat or oats (with clover, or clover and grass)
Fourth year —Clover, or clover and grass
Fifth year —Wheat (with clover)

First year —Corn
Second year —Cowpeas or soybeans
Third year —Wheat (with clover)
Fourth year —Clover
Fifth year —Wheat (with clover)

The last rotation mentioned above allows legumes to be grown four times. Alfalfa may be grown on a sixth field for five or six years in the combination rotation, alternating between two fields every five years, or rotating over all the fields if moved every six years.

Four-Year Rotations

First year —Corn
Second year —Wheat or oats (with clover)
Third year —Clover
Fourth year —Wheat (with clover)

First year —Corn
Second year —Cowpeas or soybeans
Third year —Wheat (with clover)
Fourth year —Clover

First year —Corn
Second year —Corn
Third year —Wheat or oats (with clover)
Fourth year —Clover

First year —Wheat (with clover)
Second year —Clover
Third year —Corn
Fourth year —Oats (with clover)

Alfalfa may be grown on a fifth field for four or eight years, which is to be alternated with one of the four; or the alfalfa may be moved every five years, and thus rotated over all five fields every twenty-five years.

Three-Year Rotations

First year —Corn
Second year —Oats or wheat (with clover)
Third year —Clover

First year —Wheat or oats (with clover)
Second year —Corn
Third year —Cowpeas or soybeans

By allowing the clover, in the last rotation mentioned, to grow in the spring before preparing the land for corn, we have provided a system in which legumes grow on every acre every year. This is likewise true of the following suggested two-year system:

Two-Year Rotations

First year —Oats or wheat (with sweet clover)
Second year —Corn

Altho in this two-year rotation either oats or wheat is suggested, as a matter of fact, by dividing the land devoted to small grain, both of these crops can be grown simultaneously, thus providing a three-crop system in a two-year cycle.

It should be understood that in all of the above suggested cropping systems it may be desirable in some cases to substitute rye for the wheat or oats. Or, in some cases, it may become desirable to divide the acreage of small grain and grow in the same year more than one kind. In all of these proposed rotations the word *clover* is used in a general sense to designate either red clover, alsike clover, or sweet clover. The value of sweet clover, especially as a green manure for building up depleted soils, as well as a pasture and hay-crop, is becoming thoroly established, and its importance in a crop-rotation program may well be emphasized.

SUPPLEMENT: EXPERIMENT FIELD DATA

(Results from Experiment Fields on Soil Types Similar to those Occurring in Lee County)

The University of Illinois has operated altogether about fifty soil experiment fields in different sections of the state and on various types of soil. Altho some of these fields have been discontinued, the large majority are still in operation. It is the present purpose to report the results from certain of these fields located on types of soil described in the accompanying soil report.

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 40 acres or more. They are laid off into 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 every crop represented every year.

Farming Systems

On many 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 furnished 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. Some modifications have been introduced in recent years.

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 on the young wheat in the spring and plowed under in the fall or 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 has, for the most part, been standardized according to a rather definite system, altho deviations from this system occur now and then, particularly in the older fields.

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

Animal Manures.—Animal manues, 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 grain 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.—The yearly acre-rates of application have been: for limestone, 1,000 pounds; for raw rock phosphate, 500 pounds; and for potassium, usually 200 pounds of kainit. When kainit was not available, owing to conditions brought on by the World war, potassium carbonate was used. The initial application of limestone has usually been 4 tons per acre.

Explanation of Symbols Used

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 (aP = acid phosphate, bP = bonemeal, rP = rock phosphate, sP = slag phosphate)
K = Potassium (usually in the form of kainit)
N = Nitrogen (usually in the form contained in dried blood)
Le = Legume used as green manure
Cv = Cover crop
( ) = Parentheses enclosing figures, signifying tons of hay, as distinguished from bushels of seed
| = Heavy vertical rule, indicating the beginning of complete treatment
|| = Double vertical rule, indicating a radical change in the cropping system

In discussions of this sort of data, financial profits or losses based upon assigned market values are frequently considered. However, in view of the erratic fluctuations in market values—especially in the past few years—it seems futile to attempt to set any prices for this purpose that are at all satisfactory. The yields are therefore presented with the thought that with these figures at hand the financial returns from a given practice can readily be computed upon the basis of any set of market values that the reader may choose to apply.

THE DIXON FIELD

A University soil experiment field located in Lee county has been in operation for the past 16 years. This field lies about two miles west of Dixon on land characteristic of the region. While the soil is mainly Brown Silt Loam, a detailed examination has revealed the presence of three other distinguishable types designated as Brown Silt Loam On Clay, Light Brown Silt Loam, and Brown Silt Loam, deep phase, which are scattered in spots over the field, as shown in the accompanying diagram (Fig. 2). There are also charted on this diagram

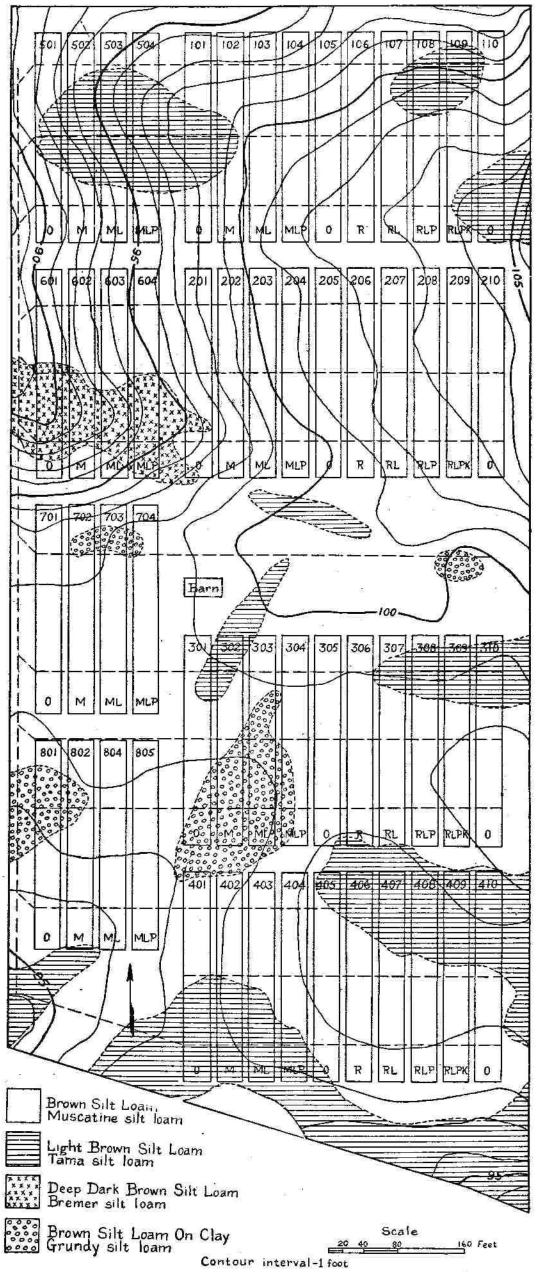


FIG. 2.—DIAGRAM OF THE DIXON SOIL EXPERIMENT FIELD

This diagram shows the arrangement of plots, the soil treatments applied, the location of the different soil types, and by means of contour lines, the natural drainage of this field.

the arrangement of plots with their respective treatments, and the topography of the land as represented by contour lines. As these lines indicate, the land is rolling, with rather steep slopes in the northern portion of the field. A thoro system of tiling has been installed and the drainage is good.

The field, which includes about 21 acres, is laid out into two general systems of plots, each system being made up of four series.

The 100, 200, 300, and 400 Series

The four series of plots designated as the 100, 200, 300, and 400 series are each made up of 10 fifth-acre plots under the different soil treatments indicated in the accompanying tables and diagram. A rotation system of wheat, corn, oats, and clover has been practiced. The crops were managed practically as described for the general plan on page 49 until 1921, when for a period of four years both the first and second crops of clover were removed as hay. At this time the practice of returning the oat straw to the land was discontinued and the following year the return of the wheat straw was likewise discontinued. In 1922 the applications of limestone were indefinitely suspended, the plots having received a total of 7½ to 9 tons an acre on the different series. In 1923 the phosphate applications were evened up to 4 tons an acre, and no more will be applied for an indefinite period.

Since the Dixon field is located in Lee county, a complete record of the yields of all crops grown is included in this Report. The results for the series under discussion are given in Table 7. These results are summarized in Table 8 to show the average annual yields for the different kinds of crops, including the years since the complete soil treatment on the respective plots has been in effect.

In looking over these results, one may observe first the extremely beneficial effect of farm manure. The crop increase due to manure used alone amounts to nearly 20 bushels an acre for corn, about 12 bushels for oats, almost 7 bushels for wheat, over two-thirds of a ton for clover, and one-third of a ton for soybean hay.

Organic manure furnished by residues has likewise proved consistently beneficial, altho not in the same degree as stable manure.

FIG. 3.—WHEAT ON THE DIXON FIELD

Under the treatment shown at the right the eleven-year average yield of wheat has been 32.9 bushels an acre, while the corresponding check plot has produced 21.7 bushels.

TABLE 7.—DIXON FIELD, SERIES 100, 200, 300, 400
Annual Crop Yields, 1910-1926—Bushels or (tons) per acre

Plot No.	Soil treatment applied	1910 Barley[1]	1911 Corn[3]	1912 Oats[5]	1913 Clover[5]	1914 Wheat[7]	1915 Corn	1916 Oats	1917 Soybeans	1918 Barley[8]	1919 Corn	1920 Oats	1921 Clover	1922 Wheat	1923 Corn	1924 Oats	1925 Clover	1926 Wheat
101	0..........	20.5	56.4	35.2	(3.14)	24.8	5.6	72.0	(1.62)	43.3	35.9	42.8	(1.11)	20.0	40.6	42.2	(2.29)	38.0
102	M..........	20.8	62.8	39.8	(3.32)	25.3	32.9	70.8	(1.82)	46.4	50.0	64.2	(1.59)	28.5	56.0	57.2	(2.34)	41.7
103	ML........	24.4	60.5	47.2	(3.47)	26.6	38.1	79.2	(2.25)	55.2	60.7	76.2	(1.88)	33.3	63.8	67.2	(2.25)	45.8
104	MLP........	24.7	64.7	42.2	(3.56)	33.5	41.7	81.6	(2.40)	58.3	70.6	86.6	(1.89)	38.2	62.0	71.6	(2.30)	48.2
105	0..........	26.8	64.3	47.8	1.00	32.8	18.5	76.6	10.8	49.5	44.8	52.3	(1.11)	26.8	42.0	45.9	(2.10)	32.0
106	R..........	24.9	65.9	50.0	1.25	37.7	24.4	78.8	9.1	53.8	42.5	66.9	(1.65)	26.0	53.6	60.3	(1.02)	40.3
107	RL........	24.4	67.5	49.5	1.00	34.2	29.0	81.2	10.8	54.5	66.5	77.7	(1.90)	29.4	60.9	79.7	(1.21)	43.5
108	RLP........	22.3	68.2	44.5	1.00	37.9	33.0	83.4	11.0	59.0	71.4	87.2	(2.36)	35.5	58.0	78.4	(1.64)	45.8
109	RLPK......	20.8	69.2	49.4	.75	35.2	32.6	78.1	10.3	56.9	70.9	83.9	(2.80)	37.5	56.1	69.7	(1.80)	44.3
110	0..........	21.6	65.0	43.3	(2.96)	24.9	2.4	69.7	(1.28)	45.4	45.9	55.6	(1.24)	23.3	42.6	41.3	(2.13)	28.3
		Clover[1]	Wheat[4]	Corn	Oats	Clover	Wheat	Corn	Oats	Soybeans	Wheat	Corn	Oats	Clover	Wheat	Corn	Oats	Clover[9]
201	0..........	(1.69)	31.9	3.3[6]	49.2	(1.76)	27.9	37.8	68.4	(1.80)	23.8	30.6	31.6	(2.13)	9.4	41.6	45.0	(.74)
202	M..........	(1.56)	31.0	12.9[6]	55.6	(2.13)	28.2	44.5	82.3	(1.80)	26.3	42.9	41.9	(2.98)	19.9	57.6	60.6	(1.84)
203	ML........	(1.54)	33.8	11.4[6]	52.7	(2.54)	29.2	49.5	85.6	(1.85)	31.2	48.3	39.2	(3.31)	21.6	62.4	75.3	(2.15)
204	MLP........	(1.87)	37.4	26.2[6]	58.4	(2.77)	34.0	52.8	93.0	(1.96)	37.3	54.2	44.5	(3.43)	25.3	62.0	70.0	(2.20)
205	0..........	(1.87)	30.5	21.1	58.9	(1.83)	28.0	43.4	76.1	14.6	27.8	44.2	31.4	(2.59)	10.3	45.0	50.3	(.87)
206	R..........	......(2)	37.9	37.5	58.4	1.42	31.3	44.3	77.7	17.1	28.9	46.9	35.8	(3.05)	13.7	51.8	52.2	(1.02)
207	RL........	......(2)	30.7	34.2	52.7	1.58	30.0	48.5	77.7	16.2	28.8	53.6	31.7	(3.24)	16.8	57.2	55.9	(1.58)
208	RLP........	......(2)	41.0	42.2	58.6	2.17	36.8	50.4	85.9	13.3	35.2	52.3	39.2	(3.65)	20.8	59.6	71.9	(2.26)
209	RLPK......	......(2)	41.6	61.5	56.1	2.00	34.6	49.4	84.4	15.0	36.4	55.2	44.7	(4.02)	24.0	62.2	76.3	(2.28)
210	0..........	(1.80)	30.6	20.4	52.3	1.17	25.1	40.9	68.1	(1.94)	28.2	39.0	36.4	(2.40)	13.6	45.8	45.9	(.70)

[1]No soil treatment. [2]No seed harvested. [3]Residues only. [4]No manure or lime. [5]Residues and lime only. [6]Corn damaged by white grubs. [7]No manure. [8]Wheat winterkilled; barley grown as a substitute crop. [9]On account of damage by insects, only one crop of clover was secured.

TABLE 7.—DIXON FIELD, SERIES 100, 200, 300, 400—*Concluded*

Plot No.	Soil treatment applied	1910 Oats[1]	1911 Soy-beans[2]	1912 Barley[3,4]	1913 Corn	1914 Oats	1915 Clover	1916 Wheat	1917 Corn	1918 Oats	1919 Soy-beans	1920 Wheat	1921 Corn	1922 Oats	1923 Clover	1924 Wheat	1925 Corn	1926 Oats
301	0..........	50.0	14.5	17.2	35.5	54.7	(1.35)	7.2	24.9	76.6	(1.25)	19.1	47.9	49.4	(.73)	20.0	55.8	22.8
302	M..........	56.9	12.8	30.6	56.6	60.6	(3.38)	9.2	55.3	91.4	(1.90)	30.8	71.3	79.7	(1.97)	33.0	85.0	40.3
303	ML........	57.3	16.7	27.0	60.4	61.1	(3.41)	11.6	57.2	89.1	(1.90)	33.2	78.8	86.1	(2.32)	41.2	87.6	50.6
304	MLP.......	54.5	16.0	32.5	55.3	60.6	(3.57)	18.2	60.7	91.2	(1.78)	36.9	77.0	88.8	(2.27)	38.2	92.6	45.0
305	0..........	56.1	17.9	27.6	42.5	60.0	.42	12.2	26.6	82.5	9.4	18.3	54.6	62.5	(1.17)	26.2	63.0	26.9
306	R..........	56.7	15.3	37.7	47.5	59.8	.58	16.2	40.6	85.9	13.8	18.7	60.7	69.5	(1.46)	27.3	64.0	34.1
307	RL.........	48.9	18.1	31.2	48.3	56.2	.58	14.9	38.7	85.8	13.4	20.7	70.8	81.3	(1.83)	35.5	79.6	43.8
308	RLP.......	49.5	17.9	37.5	49.2	54.2	.50	21.1	45.5	78.1	13.6	26.4	70.8	80.2	(1.63)	41.3	81.0	43.8
309	RLPK......	51.6	19.1	40.6	53.4	58.0	.42	22.1	46.4	76.6	14.2	27.9	75.1	87.5	(2.04)	37.7	81.2	48.8
310	0..........	48.1	15.4	27.8	44.4	58.8	(2.50)	10.6	29.4	81.4	(1.30)	13.2	49.3	57.7	(.79)	20.0	66.4	24.7
		Corn[1]	Oats[2]	Soy-beans[5]	Wheat[4]	Corn	Oats	Clover	Wheat	Corn	Oats	Soy-beans	Wheat	Corn	Oats	Clover	Wheat	Corn
401	0..........	35.8	47.8	(1.60)	16.2	43.9	65.5	(2.69)	25.5	40.7	41.1	(1.18)	21.7	56.3	25.3	(2.73)	10.7	44.4
402	M..........	40.3	48.3	(1.73)	18.2	66.8	70.5	(2.97)	26.2	69.6	45.6	(1.59)	26.6	74.0	42.5	(2.80)	25.2	59.0
403	ML........	41.3	53.8	(1.74)	17.6	68.8	58.6	(3.06)	27.5	69.7	43.8	(1.69)	31.0	77.8	52.0	(3.36)	35.2	61.0
404	MLP.......	41.3	48.4	(1.63)	23.7	66.1	54.2	(3.03)	27.8	70.1	43.9	(1.74)	33.6	79.8	53.1	(3.92)	38.0	63.6
405	0..........	42.2	48.4	12.3	18.8	49.1	73.9	.05	24.8	48.5	37.8	12.2	18.4	54.8	26.9	(2.66)	14.3	40.8
406	R..........	39.2	49.7	12.4	21.0	58.8	68.6	.03	26.8	60.7	38.8	14.1	22.5	72.9	35.6	(2.97)	21.3	51.2
407	RL.........	40.0	42.3	15.0	20.7	61.3	58.6	.04	30.7	65.1	44.1	13.7	28.2	80.2	49.4	(3.98)	29.2	52.6
408	RLP.......	39.0	47.0	14.0	23.8	55.4	58.9	.06	31.8	64.4	38.3	15.4	31.4	80.0	53.4	(4.09)	36.0	52.2
409	RLPK......	35.2	47.8	13.8	23.0	59.1	52.5	.05	35.8	71.9	43.0	16.4	31.8	86.8	44.8	(4.21)	38.5	54.8
410	0..........	43.0	48.0	(1.50)	15.0	49.0	72.7	(2.85)	25.7	45.6	30.5	(1.28)	20.5	58.3	33.0	(2.59)	12.0	39.8

[1]No soil treatment. [2]Residues only. [3]Wheat winterkilled; barley grown as a substitute crop. [4]No manure. [5]Residues and lime only.

FIG. 4.—CLOVER ON UNTREATED LAND, DIXON FIELD
A cutting of red-clover hay obtained from an untreated plot. Compare with Fig. 5.

Limestone in addition to organic manures has, with a single exception, effected more or less improvement, probably sufficient to cover the expense of application.

Rock phosphate, as usual, shows up to best advantage used with residues on the wheat crop. The effect on other crops, however, has been such that the increases in yield are not sufficient to cover the cost of the application under present market conditions.

TABLE 8.—DIXON FIELD: SERIES 100, 200, 300, 400, SUMMARY OF CROP YIELDS
Average Annual Yields 1912-1926—Bushels or (tons) per acre

Serial plot No.	Soil treatment applied	Corn *15 crops*	Oats *14 crops*	Wheat *11 crops*	Barley *1 crop*	Clover[1] *9 crops*	Soy-beans *4 crops*
1	0	36.3	49.0	20.3	43.3	(1.73)	(1.46)
2	M	55.6	61.7	26.9	46.4	(2.44)	(1.78)
3	ML	59.7	65.5	31.0	55.2	(2.70)	(1.92)
4	MLP	62.3	67.3	34.2	58.3	(2.82)	(1.97)
5	0	42.6	54.4	21.7	49.5	(1.35)	11.8
6	R	50.5	58.7	24.8	53.8	(1.47)	13.5
7	RL	56.4	62.6	28.0	54.5	(1.77)	13.3
8	RLP	57.7	65.1	32.9	59.0	(2.04)	13.3
9	RLPK	61.1	64.6	33.7	56.9	(2.18)	14.0
10	0	41.3	52.0	20.0	45.4	(1.89)	(1.45)
	Crop Increases						
	M over 0	19.3	12.7	6.6	3.1	(.71)	(.32)
	R over 0	7.9	4.3	3.1	4.3	(.12)	1.7
	ML over M	4.1	3.8	4.1	8.8	(.26)	(.14)
	RL over R	5.9	3.9	3.2	.7	(.30)	− 0.2
	MLP over ML	2.6	1.8	3.2	3.1	(.12)	(.05)
	RLP over RL	1.3	2.5	4.9	4.5	(.27)	0.0
	RLPK over RLP	3.4	− .5	.8	−2.1	(.14)	.7

[1]Including some seed crops evaluated in this summary as hay.

FIG. 5.—CLOVER ON TREATED LAND, DIXON FIELD
A cutting of red-clover hay produced under the residues-limestone-phosphate treatment.

Altho potassium has produced an average increase of 3.5 bushels an acre in corn, on other crops the effects are such as to render its use unprofitable in growing these common field crops.

Special Phosphate Experiments

A problem of especial interest arising out of the experience of this and other fields concerns the merits of rock phosphate as compared with the more readily soluble phosphates, such as bone meal and acid phosphate.

In order to provide for some additional investigations on this phosphate problem, the plots on Series 100, 200, 300, and 400 were divided in 1924 into north and south halves. The plots on the south halves of all series continue under the original soil treatment, but the plots on the north halves receive the treatment designated in Table 9. No more rock phosphate will be applied to the phosphate plots on the south halves, these plots having received a total of 8,000 pounds an acre. The same holds true for the north half of Plot 9 of all series.

On the north halves, the phosphatic fertilizers and gypsum are applied twice in the rotation—half of the rotation quota being applied ahead of wheat and half ahead of corn—at the following annual acre-rates: rock phosphate, 500 pounds; acid phosphate, 200 pounds; bone meal, 200 pounds; gypsum, 200 pounds.

The minimum amount of limestone necessary to the successful growth of clovers will be applied to Plots 1-N and 10-N, on all series, 4,000 pounds per acre having been applied in 1924.

Owing to the short time thru which these experiments have been continued, a summary of the results is scarcely warranted at this time, but the complete data are given as a matter of record in Table 9.

TABLE 9.—DIXON FIELD: SPECIAL PHOSPHATE EXPERIMENTS, SERIES 100, 200, 300, 400, DIVIDED PLOTS, 1924-1926
Annual Crop Yields—Bushels or (tons) per acre

Serial plot No.	Soil treatment	1924				1925				1926			
		Series 100 Oats	Series 200 Corn	Series 300 Wheat	Series 400 Clover	Series 100 Clover	Series 200 Oats	Series 300 Corn	Series 400 Wheat	Series 100 Wheat	Series 200 Clover	Series 300 Oats	Series 400 Corn
	South Half												
1	0	42.2	41.6	20.0	(2.73)	(2.29)	45.0	55.8	10.7	38.0	(.74)	22.8	44.4
2	M	57.2	57.6	33.0	(2.80)	(2.34)	60.6	85.0	25.2	41.7	(1.84)	40.3	59.0
3	ML	67.2	62.4	41.2	(3.36)	(2.25)	75.3	87.6	35.2	45.8	(2.15)	50.6	61.0
4	MLrP	71.6	62.0	38.2	(3.92)	(2.30)	70.0	92.6	38.0	48.2	(2.20)	45.0	63.6
5	0	45.9	45.0	26.2	(2.66)	(2.10)	50.3	63.0	14.3	32.0	(.87)	26.9	40.8
6	R	60.3	51.8	27.3	(2.97)	(1.02)	52.2	64.0	21.3	40.3	(1.02)	34.1	51.2
7	RL	79.7	57.2	35.5	(3.98)	(1.21)	55.9	79.6	29.2	43.5	(1.58)	43.8	52.6
8	RLrP	78.4	59.6	41.3	(4.09)	(1.64)	71.9	81.0	36.0	45.8	(2.26)	43.8	52.2
9	RLrPK	69.7	62.2	37.7	(4.21)	(1.80)	76.3	81.2	38.5	44.3	(2.28)	48.8	54.8
10	0	41.3	45.8	20.0	(2.59)	(2.13)	45.9	66.4	12.0	28.3	(.70)	24.7	39.8
	North Half												
1	RL	36.3	43.4	13.5	(2.25)	(1.00)	47.2	55.8	6.0	36.3	(.95)	25.9	42.0
2	MrP	60.3	62.8	30.8	(3.17)	(2.44)	60.0	85.0	20.3	39.2	(1.86)	40.3	59.4
3	MLbP	63.4	62.8	29.2	(3.51)	(2.53)	72.2	89.6	27.5	46.2	(2.17)	49.7	57.6
4	MLrP	74.1	58.0	32.2	(4.01)	(2.60)	78.1	91.2	27.8	46.2	(2.25)	50.0	58.2
5	RaP	51.6	44.8	26.3	(2.73)	(.99)	58.8	66.8	19.5	41.5	(1.36)	32.2	42.0
6	RrP	54.4	50.2	25.3	(2.67)	(1.03)	55.3	73.0	15.2	42.7	(1.50)	36.9	50.2
7	RLaP	76.6	50.2	40.8	(4.06)	(1.35)	74.4	77.2	35.7	47.3	(2.04)	50.0	49.2
8	RLrP	63.8	55.0	39.3	(4.40)	(1.61)	77.5	78.6	30.2	42.7	(2.22)	53.4	48.4
9	RLrPK—Gypsum	70.3	53.4	37.2	(4.55)	(1.80)	80.9	85.0	36.3	47.5	(2.41)	58.1	57.8
10	RLrP	41.3	40.0	19.7	(2.63)	(1.11)	55.9	71.6	11.8	34.8	(1.27)	34.7	45.4

TABLE 10.—DIXON FIELD, SERIES 500, 600, 700, 800
Annual Crop Yields, 1913-1926—Bushels or (tons) per acre

Plot No.	Soil treatment applied	1913 Potatoes[1]	1914 Potatoes[1]	1915 Barley hay[1]	1916 Alfalfa[1]	1917 Alfalfa[1]	1918 Alfalfa[1]	1919 Alfalfa[1]	1920 Soy-beans[1]	1921 Corn[5]	1922 Oats	1923 Corn	1924 Corn	1925 Oats	1926 Alfalfa
501N	K..........	109.2	87.0	(.94)	(1.93)	(1.30)	(1.12)	(2.39)	(1.97)	63.2	70.9	52.2	29.8	51.6	(1.56)
501S	0...........				(2.61)	(1.45)	(1.50)	(.95)	(1.30)	68.0	67.2	51.2	33.4	49.7	(1.63)
502N	MK.........	124.8	120.2	(1.71)	(4.21)	(1.68)	(1.66)	(3.15)	(2.06)	70.4	84.4	59.2	51.4	62.8	(3.03)
502S	M..........				(4.50)	(1.70)	(3.37)	(2.73)	(1.97)	75.6	78.4	58.2	45.4	59.1	(2.96)
503N	MLK........	127.9	106.3	(1.70)	(4.02)	(1.94)	(3.25)	(4.30)	(2.15)	76.0	84.1	53.8	55.0	71.6	(5.03)
503S	ML.........				(4.37)	(1.99)	(3.70)	(3.30)	(1.93)	77.8	79.1	62.0	51.8	66.9	(4.86)
504N	MLPK......	134.7	119.1	(1.51)	(4.00)	(2.15)	(2.77)	(3.97)	(2.11)	74.8	87.5	50.8	56.2	73.1	(5.10)
504S	MLP........				(4.28)	(2.15)	(3.42)	(3.94)	(2.01)	76.2	79.4	56.4	49.8	65.0	(5.14)
		Alfalfa hay[2,3]	Alfalfa hay[2]	Potatoes	Potatoes	Alfalfa[4]	Alfalfa	Alfalfa	Alfalfa[4]	Corn	Corn	Oats	Corn	Corn	Oats
601N	K..........	....	(6.82)	95.5	20.8	....	(2.74)	(4.08)	....	68.0	85.6	54.1	39.2	48.4	40.6
601S	0...........	....		110.3	24.2	....	(1.73)	(3.80)	....	65.2	75.4	67.5	38.6	52.6	39.4
602N	MK.........	....	(6.30)	177.2	65.8	....	(5.27)	(4.82)	....	78.6	86.2	65.6	58.0	66.6	44.1
602S	M..........	....		151.2	75.0	....	(4.81)	(4.39)	....	75.0	88.4	66.9	54.2	74.2	51.3
603N	MLK........	....	(6.33)	162.5	60.0	....	(5.46)	(5.50)	....	78.6	90.4	72.5	60.8	78.0	63.8
603S	ML.........	....		130.0	70.8	....	(6.23)	(4.63)	....	73.4	85.6	70.9	57.2	73.4	56.6
604N	MLPK......	....	(6.09)	147.3	62.5	....	(6.10)	(6.00)	....	76.8	89.8	72.5	60.0	71.8	65.0
604S	MLP........	....		96.0	65.0	....	(5.73)	(4.99)	....	76.8	79.8	68.8	59.6	72.0	[illegible]6.3

[1]No potassium. [2]No manure or potassium. [3]Plots harvested together; average yield 5.35 tons an acre. [4]Alfalfa seeding. [5]Rotation changed to corn, corn, oats (sweet clover), alfalfa.

TABLE 10.—DIXON FIELD, SERIES 500, 600, 700, 800—*Concluded*

Plot No.	Soil treatment applied	1913 Alfalfa[2,3]	1914 Alfalfa[2]	1915 Alfalfa[2]	1916 Alfalfa[2]	1917 Potatoes	1918 Potatoes	1919 Alfalfa	1920 Alfalfa	1921 Alfalfa	1922 Corn	1923 Corn	1924 Oats	1925 Corn	1926 Corn
701N	K..........	....	(5.63)	(4.91)	(5.00)	66.7	71.7	(1.83)	(4.08)	(5.14)	84.2	58.4	80.3	73.6	31.2
701S	0...........			(4.68)	(4.83)	47.5	48.3	(1.79)	(3.88)	(4.84)	81.6	52.4	72.2	69.6	28.2
702N	MK........	....	(5.39)	(4.71)	(4.23)	100.0	142.2	(2.10)	(4.19)	(5.43)	93.8	70.8	82.8	77.8	52.2
702S	M..........			(4.70)	(4.95)	76.7	124.2	(2.11)	(3.71)	(4.94)	85.8	59.4	80.0	72.4	43.8
703N	MLK.......	....	(5.91)	(4.81)	(5.48)	102.5	140.0	(2.49)	(4.72)	(5.49)	92.2	71.8	85.3	81.4	50.8
703S	ML........			(5.06)	(5.00)	81.7	123.3	(2.21)	(4.49)	(4.92)	88.0	62.4	76.9	79.0	39.6
704N	MLPK.....	....	(5.39)	(4.89)	(4.83)	95.0	155.0	(2.26)	(4.56)	(5.26)	96.0	73.8	85.3	78.2	42.0
704S	MLP.......			(4.77)	(4.21)	100.8	133.5	(1.97)	(3.80)	(4.78)	86.6	59.6	76.3	82.0	40.8
		Alfalfa[2,3]	Alfalfa[2]	Alfalfa[2]	Alfalfa[2]	Alfalfa[2,4]	Alfalfa[2]	Potatoes	Potatoes	Oats	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Corn
801N	K..........	....	(5.39)	(4.64)	(4.49)	....	(3.90)	38.3	46.0	48.4	(4.23)	(4.12)	(2.69)	(3.78)	40.4
801S	0...........			(4.52)	(4.26)	....	(4.22)	36.3	36.2	40.9	(4.11)	(4.36)	(3.17)	(4.02)	35.0
802N	MK........	....	(5.45)	(4.76)	(5.14)	....	(4.28)	64.0	92.2	53.1	(5.63)	(4.42)	(3.15)	(4.08)	53.2
802S	M..........			(4.50)	(4.52)	....	(4.56)	56.7	80.8	47.5	(5.24)	(4.35)	(3.28)	(4.19)	54.8
803N	MLK.......	....	(5.40)	(4.62)	(4.47)	....	(4.43)	49.5	98.7	52.5	(5.64)	(4.99)	(3.38)	(4.51)	58.8
803S	ML........			(4.56)	(4.22)	....	(4.40)	40.8	98.0	49.7	(5.33)	(4.69)	(3.43)	(4.19)	56.2
804N	MLPK.....	....	(6.08)	(5.09)	(4.45)	....	(4.73)	71.7	109.0	50.3	(5.75)	(5.20)	(3.21)	(4.91)	62.2
804S	MLP.......			(4.72)	(3.49)	....	(4.22)	58.3	104.5	50.3	(5.34)	(4.98)	(3.13)	(4.60)	58.8

[2]No manure or potassium. [3]Plots harvested together; average yield 5.35 tons an acre. [4]Alfalfa seeding.

The 500, 600, 700, and 800 Series

When the field was established Series 500, 600, 700, and 800 were left unplotted and were seeded to alfalfa. In 1912 they were plotted for a potato-alfalfa rotation. It was planned to grow potatoes two years in succession on the same land, while alfalfa was to be grown six years. The initial application of limestone was at the rate of 4 tons an acre. Subsequent applications were at the rate of 4 tons an acre when the land was seeded to alfalfa. Rock phosphate was applied at the annual acre-rate of 500 pounds. Manure was applied at the rate of 15 tons an acre for each potato crop. Beginning with 1915 potassium sulfate was applied to the north half of all plots at the rate of 200 pounds an acre for each potato crop. In 1921 the rotation on these series was changed to one of corn, corn, and oats with sweet clover seeding on Plots 2, 3, and 4, alfalfa occuping the fourth series for four years. The fertilizers on all series were evened up at this time, and no more will be applied for an indefinite period.

Table 10 serves to furnish an outline of the cropping history of these series. The work is summarized in Table 11, which gives the average annual acre yields for the years since the plots have been under their complete treatments. The lower part of the table gives the possible comparisons of the various combinations expressed as crop increases.

TABLE 11.—DIXON FIELD, SERIES 500, 600, 700, 800: SUMMARY OF CROP YIELDS
Average Annual Yields, 1915-1926—Bushels or (tons) per acre

Serial plot No.	Soil treatment applied	Potatoes *6 crops*	Alfalfa *12 crops*	Corn *12 crops*	Oats *6 crops*
1N	K	56.5	(2.94)	56.2	57.7
1S	0	50.5	(2.78)	54.3	56.1
2N	MK	106.9	(3.51)	68.2	65.5
2S	M	94.1	(3.33)	65.6	63.9
3N	MLK	102.2	(3.93)	70.6	71.1
3S	ML	90.8	(3.75)	65.5	66.7
4N	MLPK	106.8	(4.03)	69.4	72.3
4S	MLP	93.0	(3.70)	66.5	66.0
	Crop Increases				
	For Manure				
	M over 0	43.6	(.55)	11.3	7.8
	MK over K	50.4	(.57)	12.0	7.8
	For Limestone				
	ML over M	−3.3	(.42)	− .1	2.8
	For Phosphorus				
	MLP over ML	2.2	(−.05)	1.0	− .7
	MLPK over MLK	4.6	(.10)	−1.2	1.2
	For Potassium				
	K over 0	6.0	(.16)	1.9	1.6
	MK over M	12.8	(.18)	2.6	1.6
	MLK over ML	11.4	(.18)	5.1	4.4
	MLPK over MLP	13.8	(.33)	2.9	6.3

The beneficial results with stable manure are very pronounced, confirming those obtained on the other series discussed above.

Disregarding the effect on potatoes, which are not now being grown, the response to limestone resembles, in a general way, that on the major series described above. Moderate increases are produced, the value of which would probably just about cover the cost of application.

The effect of rock phosphate on these series has been very indifferent, and its application has been attended by a financial loss.

Potassium treatment appears in four combinations if we include the plot where it is used alone. Where used in any of the combinations with manure, potassium produced a considerable increase in the potato yield, and where limestone enters the combination, a significant increase in yield of second-year corn is found. Where combined with manure and phosphate, a third of a ton increase in alfalfa was produced.

THE VIENNA FIELD

Inasmuch as Lee county embraces in its Yellow Silt Loam and certain other types considerable land that is subject to destruction thru erosion or washing, an account of the experiments on the Vienna field should be of interest in this Report.

The Vienna field, located near Vienna in Johnson county, is representative of the sloping, erodible land so prevalent in that section of the state. Experiments were conducted for nine years for the purpose of testing different methods of reclaiming the land and preventing erosion. A brief description of this work is given in the following paragraphs.

The whole field with the exception of about three acres had been abandoned because so much of the surface soil had washed away and there were so many gullies as to render further cultivation of this land unprofitable. The field was divided into five sections. The sections designated as A, B, and C were divided into four plots each, and D into three plots. On section A, which included the steepest part of the area and contained many gullies, the land was built up into terraces at vertical intervals of 5 feet. Near the edge of each terrace a small ditch was placed so that the water could be carried to a natural outlet without much washing.

On section B the so-called embankment method was used. By this method erosion is prevented by plowing up ridges sufficiently high so that on the occasion of a heavy rainfall if the water breaks over, it will run over in a broad sheet rather than in narrow channels. At the steepest part of the slope hillside ditches were made for carrying away the run-off.

Section C was washed badly but contained only small gullies. Here the attempt was made to prevent washing by incorporating organic matter in the soil and practicing deep contour plowing and contour planting. With two exceptions, about eight loads of manure per acre were turned under each year for the corn crop.

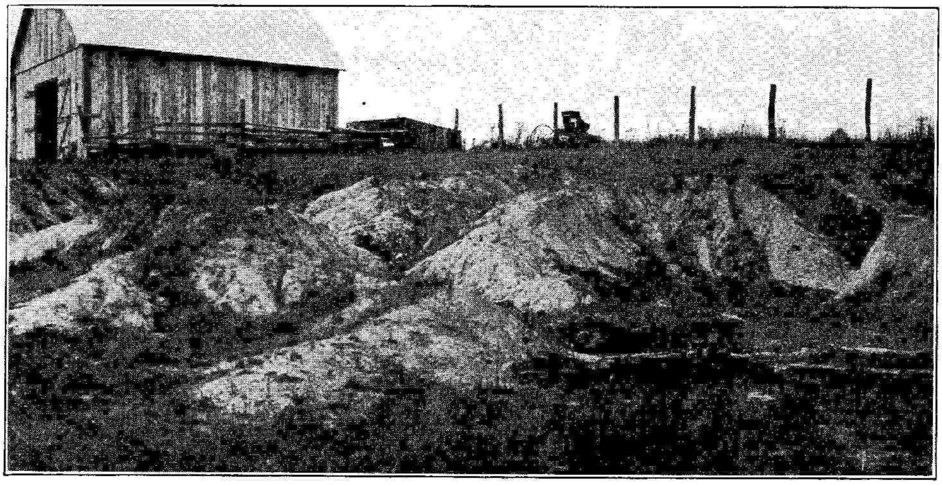


FIG. 6.—VIEW OF UNIMPROVED HILLSIDE LAND TAKEN JUST OVER THE FENCE FROM THE FIELD SHOWN IN FIG. 7

The land on section D was washed to about the same extent as that of section C. As a check on the different methods of reducing erosion, the land on section D was farmed in the most convenient way, without any special effort being made to prevent washing.

Section E was badly eroded and gullied and no attempt was made to crop it other than to fill in the gullies with brush and to seed the land to grass.

Sections A, B, C, and D were not entirely uniform; some parts were washed more than others and portions of the lower-lying land had been affected by soil material washed down from above. When the field was secured, the higher land had a very low producing capacity. On many spots little or nothing would grow.

FIG. 7.—CORN GROWING ON IMPROVED HILLSIDE OF THE VIENNA EXPERIMENT FIELD. THIS LAND FORMERLY HAD BEEN BADLY ERODED. COMPARE WITH FIG. 6

TABLE 12.—VIENNA FIELD: HANDLING HILLSIDE LAND TO PREVENT EROSION
Average Annual Yields, 1907-1915—Bushels or (tons) per acre

Section	Method	Corn *7 crops*	Wheat *7 crops*	Clover *3 crops*
A	Terrace	31.4	9.0	(0.68)
B	Embankments and hillside ditches	32.4	12.7	(0.97)
C	Organic matter, deep contour plowing, and contour planting	27.9	11.7	(0.80)
D	Check	14.1	4.6	(0.21)

Limestone was applied to the entire field at the rate of 2 tons per acre. Corn, cowpeas, wheat, and clover were grown in a four-year rotation on each section except D which had but three plots.

Table 12 contains a summarized statement of the results obtained. These results indicate something of the possibilities in improving hillside land by protecting it from erosion. The average yield of corn from the protected series (A, B, and C) was 30.6 bushels an acre, as against 14.1 bushels for series D; wheat yielded 11.1 bushels in comparison with 4.6 bushels; and clover .82 ton in comparison with .21 ton.

A comparison of Figs. 6 and 7 will serve to indicate the possibility of improving this worthless eroded land.

THE OQUAWKA FIELD

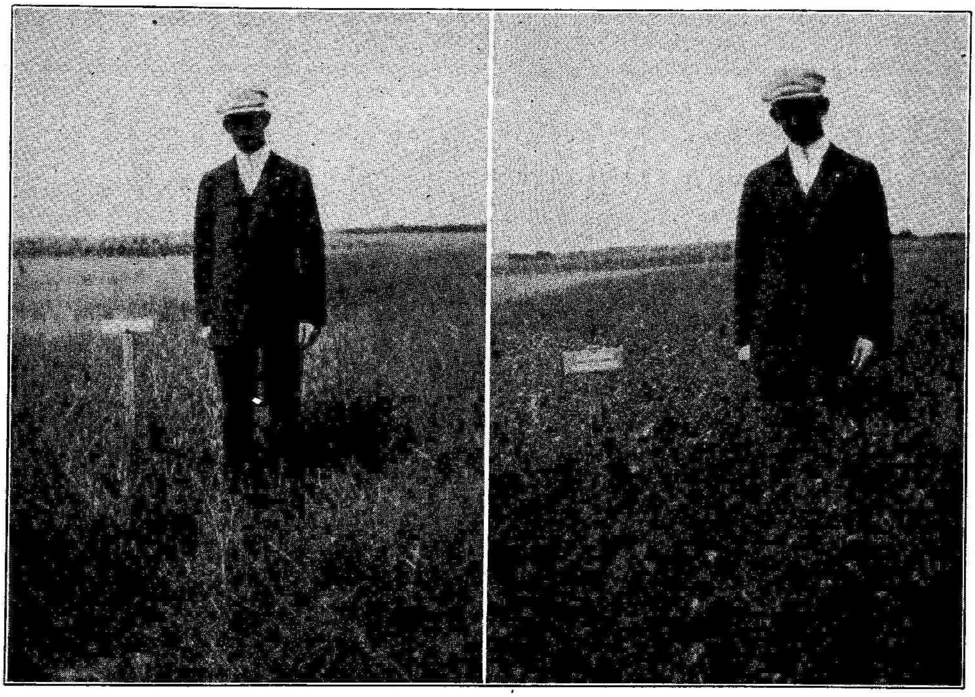
In 1913 the University came into possession of a tract of Dune Sand, Terrace, in Henderson county, near the Mississippi river, upon which an experiment field was laid out to determine the needs of these sand soils. This field is divided into six series of plots. Corn, soybeans, wheat, sweet clover, and rye, with a catch crop of sweet clover seeded in the rye on the residues plots, are grown in rotation on five series, while the sixth series is devoted to alfalfa. When sweet clover seeded in the wheat fails, cowpeas are substituted.

No catch of alfalfa or of sweet clover was obtained till the alfalfa drill was used in seeding. With this implement the seed is covered about one-half inch deep.

Table 13 indicates the kinds of treatment applied, the amounts of the materials used being in accord with the standard practice, as explained on page 49.

The data make apparent the remarkably beneficial action of limestone on this sand soil. Where limestone has been used in conjunction with crop residues, the yield of corn has been greatly increased. The limestone has also been instrumental in producing good crops of rye and fair crops of sweet clover and alfalfa.

This land appears to be quite indifferent to treatment with rock phosphate. The analyses show, however, that the stock of phosphorus in this type of soil is not large, and it may develop as time goes on and the supply diminishes along with the production of good-sized crops, that the application of this element will



Manure
Yield: Nothing

Manure and limestone
Yield: 4.43 tons per acre

FIG. 8.—ALFALFA ON THE OQUAWKA EXPERIMENT FIELD

These pictures show the possibility of improving this unproductive sandy land on the Oquawka field. Both plots were seeded alike to alfalfa. Where manure alone was applied, the crop was a total failure, but where limestone in addition to manure was applied, nearly 4½ tons of alfalfa hay was obtained as the season's yield.

become profitable. It is also quite possible that a more available form of phosphate could be used to advantage on this very sandy soil.

Altho the results show an increase of nearly 3 bushels of corn from the use of potassium salts, with ordinary prices this would not be a profitable treatment. The slight increase for the potassium treatment appearing in the other crops can scarcely be considered significant.

A significant fact which the general summary does not bring out is that the improvement under favorable treatment has been progressive, as evidenced by a very marked upward trend in production after the first few years. For example, it may be noted that the yield of corn under the limestone-residues treatment has been 36.7 bushels an acre as an average for the 11 crops since full treatment started, but if we take an average of the last five crops the yield rises to 45.7 bushels. Likewise the wheat under this same treatment gives for the 11-year average 13.9 bushels, but the last five years has given 19.6 bushels.

Experience thus far shows rye to be better adapted to this land than wheat, and, under good treatment, both alfalfa and sweet clover thrive better than soybeans. With these two legume crops thriving so well under this simple treatment, we have promise of great possibilities for the profitable culture of this land, which hitherto has been considered as practically worthless.

TABLE 13.—OQUAWKA FIELD: SUMMARY OF CROP YIELDS
Average Annual Yields 1915-1925—Bushels or (tons) per acre

Serial plot No.	Soil treatment applied	Corn *11 crops*	Soy-beans[1] *11 crops*	Wheat *11 crops*	Sweet Clover[2] *7 crops*	Rye *9 crops*	Alfalfa *8 crops*
1	0	19.8	(1.01)	7.7	0.00	11.9	(.35)
2	M	25.0	(1.20)	10.9	0.00	13.3	(.56)
3	ML	32.2	(1.60)	14.6	1.14	24.5	(2.05)
4	MLP	31.9	(1.58)	15.0	1.14	23.0	(2.12)
5	0	20.1	(.78)	9.8	0.00	11.7	(.08)
6	R	21.8	(.82)	11.1	0.00	12.7	(.09)
7	RL	36.7	(1.25)	13.9	1.57	24.3	(1.82)
8	RLP	36.1	(1.25)	14.1	1.43	24.3	(1.79)
9	RLPK	39.0	(1.17)	13.3	1.67	26.5	(1.87)
10	0	19.1	(.72)	8.8	0.00	(10.7)	(.02)
	M over 0	5.2	(.19)	3.2	0.00	1.4	(.21)
	R over 0	1.7	(.04)	1.3	0.00	1.0	(.01)
	ML over M	7.2	(.40)	3.7	1.14	11.2	(1.49)
	RL over R	14.9	(.43)	2.8	1.57	11.6	(1.73)
	MLP over ML	– .3	–(.02)	.4	0.00	– 1.5	(.07)
	RLP over RL	– .6	(0.00)	.2	– .14	0.0	–(.03)
	RLPK over RLP	2.9	–(.08)	– .8	.24	2.2	(.08)

[1]Eleven regular crops together with the extra crop described in Footnote 2 averaged as 11 crops. Several crops which were harvested as seed are evaluated in this summary as hay.
[2]Some hay evaluated as seed. In 1918, the sweet clover was killed by early cutting for a hay crop. Soybeans were seeded in July and the ensuing crop is included in the soybean average.

THE MANITO FIELD

The results secured on the Manito experiment field, which was located on Deep Peat and which was in operation during the years 1902 to 1905 inclusive, are presented in Table 14.

The field consisted of ten plots receiving the treatments indicated in the table. Where potassium was applied, the yield was from three to four times as large as where nothing was applied. Where approximately equal money values of kainit and potassium chlorid were applied, slightly greater yields were obtained with the potassium chlorid, which, however, supplied about one-third more potassium than the kainit. However, either material furnished more potassium than was required by the crops produced.

The use of 700 pounds of sodium chlorid (common salt) produced no appreciable increase over the best untreated plots, indicating that where potassium is itself actually deficient, salts of other elements cannot take its place.

Applications of 2 tons an acre of ground limestone produced no increase in the corn crops, either when applied alone or in combination with kainit, either the first year or the second.

Reducing the application of kainit from 600 to 300 pounds for each two-year period reduced the total yield of corn from 164.5 to 125.9 bushels. The two applications of 300 pounds of kainit (Plot 9) appear to be insufficient.

TABLE 14.—MANITO FIELD: DEEP PEAT
Annual Corn Yields—Bushels per acre

Plot No.	Soil treatment for 1902	Corn 1902	Corn 1903	Soil treatment for 1904	Corn 1904	Corn 1905
1	None	10.9	8.1	None	17.0	12.0
2	None	10.4	10.4	Limestone, 4000 lbs	12.0	10.1
3	Kainit, 600 lbs	30.4	32.4	Limestone, 4000 lbs. Kainit, 1200 lbs	49.6	47.3
4	Kainit, 600 lbs. Acidulated bone, 350 lbs	30.3	33.3	Kainit, 1200 lbs. Steamed bone, 395 lbs	53.5	47.6
5	Potassium chlorid, 200 lbs	31.2	33.9	Potassium chlorid, 400 lbs	48.5	52.7
6	Sodium chlorid, 700 lbs	11.1	13.1	None	24.0	22.1
7	Sodium chlorid, 700 lbs	13.3	14.5	Kainit, 1200 lbs	44.5	47.3
8	Kainit, 600 lbs	36.8	37.7	Kainit, 600 lbs	44.0	46.0
9	Kainit, 300 lbs	26.4	25.1	Kainit, 300 lbs	41.5	32.9
10	None	[1]...	14.9	None	26.0	13.6

[1]No yield was taken in 1902 because of a misunderstanding.

List of Soil Reports Published

1 Clay, 1911
2 Moultrie, 1911
3 Hardin, 1912
4 Sangamon, 1912
5 LaSalle, 1913
6 Knox, 1913
7 McDonough, 1913
8 Bond, 1913
9 Lake, 1915
10 McLean, 1915
11 Pike, 1915
12 Winnebago, 1916
13 Kankakee, 1916
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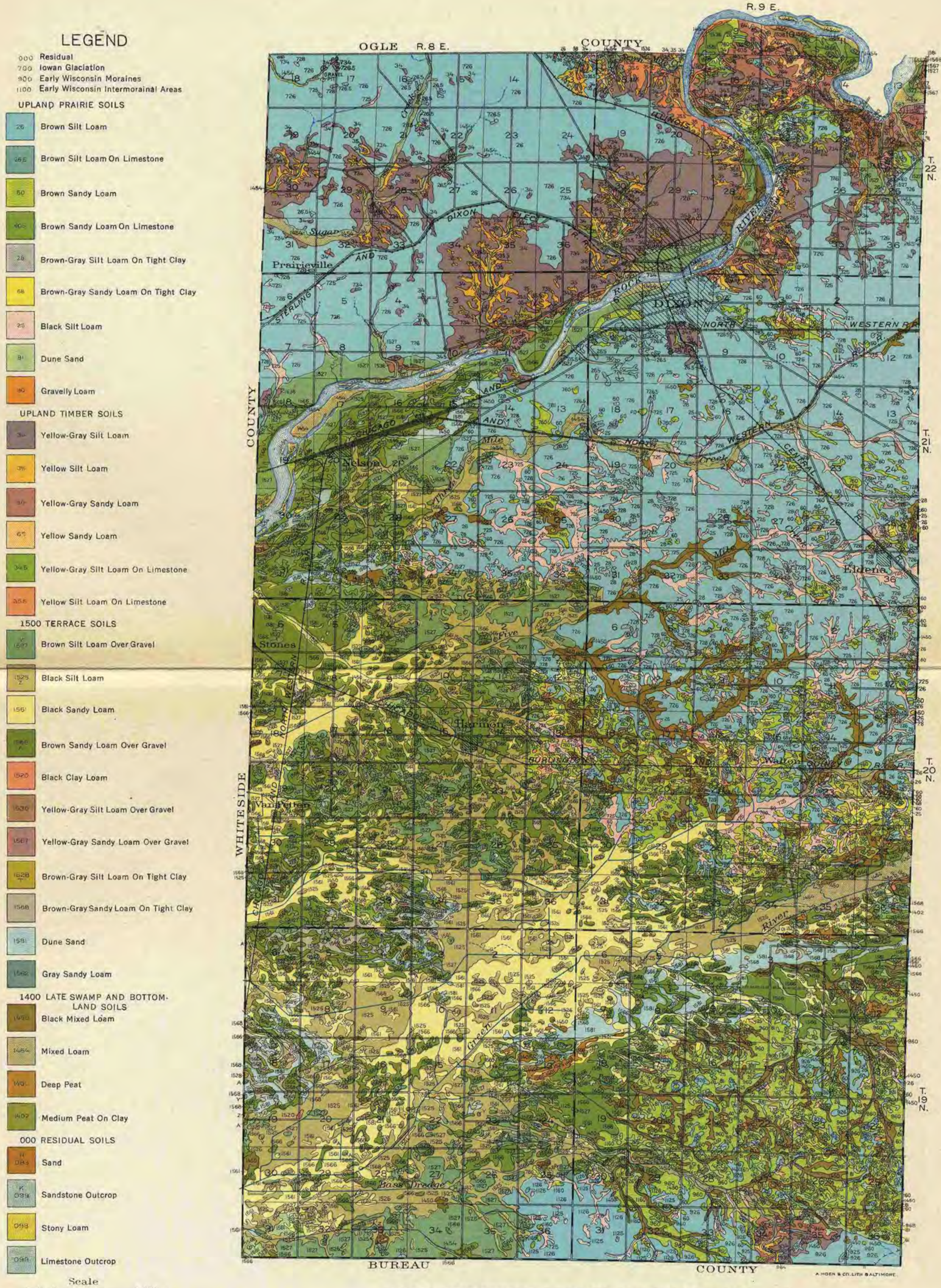


SOIL SURVEY MAP OF LEE COUNTY
UNIVERSITY OF ILLINOIS AGRICULTURAL EXPERIMENT STATION

SOIL SURVEY MAP OF LEE COUNTY

UNIVERSITY OF ILLINOIS AGRICULTURAL EXPERIMENT STATION

LEGEND

000 Residual
700 Iowan Glaciation
900 Early Wisconsin Moraines
1100 Early Wisconsin Intermorainal Areas

UPLAND PRAIRIE SOILS

26	Brown Silt Loam
265	Brown Silt Loam On Limestone
60	Brown Sandy Loam
605	Brown Sandy Loam On Limestone
28	Brown-Gray Silt Loam On Tight Clay
68	Brown-Gray Sandy Loam On Tight Clay
25	Black Silt Loam
81	Dune Sand
90	Gravelly Loam

UPLAND TIMBER SOILS

34	Yellow-Gray Silt Loam
35	Yellow Silt Loam
64	Yellow-Gray Sandy Loam
65	Yellow Sandy Loam
345	Yellow-Gray Silt Loam On Limestone
355	Yellow Silt Loam On Limestone

1500 TERRACE SOILS

Y 1527	Brown Silt Loam Over Gravel
1525 Z	Black Silt Loam
1561	Black Sandy Loam
1566 A	Brown Sandy Loam Over Gravel
1520	Black Clay Loam
1536	Yellow-Gray Silt Loam Over Gravel
1567	Yellow-Gray Sandy Loam Over Gravel
1528 T	Brown-Gray Silt Loam On Tight Clay
1568	Brown-Gray Sandy Loam On Tight Clay
1581	Dune Sand
1582	Gray Sandy Loam

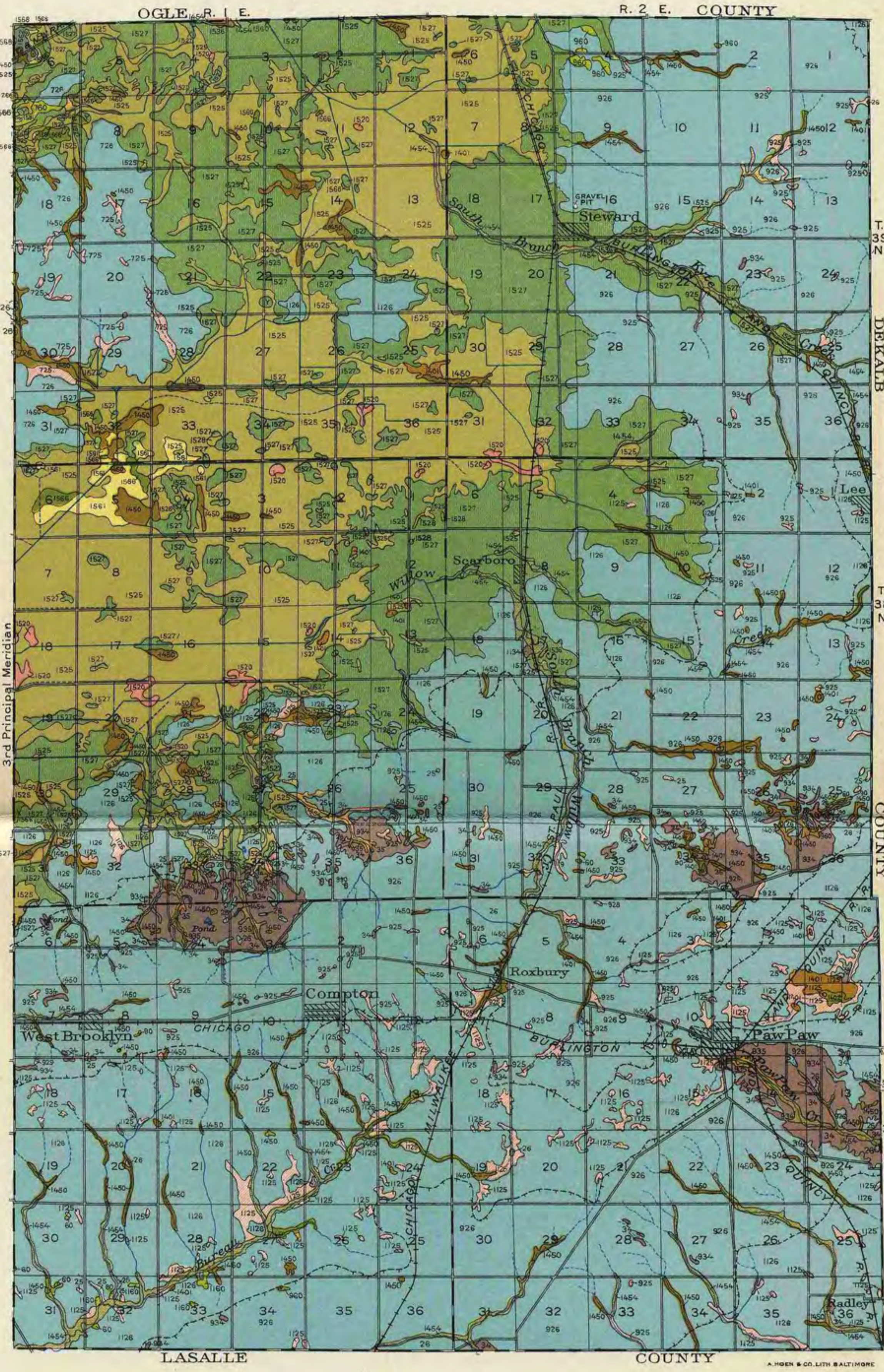
1400 LATE SWAMP AND BOTTOM-LAND SOILS

1450	Black Mixed Loam
1454	Mixed Loam
1401	Deep Peat
1402	Medium Peat On Clay

000 RESIDUAL SOILS

H 083	Sand
K 089	Sandstone Outcrop
098	Stony Loam
099	Limestone Outcrop

Scale
0 ¼ ½ 1 2 Miles



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