

UNIVERSITY OF ILLINOIS
Agricultural Experiment Station

SOIL REPORT No. 38

OGLE COUNTY SOILS

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AND L. H. SMITH



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

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INTRODUCTORY NOTE

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

This county soil report is one of a series reporting the results of the soil survey which, when completed, will cover the state of Illinois. Each county report is intended to be as nearly complete in itself as it is practicable to make it, even at the expense of some repetition. 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 Ogle county was conducted, and Mr. R. W. Dickenson who, as leader of the field party, was in direct charge of the mapping.

CONTENTS OF SOIL REPORT No. 38
OGLE COUNTY SOILS

	PAGE
LOCATION AND CLIMATE OF OGLE COUNTY.....	1
AGRICULTURAL PRODUCTION	1
SOIL FORMATION	2
Geological Aspects	2
Changes in the River Systems.....	3
Physiography and Drainage	4
Soil Development	4
Soil Groups	4
INVOICE OF THE ELEMENTS OF PLANT FOOD IN OGLE COUNTY SOILS....	6
The Upper Sampling Stratum	7
The Middle and Lower Sampling Strata	10
DESCRIPTION OF SOIL TYPES	15
(a) Upland Prairie Soils	15
(b) Upland Timber Soils	18
(c) Terrace Soils	22
(d) Residual Soils	26
(e) Late Swamp and Bottom-Land Soils	27

APPENDIX

EXPLANATIONS FOR INTERPRETING THE SOIL SURVEY.....	29
Classification of Soils	29
Soil Survey Methods	31
PRINCIPLES OF SOIL FERTILITY	32
Crop Requirements with Respect to Plant-Food Materials.....	33
Plant-Food Supply	34
Liberation of Plant Food	35
Permanent Soil Improvement	36

SUPPLEMENT

EXPERIMENT FIELD DATA	46
The Mt. Morris Field	47
The Dixon Field	54
The Vienna Field	55
The Oquawka Field	57
The Manito Field	59

OGLE COUNTY SOILS

BY R. S. SMITH, O. I. ELLIS, E. E. DeTURK, F. C. BAUER, AND L. H. SMITH¹

LOCATION AND CLIMATE OF OGLE COUNTY

Ogle county is situated in the northwestern part of Illinois, about 24 miles south of the Wisconsin state line. It comprizes about 754 square miles and is traversed almost centrally from northeast to southwest by Rock river. Most of the county is tillable with the exception of the rough and broken land along Rock river. Approximately 2½ percent of the area of the county is so rough and broken that it should be left permanently in timber.

The weather data collected at Dixon, Lee county, for the fourteen-year period from 1911 to 1924 are used to indicate the climatic conditions of this region. The greatest range in temperature for any one year was 122 degrees, in 1919. The highest temperature recorded was 104°, in 1921; the lowest, 24° below zero, in 1919. The average date of the last killing frost in spring for this period was May 5; the earliest in autumn, October 16. The average length of the growing season is therefore about 164 days.

The average annual rainfall for this period was 32.28 inches. The rainfall by months was as follows: January, 1.17 inches; February, 1.33; March, 2.79; April, 2.70; May, 3.50; June, 3.82; July, 3.29; August, 3.57; September, 3.83; October, 3.01; November, 1.69; December, 1.55.

AGRICULTURAL PRODUCTION

Ogle county is regarded as distinctly agricultural, with about 95 percent of the land tillable. The Census of 1920 reports 2,784 farms in the county, as compared with 2,962 in 1910 and 3,093 in 1900.

The agriculture of the county includes grain farming, dairying, and livestock farming. It may be classed as general farming, with great emphasis placed on dairying and livestock, including the production of beef cattle, hogs, and, to less extent, sheep. It will be noted in the following tables that the total value of all livestock, for 1919, as reported in the Fourteenth Census, was about 8 million dollars, and that the total value of all crops for this same year was 13½ million dollars. It is interesting to note in this connection that very little grain is shipped out of the county, most of it being used for feeding either on the farm where it is grown or on neighboring farms. Dairying is the predominant type of farming on the rolling and broken land adjacent to Rock river.

The following figures taken from the Fourteenth Census indicate the relative importance of the various kinds of livestock for 1920, and of livestock products for 1919:

¹ R. S. Smith, in charge of soil survey mapping; O. I. Ellis, Assistant Chief in soil survey mapping; E. E. DeTurk, in charge of soil analysis; F. C. Bauer, in charge of experiment fields; L. H. Smith, in charge of publications.

<i>Animals and Animal Products</i>	<i>Number</i>	<i>Value</i>
Horses	19,205	\$1,723,621
Mules	423	47,912
Beef cattle	39,656	2,362,449
Dairy cattle	23,898	1,772,073
Sheep	8,423	124,367
Swine	70,533	1,705,248
Poultry	325,240	338,140
Eggs and chickens . . . . .	.....	742,495
Dairy products . . . . .	.....	1,196,735
Wool	51,165 lbs.	28,037

The report gives the total value of livestock as about $7\frac{3}{4}$ million dollars.

The principal field crops are corn, oats, wheat, barley, hay, and clover. According to the Census, the total value for all crops in 1919 was \$13,585,000. The following figures give the acreage and yield of some of the more important crops for the year 1919:

<i>Crops</i>	<i>Acreage</i>	<i>Production</i>	<i>Yield per acre</i>
Corn	107,799	4,298,629 bu.	39.8 bu.
Oats	91,478	3,016,268 bu.	32.8 bu.
Wheat	26,461	433,121 bu.	16.3 bu.
Barley	11,854	293,959 bu.	24.7 bu.
Rye	4,608	67,455 bu.	15.0 bu.
Timothy	10,290	12,425 tons	1.20 tons
Timothy and clover	31,428	44,299 tons	1.09 tons
Clover	6,271	9,723 tons	1.55 tons
Silage crops	10,101	76,514 tons	7.56 tons
Corn for forage	12,387	31,361 tons	2.53 tons

Figures furnished by the U. S. Department of Agriculture give the following acre-yields for the ten-year period 1911-1920: corn, 36.2 bushels; oats, 36.5 bushels; tame hay, 1.41 tons; winter wheat, 17.5 bushels.

The fruit industry is not developed in Ogle county. Very little fruit is grown aside from small plantings for home use.

SOIL FORMATION

GEOLOGICAL ASPECTS

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. During the Glacial period, great ice sheets moved southward from the centers of accumulation in Labrador, in the Hudson Bay region, and in the northern Rocky mountains. At least six great ice movements took place, each of which covered a part of northern United States, altho the same parts were not covered during each advance.

The glaciations of northwestern Illinois, including the area occupied by Ogle county, have been a matter of uncertainty ever since the first classification of the drift sheets of this region. As explained on page 30, the system of numbering the soil types is based largely upon the glaciations as outlined on the glacial map prepared many years ago by Leverett. This map shows Ogle county as being covered mainly by the Iowan and Pre-Iowan glaciations but in the light of more recent evidence, the most of the county is now considered as belonging to

the Illinoian. It may be said, however, that so far as the identity of the soil types are concerned, the matter is not important. The eastern end of the county was probably invaded by a lobe of the early Wisconsin glaciation and the southeastern corner of the county is occupied by Wisconsin moraines.

The drift averages about 4 feet in depth on the upland, ranges from 150 to 400 feet deep in the preglacial valleys, and is about 100 feet deep on the Wisconsin moraine in the southeastern corner of the county. The loess or loess-like silt which constitutes the surface material varies from about 20 inches in depth in the eastern part of the county to 6 or 7 feet in depth in the western part. The shallow blanket of loess and drift explains the frequent occurrence of rock outcrop and stony soil along Rock river and its tributaries, where the rolling topography has allowed the removal of the soil material by erosion.

CHANGES IN THE RIVER SYSTEMS

The drainage system of Ogle county has a complicated history. The preglacial Rock river flowed south from its present junction point with Kishwaukee river thru the eastern end of Ogle county. It cut a valley 3 to 5 miles wide thru most of its course and its depth below the present surface averages about 400 feet. The minor streams also have changed their courses and in some instances reversed their direction of flow. The gravel and sand ridges, known as eskers, also indicate major changes in the drainage channels of the county. Three of these eskers occur in Ogle county, known as the Adeline, Hazelhurst, and Stillman eskers.

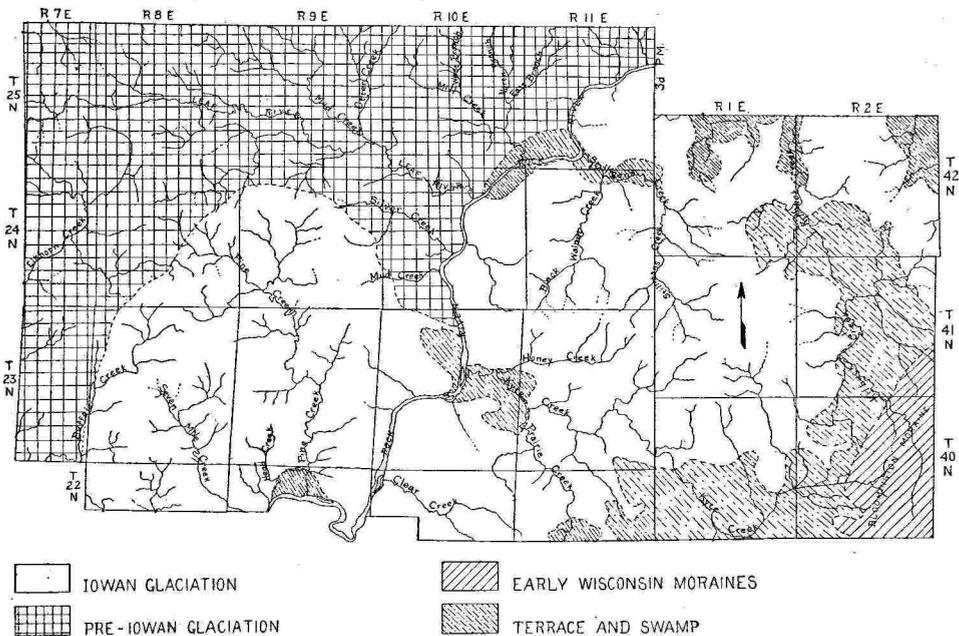


FIG. 1—DRAINAGE MAP OF OGLE COUNTY SHOWING STREAM COURSES, TERRACES AND SWAMP LANDS, AND GLACIATIONS
(Glaciations based on Leverett map)

PHYSIOGRAPHY AND DRAINAGE

The topography of Ogle county varies from flat to rolling, with rough and broken areas along Rock river and the others streams of the county. The flat topography is found in the terraces, while the undulating to rolling prevails in the upland prairie.

Rock river is the main drainage channel of the county and most of the minor streams flow into this river within the boundaries of the county. The accompanying drainage map shows the drainage of the county in detail.

The altitude of Ogle county varies from about 700 to 931 feet. The following figures give the altitudes for a few points in the county: Creston, 903 feet; Rochelle, 795; Oregon, 702; Forreston, 931; Byron, 726. The altitude of Bloomington moraine in the southeastern part of the county varies from about 850 to 910 feet.

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 but with the passing of time 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"; 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, 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 and deposited by the streams. 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 Ogle county are divided into five groups, as follows:

(a) *Upland Prairie Soils*, or dark-colored soils, usually rich in organic matter.

(b) *Upland Timber Soils*, or light-colored upland soils, usually relatively poor in organic matter.

(c) *Terrace Soils*, including bench lands and second bottoms, formed by deposits from flooded streams overloaded with sediment.

(d) *Swamp and Bottom Lands*, including flood plains along streams and some poorly drained muck and peat areas.

(e) *Residual Soils*, including Rock Outcrop and Stony Loam areas and soils formed in place thru weathering of rocks.

Table 1 gives the area of each soil type in Ogle county and its percentage of the total area. It will be observed that 57.42 percent of the county consists of upland prairie, 20.50 percent of upland timber, 11.89 percent of terrace soils, 8.56 percent of swamp and bottom-land soils, and .95 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 OGLE COUNTY, ILLINOIS

Soil type No.	Name of type	Area in square miles	Area in acres	Percent of total area
(a) Upland Prairie Soils (600, 700, 900)				
626 } 726 } 926 }	Brown Silt Loam.....	384.24	245 914	50.91
626.5 } 726.5 }	Brown Silt Loam On Limestone.....	1.38	883	.18
760	Brown Sandy Loam.....	42.21	27 014	5.59
660.5	Brown Sandy Loam On Limestone.....	1.64	1 050	.22
760.5	Brown Sandy Loam On Sandstone.....	.10	64	.02
628 } 728 }	Brown-Gray Silt Loam On Tight Clay.....	.04	25	.01
781	Dune Sand.....	2.11	1 350	.28
690 } 790 }	Gravelly Loam.....	1.58	1 011	.21
		433.30	277 311	57.42
(b) Upland Timber Soils (600, 700, 900)				
634 } 734 } 934 }	Yellow-Gray Silt Loam.....	118.46	75 814	15.70
635 } 735 }	Yellow Silt Loam.....	17.39	11 130	2.30
634.5 } 734.5 }	Yellow-Gray Silt Loam On Limestone.....	.81	518	.11
635.5 } 735.5 }	Yellow Silt Loam On Limestone.....	.89	570	.12
664 } 764 }	Yellow-Gray Sandy Loam.....	14.77	9 453	1.95
665 } 765 }	Yellow Sandy Loam.....	1.72	1 101	.22
664.5	Yellow-Gray Sandy Loam On Limestone...	.09	58	.02
764.5	Yellow-Gray Sandy Loam On Sandstone...	.63	403	.08
		154.76	99 047	20.50

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

Soil type No.	Name of type	Area in square miles	Area in acres	Percent of total area
(c) Terrace Soils (1500)				
1527	Brown Silt Loam Over Gravel.	51.70	33 088	6.85
1525	Black Silt Loam.	13.11	10 310	2.13
1566	Brown Sandy Loam Over Gravel.	7.32	4 685	.97
1560.4	Brown Sandy Loam On Gravel.	1.81	1 158	.24
1561	Black Sandy Loam. . . . .	.25	160	.04
1536	Yellow-Gray Silt Loam Over Gravel.	8.69	5 562	1.15
1567	Yellow-Gray Sandy Loam Over Gravel.	2.19	1 402	.29
1564.4	Yellow-Gray Sandy Loam On Gravel. . . . .	.46	294	.06
1581	Dune Sand.	1.07	685	.14
1528	Brown-Gray Silt Loam On Tight Clay. . . . .	.05	32	.01
1568	Brown-Gray Sandy Loam On Tight Clay. . . . .	.05	32	.01
		89.70	57 408	11.89
(d) Residual Soils (000)				
083	Sand.	2.92	1 869	.38
098	Stony Loam—Limestone.	3.62	2 317	.47
098	Stony Loam—Sandstone. . . . .	.36	230	.05
099	Limestone Outcrop. . . . .	.31	198	.04
099	Sandstone Outcrop. . . . .	.08	51	.01
		7.29	4 665	.95
(e) Late Swamp and Bottom-Land Soils (1400)				
1450	Black Mixed Loam.	21.06	13 479	2.80
1454	Mixed Loam.	43.08	27 571	5.71
1401	Deep Peat. . . . .	.38	243	.05
		64.52	41 293	8.56
(f) Miscellaneous				
	Water.	4.82	3 085	.64
	Gravel Pit. . . . .	.18	115	.03
	Rock Quarry. . . . .	.07	45	.01
		5.07	3 245	.68
	Total.	754.64	482 969	100.00

INVOICE OF THE ELEMENTS OF PLANT FOOD IN OGLE 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 6 $\frac{2}{3}$ inches), a middle stratum (6 $\frac{2}{3}$ 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 doing this the assumption is made that for ordinary types a stratum of dry soil of the area of an acre and $6\frac{2}{3}$ 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 discussions 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. It is often desirable, therefore, 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 36).

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 Ogle 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 a variation in the organic-carbon content of the different soils is 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 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, with essentially no overlapping of organic matter in the two groups of soil types. The upland timber soils range from 19,660 pounds of organic carbon an acre in Yellow Silt Loam up to 30,410 pounds in Yellow-Gray Silt Loam, with an average of 24,460 pounds. The upland prairie soils, ranging from 30,500 to 49,380 pounds, average 41,330 pounds. One type, Dune Sand, is omitted from the average for upland prairie soils as given above, for, as is usually the case with very sandy soils, it is very deficient in organic matter and nitrogen, the organic carbon amounting to only 15,640 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 soils permits the rapid oxidation of organic matter, so that it disappears from such 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 incorporating active organic materials 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 113,570 pounds an acre, with a corresponding nitrogen content of 12,990 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 only 20,000 to 30,000 pounds of organic carbon, yet the use of manure and the systematic growing of legumes for pasture and for 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 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 though 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 Ogle county soils are fairly well supplied with sulfur. It ranges, in the surface soil, from a minimum of 260 pounds an acre in Dune Sand up to 3,550 pounds in Deep Peat. Excluding Deep Peat, the sulfur content of Ogle county soils amounts to one-half to two-thirds that of phosphorus. The sulfur available for 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 was 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 pound to 10.22 pounds an acre. These figures 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 can be no extensive need for sulfur fertilizers in Ogle 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.

With regard to phosphorus, the upland timber soils as a group are found to be relatively low. One type, Black Silt Loam, is outstanding in its phosphorus content. This type in Ogle county is found in the terrace area, and the surface soil contains 2,380 pounds of phosphorus in an acre. This soil type not only exhibits an unusually high phosphorus content, but is high in organic matter, nitrogen, calcium, magnesium, and sulfur as well. This type, however, occupies only 16.11 square miles, or 2.13 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 $6\frac{2}{3}$ inches of soil being only 4,290 pounds an acre. The sandy types in Ogle county are for the most part only slightly lower in potassium content than is the case with soils of finer texture. The Residual-Sand areas, however, are particularly poor, not only in potassium but in all the other mineral elements. The potassium content of the samples obtained was only 3,060 pounds an acre, or about one-tenth the amount ordinarily found in the mineral soils. Sandy soils carry a considerable 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 of

magnesium in the surface $6\frac{2}{3}$ inches, and somewhat larger amounts of calcium. 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 comparing them with each other or with the data for the upper stratum, which is on a basis of 2 million pounds.

With this in mind it will be noted in comparing the three strata with each other 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.

With the exception of Deep Peat it will be observed that all the soil types diminish rather rapidly in organic matter and nitrogen with increasing depth, and that this diminution is quite 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 also because 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. Evidently it is the second stratum ($6\frac{2}{3}$ to 20 inches) which furnishes most of the phosphorus thus moved upward. Consequently, in nearly all the soil types in Ogle 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 content of calcium, 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 remains the same or 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 more of the latter element out into the solution to be carried farther down. Consequently, while magnesium tends to accumulate in

TABLE 2.—PLANT-FOOD ELEMENTS IN THE SOILS OF OGLE COUNTY, ILLINOIS
UPPER SAMPLING STRATUM: ABOUT 0 TO 6 $\frac{3}{8}$ INCHES
Average pounds per acre in 2 million pounds of dry soil

Soil type No.	Soil type	Total organic carbon	Total nitrogen	Total phosphorus	Total sulfur	Total potassium	Total magnesium	Total calcium
Upland Prairie Soils (600, 700, 900)								
626	Brown Silt Loam.....	49 210	5 000	1 120	840	33 060	7 080	9 830
726								
926	Brown Silt Loam On Rock.....	43 520	5 100	1 100	860	31 460	9 080	11 180
726.5								
760	Brown Sandy Loam.....	30 500	2 580	860	600	29 910	3 690	7 000
760.5								
728	Brown-Gray Silt Loam On Tight Clay.....	49 380	4 040	660	640	23 400	6 240	10 880
681								
690	Dune Sand.....	15 640	1 220	780	260	29 760	1 620	3 040
	Gravelly Loam ¹							
Upland Timber Soils (600, 700)								
734	Yellow-Gray Silt Loam.....	30 410	3 120	860	490	32 650	6 560	10 230
735	Yellow Silt Loam.....	19 660	2 440	900	380	26 800	6 100	9 720
734.5	Yellow-Gray Silt Loam On Limestone.....	23 600	2 480	620	920	31 780	6 460	10 160
635.5	Yellow Silt Loam On Limestone.....	20 680	2 340	600	340	35 600	8 060	11 040
764	Yellow-Gray Sandy Loam.....	29 050	2 260	680	450	29 880	3 850	6 950
765	Yellow Sandy Loam.....	22 100	1 560	620	580	26 880	4 880	8 300
764.5	Yellow-Gray Sandy Loam On Limestone.....	25 690	2 050	730	330	25 760	3 620	6 390
Terrace Soils (1500)								
1527	Brown Silt Loam Over Gravel..	60 740	5 770	1 260	890	32 090	4 550	8 690
1525	Black Silt Loam.....	113 570	12 990	2 380	1 750	27 220	13 860	54 630
1566	Brown Sandy Loam.....	24 760	1 600	600	340	27 300	2 200	3 440
1560.4	Brown Sandy Loam On Gravel..	20 180	1 720	700	520	27 000	2 940	4 780
1561	Black Sandy Loam.....	90 160	8 000	1 520	1 220	35 900	9 060	21 580
1536	Yellow-Gray Silt Loam Over Gravel.....	25 370	2 610	860	590	30 590	4 130	7 610
1567	Yellow-Gray Sandy Loam Over Gravel.....	31 120	2 620	860	760	23 120	3 520	5 180
1564.4	Yellow-Gray Sandy Loam On Gravel.....	20 340	1 620	720	420	21 240	2 560	5 160
1528	Brown-Gray Silt Loam On Tight Clay.....	29 260	2 120	720	660	15 980	2 460	3 880
Residual Soils (000)								
083	Residual Sand.....	28 340	1 680	620	520	3 060	1 620	1 140
098	Stony Loam ²							
Late Swamp and Bottom-Land Soils (1400)								
1450	Black Mixed Loam ³							
1454	Mixed Loam ³							
1401	Deep Peat ⁴	287 460	31 880	1 740	3 550	4 290	6 730	25 280

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 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.

¹Analyses not given because of uncertainty regarding the sample.

²Representative samples could not be taken because of the stony character of the soil.

³On account of the heterogeneous character of mixed loams, chemical analyses are not included for these types.

⁴Amounts reported are for 1 million pounds of Deep Peat.

TABLE 3.—PLANT-FOOD ELEMENTS IN THE SOILS OF OGLE COUNTY, ILLINOIS
MIDDLE SAMPLING STRATUM: ABOUT 6½ TO 20 INCHES
Average pounds per acre in 4 million pounds of dry soil

Soil type No.	Soil type	Total organic carbon	Total nitrogen	Total phosphorus	Total sulfur	Total potassium	Total magnesium	Total calcium
Upland Prairie Soils (600, 700, 900)								
626	Brown Silt Loam.....	51 320	5 000	1 820	1 270	66 740	17 670	20 800
726								
926								
726.5	Brown Silt Loam On Rock.....	56 920	5 720	2 000	1 040	63 200	20 120	25 960
760	Brown Sandy Loam.....	44 690	4 390	1 590	970	64 200	8 550	15 190
760.5	Brown Sandy Loam On Rock...	50 900	4 300	1 960	900	64 660	7 620	10 900
728	Brown-Gray Silt Loam On Tight Clay.....	38 520	3 400	1 360	920	49 760	15 920	19 760
681	Dune Sand.....	26 480	1 640	2 120	240	65 480	2 320	5 560
690	Gravelly Loam ¹							
Upland Timber Soils (600, 700)								
734	Yellow-Gray Silt Loam.....	26 800	2 910	1 670	690	65 680	14 760	20 310
735	Yellow Silt Loam.....	20 840	1 920	1 800	800	59 000	10 000	20 200
734.5	Yellow-Gray Silt Loam On Limestone.....	26 840	2 280	1 320	1 200	58 520	16 760	18 520
635.5	Yellow Silt Loam On Limestone	29 600	2 760	1 400	600	68 320	75 960	198 360
764	Yellow-Gray Sandy Loam.....	25 960	2 050	1 110	520	55 570	10 660	13 370
765	Yellow Sandy Loam.....	25 400	3 600	1 560	960	54 120	14 200	13 840
764.5	Yellow-Gray Sandy Loam On Limestone.....	30 480	2 440	1 520	600	48 720	9 080	13 400
Terrace Soils (1500)								
1527	Brown Silt Loam Over Gravel	65 310	5 750	1 830	1 090	66 080	13 750	16 150
1525	Black Silt Loam.....	91 400	9 200	3 280	1 820	55 880	17 180	62 520
1566	Brown Sandy Loam.....	40 040	3 080	1 360	720	53 880	3 800	7 920
1560.4	Brown Sandy Loam On Gravel	29 080	2 400	1 320	680	52 600	7 520	10 000
1561	Black Sandy Loam.....	92 720	7 800	2 400	1 320	64 960	19 800	37 720
1536	Yellow-Gray Silt Loam Over Gravel.....	24 640	2 320	1 460	980	64 720	13 920	15 800
1567	Yellow-Gray Sandy Loam Over Gravel.....	29 440	2 200	1 520	1 080	44 800	10 680	10 000
1564.4	Yellow-Gray Sandy Loam On Gravel.....	23 200	2 160	1 560	600	53 320	6 800	9 560
1528	Brown-Gray Silt Loam On Tight Clay.....	24 360	1 680	1 000	880	31 080	6 360	7 560
Residual Soils (000)								
083	Residual Sand.....	34 440	2 000	1 040	840	5 600	2 360	3 280
098	Stony Loam ¹							
Late Swamp and Bottom-Land Soils (1400)								
1450	Black Mixed Loam ²							
1454	Mixed Loam ²							
1401	Deep Peat ³	572 400	54 980	1 760	2 200	10 380	8 120	40 620

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

¹Representative samples could not be taken because of the stony character of the soil.

²On account of the heterogeneous character of the mixed loams, chemical analyses are not reported for these types.

³Amounts reported are for 2 million pounds of Deep Peat.

the middle and lower strata, the liberated calcium, which is thus carried farther down than magnesium may accumulate at still great 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.

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

Soil type No.	Soil type	Total organic carbon	Total nitrogen	Total phosphorus	Total sulfur	Total potassium	Total magnesium	Total calcium
Upland Prairie Soils (600, 700, 900)								
626	Brown Silt Loam.....	35 380	3 880	2 930	1 310	97 780	38 220	48 630
726								
926								
726.5	Brown Silt Loam On Rock ¹							
760	Brown Sandy Loam.....	35 840	3 940	2 260	960	94 960	48 020	84 200
760.5	Brown Sandy Loam On Rock ¹							
728	Brown-Gray Silt Loam On Tight Clay.....	33 840	3 000	3 000	540	74 460	35 880	41 880
681	Dune Sand.....	28 740	780	1 800	780	95 220	5 520	9 540
690	Gravelly Loam ¹							
Upland Timber Soils (600, 700)								
734	Yellow-Gray Silt Loam.....	29 400	3 090	3 270	980	96 200	30 260	47 430
735	Yellow Silt Loam.....	25 020	2 220	3 360	1 140	89 820	33 780	34 920
734.5	Yellow-Gray Silt Loam On Limestone.....	30 540	2 820	2 640	1 320	88 740	9 780	55 320
635.5	Yellow Silt Loam On Limestone ¹							
764	Yellow-Gray Sandy Loam.....	27 080	2 100	2 200	880	89 220	20 620	25 740
765	Yellow Sandy Loam.....	31 320	3 240	3 960	1 020	75 420	58 140	94 380
764.5	Yellow-Gray Sandy Loam On Limestone ¹							
Terrace Soils (1500)								
1527	Brown Silt Loam Over Gravel.....	35 540	3 260	2 900	1 100	98 560	28 500	28 540
1525	Black Silt Loam.....	37 320	3 840	3 960	1 200	83 730	44 040	60 330
1566	Brown Sandy Loam.....	27 960	2 160	1 320	780	78 420	4 800	9 180
1560.4	Brown Sandy Loam On Gravel.....	22 020	1 860	1 680	1 260	75 000	9 000	14 340
1561	Black Sandy Loam.....	23 810	2 520	2 640	900	98 340	68 880	133 560
1536	Yellow-Gray Silt Loam Over Gravel.....	27 150	2 490	2 940	1 200	99 300	32 550	36 090
1567	Yellow-Gray Sandy Loam Over Gravel.....	28 320	2 110	1 980	1 080	35 820	12 420	7 980
1564.4	Yellow-Gray Sandy Loam On Gravel.....	27 360	1 500	2 580	1 620	68 220	16 560	12 900
1528	Brown-Gray Silt Loam On Tight Clay.....	25 080	2 220	1 260	780	61 500	11 760	14 100
Residual Soils (000)								
083	Residual Sand.....							
098	Stony Loam ¹							
Late Swamp and Bottom-Land Soils (1400)								
1450	Black Mixed Loam ²							
1454	Mixed Loam ²							
1401	Deep Peat ³	904 140	95 250	2 280	2 490	15 120	14 160	72 090

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

¹Representative samples could not be taken because of the stony character of the soil.

²On account of the heterogeneous character of the mixed loams chemical analyses are not reported for these types.

³Amounts reported are for 3 million pounds of Deep Peat.

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 all of the 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.

Studying the figures 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 one of the most extensive soil types 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 13,880 pounds. This is about the amount of nitrogen contained in the same number of bushels of corn. The amount of phosphorus, 5,870 pounds, contained in the same soil is equivalent to that contained in 34,500 bushels of corn, while in the same quantity of this soil there is present 197,580 pounds of potassium, the equivalent of that contained in approximately 1 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 9,120 pounds per acre of nitrogen, an amount equal to that in 9,120 bushels of corn. The phosphorus content is nearly as high as in Brown Silt Loam, namely, 5,800 pounds in an acre, which is equivalent to that contained in 34,100 bushels of corn. The potassium content of Yellow-Gray Silt Loam amounts to 194,530 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 is acid thruout the entire 40-inch depth, the carbonates having been leached to a greater depth than 40 inches. Another sample of the same type contains carbonates in the lower stratum (20 to 40 inches) and consequently is non-acid. The acid sample contains 26,940 pounds per acre of calcium in the lower stratum while the other has 95,640 pounds, or more than three times as much. These differences are thus much greater than the variations between averages of different soil types.

The above statements 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 other factors enter into consideration aside from merely the amount of plant-food elements present. 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 chemical data 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

(a) UPLAND PRAIRIE SOILS

The upland prairie soils of Ogle county occupy 433.30 square miles, or 57.46 percent of the area of the county. They are fairly well distributed over the county with the exception of the territory adjacent to Rock river, which is occupied by timber soils.

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, moist soil and mat of vegetative material consisting of old grass stems and leaves. The stems and leaves were burned in part by prairie fires or disappeared in part by decay. Thus they added but little organic matter to the soil directly, but, being constantly renewed, they helped to check the decay of the fibrous roots.

Brown Silt Loam (626, 726, 926)

Brown Silt Loam is the most extensive of the upland types in Ogle county. It covers an area of 384.24 square miles, or just about one-half of the area of the county.

This type shows some variation in the different parts of the county with reference to the depth of horizons, color, texture, and topography. Its topography varies from undulating to rolling. The southeastern corner of the county, which is morainal, and the north and west portions are rolling. The remainder of the Brown Silt Loam is undulating to slightly rolling in topography.

Drainage in this type is well developed. The depth to the glacial till varies in the different parts of the county. The underlying material thruout the type is glacial drift, with the exception of the areas where no till was deposited or where it has been eroded away, in which cases the soil has developed directly on the bed rock. The thickness of the surface loess, or loess-like material, varies from about 20 inches to as much as 6 feet. These differences in depth and associated differences in soils are not shown on the soil map. Brown Silt Loam adjacent to Sandy Loam is more or less of a sandy texture. Practically all of the type is under cultivation.

The A₁ horizon, which is about 7 inches thick, is a light to medium brown silt loam, having an appreciable amount of sand present near the sandy areas. The A₂ horizon, extending to a depth of about 18 inches, is friable in texture and varies from a light brown silt loam with a slight yellow cast to a yellowish brown silt loam. The yellowish shade occurs on the more rolling areas. The B horizon is about 20 inches in thickness and is a slightly compact yellow silt loam with slight joint mottling. Below a depth of 24 to 38 inches the C horizon occurs. This is a friable yellow silt loam, somewhat mottled in the joints and splotched with yellow and red iron concretions.

The type shows the same character of profile on the areas where the till lies within 20 inches or so of the surface, with the exception that the surface, sub-surface, and subsoil horizons are not so thick as where the till is deeper.

Management.—For suggestions regarding the management of this soil, the reader is referred to the results of experiment fields at Mt. Morris and at Dixon, pages 47 and 54, which may be considered as fairly representative of most of the Brown Silt Loam as it occurs in Ogle county. It will be noted that manure has given excellent returns on these fields 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 one-half ton of this material per acre once in four years. The reader is referred to page 39 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 also nitrogen. At the same time this is being done, trials may well be made of the various phosphates including rock phosphate, basic slag, steamed bone meal, 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 (626.5, 726.5)

Brown Silt Loam On Limestone occurs in small scattering areas thruout most of the county, occupying a total of 1.38 square miles. This type is usually located on the slopes of the more rolling areas of prairie soil where the limestone occurs within 30 inches of the surface. Only a very general description of the soil horizons can be written because the depth to the rock varies from a few inches to about 30 inches.

The A₁ horizon, with an average depth of 6 inches, is a brown silt loam. The A₂ horizon, extending to a depth of about 18 inches, is a light brown to a yellowish brown silt loam. The B horizon extends to the bed rock which occurs at variable depths as stated above. This horizon occurs in two parts. The upper part is a slightly compact yellow silt loam; the lower is a compact, red, residual clay from 2 to 4 inches in thickness resting directly on the limestone.

Management.—This type is suitable only for pasture because of its drouthy nature. It produces excellent bluegrass and, with the exception of the shallower portions, should grow good sweet clover.

Brown Sandy Loam (760)

Brown Sandy Loam occurs east of Rock river, in the regions of the glacial fills of the old preglacial stream valleys, and also adjacent to Rock river. The sandy texture of the soil is due to wind action which has blown the sand out of the bottoms upon the uplands. The topography of the type is undulating to rolling. The drainage is usually well developed, owing to the open subsoil.

The A₁ horizon, extending to a depth of about 8 inches, is a brown sandy loam. The A₂ horizon which extends to a depth of about 18 inches, is a light brown to yellowish brown sandy loam. The upper 8 or 9 inches of the B horizon

varies from a friable, yellow sandy loam, splotted with gray, to a slightly compact, yellow clayey sand. The C horizon is a yellow, sandy, gravelly loam. It occurs at a depth of 25 to 35 inches.

Management.—Brown Sandy Loam is somewhat acid, tho it varies in degree of acidity. It has a slight tendency to be drouthy in places where the soil is shallow, and in some areas considerable trouble is caused by its drifting with the wind.

The general recommendations for the management of this type include the application of limestone at the proper rate, the growing and turning down of legumes, preferably sweet clover, and the use of early maturing crops on the drouthy areas. The proper rate of application of limestone can be determined by the County Farm Adviser or by securing the assistance of the Agricultural Experiment Station. Alfalfa will do well on this soil after sufficient limestone has been applied, particularly if it is preceded by sweet clover.

Brown Sandy Loam On Limestone (660.5)

Brown Sandy Loam On Limestone, which occupies only 1.64 square miles, or .22 percent of the area of the county, occurs in scattering areas along the east side of Rock river. Usually, these areas are rather indefinite as to outline because of the irregularity in the contours of the limestone beds. Most of the areas have been left in permanent pasture, because the rock is too near the surface for cropping. The topography is slightly rolling, permitting good drainage. The limestone lies at depths varying from a few inches to 30 inches below the surface, the most common depth being 8 to 20 inches.

The A₁ horizon, varying from 4 to 7 inches in thickness, is a brown sandy loam. The A₂ horizon is a light brown sandy loam. The B horizon, which varies from 4 to 6 inches in thickness, lies directly on the limestone and is either a compact, reddish yellow, gravelly, sandy clay, or a red clay.

Management.—This type is better adapted to permanent pasture than to the general farm crops. Its occurrence, however, as small scattering areas in the Brown Sandy Loam makes it necessary to farm many of the areas in the same way that the latter type is farmed. General suggestions for the management of Brown Sandy Loam may be found on page 16.

Brown Sandy Loam On Sandstone (760.5)

Brown Sandy Loam On Sandstone, which occupies a total of only 64 acres, occurs south of Oregon. The topography of the region in which the small areas of this type occur is undulating to rolling. Drainage is well developed, owing to the slope and to the open nature of the soil.

This type may be thought of as poor spots in Brown Sandy Loam. For this reason it usually is not practical to give it any special management.

Brown-Gray Silt Loam On Tight Clay (628, 728)

Only 25 acres of Brown-Gray Silt Loam On Tight Clay, Upland, occur in Ogle county.

The A₁ horizon is a grayish brown silt loam. The A₂ horizon is a gray silt loam, and the B horizon is a tough, plastic, compact, drab clay.

Management.—The small area of this type in Ogle county makes its management of no general interest. Suggestions may be secured from the Agricultural Experiment Station by anyone interested.

Dune Sand (781)

Dune Sand, Upland, comprizes a total of 2.11 square miles in Ogle county. It occurs in the areas of sandy loams where the wind has had opportunity to rework the sand particles and has redeposited them in dune-like formations. Blowouts, as well as dunes, are common in the region. The topography of the type is billowy.

The A₁ horizon, which varies from 0 to 3 inches in thickness, depending on the amount of organic matter that has accumulated, is a brownish yellow to yellow, loamy sand. There is no distinct horizon development below this shallow, brownish surface, the material below consisting of yellow sand.

Management.—Dune Sand is somewhat acid and the correction of this condition by the use of limestone is the first step towards the profitable utilization of this type. The Oquawka experiment field is located on Dune Sand and very striking results have been secured there with limestone and manure and with limestone and sweet clover. The reader is referred to page 58, where the crop yields on this field are given. The information given by these figures is the best available for Dune Sand, either Terrace or Upland, as it occurs in Ogle county.

Gravelly Loam (690, 790)

Gravelly Loam occupies a total area of only a little more than 11½ square miles. It occurs in the localities where eskers, or gravelly ridges, have been built by subglacial streams or in crevices of the ice mass. Very little loessial material occurs on these gravel ridges. The three main areas of Gravelly Loam are the Adeline, Hazelhurst, and Stillman Valley eskers. They are of very little agricultural value aside from pasture. The gravels are used for road building and railroad fills.

(b) UPLAND TIMBER SOILS

The upland timber soils occur as irregular zones along streams and on or near somewhat steep morainal ridges. Their most noticeable characteristic is the yellowish gray color of the surface, due in part to its low organic-matter content. The deficiency in organic matter has been caused by the long-continued growth of forest trees. Two effects were produced by the forest trees: the shade from the trees prevented the growth of prairie grasses, the roots of which are mainly responsible for the large organic-matter 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. As a result, the organic-matter content of the upland timber soils is always less 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 occupy 154.76 square miles, or practically one-fifth of the area of the county.

Yellow-Gray Silt Loam (634, 734, 934)

The total area of Yellow-Gray Silt Loam in Ogle county is 118.46 square miles, or 15.70 percent of the area of the county and approximately 75 percent of the total area of the timber soils. It occupies the portion of the light-colored or timber soil area of the county which has an undulating to slightly rolling topography. In the northwestern part of the county certain areas have been classified as Yellow-Gray Silt Loam in which the light color of the soil is the result of erosion rather than of forest growth. These areas altho not strictly of the type Yellow-Gray Silt Loam, are correlated with it because of their small total extent.

The A₁ horizon, which is about 6 inches in thickness, is a brownish yellow to a grayish yellow silt loam. The A₂ horizon, extending to a depth of about 18 inches, is a yellow silt loam mottled with gray. The B horizon, extending to about 32 inches in depth, is a slightly mottled, slightly compact, yellow silt loam. The C horizon, below 32 inches, is a friable, strongly mottled, yellow silt loam spotted with brown and red iron concretions.

Management.—Yellow-Gray Silt Loam is slightly acid and is low in nitrogen and organic matter. The application of about 2 tons of limestone an acre and the growing of sweet clover are recommended as effective treatments in rapidly increasing the productivity of this soil. The sweet clover can be used to advantage by pasturing it in the fall of the first year and plowing it down for corn in the spring of the second year. If wheat is grown, it is suggested that a trial be made of one or more of the following carriers of phosphorus: acid phosphate applied at the rate of about 300 pounds an acre, steamed bone meal at half the above rate, basic slag applied at the rate of about 200 pounds an acre, or rock phosphate applied at the rate of about 1,000 pounds an acre. There are no experiment field results exactly applicable to this soil type as it occurs in Ogle county, but the very striking increases in yield obtained with steamed bone meal as well as with rock phosphate, on a somewhat similar soil in Lake county, leads to the suggestion that some form of phosphate be given thoro trial.

Yellow Silt Loam (635, 735)

Yellow Silt Loam occurs in irregular areas as rough and broken land immediately adjacent to streams and on slopes at some distance from the streams. As mapped, it is the eroded portion of the timber soils from which much or all of the surface soil has been removed by washing, exposing a yellow subsoil. Yellow Silt Loam covers 17.39 square miles, or 2.30 percent of the area of the county. The exact character of this type varies greatly because of differences in vegetation and the amount of washing.

The A₁ horizon, which may extend to a depth of 3 or 4 inches, is usually a grayish yellow to a brownish yellow silt loam. Below this depth, a friable yellow silt loam may occur, which rests on a medium plastic, rather compact, yellow

silty clay loam. Till and limestone rock vary in depth below the surface, depending on the amount of erosion that has taken place. Usually the depth to till or rock varies from 25 or 30 inches to 4 or 5 feet. A stratum of yellowish red, sandy clay loam, 4 to 8 inches in thickness, frequently occurs directly above the limestone.

Management.—The timber has been cut off from practically all of the land included in this type. Certain areas of the type near Rock river have grown up in underbrush and scrub timber and are of no value as sources of timber and of little value as pasture. Other areas have been farmed with disastrous results because of erosion. The less steep slopes may be farmed successfully but special precautions must be taken to reduce erosion. The wisest course to follow with this land is to put the steepest slopes in timber and the less steep slopes in orchard or permanent pasture. Results of some experiments on this type as it occurs in southern Illinois is given in the account of the Vienna field, found on page 55.

Yellow-Gray Silt Loam On Limestone (634.5, 734.5)

Yellow-Gray Silt Loam On Limestone occupies a total area of less than one square mile. It occurs as small areas thruout Yellow-Gray Silt Loam.

The A₁ horizon, which is about 5 or 6 inches in thickness, is a grayish yellow silt loam. The A₂ horizon, extending to about 14 inches in depth, is a yellow silt loam mottled with gray. The B horizon, which is made up of two distinct strata, extends to the bed rock. The upper portion is a compact, slightly mottled, yellow silty clay loam. It rests on a layer of sticky, compact, reddish yellow to red residual clay about 3 or 4 inches in thickness. This red clay rests directly upon the limestone which lies 20 to 30 inches below the surface.

Management.—Since this type is so intimately associated with Yellow-Gray Silt Loam, it must in most cases receive the same management as Yellow-Gray Silt Loam. The reader is referred to the discussion of the latter type on page 19.

Yellow Silt Loam On Limestone (635.5, 735.5)

Yellow Silt Loam On Limestone occupies the same topographic position as Yellow Silt Loam. It covers only .89 of a square mile and is usually found on the steepest slopes. The type is non-agricultural, owing to the nearness of the limestone to the surface and the steepness of its topography. The depth to limestone varies from a few inches to as much as 30 inches below the surface.

The A₁ horizon is usually about 2 or 3 inches in thickness and varies from a dark brown or brownish yellow to a grayish yellow silt loam. Below this depth a stratum of yellow silt loam occurs which is usually about 6 inches in thickness. As the underlying limestone is approached, the material becomes a plastic, sandy to gravelly, yellow clay loam, with a stratum of red, residual clay immediately on top of the limestone.

Management.—This type can be used in most cases only for timber or pasture.

Yellow-Gray Sandy Loam (664, 764)

Yellow-Gray Sandy Loam occurs near Rock river, where a considerable amount of sand has been blown from the bottom land and deposited on the upland by the winds. It occupies 14.77 square miles, or 1.95 percent of the area of the county. The topography of the type varies from undulating to rolling. Drainage is good because of the open sandy subsoil.

The A₁ horizon, which is about 5 inches in thickness, is a grayish yellow sandy loam. The A₂ horizon, extending to a depth of about 15 inches, is a yellow sandy loam with slight joint mottling. The B horizon, in the upper portion, is a slightly compact, yellow, sandy silt loam. In the lower portion it is a yellow sand at about 24 or 25 inches. At about 32 inches a gravelly glacial till occurs, which may rest on limestone bed rock within 35 or 40 inches of the surface.

Management.—A portion of this type remains in timber and some of it is in permanent pasture. Both the nitrogen and organic-matter contents of the soil are low and an application of about 2 tons of limestone an acre must be made before sweet clover or alfalfa can be grown. The open nature of the subsoil makes this type somewhat drouthy, and for that reason it is advisable to grow early maturing crops. Provision should be made in the cropping system for the regular addition of leguminous green manure to the soil. No mineral fertilizer treatment is advised for this type except on a small trial basis.

Yellow Sandy Loam (665, 765)

Yellow Sandy Loam occurs as eroded areas in the same region as Yellow-Gray Sandy Loam. It is also found on some of the steep slopes of the Residual Sand areas. It occupies a total of only 1.72 square miles, and only areas of small acreage are to be found, most of which are near Rock river.

This soil to a depth of 2 to 5 inches is a brownish yellow to yellow sandy loam. No distinct A₂, B, or C horizons are distinguishable because of the fact that this soil is immature, owing to rapid erosion. For a depth of 15 to 18 inches it is usually a yellow sandy loam, and below this depth a yellow to reddish yellow, sandy clay loam occurs. The reddish color usually occurs in a stratum 6 to 8 inches thick, which lies directly above the sandstone or limestone.

Management.—Yellow Sandy Loam is, for the most part, kept in pasture and timber and this practice should be continued.

Yellow-Gray Sandy Loam On Limestone (664.5)

Yellow-Gray Sandy Loam On Limestone occurs in small, scattering areas thruout the limestone region along Rock river. It covers a total of only .09 of a square mile. This type is very similar to Yellow-Gray Silt Loam with the exception that the underlying limestone occurs at a depth of 12 to 28 or 30 inches below the surface. It is of very little importance and should be handled in the same way as Yellow-Gray Sandy Loam (see management discussion above).

Yellow-Gray Sandy Loam On Sandstone (764.5)

Yellow-Gray Sandy Loam On Sandstone occurs in scattering areas in the sandstone region. It occupies a total of only .63 of a square mile. Most of the type is utilized for pasture land because the sandstone is too near the surface for good farm land. It is of even less value than Yellow-Gray Sandy Loam On Limestone and no effort should be made to put it in cultivated crops.

(c) TERRACE SOILS

Nearly all of the terrace soils are located in the eastern part of the county along the course occupied by the preglacial Rock river. In addition to this large terrace Rock river has constructed small sand and gravel terraces along its present course, and some small terraces are found along the small streams.

These terraces were formed by streams overloaded with sediment during flood periods. Later when the streams diminished in volume, these former flood plains were no longer overflowed and became terraces. At the same time new flood plains at lower levels were formed.

Brown Silt Loam Over Gravel (1527)

Nearly all the areas of Brown Silt Loam Over Gravel are found in the eastern part of the county, in the preglacial Rock river terrace. Some small areas occur along Rock river and its tributaries. The type occupies 51.7 square miles, or 6.85 percent of the area of the county. In topography it varies from flat to undulating. Drainage has, for the most part, been well established thru the construction of dredges and lateral tiling. In the southern part of the county near Rochelle the type is a heavier phase and needs better drainage than is at present provided.

The A₁ horizon, which is about 8 inches thick, is a brown to dark brown silt loam. The A₂ horizon, extending to a depth of about 18 inches, is a yellowish brown silt loam. The B horizon occurs as a stratum about 12 inches in thickness. It varies from a slightly plastic, fairly compact, silty clay to silt loam. It is usually drabbish gray in color. The C horizon occurs below 30 inches. It is a friable, mottled, yellow silt loam splotted with orange-red concretions. The depth to sand and gravel varies from 42 to 50 inches below the surface.

Management.—This type varies in acidity and each field should be tested before applying limestone. The reader is referred to the discussion of Brown Silt Loam, Upland, page 15, for suggestions regarding the management of this terrace type.

Black Silt Loam (1525)

Black Silt Loam is second in extent of the terrace types, occupying 16.11 square miles. It is found in scattered areas thruout the preglacial Rock river terrace and occupies the low-lying, flat land. The transition from Brown Silt Loam to Black Silt Loam is very gradual.

The A₁ horizon, which is about 6 inches thick, varies from black silt loam to black silty clay loam, with a slight gray cast in areas which are alkaline. The A₂ horizon, which extends to a depth of about 17 inches, is a plastic, black clay

loam. The B horizon in the upper 14 inches is a plastic, compact, drab clay loam, splotched with yellow and gray streaks. The lower part of the B horizon, extending to about 40 inches in depth, varies from a plastic, drab to gray, silty clay loam. Below 40 inches it changes to a friable material which rests on a substratum of yellow to gray sand at a depth of about 48 inches.

Management.—The drainage of the low-lying, flat land occupied by this type has been fairly well taken care of by dredge ditches and tile, altho portions of the type need additional drainage. Alkali is common thruout the type and occurs in harmful amounts in some places. Its bad effects may be counteracted by the use of about 100 pounds of a potash salt per acre. The organic-matter content of this soil is high, but it should not be cropped continuously without the addition of fresh organic matter at regular intervals in the rotation. The practice has become common of raising a crop of sweet corn on this land followed the same year by a crop of peas. This practice gives a high return, but if continued on the same land year after year, it would not provide for returning sufficient organic matter to the soil.

Brown Sandy Loam Over Gravel (1566)

Brown Sandy Loam Over Gravel is found in scattered areas thruout the different terrace formations of the county; most of it, however, occurs along Rock river, and Stillman and Kyte creeks. The topography of the type varies from undulating to rolling. Drainage is good because the type is underlain with sand and gravel. It occupies 7.32 square miles, or .97 percent of the area of the county. Practically all of the type is under cultivation, altho some of it in the vicinity of Daysville and Honey Creek is left in pasture because of the low organic-matter content and the high percent of sand.

The A₁ horizon, extending to about 8 inches in depth, is a medium to coarse-grained brown sandy loam. The A₂ horizon, which extends to a depth of about 18 inches, is a yellowish brown to yellow sand. The B horizon, in the upper 6 or 7 inches, is a slightly plastic, somewhat compact, yellow, sandy clay loam, slightly mottled and splotched with brown iron concretions. Below 28 inches, it is a yellow sand, strongly splotched with red iron concretions. About 38 to 45 inches below the surface, the sand contains a considerable amount of small pebbles.

Management.—As a general rule the drainage of the undulating phase is fair, but in the flat areas near Daysville, artificial drainage is necessary. Some difficulty is encountered in the case of open ditches which tend to fill up rapidly with sediment. This soil will respond well to good farming, including the application of limestone and the turning down of nitrogenous organic matter. It is a good alfalfa soil and produces good corn following sweet clover or alfalfa.

Brown Sandy Loam On Gravel (1560.4)

Brown Sandy Loam On Gravel occurs along the old preglacial Stillman creek in the vicinity of Stillman Valley and a few scattering areas along Rock river. It covers a total area of only 1.81 square miles. The topography is undulating and the drainage is well developed since there is plenty of fall to the

streams and the substratum is open. The nearness of the gravel to the surface has a detrimental effect upon growing crops during seasons of drouth.

The A_1 horizon, extending to a depth of 8 inches, is a medium to coarse-grained brown sandy loam. The A_2 horizon, which extends to about 21 inches in depth, is a yellowish brown sand. Since the depth to the underlying gravel varies from 22 to 34 inches, depending on the contour of the gravel bed, the B horizon is variable in depth and texture. On an average it is 6 or 7 inches in thickness and is a slightly compact, yellow clayey sand, with some fine gravel, resting on gravelly sand, directly above the gravel deposits.

Management.—The fact that the stratum of soil above the gravel is rather thin accounts for the drouthy nature of this type. Since the soil is low in nitrogen and organic matter, the growing of legumes is advised. With the tendency of the type to be slightly acid, an application of about 2 tons of limestone is advisable. Also, the use of early maturing crops is recommended because for such crops the period of greatest need of moisture is past before the driest part of the season approaches.

Black Sandy Loam (1561)

Black Sandy Loam is located in the terraces of Kishwaukee river in the northeast part of the county. It occupies only about 160 acres. It is flat in topography and has been fairly well drained of late years. It is slightly lower in elevation than the adjoining types.

The A_1 horizon, which is about 6 inches thick, is a black sandy loam, with some silty and clayey spots too small to show on the map. The A_2 horizon, extending to a depth of about 17 inches, is a brown to black sandy loam. The B horizon in the upper 7 inches is a drab sandy loam, becoming a clayey sand at about 24 inches. Below this depth it is a slightly compact, sandy clay loam, drabbish yellow to yellow in color, which passes into a yellow sand at depths varying from 36 to 45 inches below the surface.

Management.—The improvement of the underdrainage is the first problem in the management of this type in order to lower the water table and remove the alkali which occurs in spots. These spots can be made productive by applying potassium salts at the rate of about 100 pounds an acre. Plowing down manure and straw also helps in overcoming the bad effects of the alkali. Legumes should have a regular place in the rotation as a source of nitrogen and readily decomposable organic matter, particularly for the non-alkali portions of the type.

Yellow-Gray Silt Loam Over Gravel (1536)

Yellow-Gray Silt Loam Over Gravel occurs in scattered areas thruout the terraces, particularly along Rock river and its tributaries. The type occupies a total of 8.69 square miles. Its topography is undulating and the drainage is fairly well established, altho there are small depressions of a heavier soil, rather poorly drained, scattered thruout the areas.

The A_1 horizon, which is about 6 inches in thickness, is a friable brownish yellow or grayish yellow silt loam. The A_2 horizon, extending to a depth of about 18 inches, is a friable, mottled, yellow silt loam. The B horizon in its upper

18 inches is a plastic, compact, slightly mottled, yellow silty clay loam which changes to a plastic, compact, golden yellow silt loam at about 42 inches. This lower stratum rests on the gravel which is calcareous and well stratified.

Management.—The management requirements of this type are the same as for Yellow-Gray Silt Loam, Upland (see page 19).

Yellow-Gray Sandy Loam Over Gravel (1567)

Yellow-Gray Sandy Loam Over Gravel occurs in small areas thruout the terraces of Rock river and some of the preglacial stream formations. It occupies a total area of only 2.19 square miles. It is undulating in topography. Because of the closeness of the gravel beds to the surface, the type is well drained and yet at the same time it is not drouthy.

The A₁ horizon, which is about 7 inches thick, varies from a yellowish brown to a grayish yellow sandy loam. The A₂ horizon, which extends to a depth of about 15 inches, is a slightly mottled, yellow sandy loam. The B horizon to a depth of about 22 inches is a fairly compact, yellow sandy clay loam. Below 22 inches it is a yellow sand with sand and gravel beds occurring at about 36 inches.

Management.—This type should be managed in the same way as Yellow-Gray Sandy Loam, Upland.

Yellow-Gray Sandy Loam On Gravel (1564.4)

Yellow-Gray Sandy Loam On Gravel occupies only .46 of a square mile. Nearly all of the areas occur along Rock river and in the pre-glacial Leaf river between Rock river and the village of Stillman Valley. The topography is undulating. Drainage is practically all vertical thru the gravel deposits. The gravel is so near the surface that the growing crops are affected during seasons of drouth.

The A₁ horizon, which is approximately 4 inches in thickness is a medium to coarse-grained, grayish yellow sandy loam. The A₂ horizon, extending to about 17 inches in depth, is a mottled, yellow sandy loam or yellow sand. The B horizon in its upper 7 inches is a fairly compact, yellow clayey sand which rests on gravelly yellow sand.

Management.—The management of this type is about the same as for Brown Sandy Loam On Gravel (1560.4). Since the type is low in organic matter and nitrogen, legumes should be grown wherever it is possible in the rotation. An application of about 2 tons of limestone an acre will aid the growth of legumes.

Dune Sand (1581)

Sand dunes occur in scattered areas thruout the terraces of the county associated with the sandy loam types. The dune formations are the result of wind action which has reworked the sand and deposited it in ridges. Near Oregon some of the sand dunes have had large blowouts formed in them. Some of the low-lying areas of sand are not true dune formations. This type in the terrace covers 1.07 square miles, or .14 percent of the area of the county. Drainage is rapid because of seepage thru the open substrata, often causing mucky and

peaty spots adjacent to the dunes. However, most of these peaty spots are too small to be shown on the map.

The A₁ horizon varies from 0 to 3 inches in thickness, depending on the amount of organic matter that has accumulated. It varies in color from a light brown to yellow sand. Below this horizon the material is uniformly a yellow sand to a depth of 4 feet or more.

Management.—Most of the Dune Sand, Terrace, is not used for farming. Its use for cropping presents peculiar difficulties. The reader is referred to the discussion of Dune Sand, Upland, page 18.

Brown-Gray Silt Loam On Tight Clay (1528)

Brown-Gray Silt Loam On Tight Clay, Terrace, occupies only 32 acres. It is flat in topography and is poorly drained, owing to the compact, plastic clay layer which is almost impervious to the movement of water. Suggestions regarding its management may be secured from the Agricultural Experiment Station.

Brown-Gray Sandy Loam On Tight Clay (1568)

Brown-Gray Sandy Loam On Tight Clay occupies only about 32 acres. It occurs in Section 13, Township 22 North, Range 11 East. It is poorly drained owing to the compact subsoil and the seepage water which it receives. Most of this type is left in pasture.

(d) RESIDUAL SOILS

Residual soils are formed from the residue left in place from the weathering of the rock and by the accumulation of organic matter. Most of the residual soil areas are located along the present valley of Rock river and some of the preglacial valleys of small streams, where the former streams, as well as erosion, have swept all the glacial material from the rock and left it exposed.

Sand (083)

Residual Sand occurs along Rock river from Oregon to Grand Detour. Very few areas of this type occur at any great distance from Rock River. Along the north shore of the preglacial Kyte creek and north of Brookville some outcrops of sandstone occur. The topography of the type is rough to broken. It is non-agricultural except for some pasture. Some of the sand is being quarried for use in glass manufacturing. A characteristic of the sandstone bedrock is that it weathers and crumbles readily when exposed. The residual sand is gray or white, except where organic matter from the rotting leaf mold is incorporated in the upper part, forming a brown color to a depth of 1 or 2 inches. The type occupies about 3 square miles of the county.

Management.—Pasture and permanent forestry are apparently the only ways in which this type can be utilized other than as a source for sand for industrial uses.

Stony Loam, Limestone (098)

Stony Loam, Limestone, occurs principally on the eroded slopes which are underlain with limestone near the surface. The stones vary in size from gravel

to 6 or 8 inches in diameter. They are mixed with some soil material which may be either silty or sandy. The type occupies 3.62 square miles, or .47 percent of the area of the county. The only agricultural value of the type is for pasture and timber land.

Stony Loam, Sandstone (098)

Stony Loam, Sandstone, occurs in the region of the St. Peter's sandstone on the eroded slopes where the weathering processes have disintegrated the sandstone to form broken pieces varying in diameter from 2 to 10 or 12 inches, mixed with sand. The type is of no agricultural value, even for pasturing purposes.

Limestone Outcrop (099)

Limestone Outcrop, which occupies altogether 198 acres, is found along Rock river and some of the small streams. The rock exposures vary in height from 20 to 125 or 150 feet. It is non-agricultural, aside from its value as a source of crushed limestone. In some localities, beyond hauling distance from shipping points, portable limestone crushers have been set up, thus furnishing neighboring farmers with ground limestone for agricultural use. There are numerous local quarry sites well distributed over the county.

Sandstone Outcrop (099)

Sandstone as an outcrop occupies only 51 acres. It is non-agricultural in value. The only interest in these areas lies in their scenic beauty.

(e) LATE SWAMP AND BOTTOM-LAND SOILS

This group includes the bottom lands along streams, the swamps, and the poorly drained lowlands. Much of the soil, therefore, is of alluvial formation and is largely subject to overflow. Overflow occurs, however, only during periods of excessive rains, and soon subsides.

The swamps occupy the low marshy areas in the preglacial Rock river terrace and some of the preglacial valleys formed by its tributaries. They also occupy the depressions in the upland that are often the sources of intermittent streams.

This group includes only three soil types which occupy a total area of 64.52 square miles, or 8.56 percent of the area of the county.

Black Mixed Loam (1450)

Black Mixed Loam occupies 21.06 square miles, or 2.80 percent of the area of the county. The largest areas are located in the eastern part of the county in what is known as the preglacial Rock river terrace. The other areas are scattered thruout the upland, usually occurring as depressions in the undulating or rolling upland in which many of the small, intermittent streams find their sources. Much seepage and drainage water reaches these areas, thus providing optimum conditions for the accumulation of organic matter. Usually, the streams which flow thru these areas have no well-defined channels and remain sluggish thru lack of sufficient fall. However, in the larger areas, drainage is better established

thru the construction of dredges and the installation of tile. As the name indicates, Black Mixed Loam is black in color, and is made up of a number of types which would be shown on the map if they occurred in larger areas.

The A₁ horizon varies from a peaty loam or muck to a silt or sandy loam, brown to black in color. This horizon is rich in nitrogen and organic matter. The A₂ horizon is usually a black clay loam. The B horizon is a fairly compact, plastic but pervious drab clay loam, which has some streaks of yellow at a depth of 36 to 40 inches.

Management.—The first important factor in management of this type is good drainage, which is frequently difficult to obtain because of the lack of an outlet. The soil is very productive, tho it is alkaline in some spots. Good drainage and the application of potash salts, manure, and straw will counteract the ill effects of the alkali. The installation of drainage has opened up many areas of this type for cultivation which were, until recently, used only for pasture.

Mixed Loam (1454)

Mixed Loam occurs as bottom land along Rock river as well as the small streams thruout the county. It usually takes the form of narrow strips rarely more than a quarter of a mile in width. The type occupes 43.08 square miles, or 5.71 percent of the area of the county. As the name indicates, this type is made up of a number of types, the areas of which are too small to be shown on the map. In texture it may be a silt loam, sandy loam, loam, or sand. In color it varies from a grayish yellow or yellow to a brown or black. Even if it were possible to indicate these different variations on the map, the first flood would probably leave a different mixture of soil material. For this reason it is impossible to write a detailed description which will apply to the type as a whole.

Management.—Practically all of this type is subject to overflow. The sediment deposited at each flood maintains a good supply of the elements of plant food. Since there is danger of this type being flooded at any time, the general practice is to keep it in pasture instead of growing cultivated crops on it.

Deep Peat (1401)

Deep Peat occupes only .38 of a square mile in Ogle county. The deposits occur in scattered areas, none of which are large and most of which are poorly drained.

To a depth of about 8 inches the type is a well-decomposed peat with its fibrous structure destroyed. Below this depth some fibrous material occurs. The proportion of fibrous material increases with increasing depth until the plastic, fairly compact, drab to black clay loam, which underlies the peat at a depth of about 40 inches, is reached.

Management.—Very little effort has been made to farm the peat deposits in Ogle county because they are swampy and difficult to drain. The peat bogs in the pastures have many hummocks varying from 4 to 12 inches or more in height. Some areas have been put under cultivation, and, with an application of potassium salts, produce fair yields.

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 a stratum or zone are discernible, in which case it is 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 $6\frac{2}{3}$ inches, $6\frac{2}{3}$ 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 land-owners 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, crop-

ping, 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, chlorine, 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 CROPS¹

Produce		Nitrogen	Phosphorus	Sulfur	Potassium	Magnesium	Calcium	Iron
Kind	Amount							
		<i>lbs.</i>	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	.....

¹These 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 6½ 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 FERTILIZERS¹

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

¹See footnote to Table 5.²Young second-year growth ready to plow under as green manure.³Wood 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—

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 6 $\frac{2}{3}$ 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 dioxide 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

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; 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.

The two following rotations are suggested as especially adapted for combating the corn borer:

<i>First year</i> —Corn	<i>First year</i> —Corn
<i>Second year</i> —Soybeans	<i>Second year</i> —Soybeans
<i>Third year</i> —Small grain (with legume)	<i>Third year</i> —Small grain (with legume)
<i>Fourth year</i> —Legume	<i>Fourth year</i> —Legume
<i>Fifth year</i> —Corn (for silage)	<i>Fifth year</i> —Wheat (with alfalfa)
<i>Sixth year</i> —Wheat (with sweet clover)	<i>Sixth year</i> —Alfalfa

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 —Soybeans
Third year —Corn
Fourth year —Wheat (with legume)
Fifth year —Legume

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

First year —Corn
Second year —Cowpeas or soybeans
Third year —Wheat (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 barley or 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, or it may include alfalfa used as a biennial. The mixing of alfalfa with clover seed for a legume crop is a recommendable practice. 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 Ogle County)

The University of Illinois has conducted 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 majority are still in operation. It is the present purpose to report the summarized 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.

Two Farming Systems Provided

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 furnish organic matter and nitrogen. The amount applied to a plot is based upon the amount that can be produced from crops raised on that plot.

In the grain system no animal manure is used. The organic matter and nitrogen are applied in the form of plant manures, including the plant residues produced, such as cornstalks, straw from wheat, oats, clover, etc., along with leguminous catch crops plowed under. It is 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. Certain modifications have been introduced in recent years.

Definite Crop Rotations Followed

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

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

Mineral Manures.—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 MT. MORRIS FIELD

A University soil experiment field located in Ogle county has been in operation for the past sixteen years. This field is situated near the center of the county at the edge of the town of Mt. Morris. The soil type as shown on the county map is Brown Silt Loam but, as explained in the description of the Brown Silt Loam, this type as mapped in Ogle county embraces several variations. A detailed examination of the soil of the Mt. Morris field discloses five distinguishable types which, on a large-scale map, can be indicated. Such a map is pre-

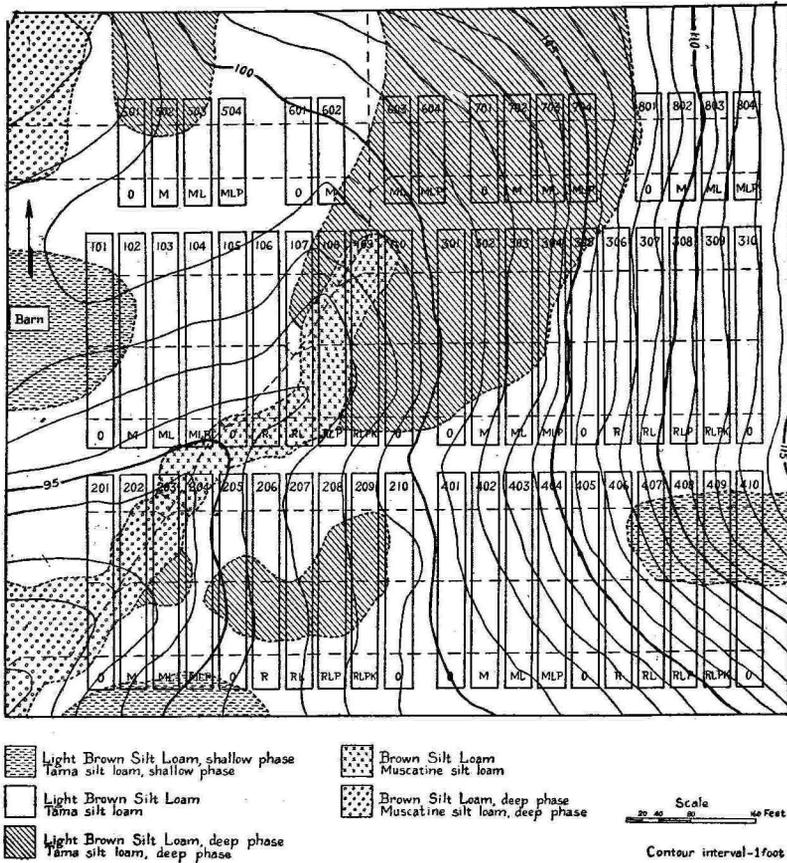


FIG. 2.—DIAGRAM OF THE MT. MORRIS SOIL EXPERIMENT FIELD

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.

sented in the accompanying diagram (Fig. 2). The names of these types and their distribution over the field are shown in the diagram. There are also charted the arrangement of plots with their respective soil treatments, and the topography of the land as represented by contour lines. As these lines indicate, the land is somewhat rolling and there is a tendency to wash in some places. The field has been tiled and the drainage is good excepting on some of the lower spots.

The field, which includes 20 acres, is laid out in two general systems of plots which have been designated as the major and the minor systems. Each system embraces four series of plots as described below.

The Major Series—100, 200, 300, 400

The four series of plots constituting the major system, 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 was practiced. The crops were managed practically as described for the general plan on page 46 until 1921, when it was planned to remove all clover as hay,

and to discontinue the return of oat straw. In 1922 the return of the wheat straw was also discontinued as well as the application of limestone. In 1923 the phosphate applications were evened up on all phosphate plots to a total amount of 4 tons an acre and no more will be applied for an indefinite period.

Since the Mt. Morris field is located in Ogle county, a complete record of the yields of all crops grown is included in this report. The results for the major series are given in detail in Table 7 and these results are summarized in Table 8 to show the average annual yields per acre for the different kinds of crops, including the years since complete soil treatment on the respective plots has been in effect.

In looking over these results, one may observe first the beneficial effect of farm manure. The annual crop increases due to the use of manure alone amount to over 14 bushels an acre for corn, nearly 9 bushels of oats, almost 5 bushels of wheat, and about $\frac{1}{2}$ ton of clover. Organic manure furnished by "residues" has likewise proved beneficial to all crops, but not in the same degree as stable manure.

Limestone in addition to organic manures has been used with good effect, the improvement being especially marked in the residues system.

Rock phosphate has produced no significant effect applied with manure and limestone. In the corresponding residues system the increases in yield obtained from rock phosphate are somewhat larger, but they have not been sufficient to cover the cost of the phosphate applied.

Potassium, in the combination used in these experiments, has produced no results of significance.



FIG. 3.—CORN ON THE MT. MORRIS FIELD

The two pictures represent the extremes in corn production according to soil treatment. Where the untreated land has produced as a fourteen-year average 44.6 bushels an acre, the land under the residues, limestone, phosphate, potash treatment has yielded 67.2 bushels. The most profitable treatment on this field, however, has been that of residues and limestone, which has produced 62.2 bushels an acre.

TABLE 7.—MT. MORRIS FIELD: SERIES 100, 200, 300, 400
Annual Crop Yields—Bushels or (tons) per acre

Plot No.	Soil treatment applied	1910 Barley ¹	1911 Corn ²	1912 Oats ²	1913 Clover ⁵	1914 Wheat ⁵	1915 Corn	1916 Oats	1917 Clover	1918 Wheat	1919 Corn	1920 Oats	1921 Clover	1922 Wheat	1923 Corn	1924 Oats	1925 Clover	1926 Wheat
101	0.....	44.6	53.8	49.1	(3.17)	40.5	17.9	67.0	(1.23)	16.6	47.1	57.2	(1.53)	28.5	38.4	66.9	(1.73)	29.2
102	M.....	42.9	54.1	50.0	(3.70)	42.8	36.7	71.6	(1.72)	22.5	58.8	85.2	(1.91)	34.8	61.8	81.7	(2.13)	33.2
103	ML.....	30.2	46.7	27.0	(2.37)	36.2	41.0	63.0	(2.41)	25.6	61.7	85.0	(1.89)	42.3	77.1	90.9	(2.26)	42.7
104	MLrP....	26.4	46.5	40.3	(2.18)	36.8	39.5	63.8	(2.52)	28.4	60.4	88.4	(1.90)	41.7	69.3	92.8	(2.15)	39.8
105	0.....	27.3	51.5	43.1	(2.59)	37.3	16.0	59.5	.50	20.0	47.6	67.0	(2.00)	36.3	37.6	67.7	(1.99)	29.1
106	R.....	23.1	52.1	39.4	.58	38.4	20.9	60.0	1.10	20.9	61.2	66.6	(2.11)	34.9	46.8	70.0	(.74)	31.2
107	RL.....	32.8	53.5	41.9	1.00	42.8	35.2	61.9	1.33	24.0	64.9	93.8	(2.45)	39.3	64.1	67.5	(.82)	38.4
108	RLrP....	30.7	57.9	47.5	.83	43.4	38.0	54.7	1.17	25.8	81.0	93.4	(2.17)	40.7	66.1	72.3	(.82)	42.0
109	RLrPK...	34.7	52.9	48.4	.92	47.4	40.5	62.8	.83	26.6	68.1	77.0	(2.20)	41.5	75.9	73.0	(.86)	45.6
110	0.....	30.7	55.7	41.6	(3.66)	44.6	19.7	30.3	(1.25)	12.6	35.5	68.3	(1.45)	31.8	43.3	66.6	(2.13)	25.4
		Soy-beans ¹	Wheat ³	Corn ⁴	Oats	Clover	Wheat	Corn	Oats	Soy-beans	Wheat	Corn	Oats	Clover	Wheat	Corn	Oats	Clover
201	0.....	17.8	20.8	48.6	52.8	(1.85)	31.7	29.5	76.2	(1.76)	27.5	36.1	35.5	(2.12)	8.5	31.4	55.2	(.50)
202	M.....	15.8	16.2	56.8	63.0	(2.74)	35.9	43.8	85.2	(1.89)	24.2	42.2	43.9	(3.28)	24.8	46.6	72.0	(1.63)
203	ML.....	15.2	15.4	57.4	50.3	(3.44)	40.1	50.7	97.3	(1.71)	29.2	54.9	48.3	(3.30)	36.6	50.2	88.8	(2.75)
204	MLrP....	12.3	16.5	58.7	61.7	(3.52)	44.0	51.0	95.5	(2.20)	30.5	51.6	48.3	(3.08)	38.3	55.4	84.2	(2.89)
205	0.....	16.1	17.0	49.6	48.8	(1.74)	30.8	33.3	78.4	14.0	20.0	34.6	30.3	(1.93)	16.8	32.2	53.3	(.38)
206	R.....	16.1	16.3	45.8	62.5	1.00	37.7	42.9	81.1	16.7	23.3	42.1	31.7	(2.87)	17.9	38.4	69.1	(.51)
207	RL.....	16.3	18.2	48.8	63.3	1.25	42.1	55.5	95.8	17.7	32.5	63.2	48.6	(3.57)	30.0	43.8	94.7	(1.97)
208	RLrP....	14.5	21.3	53.0	69.2	1.00	47.1	57.2	99.4	21.3	33.3	61.9	43.9	(3.83)	35.3	45.0	90.9	(2.38)
209	RLrPK...	11.8	23.5	62.1	63.1	1.67	48.2	56.5	101.4	20.3	31.7	64.6	52.5	(3.99)	38.0	48.0	97.2	(2.68)
210	0.....	12.2	22.0	51.1	48.0	1.50	42.9	42.4	74.5	(1.91)	29.2	42.3	28.9	(2.47)	15.7	37.2	51.1	(.29)

¹No treatment. ²Residues only. ³No manure or lime. ⁴No lime. ⁵Residues and lime only. ⁶No manure.

TABLE 7.—MT. MORRIS FIELD: Series 100, 200, 300, 400—Concluded

Plot No.	Soil treatment applied	1910 Oats ¹	1911 Soy-beans ²	1912 Barley ³	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.....	54.2	13.7	32.2	57.5	57.3	(4.35)	13.3	28.9	77.8	(1.36)	34.4	57.6	68.4	(1.31)	33.9	65.9	50.6
302	M.....	53.1	18.3	31.3	72.9	56.4	(4.24)	17.6	48.2	76.9	(1.51)	42.5	69.9	72.0	(1.58)	34.9	74.6	61.9
303	ML.....	50.8	16.0	35.8	70.7	55.5	(4.18)	19.8	56.2	74.4	(1.88)	46.2	70.2	82.2	(2.08)	43.7	79.9	74.8
304	MLrP....	51.6	17.4	33.3	67.1	51.7	(4.24)	24.8	57.4	82.8	(1.64)	46.1	74.0	80.5	(1.76)	44.7	85.9	72.7
305	0.....	70.9	15.3	31.5	58.4	43.8	.42	17.0	31.0	82.2	12.9	26.2	50.7	44.8	(.90)	29.6	58.8	33.6
306	R.....	68.7	18.5	30.2	66.1	50.0	.50	19.7	38.0	78.4	15.2	31.8	46.6	56.6	(1.36)	34.0	63.8	39.8
307	RL.....	75.8	15.9	31.9	69.2	47.0	.42	22.3	48.7	75.0	20.0	42.0	63.3	77.0	(2.19)	43.3	85.4	62.5
308	RLrP....	62.5	19.6	33.4	76.8	56.2	.17	26.8	51.7	76.9	20.0	48.3	64.7	76.1	(2.50)	45.2	87.0	70.0
309	RLrPK...	78.1	16.9	39.3	68.9	54.2	.08	28.7	56.4	70.3	19.7	48.5	69.1	83.3	(2.45)	38.0	91.0	69.7
310	0.....	62.5	18.2	29.8	51.5	53.1	(3.37)	21.2	30.0	75.2	(1.45)	32.8	43.7	45.0	(1.01)	32.5	50.1	36.9
		Corn ¹	Oats ²	Clover ²	Wheat ⁴	Corn	Oats	Clover	Wheat	Corn	Oats	Clover	Wheat	Corn	Oats	Clover	Wheat	Corn
401	0.....	34.3	60.2	(2.10)	25.2	58.2	70.0	(2.16)	7.1	55.2	51.6	(1.61)	29.4	63.7	32.3	(3.15)	19.4	46.9
402	M.....	35.1	63.6	(2.67)	26.2	71.3	67.0	(2.74)	7.8	70.4	60.2	(2.14)	31.4	76.5	46.9	(3.70)	28.0	59.6
403	ML.....	36.9	60.3	(2.87)	29.5	73.6	67.0	(3.09)	11.5	74.1	52.3	(2.91)	33.3	74.8	57.7	(4.39)	42.2	66.2
404	MLrP....	35.8	70.3	(2.75)	33.3	68.8	69.4	(3.01)	11.8	75.1	50.0	(2.83)	35.8	82.8	59.4	(4.19)	44.5	61.8
405	0.....	37.1	65.3	(2.73)	27.8	58.4	66.4	.58	7.8	57.0	55.9	(1.01) 3.96	27.4	67.7	36.7	(2.59)	20.9	41.1
406	R.....	42.0	65.0	1.42	33.5	59.5	64.7	.50	8.1	68.1	60.9	(1.27) 4.36	26.3	73.0	39.7	(3.16)	23.3	49.7
407	RL.....	41.2	71.1	1.42	32.0	64.5	57.7	.67	11.5	74.1	64.4	(1.59) 4.36	29.7	80.5	54.4	(4.04)	36.8	58.1
408	RLrP....	40.3	68.3	1.25	33.3	66.4	57.2	.50	13.6	78.3	65.9	(1.60) 3.72	33.8	79.6	56.6	(4.69)	42.5	65.2
409	RLrPK...	40.9	68.3	1.17	36.8	67.5	57.3	.42	13.1	79.1	68.0	(1.77) 3.65	33.8	90.0	55.8	(4.03)	42.5	65.7
410	0.....	36.2	63.0	(2.18)	30.3	57.5	71.6	(2.23)	5.9	55.6	52.3	(1.40)	24.8	63.0	32.5	(2.40)	21.8	38.2

¹No treatment. ²Residues only. ³No manure or lime. Wheat winterkilled; barley grown as a substitute crop. ⁴No manure.

TABLE 8.—MT. MORRIS FIELD: SERIES 100, 200, 300, 400, SUMMARY OF CROP YIELDS
Average Annual Yields, 1913-1926—Bushels or (tons) per acre

Serial plot No.	Soil treatment applied	Corn	Oats	Wheat	Clover ¹	Soy-beans
		14 crops	14 crops	12 crops	10 crops	2 crops
1	0.....	45.3	58.5	23.3	(1.96)	(1.56)
2	M.....	59.5	67.4	28.1	(2.53)	(1.70)
3	ML.....	64.4	70.5	34.4	(2.97)	(1.80)
4	MLP.....	64.3	71.5	35.9	(2.92)	(1.92)
5	0.....	44.6	54.9	23.5	(1.61)	13.5
6	R.....	51.2	59.4	25.8	(1.77)	16.0
7	RL.....	62.2	68.8	32.7	(2.24)	18.9
8	RLP.....	65.6	70.2	36.2	(2.23)	20.7
9	RLPK.....	67.2	70.4	36.3	(2.24)	20.0
10	0.....	43.6	52.4	24.6	(1.79)	(1.68)

Crop Increases

M over 0.....	14.2	8.9	4.8	(.57)	(.14)
R over 0.....	6.6	4.5	2.3	(.16)	2.5
ML over M.....	4.9	3.1	6.3	(.44)	(.10)
RL over R.....	11.0	9.4	6.9	(.47)	2.9
MLP over ML.....	— .1	1.0	1.5	— (.05)	(.12)
RLP over RL.....	3.4	1.4	3.5	— (.01)	1.8
RLPK over RLP.....	1.6	.2	.1	(.01)	— .7

¹Some clover seed evaluated as hay.

The Minor Series—500, 600, 700, 800

The plots of the minor series were not laid out until 1912. At this time a rotation of potatoes two years, and alfalfa six years, was started. Manure was applied at the rate of 15 tons an acre for each potato crop. In the beginning 4 tons of limestone an acre was applied, and thereafter the applications were continued at the rate of ½ ton a year, all applied in preparation for the alfalfa. Rock phosphate was applied at the annual acre rate of 500 pounds before the first potato crop. In 1921 the rotation was changed to corn, barley, sweet clover, and alfalfa. The manure was evened up to a total of 30 tons an acre, the limestone to 9 tons, and the rock phosphate to 3½ tons, no more of these materials to be applied for an indefinite period.

Table 9 presents an outline of the cropping history of these series, while Table 10 summarizes the work in terms of average annual acre-yields for those years since the plots have been under their full treatments.

The general beneficial effect of farm manure is again demonstrated. The use of limestone has also given profitable returns, particularly in the alfalfa hay. The negative result with sweet clover seed is probably due to the fact that the ranker vegetative growth observed on the lime plots was detrimental to seed production.

Here, as on the major system of plots, with a different crop rotation, rock phosphate has produced no significant effect.

TABLE 9.—MT. MORRIS FIELD: SERIES 500, 600, 700, 800
Annual Crop Yields—Bushels or (tons) per acre

Plot No.	Soil treatment applied	1913 Potatoes	1914 Potatoes	1915 Barley hay	1916 Alfalfa	1917 Alfalfa ³	1918 Alfalfa	1919 Alfalfa	1920 Alfalfa	1921 Barley	1922 Sweet clover seed	1923 Corn	1924 Barley	1925 Alfalfa	1926 Alfalfa
501	O.....	112.5	78.3	(.52)	(1.16)	....	(1.47)	(3.18)	(2.66)	22.1	2.92	61.2	29.4	(0.00)	(1.93)
502	M.....	163.2	158.0	(2.33)	(3.88)	....	(2.57)	(4.98)	(3.21)	36.9	2.92	66.4	34.4	(0.00)	(2.21)
503	ML.....	184.3	173.8	(1.96)	(5.33)	....	(4.46)	(6.10)	(4.22)	44.4	3.05	70.6	40.4	(1.38)	(3.90)
504	MLP.....	207.7	175.0	(1.79)	(5.10)	....	(4.39)	(6.26)	(3.93)	40.0	2.83	77.2	41.0	(1.24)	(3.94)
		Alfalfa ^{1,2}	Alfalfa ¹	Potatoes	Potatoes	Alfalfa ³	Alfalfa	Alfalfa	Alfalfa	Corn	Barley	Sweet clover seed	Corn	Barley	Timothy-alsike
601	O.....	....	(5.32)	197.8	71.7	....	(4.00)	(5.31)	(2.27)	67.8	52.1	6.96	59.4	33.8	(1.46)
602	M.....	....	(5.47)	266.7	137.0	....	(5.04)	(6.03)	(3.16)	57.8	57.9	8.08	61.0	43.9	(2.01)
603	ML.....	....	(6.32)	252.5	145.0	....	(5.37)	(5.08)	(3.68)	74.0	60.0	6.28	66.4	71.9	(2.45)
604	MLP.....	....	(6.70)	265.8	144.7	....	(5.19)	(5.52)	(4.08)	77.6	57.5	5.96	53.0	71.5	(2.54)
		Alfalfa ^{1,2}	Alfalfa ¹	Alfalfa ¹	Alfalfa ¹	Potatoes	Potatoes	Alfalfa	Alfalfa	Alfalfa	Corn	Barley	Sweet clover seed	Corn	Barley
701	O.....	....	(5.78)	(5.01)	(4.98)	94.8	101.0	(3.03)	(2.48)	(3.61)	86.0	37.5	1.67	76.6	51.4
702	M.....	....	(5.95)	(5.16)	(5.77)	130.3	154.2	(3.74)	(3.79)	(3.78)	88.8	52.3	1.83	84.8	60.4
703	ML.....	....	(6.68)	(5.57)	(5.66)	126.5	158.7	(3.91)	(4.94)	(4.62)	87.8	58.3	.50	83.4	58.5
704	MLP.....	....	(6.67)	(5.61)	(5.57)	119.8	150.2	(4.06)	(4.93)	(4.54)	88.2	59.2	.50	86.6	62.5
		Alfalfa ^{1,2}	Alfalfa ¹	Alfalfa ¹	Alfalfa ¹	Alfalfa ^{1,3}	Alfalfa ¹	Potatoes	Potatoes	Alfalfa seeding	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Corn
801	O.....	....	(5.56)	(4.98)	(5.27)	....	(3.50)	46.7	15.7	....	(4.26)	(3.50)	(3.09)	(2.62)	57.8
802	M.....	....	(5.51)	(4.80)	(5.34)	....	(3.73)	61.7	31.3	....	(4.90)	(4.40)	(3.33)	(3.13)	64.6
803	ML.....	....	(5.42)	(4.55)	(5.40)	....	(3.09)	71.7	35.5	....	(5.39)	(5.05)	(4.19)	(4.03)	62.0
804	MLP.....	....	(5.77)	(4.90)	(5.17)	....	(3.26)	62.7	33.3	....	(5.58)	(5.59)	(4.44)	(4.14)	65.0

¹No manure. ²Series 600, 700, 800 harvested as a unit. ³Alfalfa winterkilled in 1917.

TABLE 10.—MT. MORRIS FIELD: SERIES 500, 600, 700, 800, SUMMARY OF CROP YIELDS
Average Annual Yields, 1913-1926—Bushels or (tons) per acre

Serial plot No.	Soil treatment applied	Potatoes	Alfalfa	Corn	Barley	Sweet clover seed	Timothy-alsike
		8 crops	19 crops	6 crops	6 crops	3 crops	1 crop
1	0.....	89.8	(2.35)	68.0	37.8	3.83	(1.46)
2	M.....	137.8	(3.03)	70.6	49.3	4.28	(2.01)
3	ML.....	143.5	(3.77)	74.0	55.4	3.24	(2.45)
4	MLP.....	141.1	(3.89)	74.7	55.3	3.10	(2.54)
Crop Increases							
	M over 0.....	48.0	(.71)	2.6	11.5	.45	(.55)
	ML over M.....	5.7	(.71)	3.4	6.1	-1.04	(.44)
	MLP over ML.....	-2.4	(.12)	.7	-.1	-.14	(.09)

THE DIXON FIELD

A summary of the results of the Dixon experiment field are presented here, inasmuch as the soil of this field is similar to some of that found in Ogle county.

This field, which includes about 21 acres, is laid out into two general systems of plots, a major and a minor system. The results from the major system will be considered here.

The rotation practiced has been wheat, corn, oats, and clover. The treatment of the plots and management of the crops have been, for the most part, according to the general plan described above on page 46. The more important modification of this plan has been the discontinuance within the last few years of the applications of limestone, phosphate, and straw residues.

TABLE 11.—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	Oats	Wheat	Barley	Clover ¹	Soybeans
		15 crops	14 crops	11 crops	1 crop	9 crops	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)	-.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

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

Table 11 gives a summary of the results in terms of the average annual crop yields obtained since the plots have been under complete treatment.

In considering these results, the most striking feature to be observed is the outstanding effect of farm manure. The average annual increase per acre in crop yields due to the use of manure alone amounts to nearly 20 bushels of corn, more than 12 bushels of oats, nearly 7 bushels of wheat, $\frac{2}{3}$ of a ton of clover, and $\frac{1}{3}$ of a ton of soybean hay.

Organic manure in the form of crop residues has also produced increases in yields altho not to the extent of those produced by animal manure.

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 existing market conditions.

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

THE VIENNA FIELD

Inasmuch as Ogle county embraces in its Yellow Silt Loam and certain other soil 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 in Johnson county, is representative of the sloping erodible land so prevalent in that section of the state. Experiments were conducted nine years with the purpose of testing different methods of reclaiming this badly gullied land and preventing further erosion. 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. Experiments were started at once to reclaim this land, the different methods described below being used for this purpose.

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 five 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



FIG. 4.—VIEW OF AN UNIMPROVED HILLSIDE JUST OVER THE FENCE FROM THE FIELD SHOWN IN FIG. 5

soil and practicing deep contour plowing and contour planting. With two exceptions, about 8 loads of manure per acre were turned under each year for the corn crop.

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



FIG. 5.—CORN GROWING ON IMPROVED HILLSIDE OF THE VIENNA EXPERIMENT FIELD. THIS LAND FORMERLY HAD BEEN BADLY ERODED. COMPARE WITH FIG. 4

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	(.68)
B	Embankments and hillside ditches.....	32.4	12.7	(.97)
C	Organic matter, deep contour plowing, and contour planting.....	27.9	11.7	(.80)
D	Check.....	14.1	4.6	(.21)

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.

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 per 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. 4 and 5 will serve to indicate the possibility of improving this type of soil.

THE OQUAWKA FIELD

In 1913 the University established an experiment field on Dune Sand, Terrace, in Henderson county, near the Mississippi river. This field is divided into six series of plots. Corn, soybean, 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.

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 47.

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 practically doubled. The limestone has also produced 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 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 about 2 bushels of corn from the use of potassium salts, with ordinary prices this would not be a profitable treatment.

TABLE 13.—OQUAWKA FIELD: SUMMARY OF CROP YIELDS
Average Annual Yields, 1915-1926—Bushels or (tons) per acre

Serial plot No.	Soil treatment applied	Corn	Soybeans ¹	Wheat	Sweet clover ²	Rye	Alfalfa
		12 crops	12 crops	12 crops	8 crops	10 crops	9 crops
1	0.....	20.2	(.99)	8.7	0.0	12.1	(.42)
2	M.....	25.3	(1.19)	12.0	0.0	13.7	(.92)
3	ML.....	33.4	(1.61)	16.1	1.03	24.7	(2.37)
4	MLP.....	33.9	(1.56)	16.4	1.05	23.4	(2.45)
5	0.....	19.7	(.77)	10.7	0.0	12.7	(.40)
6	R.....	21.2	(.82)	12.2	0.0	12.9	(.45)
7	RL.....	37.2	(1.17)	15.1	1.41	24.0	(2.11)
8	RLP.....	37.0	(1.25)	15.6	1.28	24.1	(2.10)
9	RLPK.....	39.2	(1.20)	14.9	1.49	26.0	(2.17)
10	0.....	18.6	(.71)	9.6	0.0	10.3	(.29)
CROP INCREASES							
	M over 0.....	5.1	(.20)	3.3	0.0	1.6	(.50)
	R over 0.....	1.5	(.05)	1.5	0.0	.2	(.05)
	ML over M.....	8.1	(.42)	4.1	1.03	11.0	(1.45)
	RL over R.....	16.0	(.35)	2.9	1.41	11.1	(1.66)
	MLP over ML.....	.5	(-.05)	.3	.02	- 1.3	(.08)
	RLP over RL.....	-.2	(.08)	.5	-.13	.1	(-.01)
	RLPK over RLP.....	2.2	(-.05)	-.07	.21	1.9	(.07)

¹Eleven regular crops, together with the extra crop described in the following footnote, averaged as 11 crops. Several crops which were harvested as seed are evaluated in this summary as hay.

²Some 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 slight increases from the use of potassium appearing in the other crops are scarcely significant.

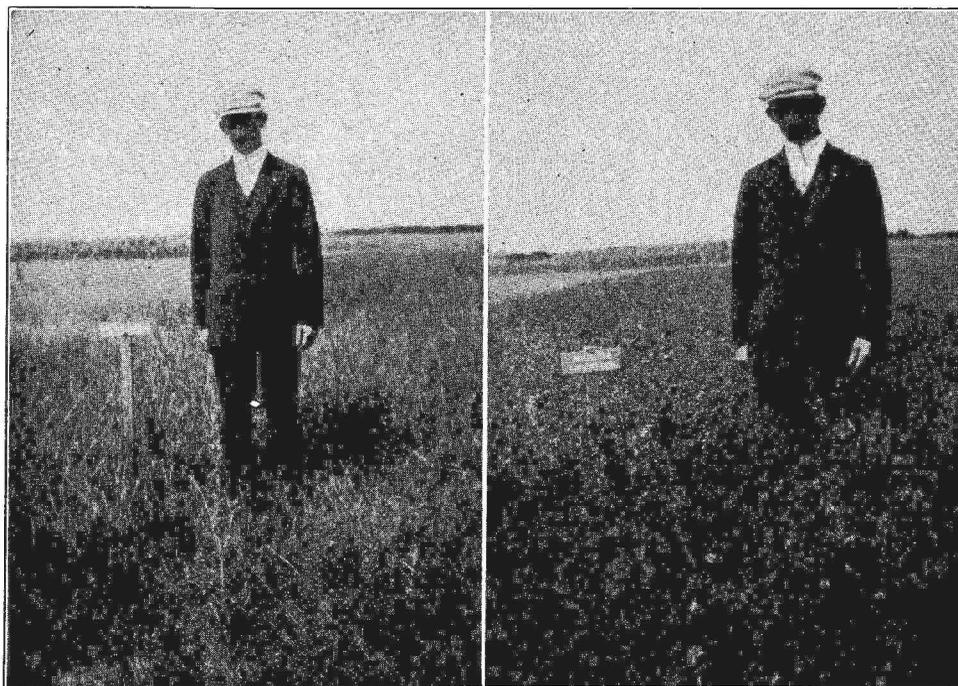
A significant fact which the above summary does not bring out is that improvement under favorable treatment has been progressive as evidenced by a very marked upward trend in production after the first few years. For example, it may be noted that the yield of corn under the limestone-residues treatment has been 37.2 bushels an acre as an average for the 12 crops since full treatment started, but if we take an average of the last five crops, the yield rises to 42.9 bushels. Likewise the wheat yield under this same treatment for the 11-year average is 15.1 bushels, but the average for the last five years is 22.3 bushels.

Experience thus far shows rye to be better adapted to this land than wheat, and 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.

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.

There were ten plots receiving the treatments indicated in the table. Where potassium was applied, the yield was three to four times as large as where



Manure
Yield: Nothing

Manure and limestone
Yield: 4.43 tons per acre

FIG. 6.—ALFALFA ON THE OQUAWKA FIELD

These pictures show the possibility of improving this unproductive sandy land of 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.

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

TABLE 14.—MANITO FIELD: DEEP PEAT
Annual Crop Yields—Bushels per Acre

Plot No.	Soil treatment 1902	Corn 1902	Corn 1903	Soil treatment 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

¹Yield not recorded for 1902.

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 per 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.

List of Soil Reports Published

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| 1 Clay, 1911 | 20 Bureau, 1921 |
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| 4 Sangamon, 1912 | 23 DeKalb, 1922 |
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| 19 Peoria, 1921 | 38 Ogle, 1927 |

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Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410;
- (2) fax: (202) 690-7442; or
- (3) email: program.intake@usda.gov.

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LEGEND

- 000 Residual
- 600 Pre-lowan Glaciation
- 700 Iowan Glaciation
- 900 Early Wisconsin Moraines
- 1100 Early Wisconsin Intermoraine Area

(a) UPLAND PRAIRIE SOILS

- 26 Brown silt loam
- 26.5 Brown silt loam on limestone
- 60 Brown sandy loam
- 60.5 Brown sandy loam on limestone
- 60.5 Brown sandy loam on sandstone
- 628 728 Brown-gray silt loam on tight clay
- 81 Dune sand
- 90 Gravelly loam

(b) UPLAND TIMBER SOILS

- 34 Yellow-gray silt loam
- 35 Yellow silt loam
- 34.5 Yellow-gray silt loam on limestone
- 35.5 Yellow silt loam on limestone
- 684 784 Yellow-gray sandy loam
- 665 765 Yellow sandy loam
- 64.5 Yellow-gray sandy loam on limestone
- 64.5 Yellow-gray sandy loam on sandstone

(c) 1500 TERRACE SOILS

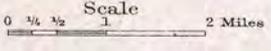
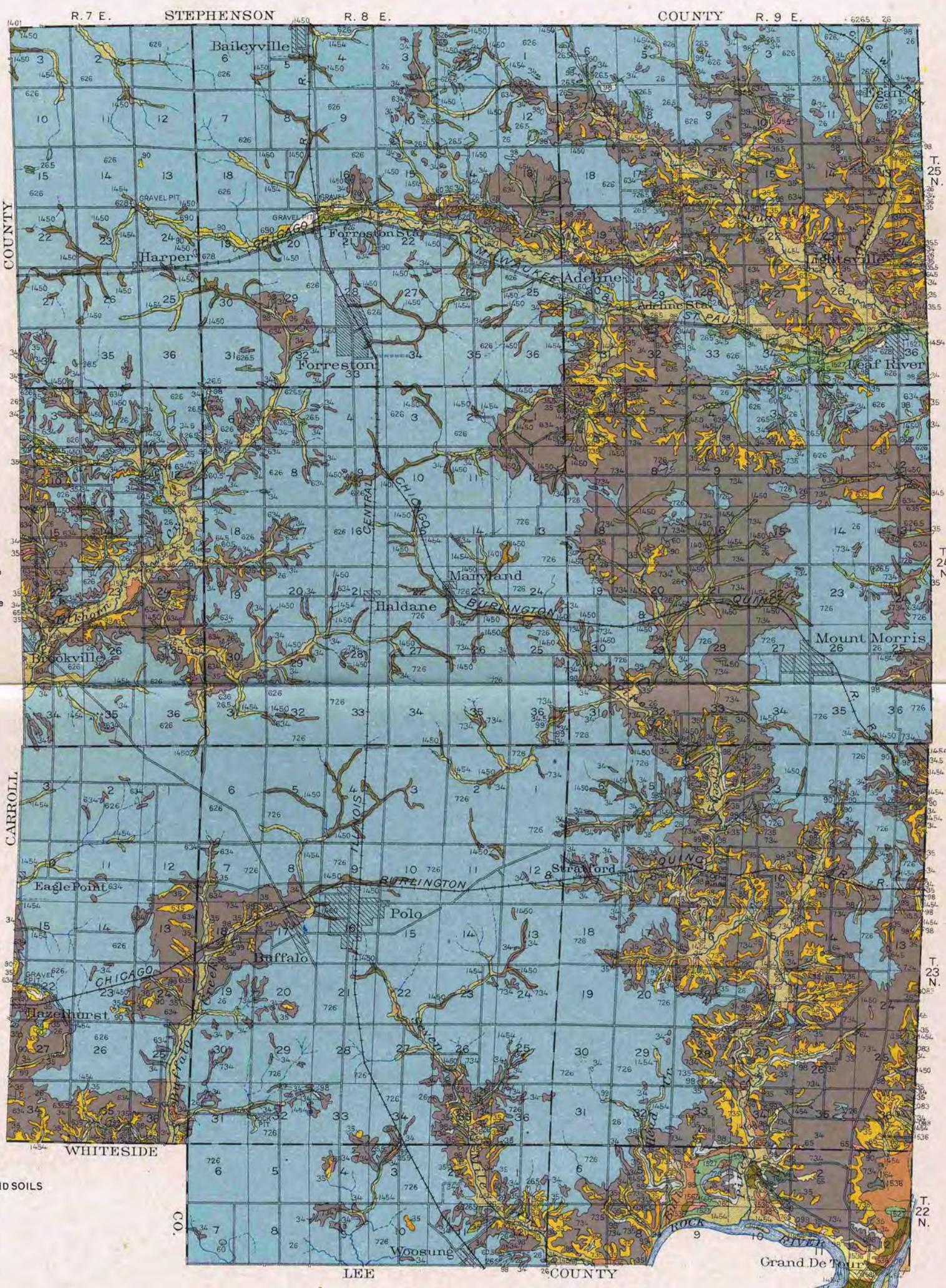
- 1527 Brown silt loam over gravel
- 1525 Black silt loam
- 1566 Brown sandy loam over gravel
- 15604 Brown sandy loam on gravel
- 1561 Black sandy loam
- 1536 Yellow-gray silt loam over gravel
- 1567 Yellow-gray sandy loam over gravel
- 15944 Yellow-gray sandy loam on gravel
- 1581 Dune sand
- 1528 Brown-gray silt loam on tight clay
- 1568 Brown-gray sandy loam on tight clay

(d) 0000 RESIDUAL

- 1 Sand
- 088 Stony loam—limestone
- 088 Stony loam—sandstone
- 099 Limestone outcrop
- 099 Sandstone outcrop
- Small areas of limestone outcrop
- Small areas of sandstone outcrop

(e) 1400 LATE SWAMP AND BOTTOM-LAND SOILS

- 1450 Black mixed loam
- 1554 Mixed loam
- 1401 Deep peat

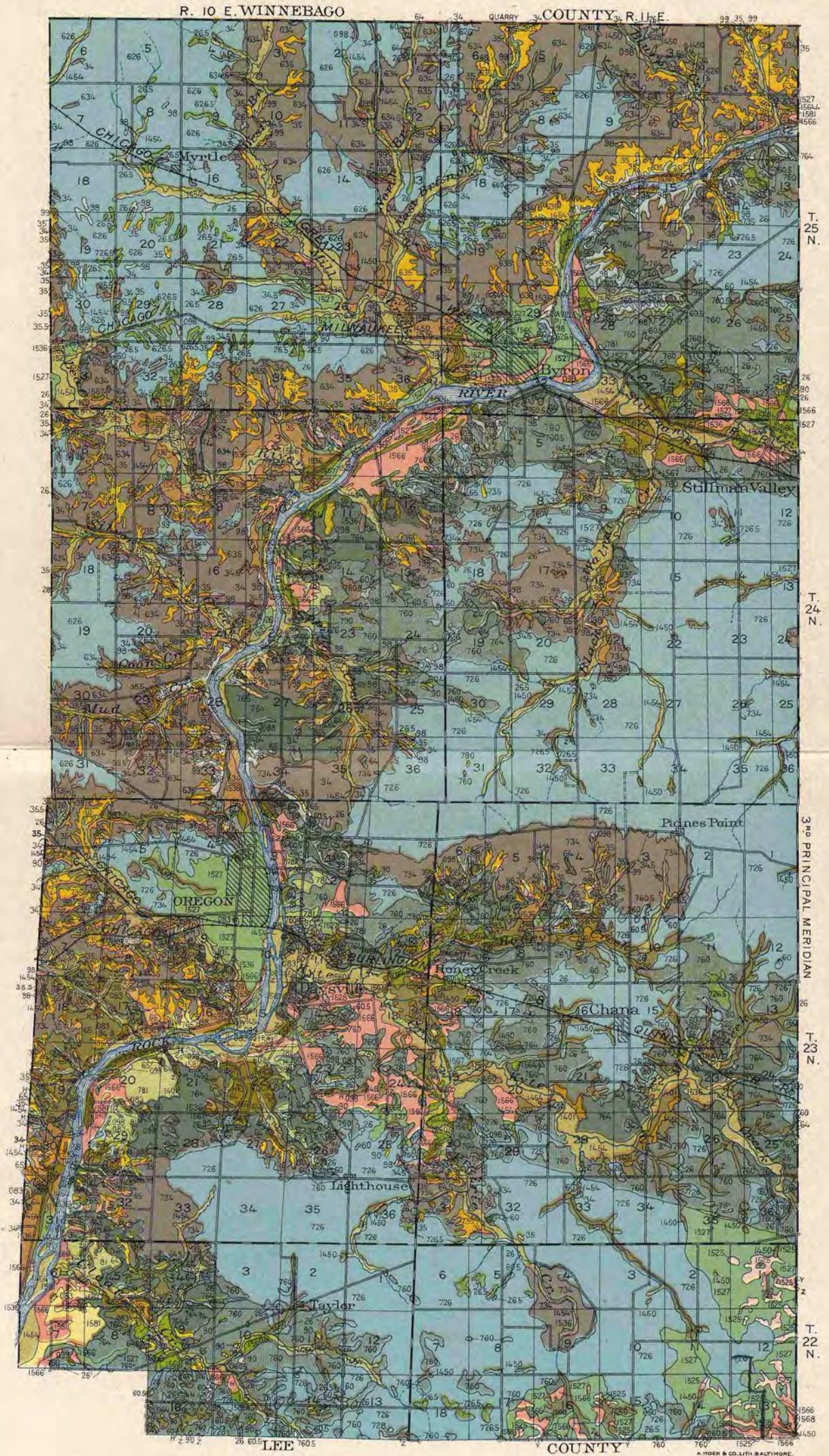


SOIL SURVEY MAP OF OGLE COUNTY
 UNIVERSITY OF ILLINOIS AGRICULTURAL EXPERIMENT STATION

A. HOEN & CO. LITH. BALTIMORE

LEGEND

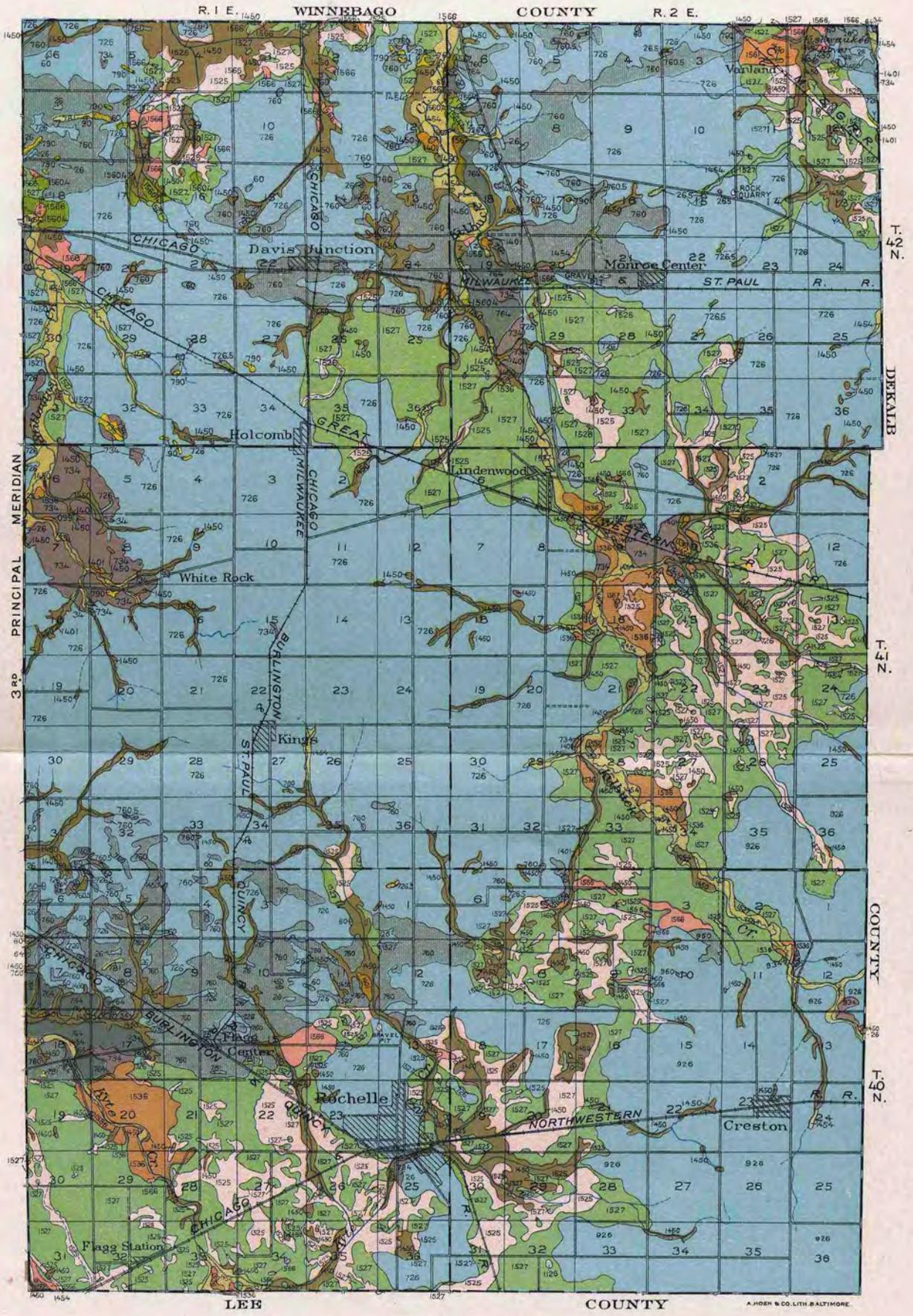
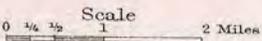
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- 628 726 Brown-gray silt loam on tight clay
- 81 Dune sand
- 90 Gravelly loam
- (b) UPLAND TIMBER SOILS**
- 34 Yellow-gray silt loam
- 35 Yellow silt loam
- 34.5 Yellow-gray silt loam on limestone
- 35.5 Yellow silt loam on limestone
- 664 764 Yellow-gray sandy loam
- 665 765 Yellow sandy loam
- 64.5 Yellow-gray sandy loam on sandstone
- 64.5 Yellow-gray sandy loam on limestone
- (c) TERRACE SOILS**
- 1527 Brown silt loam over gravel
- 1525 Black silt loam
- 1566 Brown sandy loam over gravel
- 15604 Brown sandy loam on gravel
- 1561 Black sandy loam
- 1534 Yellow-gray silt loam over gravel
- 1567 Yellow-gray sandy loam over gravel
- 15644 Yellow-gray sandy loam on gravel
- 1581 Dune sand
- 1528 Brown-gray silt loam on tight clay
- 1568 Brown-gray sandy loam on tight clay
- (d) RESIDUAL**
- 083 Sand
- 098 Stony loam—limestone
- 098 Stony loam—sandstone
- 099 Limestone outcrop
- 099 Sandstone outcrop
- Small areas of limestone outcrop
- Small areas of sandstone outcrop
- (e) LATE SWAMP AND BOTTOM-LAND SOILS**
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 - 1581 Dune sand
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 - 1568 Brown-gray sandy loam on tight clay
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 - 098 Stony loam—limestone
 - 098 Stony loam—sandstone
 - 099 Limestone outcrop
 - K 099 Sandstone outcrop
 - Small areas of limestone outcrop
 - Small areas of sandstone outcrop



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