In the first chapter of the book of books it is written:

"And God said unto them, be fruitful, and multiply, and replenish the earth, and subdue it."

Of these four commandments we have obeyed the first two, but we have disobeyed in America, since 1607, the last two of these commandments.

When our own fathers were born (and many of them are still living), there were 17 million people in the United States,—in 1840; but the census of 1910 reveals a population of 92 millions in contiguous continental United States.

Yes, we have multiplied,—multiplied by 500 percent during the full time of one life. But have we replenished the earth and subdued it? Have we increased our acre-yield by 500 percent? No, we have not. For three centuries we have taken from the earth and have not replenished it. Neither have we subdued the earth, but we have been subdued by it. As tillers of the soil, men made in the image of God, we have been defeated by the inanimate earth, driven out from our eastern states and forced to

*Address before the Illinois State Farmers' Institute at Centralia, February 20, 1912.
surrender back to nature millions of acres of once fertile farm lands, now agriculturally abandoned, to such an extent that the congressmen of the United States can not enter the capital of this great nation from any direction without passing abandoned farms.

Within the last twelve months a five-hundred-acre farm of gently undulating upland loam soil (which I selected because of its special advantages) has been purchased for $10 an acre, within 15 miles of the District of Columbia, within an hour's ride of Baltimore, and within two miles of a railroad station on two railroads. A good tract of this farm which had been "rested" for several years made an average yield of 12½ bushels of corn per acre in 1911. This is beautiful farm land, which, lying at the door of our greatest markets, ought to be worth, not $10 but $300 an acre, when we consider that our rich, almost virgin soil nearly a thousand miles farther west is now selling for $200 to $250 an acre. And yet that land, and, likewise, the depleted lands of southern Illinois can be made worth $300 an acre. How? By the profitable investment of money in a rational system of soil improvement,—in an economic system of positive and permanent soil enrichment, based upon established science, rather than upon the advice of some fertilizer agent who has some high-priced soil stimulant to sell, which enriches not the soil but the seller.

Across the face of the agricultural building of the University of Illinois are these words:

"The wealth of Illinois is in her soil, and her strength lies in its intelligent development."

Those words were spoken by Andrew S. Draper, then President of the University of Illinois, now Commissioner of Education for the State of New York. Truer words than these were never spoken, for the very life of the state and nation rests upon the soil.

While manhood and womanhood of high moral character and strong intellectual power constitute the attainment desired, it is also true that the possibility of this attainment depends in part upon material prosperity. Poverty does not build, equip, and man consolidated high schools in country districts. The general intelligence and wide-spread education of the American people
are the result of our past prosperity, and they should be both the result and the cause of the future prosperity of our people.

The foundation for Illinois prosperity is her soil, and the future prosperity, educational advantages, and general intelligence of her people will depend in large measure upon the improvement and preservation of the soil. It is the farmer who labors together with God in the creation of food and clothing materials. Other people may live by transporting, milling and trading, but the renewal, the yearly supply, must always come from the soil.

"Public prosperity is like a tree; agriculture is its roots; industry and commerce are its branches and leaves. If the root suffers, the leaves fall, the branches break, and the tree dies."

(This is the philosophy of the Mongolian people who have maintained some of their soils for more than 4,000 years.)

Daniel Webster gave us the following words of wisdom:

"Unstable is the future of a country which has lost its taste for agriculture. If there is one lesson of history that is unmistakable, it is that national strength lies very near the soil."

Even James J. Hill, himself a railroad man, financially interested almost solely in the commerce of the country, recently made the following statement:

"The farm is the basis of all industry, but for many years this country has made the mistake of unduly assisting manufacture, commerce, and other activities that center in cities, at the expense of the farm."

All must admit that the states and the nation turned their lands over rapidly and generously to private ownership, and hitherto the federal and state governments have also left largely to private interests the matter of soil preservation; but all must likewise admit that, with the exception of the market gardens largely maintained with waste fertility from the cities, private interests have not preserved the soil of America.

No longer can it be said that "Uncle Sam is rich enough to give us all a farm". In his address before the recent National Conservation Congress, the President of the United States reported that, while our population increased by 21 percent during the last decade, the area of farm land increased less than 5 percent; and that a further increase of 9 percent will include all the remaining public land that is capable of cultivation.
When we became unable properly to feed our increasing population by increasing our acreage of farm land, we began decreasing our exportation of foodstuffs, and the average of the last five years, compared with an average of the five years ending with 1900, shows that during the ten-year period our exportations decreased from 198 million to 116 million bushels of wheat, and from 193 million to only 57 million bushels of corn. That the limit of our relief is near in this direction must be plain to all.

Now we must increase our acre-yields, or the cry from an ever increasing population against the high cost of plain living will just as surely bring distress and disgrace upon this great nation as it has upon 400 million people in India and Russia, where famine is now looked upon as a permanent feature in the life of our own Aryan race.

Intelligent optimism is admirable; but blind bigotry paraded as optimism is condemnable. There seems, however, to be always a few people who can live, in a sense, on "hot air"; but you will agree that something more substantial will be required to feed and clothe in reasonable comfort the progeny of 92 million people, and added millions of immigrants; and this grave question needs grave consideration by men and women of influence.

If there is any material thing which should be guarded and protected by the sovereign power of the state, it is the soil,—the breast of Mother Earth from which her children must always draw their nourishment, or perish.

Who is responsible for the fact that the ten-year average yield of wheat is 29 bushels per acre for the German Empire and only 16 bushels in Illinois? Is it the farmer who works the land for all that's in it, from early till late, year in and year out? Is he solely responsible for soil depletion? No, the responsibility rests largely with the people of influence, whether they live in town or country. The teacher, the preacher, the banker, and the statesman are more responsible than is the average farmer for safe-guarding the foundations upon which rests the future prosperity of the state and nation.

The combined area of Germany and Illinois is equal only to that of Texas, but in Germany agriculture is taught in 23 universities and in 415 other colleges and schools. Were the present farmers and landowners of Illinois taught the principles of soil
improvement in the schools which they attended, or were they left largely to the teaching and influence of the commercial fertilizer trusts, their agents, promoters, advertisements, and widely circulated pamphlets and newspaper articles whose publication is paid for even in some of the cheap agricultural journals?

Average crop yields for the past 46 years are now reported by the United States Department of Agriculture. The details for individual states are not available to make two 23-year averages, but it is possible to make one average of 24 years, followed by another average of 22 years. These averages for the entire United States show that the yield of wheat has increased by $1\frac{1}{2}$ bushels per acre and the yield of oats by $\frac{1}{6}$ bushel, while the average yield of corn has decreased by $\frac{1}{2}$ bushel and that of potatoes by $\frac{3}{8}$ bushel per acre.

The fact that half of all the wheat crop of the United States is produced in the five states of Minnesota, Kansas, Nebraska, and the Dakotas, emphasizes the important place that virgin soil has occupied in maintaining our wheat yield. Less than 20-year averages are not at all trustworthy for the consideration of small changes in yield per acre. Thus, if we interchange the highest average yield of corn (30.8 bushels in 1872) and the lowest average yield (16.7 bushels in 1901), then the above comparison would show an average increase of 0.7 of a bushel instead of a decrease of $\frac{1}{2}$ bushel per acre in the corn crop of the United States.

I present these figures because they furnish the best statistics the United States affords concerning the question as to whether our crop production is keeping pace with our needs. You will recognize these as the most important vegetable and grain crops grown in this state. These figures show an average increase in acre-yield of less than 1 percent in 23 years, while the United States census shows an increase of 47 percent in our population during 20 years; and yet the cities, the states, and the national government are still seeking the cause of the increased cost of living in this country.

If we examine the corresponding federal crop statistics for Illinois, we find increased yields of 5 bushels per acre for corn and 1.4 bushels for wheat, while the yield of oats has decreased by 1.4 bushels and that of potatoes by 2.4 bushels.

The increase in yield of corn is to be attributed largely to two
factors: First, to the change from deep to shallow cultivation; and, second, to the substitution of recognized standard varieties of corn for most of the scrub varieties formerly grown.

Better drainage and better crop rotations have also helped to hide the fact that, as a general average, the corn-belt soils of Illinois are being rapidly depleted of their fertility, a fact which is revealed to some extent in the average decreases of 1.4 bushels of oats, 2.4 bushels of potatoes, and .08 ton of hay per acre in Illinois during the 23 years.

On the other hand, the increase in yield of wheat in this state is largely due to the system of soil improvement already inaugurated in the great wheat belt of southern Illinois. I think it is safe to say that some effort to enrich the soil is now made on at least one-third of the land annually seeded to wheat in southern Illinois.

For ten years the Experiment Station has demonstrated and recommended definite soil treatment for improving the wheat crop of southern Illinois. Under the conditions existing on most southern Illinois farms we have advised the use of steamed bone meal at the rate of about 200 pounds per acre, as initial treatment; and the use of this material reached such proportions in southern Illinois that several years ago one of the principal producers withdrew the sale of steamed bone from all other states in order to supply the demand in Illinois.

As an average of ten crops of wheat grown in a 3-year rotation of wheat, corn, and cowpeas, on the Cutler Experiment Field, in Perry county, the increase from steamed bone meal has been 3½ bushels per acre in live-stock farming and 5 bushels in grain farming.

As an average of 9 years, steamed bone meal applied to the Odin Experiment Field in this county has increased the yield of wheat by 8 bushels per acre in duplicate tests in grain farming in a 4-year rotation of corn, cowpeas, wheat, and clover.

On the DuBois Experiment Field in Washington county, two wheat crops have been grown during the ten years in a 4-year rotation of corn, oats, wheat, and clover; and, as an average of duplicate tests, 13 bushels increase per acre was the effect produced by steamed bone.

As a general average of these forty-two tests extending over
ten years in three different counties on the common prairie land in this section of Illinois, the yield of wheat has been increased by 6.6 bushels per acre; and where both bone meal and lime or limestone have been applied the average increase on the same experiment fields has been 11.7 bushels of wheat per acre.

These definite results plainly show the possibility of increasing the yield of wheat in this section by the use of phosphorus and limestone, the two materials which have been used by a very considerable number of farmers in southern Illinois during recent years. The crop statistics show, also, that the increase in yield of wheat in Illinois has practically all taken place since the beginning of soil investigations and the establishment of soil experiment fields in southern Illinois. Thus the federal statistics furnish the following averages for the yield of wheat in Illinois:

For 24 years (1866 to 1889) ............... 12.8 bushels
For 11 years (1890 to 1900) ............... 13.0 bushels
For 11 years (1901 to 1911) ............... 15.7 bushels

Furthermore, the crop statistics collected independently by the Illinois State Board of Agriculture furnish the following averages:

For 24 years (1866 to 1889) ............... 13.2 bushels
For 11 years (1890 to 1900) ............... 13.3 bushels
For 11 years (1901 to 1911) ............... 16.4 bushels

On the other hand, the principal increase in the yield of corn in this state occurred before 1900, as is shown by both federal and state statistics, and these facts support the opinion that the corn belt has increased the yield of corn by improved methods of cultivation, influenced directly by the manufacturers of the shallow cultivators, which were quite generally adapted some twenty years ago, following the early and conclusive experiments of Morrow and Hunt along that line; and later by the use of better seed corn. That the increase in the corn belt has been made at the expense of the soil, is shown by the decreased yields of both oats and hay.

These data support another opinion which is based upon even more definite facts; namely, that if southern Illinois farmers continue their work of soil improvement to the extent of adopting truly permanent systems, and if the corn-belt farmers continue
their past and present methods of soil depletion, then the time will come when the people from the north will again go down into "Egypt" to buy corn.

Since the farmers of southern Illinois began the extensive use of steamed bone meal, two very important things have happened: First, the price of steamed bone has gone up, and, second, the quality of the steamed bone sold in this state has gone down,—its average phosphorus content being now distinctly less than ten years ago.

In one sense, however, these changed conditions with respect to bone meal, are likely to result in greater ultimate benefit to southern Illinois farmers, because they are added inducements for them to adopt more economical and truly permanent systems of soil improvement, by making large use of ground limestone and clover and other legume crops and crop residues, plowed under directly in grain farming, or in farm manure in stock farming; and by gradually discontinuing the use of high-priced bone meal and substituting therefor at less expense two or three times the quantity of fine-ground natural rock phosphate, which becomes available when plowed under with plenty of vegetable matter, such as clover, cowpeas, or farm manure.

Let us remember that three things are necessary for the most profitable improvement and permanent preservation of our most common upland prairie and timber soils, not only in southern Illinois, but also in the central and northern parts of the state. These are limestone, organic matter, and phosphorus.

Limestone is needed both to correct the acidity of the soil and to supply the plant-food element called calcium; and if dolomitic limestone is used, both calcium and magnesium will be supplied.

The organic matter, or vegetable matter, is needed to supply nitrogen which can be secured from the inexhaustible supply in the air by the legume crops, such as clover and cowpeas, and as this vegetable matter decays in the soil it liberates potassium from the practically inexhaustible supply of that element contained in all our common soils, and it also liberates phosphorus from the low-priced natural rock phosphate.

Finally, the phosphorus must be applied because the supply
in the soil is small, and it is constantly being removed by the crops grown.

For southern Illinois this is the order in which they should be used in the most economical methods:

First, apply 2 to 5 tons per acre of ground limestone.

Second, grow clover or cowpeas.

Third, apply 1,000 to 2,000 pounds per acre of very finely ground natural rock phosphate, to be plowed under with the clover or cowpeas, either directly or in the form of farm manure.

In central and northern Illinois the same materials are needed, but there the limestone may take third place, while it is of first importance in this part of the state.

The average cost of ground limestone delivered in bulk in carload lots at the farmer's railroad station in southern Illinois is about $1.25 per ton; and 2 tons per acre every four years, which is sufficient to keep the soil sweet, would cost $2.50. The delivered price varies from 85 cents to about $1.15 per ton within 100 miles of the Southern Illinois Penitentiary, and about the same from other plants. This amounts to less than $1.00 per acre a year for limestone applied.

During the last eight years, we have made 318 tests to determine the effect of lime or ground limestone on crop yields in southern Illinois. These tests were made at Odin, Edgewood, Mascoutah, DuBois, Cutler, Ewing, Raleigh, and Vienna,—in the counties of Marion, Effingham, St. Clair, Washington, Perry, Franklin, Saline, and Johnson. They include 79 tests on legumes (clover, cowpeas, and soybeans), 122 tests on corn, 55 tests on oats, and 62 tests on wheat, these crops being grown in the rotations practiced.

As an average of all tests the yield per acre has been increased by $2 ton of hay (exactly .54 ton), by 5.0 bushels of corn, by 6.6 bushels of oats, and by 4.0 bushels of wheat. The data secured and here reported are amply sufficient to justify the conclusion that, in practical economic systems of farming on the common prairie and timber soils of southern Illinois, limestone, at less than $1.00 per acre per year, will produce $2 ton more clover or cowpea hay, 5 bushels more corn, 6 bushels more oats, and 4 bushels more wheat per acre.

Where one is able to put on 4 or 5 tons per acre for the first
application it will be wise to do so, but subsequent applications need not be more than 2 tons per acre every four years.

As an average of the first two years' work on two different experiment fields (Ewing and Raleigh) where the initial application was about 5 tons per acre, the average increases were $\frac{1}{4}$ ton of hay, 9$\frac{1}{4}$ bushels of corn, 8.9 bushels of oats, and 3$\frac{1}{2}$ bushels of wheat; and, as the increased farm manure or increased crop residues from these larger crops are returned to the land, the effect becomes more marked in subsequent years.

On the Vienna experiment field in Johnson county about 9 tons per acre of ground limestone were applied ten years ago. At a cost of $1.25$ a ton this would amount to $11.25$, and the returns for this investment have thus far amounted to 90.3 bushels of corn, or to 42.2 bushels of wheat, or to 3$\frac{1}{2}$ tons of clover. Any one of these will pay for the limestone three times over; and, in addition, two-thirds of the legume crops grown have been plowed under as green manure, and at the end of nine years with no further application, the land treated with limestone is producing 5 bushels more wheat, 9.3 bushels more corn, and 1.4 tons more clover hay per acre than the land not so treated. Indeed, as an average of the last two years, this old worn hill land has produced larger crops where limestone had been applied than the average yield for the state of Illinois, for each of the crops, corn, wheat, and hay.

It should never be forgotten, however, that phosphorus must also be included and applied with the vegetable matter if a permanent system of soil improvement and preservation is to be adopted. While liberal use of limestone and the return of the increased vegetable matter will make marked and profitable improvement in southern Illinois soils, yet the improvement will be temporary unless phosphorus is also applied, because this element is present in the soil in small amount and it is removed in crops and sold from the farm not only in grain and hay, but also in bone, in meat, and in milk.

The only exception to be made to this general plan for the upland soils of southern Illinois is the rolling or steeply sloping hill lands where marked soil erosion occurs. On such lands only limestone and vegetable matter are necessary, because the supply of phosphorus is naturally renewed from the subsoil, which grad-
ually becomes surface soil owing to the surface washing.

On the common land of southern Illinois, where the soil is poor in decaying vegetable matter, the effect of phosphorus is not marked on corn, oats, or cowpeas, but it markedly benefits the wheat and also helps the clover; and the cumulative effect of the increased supply of clover or manure is then seen in all crops.

In order to reduce to the simplest terms the results secured from soil improvement, it is necessary to assign a money value to each kind of produce; and it should be kept in mind that while the increase in yield is produced in the field with no extra labor till harvest, it is not taken from the field and delivered at the market free of expense; consequently, it is important that conservative prices shall be used in making computations to show the value of the increase from soil treatment.

The standard prices used by the Illinois Experiment Station for such computations are as follows:

- **Corn** .................. 35 cents a bushel
- **Oats** .................... 30 cents a bushel
- **Wheat** .................. 70 cents a bushel
- **Hay** ...................... $6.00 a ton
- **Clover seed** ............. $6.00 a bushel
- **Cowpea or soybean seed** $1.00 a bushel

In computations of this character we do not include any value for straw or corn stalks.

At these conservative prices for the farm produce, and as an average of the ten years from 1902 to 1911, the use of lime, phosphorus, and organic matter at Cutler has increased the value of the produce from four acres of land in a rotation of corn, wheat, and legumes from $23.81 to $47.64 in grain farming, and to $49.05 in live-stock farming, the organic manures being dependent upon the crops grown on the land, in both systems.

A similar comparison for grain farming in a rotation of corn, cowpeas, wheat, and clover (or soybeans) on the Odin Experiment Field shows the crop values to have been increased from $29.62 to $44.51 by lime, phosphorus, and organic matter produced on the land.

At both Cutler and Odin the phosphorus is supplied in the form of steamed bone meal, but on the Fairfield Experiment Field,
in Wayne county, raw rock phosphate and ground limestone are used.

As an average of the last four years, the limestone and phosphate at Fairfield have increased the crop values on four acres from $27.30 to $40.80 in grain farming, and from $35.02 to $55.60 in livestock farming.

We have no land on the Fairfield field to which neither crop residues nor farm manure is applied, and this experiment field has been in progress for only seven years. Since we lack three years for the ten-year record at Fairfield, we also omit the first three years' records, and thus compare the results of a four-year period, with the rotation well underway, with the ten-year averages from Cutler and Odin.

We thus find that lime and bone meal have increased the value of crops from four acres as follows:

- Odin, grain farming: $11.89
- Cutler, grain farming: $17.43
- Cutler, live stock farming: $12.20
- Cost of lime ($2.50) and bone meal ($10): $12.50

We likewise find that limestone and rock phosphate have produced the following results:

- Fairfield, grain farming: $13.00
- Fairfield, live stock farming: $20.58
- Cost of limestone ($2.50) and phosphate ($7.50): $10.00

It should be stated that the application of manure at Fairfield was begun seven years ago, the first applications having been made at the rate of 8 tons per acre, whereas the plowing under of the crop residues in the grain system has been practiced only during the last two or three years. This probably accounts for the better utilization of the phosphate in the live-stock system at Fairfield, although where the addition of organic matter is fairly comparable in the two systems the added phosphorus usually gives the greater gain in grain farming, as at Cutler, because there is less phosphorus returned in the crop residues than in the farm manure. As a general average these prices show $13.84 returned at a cost of $12.50 where bone meal was the source of phosphorus; while the average return was $16.79 at a cost of $10.00 where rock phosphate was used. In addition we have the fact that we are enriching the soil in phosphorus two
and one-half times as much where raw rock phosphate is used as where bone meal is applied; and of course the annual expense for rock phosphate will be greatly reduced after the soil becomes sufficiently rich in phosphorus to produce the most profitable crop yields.

As an average of the four years at Fairfield, the limestone and phosphate costing $2.50 per acre per annum have increased the yield per acre by 4.8 bushels of corn, by 13.7 bushels of wheat (three years; oats increased by 6.3 bushels one year), by 3.4 bushels of cowpeas (or soybeans), and by .93 ton of hay.

During the last eight years on typical corn-belt prairie soil on the South Farm of the University of Illinois, at Urbana, we have practiced on four different fields a 4-year rotation including wheat, corn, oats, and clover. On each field we have four different plots which receive 1 ton per acre of raw rock phosphate in comparison with check plots which are otherwise cropped and cultivated the same.

As an average of the eight years the phosphate has increased the crop yields per acre by 8.1 bushels of wheat, by 4.7 bushels of corn, by 4.0 bushels of oats, and by .42 ton of clover hay (or bushel of clover seed).

The cost of the phosphate applied is not more than $7.50 per acre for each four years, and, at present prices for the farm produce, it has paid for itself several times, and the plowed soil of the treated land is now one-fourth richer in phosphorus than the land not treated with phosphate.

But if we figure the value of the increase at 35 cents a bushel for corn, 30 cents for oats, and 70 cents for wheat, and at $6.00 a ton for clover hay (or $6.00 a bushel for clover seed), the phosphate costing $7.50 paid back $9.04 during the first four years, and $13.13 during the second four-year period.

This shows very substantial profit at most conservative prices, but of even greater importance is the fact that the system is one of positive soil enrichment and permanent preservation. The phosphorus content of the plowed soil has increased from 1100 to 1500 pounds per acre during the eight years in spite of the larger crops removed, whereas the untreated soil has grown poorer by about 65 pounds of phosphorus per acre.
Attention is called to the fact that in the oldest continuous fertilizer experiments of the United States, which are in progress at the Pennsylvania State College, there are four different fields and the same four crops are grown but in the order of corn, oats, wheat, and clover. In these experiments $5.04 worth of acid phosphate per acre is applied every four years, but this paid back only $11.84 during the first eight years, at prices mentioned above. Thus the actual return per dollar invested was less than in these Illinois experiments with raw rock phosphate; and while the raw phosphate furnishes 250 pounds of phosphorus for $7.50, the acid phosphate, which would cost $5.04 in Illinois, would supply only 42 pounds of phosphorus, and this is less than we actually remove in the crops from our well-treated land.

In addition, I would only emphasize the fact that accumulating results from Illinois soil investigations support the conclusion that for the most economic and profitable systems of permanent agriculture in general farming, we should make large use of natural materials including for normal soils ground limestone, raw rock phosphate, and organic matter to be supplied by plowing under legume crops and other crop residues, either directly or in farm manure.

In closing, I beg the privilege of expressing to the Illinois State Farmers' Institute my own appreciation of the honor of having been invited for ten consecutive years to occupy a place on your program. I also appreciate, and I want you to understand and appreciate, that I come only as the spokesman for those who, as investigators and advisers, have been working together in unity for a decade to discover and demonstrate, and to bring about the adoption of, systems of permanent profitable agriculture in this state.

The original conception of the need and possibilities of the work was not mine, but only one of many fundamental and far-sighted conceptions of Eugene Davenport.

In the formation and gradual completion of definite plans of procedure, the Soils Advisory Committee from this Institute has had large part; and the names of Allen and Mann, of Abbott, Mason, and Burroughs are honored by all who know of the helpful, serious thought, the vital energy, the weeks of time, and the personal sacrifice that these patriotic citizens of the common-
wealth have annually devoted to this work. In some respects it has been pioneer work, and, as most of you know, we have at times been compelled, by the force of truth and fact and interest in permanent agriculture, to break away from some of the teaching of other investigators, and from some of the practice in other states and countries; and I cannot fully express to you the gratitude and admiration we hold for those progressive and influential farmers of Illinois who, with judgment and with effect, have stepped out when necessary into public view, in the press or on the platform, have placed their shoulder under the load, and supported the truth by their own knowledge of methods applied in practice.

And the success thus far attained in carrying forward the detailed investigations in this great movement, for the restoration, improvement, and permanent preservation of Illinois soils, is very largely due to the accuracy, integrity, and almost tireless energy of my own associates.

Without such men as Readhimer, Pettit, Eckhardt, Gustafson, Logan, Fisher, Van Alstine, Whitchurch, Hoskins, and others, no such progress would have been possible in this service for the people of Illinois.

Note: For greater details concerning Illinois soils and methods of soil improvement see the following publications:
Circular 110, "Ground Limestone for Acid Soils"
Circular 127, "Shall we use Natural Phosphate or Manufactured Acid Phosphate for the Permanent Improvement of Illinois Soils?"
Circular 129, "The Use of Commercial Fertilizers"
Circular 141, "Crop Rotation for Illinois Soils"
Bulletin 123, "The Fertility in Illinois Soils"
Soil Reports Nos. 1 and 2, which report the detail soil survey for Clay county and Moultrie county, respectively, which are largely representative (1) of the great wheat belt of Southern Illinois, and (2) of the still greater wheat belt of the central and northern parts of the State.
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