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Plant Food and Prosperity

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By HENRY G. BELL

Agronomist of the Middle West Soil Improvement Committee
of the National Fertilizer Association

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Plantfood and Prosperity.

It is the ambition of every citizen to be prosperous. It is the endeavor of each and every community and state, and the nation itself, to show a balance in funds or improvements at the end of each year's business.

This is a rightful and healthy ambition which should command attention and close study.

True progress, either individual or national, is accomplished only, when individual or nation rises to a manhood that shows mastery over circumstances.

Carlyle says: "Manhood begins when we have in any way made truce with Necessity; begins, even when we have surrendered to Necessity, as the most part only do; but begins joyfully and hopefully only when we have reconciled ourselves to Necessity; and thus, in reality, triumphed over it, and felt that in Necessity we are free."

What should be our line of action, then, as tillers of these millions of acres of farm land? Clearly, it should be to study conditions basic to our prosperity and learn as much as possible about them. Reconcile ourselves to these conditions that constitute Necessity and thereby triumph and feel that in Necessity we are free.

Now, what is basic to prosperity? We believe that underneath all contributing factors, such as business management, good government, etc., lies the great and fundamental factor Plantfood supply.

With a sufficient supply of the correct elements of plantfood, profitable crops can be raised, profitable livestock maintained and the whole machinery of business accelerated. A scarcity of suitable plantfood means that farms degenerate and business lags.

Economic conditions of this nation force the plantfood problem upon us.

Our population in 1900 was approximately 76,000,000. In 1910, it was approximately 92,000,000—an increase of 21%. The increase in crop production, during the same period, was only 10% in volume

In 1902, we were exporting 31% of our wheat and wheat flour, but in 1912, we were exporting only 13%.

Our importation of crude foodstuff and crude animals, for the same period increased from \$120,000,000 to \$230,000,000—almost doubling in ten years. Our imports of foodstuffs, partly or wholly manufactured, increased from \$93,000,000 in 1902 to \$196,000,000 in 1912. The number of beef cattle, produced in this country, has fallen off 32% in six years, while population has grown at the rate of 21%.

We are approaching the limit of home maintenance.

These are sufficient reasons for our interest in the Plantfood problem.

How the Ancients Looked Upon Plantfood.

Ancient history tells us that the Egyptians and the Mesopotamians were early in acquiring the elements of civilization. The Egyptians, for instance, utilized the fertile valley of the Nile for the production of great quantities of grain. Early scripture narratives tell us of the dependence upon Egypt for provisions during protracted seasons of famine.

The progress not only of Egypt, but of all the Roman Empire, was dependent entirely upon the fertility of the soil. In the very infancy of modern civilization, therefore, plantfood was the key to prosperity. Babylonians, Egyptians, Israelites and Romans, classed as the great peoples of antiquity, rose to prominence as they made use of methods of soil management which produced large and valuable crops, and fell into obscurity as fundamental principles of agriculture were disregarded. Pliny, who lived from 23 A. D. to 79 A. D., says of his contemporary, Virgil:

“Our poet is of the opinion that ultimate fallows should be made, and that the land should rest entirely every second year. And this is, indeed, both true and profitable, provided a man have land enough to give the soil this repose. But how, if his extent be not sufficient? Let him in that case help himself thus. Let him sow next year's wheat crop on the field where he has just gathered his beans, vetches or lupines (legumes as we call them), or such other crop as enriches the ground. For indeed it is worth notice that some crops are sown for no other purpose but as food for others.”

These facts show that the rotation of crops is no new practice, nor is the growing of legumes as new as we are often led to believe.

The Roman writer, Cato, 234 B. C. to 149 B. C., impresses the necessity of “the soil of a farm being good and fertile, and that the farm be near to plenty of laborers; that it be not far from a large town. Moreover, it should have sufficient means of transportation of its produce, either by land or water.” He says that “a good husbandman ought to

be a seller rather than a buyer; that a man should stock his ground early and well, but take a long time and leisure before he be a builder."

All of these points show that at that early date they were impressed with the necessity of timely attention to the fertility of the soil.

The early peoples of Northern Europe,—the Goths, Vandals and Moors, practiced livestock farming to a large extent. However, Spaniards, who immigrated to Peru, developed agriculture to a high degree of perfection. Investigators found ruins of basins and canals showing that splendid systems of irrigation had formerly been in operation. Cultivated sides of the mountains were terraced and the fertility of the soil was reinforced by suitable applications of manure. This manure consisted largely of guano,—the excrement of sea-fowl.

Soil Tillage, an Early Consideration.

English writers discussed agriculture as early as 1534. Early in the 17th Century, writers tell us that farm operations were performed with considerably greater care and correctness than formerly. Fallows were better worked, weeds were kept out, and much more attention was paid to manure of every kind.

One of the early English authorities on agriculture was Jethro Tull, a farmer of Berkshire, England. He published a book in 1731 known as "Horse Hoeing Husbandry." In this he expressed the belief that the soil particles should be so fined or reduced in size by constant work and tillage that the rootlets could take them up. He even thought that inter-tillage would take the place of manure. This, of course, is erroneous, but the effectiveness of thorough tillage in the preparation of seedbed is generally recognized at the present time.

Boussingault, Director Hall tells us, inaugurated the first system of field experiments. From his experiments, he concluded that the nitrogen of the crop was taken from the soil. He also showed that in certain locations, more nitrogen is removed in the crop than is supplied in the manure. Hellriegel and Wilfarth gave us the first glimpse of the work of bacteria on the roots of legumes.

Early Plantfood Studies.

One of the greatest contributors to agricultural information was Leibig, who in 1840 published his Chemical Letters. By a demonstrative experiment, he pointed out the sources of the different elements of plant constitution. He indicated from whence these could be supplied. He was the first to demonstrate that what we called "Essential Plantfood Constituents,"—namely, Nitrogen, Phosphoric Acid and Potash,—could be supplied profitably to the plant from available fertilizers. In 1843, inspired by the epochmaking discoveries of Leibig, Sir John Lawes and

Sir Joseph H. Gilbert founded at Rothamsted, England, the world-renowned experiment station of Rothamsted. The work of this experiment station has been devoted almost entirely to an investigation of the effect of available fertilizers upon the yield and quality of farm crops. In 1843, definite rotations of crops were established, and the grounds were laid out in systematic series of experiment plots. These plots of wheat, oats, barley, hay crops and roots, received systematic applications of different quantities of different mineral plantfood, supplying nitrogen, phosphoric acid and potash; also magnesium. In these experiments no attention was paid to the profitableness with which the materials were applied, since the object of the experiments was to demonstrate that crops could be improved in yield and quality by the use of fertilizers. Let it here be definitely noted, therefore, that while the results of the Rothamsted Experiment Station prove without a doubt the effectiveness of the application of fertilizers, it is in no way fair to figure the profitableness with which these fertilizers were applied for three reasons.

- (1st) The fertilizers were applied in quantities much larger than later investigation in this country would advise on average grain crops.
- (2nd) There were used in the fertilizers, materials from sources which made them exceedingly costly,—much more so than the same elements supplied in modern fertilizers.
- (3rd) Such materials as magnesium sulphate were applied. American soils are sufficiently rich in magnesium generally so that this element can be entirely eliminated.

Hall says that we owe one essential discovery to DeSaussure,—that is, that the nutrient substances must first of all be dissolved or capable of going into solution before they can feed the plant. Solubility, to the mind of this great scientist, is the first essential in valuing a fertilizer. He says that the distinguishing feature of a fertilizer which makes it effective when supplied in quantities comparable with those removed by the crop, is its availability.

Conditions to Consider.

Now, the farmer must face two fundamental facts, to-wit: In order to get the best of crops from his land, he must see (1st) that the place where the plants have to grow is suitable; (2nd) he must see that the supply and nature of plantfood is suited to the needs of the crops. In his work, the farmer is continually face to face with two types of conditions: (1st) those that he cannot control, and (2nd) those which he can control.

His uncontrollable conditions are:

- (1st) The amount of sunshine that his crops receive during the growing season.

(2nd) Range of temperature. This of course includes how early spring opens and how long is the season between frosts. It also includes total heat of the growing season.

(3rd) The annual rainfall.

Over these three general conditions, he has no power. However, he can control the following conditions:

(1st) Conservation of the moisture in the soil.

(2nd) Circulation of air in the soil.

(3rd) The chemical reaction of the soil—that is, whether the land is sweet or sour.

(4th) The supply of available plantfood in his soil.

Soil Moisture Important.

The amount of moisture retained in the soil is very largely determined by the care given to the soil. In order to retain a maximum amount of moisture, the soil should be deeply stirred in the fall so as to catch the rainfall of autumn, winter and spring. In spring the surface of the soil should be worked early so as to prevent the evaporation of a large amount of the moisture that has been stored up.

Another great factor in the retention of moisture is the organic matter which the farmer incorporates in his soil when he plows under clover or some other crop which has been grown specially to get humus in the soil. Not only does this vegetable matter make a reservoir for the storage of moisture, but applied to loose soils, it binds them together so that they have sufficient body to bear crops. Applied to heavy clay soils, it loosens up clay soils so that air can permeate them. Now, air has essential duties to perform. Inhabiting the soil, which we formerly looked upon as dead material, there exists innumerable forms of life, known by the general name Bacteria. These minute forms are constantly working for the farmer, breaking down the unavailable plantfood in his soil and bringing it into such form that it can be made use of by growing crops. In a soil filled with water, such as an undrained soil, this form of life cannot well exist. In a sour soil, bacterial life cannot reproduce and grow to best proportion. It is, therefore, necessary on a sour soil (which is indicated by sorrel or moss growing on the soil and lack of clover) to apply lime or limestone in some form. Director Lipman of New Jersey Experiment Station tells us that the application of fertilizers, carrying a large percentage of available phosphoric acid, gives great energy to soil bacteria.

Regarding the last factor under the controllable influences, after due attention has been given to the physical conditions of the soil, the supply of available plantfood determines the quantity and quality of crop yield.

Now, the growing plant consists of 14 elements. One of these it gets from the air, two from water, and eleven from the soil. All of these elements of plantfood must be dissolved before they can be made use of by the plant. Of the eleven elements taken up from the soil, all but four, exist now in sufficient quantities in the soil so that as a matter of study their supply may be eliminated. These four elements, which are of such supreme importance, are nitrogen, phosphoric acid, potash and calcium. Calcium is the base of limestone; hence can be supplied in that form.

We are not so dependent on natural conditions, then, as we had supposed. Good systems of tillage and general farm management will do a great deal toward warding off injury from drought and plant starvation.

European Yields Double Ours.

How fully has our American farmer realized these facts? Let us examine his crop yields.

	AVERAGE YIELD PER ACRE 1903-1912.			
	Wheat.	Oats.	Barley.	Potatoes.
United States.....	14.1	29.6	25.3	94.2
Germany.....	30.1	51.9	36.3	194.4
United Kingdom.....	31.7	44.3	34.7	202.8

Why such a discrepancy between the yields obtained in Europe and America?

Dean Homer C. Price of Ohio University, after two years study of the agriculture of Germany presents the following data:

Increase in Yield in Farm Crops of Germany in Twenty Years.

Crop.	AVERAGE YIELD PER ACRE.		
	Period	Period	Increase in
	1886-1895	1906-1910	
	Bushels.	Bushels.	20 years.
Wheat.....	21.2	31.2	47.8 per cent
Rye.....	16.6	28.3	70.0 per cent
Oats.....	34.1	57.5	68.6 per cent
Barley.....	24.5	37.2	51.8 per cent
Potatoes.....	130.0	210.1	71.6 per cent

"Practically the same figures for the United States present a very different picture. Our yields are not only in most cases less than one-half what they are in Germany, but the percentage of increase has been very much less, as shown by the following table:

Increase in Yield in Farm Crops of United States in Eighteen Years.

Crop.	AVERAGE YIELD PER ACRE.		
	Period 1886-1895 Bushels.	Period 1906-1910 Bushels.	Increase in 18 years.
Wheat.....	12.7	14.7	15.7 per cent.
Rye.....	12.7	16.4	29.2 per cent.
Oats.....	25.6	29.0	13.3 per cent.
Barley.....	22.6	24.6	8.8 per cent.
Potatoes.....	73.2	96.9	32.3 per cent.

Dean Price asks the reason for such differences in yield as follows:

“What has made this rapid increase and why are the yields so much greater than in America?”

And here is his answer:

The Reason.

“Primarily, it is due to more intensive systems of farming, and certainly not to land that is naturally more fertile than in America. The German farmer spends much more labor and capital in the growing of his crops than the American farmer. His fields are prepared so that they look like a garden, and the soil is in fine condition before the crops are planted. He is more careful in the selection of his seed and his stand of the crop on the ground is more perfect. He has also learned how to feed his crops with fertilizers. In the first place he scrupulously saves every bit of waste on the farm and returns it to the land. Stable manures are carefully preserved and then generously supplemented with commercial fertilizers. The German farmer has learned how to use commercial fertilizers, and he knows they are not to be used to replace stable manures, but only to supplement them. He has also learned the necessity of keeping his land filled with humus to make it “crumbly” so that it may be easy to cultivate and will hold rain water that falls on it. He does this by growing alfalfa and legumes, by plowing green crops under and by the use of stable manure.”

It is interesting to note the difference in yield per acre of staple crops between the five Northeastern States of this country, where the land has been under crop for a century and a half, and the five Middle Western States where a great deal of the land has not been cropped more than a quarter of a century. It is especially interesting to compare these yields with those of Germany.

	AVERAGE YIELD PER ACRE FOR 1910-1912, INCLUSIVE		
	Wheat.	Oats.	Potatoes.
Germany.....	31.3	51.0	186.3
5 Northeastern States..... (Me., N. H., Vt., Mass., N. Y.)	23.9	36.6	134.5
5 Central States..... (Ill., Ia., O., Ind., Mo.)	14.5	34.4	79.5

Again we ask, why this difference? Surely the land of Germany and the New England States is no richer originally than that of Illinois and Iowa.

We believe, as Dean Price has pointed out, concerning the superior yields obtained in Germany, larger yields obtained in the five North-eastern States of this country, as compared with those of the States of the Middle West is due to the more intensive methods followed on the farms of the East in contrast with the extensive methods which have been in vogue on the larger areas of the Middle Western States.

Intensive Methods.

Intensive methods, as we have already said, include good drainage, maintenance of organic matter in the soil, thorough tillage, application of lime where necessary, rotation of crops, use of selected seed, careful preservation and wise use of all the barnyard manure obtainable, plowing under of green crops and the supplementing of the fertility of the soil with suitable fertilizers. It is interesting to study the relative amounts of fertilizers used in Germany and in America when speaking of the relative yields obtained. The official German Crop Returns, issued by the Imperial Statistical office, states that in 1912 there was a 38% increase in the crop production of Germany over the crop of 1911. In fact, the crop of 1912 was the largest crop harvested in 10 years. It is interesting to note, in this connection, that in 1900 Germany used a little over 3,000,000 tons of fertilizers, while in 1910, she used almost 6,000,000 tons. In 1912, American farmers used about 6,500,000 tons upon the 478,451,750 acres of tillable land in this country. Germany used almost the same amount of fertilizers upon her farms as was used in America, although the German farm aggregates only 1-15 of the area under tillage in America. The judicious use of fertilizers, undoubtedly, is responsible in a very large degree for the superior yields of superior quality obtained across the sea.

It seems to me that the use of fertilizers has been unnecessarily complicated for various reasons in this country. First of all, the American farmer, especially the farmer residing in the Middle and Far West, is loath to admit that his fertile looking soil needs fertilizers.

What Fertilizers Are and Do.

Frequently the farmer has misconstrued or misunderstood the mission of fertilizers. The distinct duty of fertilizers is to supply suitable plantfood to the infant plant. Fed on this suitable plantfood, the little plant makes a thrifty, vigorous start in life, reaching out and laying hold of unavailable plantfood which is stored in almost unlimited supply in the soil.

There seems to have been a vague superstition instilled in the minds of some farmers against the use of fertilizers. Now, plantfood in the form of fertilizers is just plantfood. There is no mystery about it. If it is good practice to feed the plant with nitrogen, phosphoric acid and potash from stable manure, it is also good practice to give it the same plantfood from fertilizers.

Fertilizers are the forms of food which balance up what is lacking in our prevailing types of soils and supply plantfood ingredients necessary to make up a well rounded diet for the enormous crops of corn, wheat, potatoes, etc., which we are harvesting annually.

It is a commonly recognized fact that nitrogen, phosphoric acid and potash are the corner stones of soil fertility. The common sense and experience of every farmer here, tells him that the waste tissue of animal matter is good material to apply to *your* soil. Moreover, the plantfood from phosphate rock, when it has been made available by acidulation, supplies the great lacking ingredient of most of our soils,—viz., phosphoric acid. The potash of fertilizer is already water soluble; hence, in shape for immediate absorption by the plant.

Now, if these ingredients of plantfood could be obtained for nothing, there is not a man in this audience but would say that it is good business to apply them to his crops. None but a blind man can fail to perceive the effects of fertilizers upon the yield of crops. Granted this point then, it is a commercial proposition as to whether it will pay me to apply fertilizers on my soil or not. Do fertilizers pay you, I asked farmers of Indiana, Ohio, Michigan, Missouri, Wisconsin and Illinois? They invariably answer "Yes," and their opinions are backed up by actual profitable results. I could give you authentic instances by the scores where yields have been greatly and profitably increased, and quality has been improved by the judicious use of fertilizers.

European Evidence.

The Illinois Experiment Station, addressed inquiries to prominent European Agricultural authorities, asking them as to the effect of fertilizers upon the crop yields of their countries. The following four letters, are replies received.

From "Von Seelhorst," Royal Agricultural Experiment Station, Göttingen, Germany:

"I believe that the principal increase of the harvest is to be attributed in part to the application of artificial fertilizers themselves and in part to their combination with green manures. Through the application of the two, the yield upon the average has been doubled on our common light soils. In some cases the yield has even been increased two and one-half to three fold.

In general I assume that of the 100% increase in the yield can be attributed:

To artificial fertilizers50%
Effect of artificial fertilizers increased by better tillage...25%”

From the Minister of Agriculture, Paris, France:

“As near as can be determined the relative importance of the different factors are as follows:

In Intensive Agriculture—Increased use of farm
manure and commercial fertilizers.....50% at least

Better preparation of land.....30%

Selection of seed.....15 to 20%

In Extensive Agriculture—Effect of fertilizer...70%

Effect of preparation of land.....15 to 20%

Effect of selection of seed..... 5 to 10%”

From President Creelman, Ontario Agricultural College:

“Italy has been practicing the art of agriculture since the early days of old civilization, hundreds of years before the Christian Era began, and agriculture is still the most important industry in Italy, as 85% of the soil is productive.

“In this connection, the published statistics showing the amount of commercial plantfood materials used in Italy are significant. With a total area of less than 115,000 square miles (about twice the area of Illinois), Italy used 1,147,700 tons of commercial fertilizers in 1907.”

From A. D. Hall, Rothamsted Experimental Station, Harpenden, England:

“The great factor has been the introduction of fertilizers and purchased feeding stuffs. As soon as you can introduce on a farm some extraneous source of fertility you can raise the standard of production.”

Interesting Tenancy Law.

The day has long passed when the British farmer inquired as to whether it paid to use fertilizers or not. Indeed, so far has this day passed that in the Tenancy Act of 1908, there appeared the following clauses:

“(1) Where a tenant of a holding has made thereon any improvement comprised in the First Schedule to this Act he shall, subject as in this Act mentioned, be entitled, at the termination of a tenancy on quitting his holding to obtain from the landlord as compensation under this Act for the improvement such sum as fairly represents the value of the improvement to an incoming tenant.

“(2) In the ascertainment of the amount of the compensation payable to a tenant under this section, there shall be taken into account—

- (a) any benefit which the landlord has given or allowed to the tenant executing the improvement; and
- (b) as respects manuring as defined by this Act, the value of the manure required by the contract of tenancy or by custom to be returned to the holding in respect of any crops sold off or removed from the holding within the last two years of the tenancy or other less time for which the tenancy has endured, not exceeding the value of the manure, which would have been the holding of the crops so sold off or removed."

(Manuring in sub-section "B" is defined as applying to stock manure, purchase and application of commercial fertilizers, liming of the soil, growing of legumes, and other practices made use of in English agriculture but not common in America.)

Now, if the judicious use of fertilizers is of such importance, that the British government compels its landlords to compensate their tenants for the application of fertilizers to their soil, it goes without saying that the British farmer long ago concluded that fertilizers have a logical place in an economic system of farm management.

So enthusiastic are the German farmers, indeed, that one of their noted authorities, Prof. Wohltmann, says that he is confident that German farmers can increase their yields by 40% within the next twenty years.

What Experiment Stations Say About the Permanent Effect of Fertilizers.

We are not forced to cross the Atlantic to find convincing proof of the effect of available plantfood.

In 1912, we addressed a letter of inquiry to a number of Experiment Station Directors and State Commissioners of Agriculture in the Eastern and Southern States. We asked the following questions among others:

- (1) How much have the farms in your State increased in value in the last ten years?
- (2) How much have the farms in your State increased in productivity in the last ten years?
- (3) How much of this increase is due to A, B, or C, or any combination?

Reasons:

A—Better Farm Management.

B—Use of Selected Seed.

C—Judicious Use of Fertilizers.

(4) Do you believe that the judicious use of fertilizers has benefited, left neutral or injured your farms?

(5) How many abandoned farms are there in your State?

The answers which we received contained the following information:

Replies from Directors.

State.	Increase.		Due to.	Abandoned Farms.
	Value.	Productiveness.		
North Carolina.....	100%	50%	ABC	0
South Carolina.....	200%	100%	AC	0
Alabama.....	100%			0
Maryland.....	20%		ABC	0
New York.....		10%	ABC	0
New Jersey.....	38%	30%	ABC	0
Connecticut.....	50%	20%	ABC	0
Massachusetts.....	32%	20%	AC	0
Rhode Island.....		10 to 15%	ABC	0

Replies from Commissioners.

State.	INCREASE IN 10 YEARS.			Abandoned Farms.
	Value.	Productiveness.	Due to.	
Georgia.....	10th to 4th	ABC	0
Pennsylvania.....	15%		AC	0
Alabama.....	25-100%	50%	ABC	0
Tennessee.....	30-50%	25%	ABC	0
New Jersey.....	33%	250%	75% AC	0
Massachusetts.....	32%		Benefit	0
North Carolina.....	30%		ABC	Very few.
New York.....	26%	20%	ABC	0
Vermont.....	10%	10%	AC	0

Abandoned Farm Farce.

Incidentally, we enquired as to the number of abandoned farms in each state. As the answers to the above questions show these farms were not abandoned in the sense of the bugaboo which has been held up so generally before the agricultural public within the last few years. By modern agriculture, which includes the judicious use of fertilizers, many of these farms are being brought into a productiveness that they never knew before.

When I was head of the Agronomy Department, University of Maine, I managed one of these run down farms. It had been raising hay 40 years without a spoonful of plantfood being put back in any form. It cut less than $\frac{1}{4}$ ton per acre, the last year it was in hay. By applying modern methods to it, I brought its yield in two years up to 60 bushels of oats per acre; $2\frac{1}{2}$ tons of hay per acre; 150 bushels of potatoes per acre; 8 tons of ensilage corn per acre.

These modern methods included the judicious use of fertilizers. It is time this ghost of abandoned farms was permanently shelved.

More Intensive Farming Needed.

Now, gentlemen, the point of my somewhat lengthy remarks is, in my opinion the farming of this country must be more intensive and less extensive if the farming industry is to maintain itself on a business basis. Indeed, if the young men now growing up upon our farms are to be held thereon, or better said, if they are to be interested therein, when they come to years of discretion, they must see that the farming business returns as good an interest on the money invested therein as the average business in town or city. Understand me, I do not believe that the dollar and cent argument should be the only argument applied to the retention of our farmers upon their land. But this is an audience of farmer-business men interested in the dollars and cents view of the proposition.

You ask, "How am I to convince myself as to the profitableness of adopting modern methods upon my farm?" You are already convinced of the necessity of good drainage, maintenance of organic matter, application of barn manure, turning under of green manures, good tillage, application of lime when necessary and the use of selected seed. The plantfood problem is probably the one on which you desire light. In the literature of the prominent experiment stations of this country is found an abundance of reports of investigations which have been made relative to the application of fertilizers of different kinds on varied soils to various crops. In every case, where the fertilizers have been suited to balance the deficiencies of the soil, and to meet the peculiar needs of the crops, they have been applied at a profit.

The use of fertilizers is no new experiment. We have records of the successful and profitable addition of plantfood in fertilizers reaching back almost 100 years.

If German and British agriculture has developed to a state of excellence and superiority, which no student of agriculture will gainsay, by a system of soil management which includes the judicious use of fertilizers, is it not a loss of time and opportunity for good farmers to talk about experimenting with an acre or two? You are losing the added yields and superior quality that Germany and Great Britain, and many parts of this country have demonstrated possible and profitable, if you do not adopt modern methods of crop production.

In conclusion, gentlemen, let me summarize my statement by saying that the best physical condition must be supplemented by the best chemical conditions in the soil in order that the plant may make the most rapid growth and that it may bear fruit in the greatest quantity and of best quality. By quoting foreign farm yields in comparison with our own, I do wish to say that it is not my opinion that all of the conditions pre-

vailing in Europe could be transplanted in toto to America. I do believe, however, that we can study German and British methods of agriculture which have given such excellent results, and can apply much of their agricultural knowledge and practices to great profit in this country. This is a time above all times when the great audience of American farmers should be open minded, ready to learn from their fellows; not necessarily neighbors on adjoining farms, or counties, or States, but they should be ready and willing to learn from their fellow farmers in whatever part of the world they are located.

Let us keep our eyes, ears and minds wide open for suggestions. We have learned the art of acquiring large areas of land. We know how to operate these large areas in an extensive manner. Now, let us learn how to make each valuable acre yield twice what it produces at present, and that of better quality. That which was in the beginning, is now, and shall be as long as the products of agriculture maintain man. Plantfood is the foundation of prosperity.

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