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Bulletin 303

September, 1911

SOIL FERTILIZATION

How to Supply the Missing Elements
in Worn-Out Soils

Issued by

Department of Chemistry

Eagle Lime Products Co.

Office Pereles Bldg., Milwaukee, Wis.

Plant, Dousman, Wis.

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Foreword

This pamphlet, describing Soil Tonic and its uses, has been prepared in order to interest you in better farming. To be successful, the modern farmer must be a business man and apply business methods to his farm. American farming is no longer merely a means of raising enough to feed one's own family, but of supplying food to the world. It has become a business.

Two hundred and fifty years ago, when our country was first being settled, each colonist raised his own grains and vegetables. It was merely necessary to break ground and plant seed. There was plenty of virgin soil. Today our rich farm lands are scarcer and more costly. The farmer must raise more from each acre and must cultivate every available part of his land. In order to accomplish this, he needs an agent to free the elements of his soil and an agent to place all his soil in proper condition. That agent is Soil Tonic, which is a Marl or Carbonate of Lime.

Soil Fertilization

SOIL TONIC AND ITS USES.

The value of the farm depends primarily on the character of the soil—its fertility and the crops it will produce. All farmers are aware of the vast difference there is, in this respect, between soils in different localities, or indeed, on different farms in the same locality. In many cases a large amount of natural fertility was stored up in the soil, and this has been maintained by a wise system of farming so that paying crops are harvested from the land season after season. In other cases, the soil has always had a low crop-producing power and unless the farmer uses scientific methods to increase the fertility of the land the returns obtained by tilling the soil will remain low.

The fertility of the soil must be maintained above everything else, in order that the farm may yield sufficient income to the owner and his family for the necessities of life and the comforts to which they are entitled. Science has shown us how to accomplish this; how to earn a comfortable living from the farm and at the same time leave it in a better condition for the production of future crops.

THE CHARACTER AND COMPOSITION OF SOILS.

Soil is, in most cases, largely of mineral origin, derived from the decomposition and weathering of rock materials that make up the earth's crust. This decomposition has come through the action of water, frost, chemicals, previous vegetation, and animal and bacterial life which is found in the soil. Some soils, like peat, marsh or alluvial land, are largely of vegetable origin, having been formed from decayed vegetation, but most of these also contain a considerable proportion of fine mineral soil components. Soils are generally classified as clay, loamy, sandy, calcareous, gravelly or humus, according to their main chemical characteristics; the former two are sometimes sub-divided into sandy and pure clays; clay, silt, sandy and gravelly loams, etc. The origin of the soils determines in the main their inherent fertility and their value for agricultural production.

Evidently, therefore, the first thing we must look for is the latent supply of plant food in soils of different types. This is the capital with which the farmer has to work, the bank account that he cannot afford to draw upon too heavily. If he does, disastrous results are sure to follow; the returns that he will obtain for his labors will gradually decrease, and after a while he will become convinced that "farming don't pay," and may blame the soil, the climate, the trusts, or anything else he can think of, except facing the situation fairly and squarely and admitting to himself that the fault lies, not in the soil, but with himself, in the method of farming he has been following.

In studying the composition of the soil, chemists have learned that all arable soils contain certain elements which are absolutely necessary to plant life. The proportions and character of these elements vary greatly. The elements that are necessary for plant production are only about a dozen in number, viz.: Carbon, oxygen, hydrogen, nitrogen, potassium, phosphorus, calcium, iron, aluminum, sulphur, chlorine, silicon and sodium.

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The plant finds these various elements in the soil dissolved in the soil water, except the first two elements, which are derived from the air in the form of free oxygen and carbonic acid gases. In the mysterious processes of cell-building by plants, the carbonic acid is decomposed into carbon and oxygen, and the former unites with the elements drawn from the soil solution and forms the carbon compounds of which vegetation is largely composed. In the absence of any one of the elements mentioned, no plant can, however, build up its structure, or continue its own life through blossoming and ripening fruits, from which new plants may grow.

Now it happens that there is an abundance, in all kinds of soils, of all the elements given, except of four, viz., nitrogen, phosphorus, potassium and calcium, and since crop production will be reduced if the supply of these runs below a certain point, the art of farming consists, among other things, in always maintaining a necessary proportion of them in the soil, or in increasing this proportion by direct addition of the missing elements so that maximum crops may be secured in farming the land. This is done by applications of barn-yard manure containing the waste of farm animals, or by the addition of artificial fertilizers to the soil. By either of these methods the farmer is able to maintain a supply of necessary fertilizing ingredients in the soil that will secure large crops and good returns, both for the labor spent in growing crops and for the capital invested in the farm and its equipment.

ARTIFICIAL FERTILIZERS.

The fertilizing ingredients supplied in artificial fertilizers are the same as those found in barnyard manure, viz., nitrogen, phosphoric acid, potash and lime. These are supplied mainly in the following materials:

Nitrogen—In nitrate of soda, sulphate of ammonia, or slaughter-house offal-products, like dried blood, tankage, etc.

Phosphoric acid—In bone, rock phosphate, superphosphate, dissolved bone, basic slag, etc.

Potash—In potash salts, like muriate or sulphate of potash, and iron-wood ashes.

Lime—Marl or carbonate of lime (Soil Tonic), quick-lime or slaked lime.

We are here concerned more especially with the uses and benefits of marl or lime fertilizers and shall not further discuss the other materials, beyond stating that they may be secured in sufficient quantities in farm-yard manure.

MARL OR CARBONATE OF LIME.

Lime is sometimes spoken of, not as a fertilizer, but merely as a soil amendment, or a soil tonic. In order to show that it may have as great value as a direct fertilizer as the other generally recognized fertilizer ingredients, it may be well to explain in a few words the benefits of applications of lime to the soil, and the special functions of lime in increasing the crop-producing quality of the soil.

It is an important fact that we find the largest amounts of lime in the best kinds of agricultural soils and the least lime in the poorest grades of soil. The eminent German authority, Dr. Maercker, gives the following standards for the percentage of lime in clay and sandy soil of different productive capacity.

SOIL TONIC AND ITS USES

Per Cent of Lime in Different Soils.

	Clay Soils.	Sandy Soils.
Poor	Below .10%	Below .10% Lime.
Medium .....	.10— .25	.10— .15
Normal .....	.25— .50	.15— .20
Good .....	.50— 1.00	.20— .30
Rich	Above 1.00%	Above .30%

A study of the figures given in the above table will impress one with the importance of liberal fertilization with lime or marl (Soil Tonic) for all soils that are naturally low in this compound. It is a safe general rule to go by that applications of Soil Tonic will be required in all cases where the per cent of lime in the soil is below .30 per cent in sandy soils and 1.0 per cent in clay soils. When the per cent falls below these figures, the fertility of the soils is not what it should be, and what it will be, if its lime content be increased through direct application of our Soil Tonic. At the same time it may be necessary to supply the other valuable fertilizer ingredients in the form of barnyard manure or artificial fertilizers, but an application of either of these materials will still require liming of the soil. Our system of fertilization does not render the use of barnyard manure unnecessary, as both are equally important, and together they will develop the soil to its maximum fertility.

An ample supply of marl or lime in the soil is not only of importance for crop production, because plants grow best under these conditions, and some plants, like clover, alfalfa and sugar beets, do especially well in soils containing high percentages of lime; but lime has also other important functions, viz., to favor nitrification and oxidation of organic matter in the soil, to improve its texture, and to correct acidity of soils that have an acid reaction.

BENEFITS OF USING OUR MARL (CARBONATE OF LIME).

The benefits of liming are briefly stated by the Director of the Rhode Island Experiment Station, Professor Wheeler, who has given much special study to this subject, as follows:

1. Directly, as a substance essential to the growth of agricultural plants. Many soils are in need of lime for other reasons, even though they have enough of it already, in certain combinations, to meet the strict requirements of plant-food.

2. In promoting the formation of nitric acid and the resulting nitrates from both plant and animal refuse (barnyard manure), whether applied artificially or existing naturally in the soil.

3. In neutralizing acids and acid compounds existing in the soil, and by rendering harmless other toxic compounds which may accompany soil acidity.

4. Indirectly, in aiding the plant to take more phosphorus, potassium and magnesium from the soil than would be possible in the absence of lime.

5. In binding certain loose sandy soils. For this purpose it is beneficial only when used in small quantities and preferably as carbonate of lime (Soil Tonic).

6. In flocculating clayey soils, thus making their tillage easier, the movement of water and air within them more nearly normal, and in lessening their tendency to "wash."

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7. In lessening injury by insects, but only in specific cases and when used in liberal quantities.

8. As a means of lessening the injury caused by certain plant diseases, as, for example, in counteracting the tendency to "finger-and-toe" disease in the case of the turnip, cabbage and closely related plants.

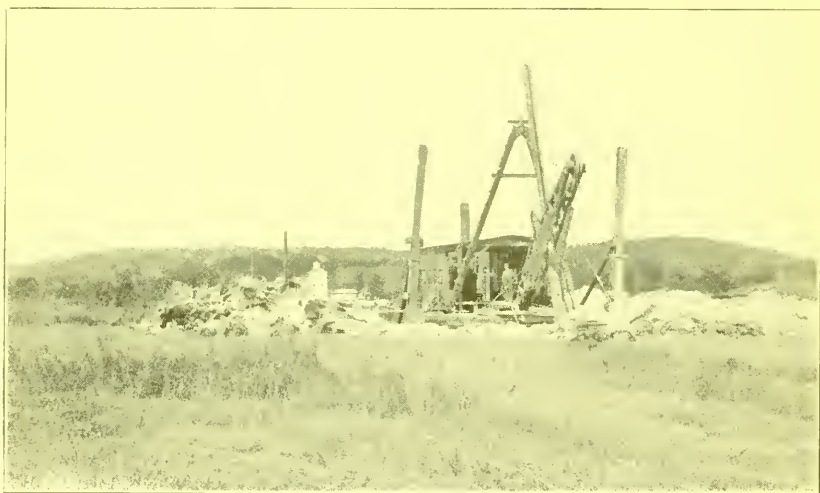
9. As a means of counteracting the occasional ill effects from the use of German potash salts, and especially of ammonium chlorid and ammonium sulphate.

10. In overcoming the tendency of nitrate of soda to cause heavy clay soils to become too compact and hence difficult to till.

11. In preventing or overcoming the injury due to the presence of certain toxic iron salts.

12. In improving the conditions necessary to the welfare of certain soil bacteria.

We note that the benefits of applications of lime fertilizers to the soil are either chemical or physical, and it is often a question which of these are of the greater importance. The effect of *Soil Tonic*, for instance, so far



Dredging the Raw Material for Soil Tonic

as the chemical composition of the soil is concerned, is as we have seen, partly to supply a deficiency of lime for crop production and partly to correct the acidity of soils from which crops have been harvested for a long time. A study of analyses made of different types of soil will show whether a soil is likely to be deficient in lime. Chemical analyses of soil cannot, however, be made outside of chemical laboratories and call for considerable expert knowledge, besides requiring a great deal of time and expense. An acidity test, on the other hand, can be readily made in the field by the farmer himself. It may be made by the litmus test which depends on the fact that blue litmus paper is changed to a red color when brought into contact with an acid solution. The test may be made in two different ways.

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ACIDITY TEST OF SOILS.

First Method. Five cents worth of blue litmus paper may be bought from a druggist; a handful of the soil is taken, preferably when somewhat moist after a rain; a slit is cut in the earth with a clean jack-knife, and a strip of the litmus paper is inserted in the slit and the soil pressed firmly around it. After thirty minutes the strip of paper is taken out and carefully examined. If the color has been changed to red or pink, the soil has an acid reaction. Care should be taken in handling the litmus paper so that the portion used for the test does not come in contact with the fingers; these may be moist from perspiration, which is also acid in nature and will have the same effect on the color of the paper as an acid soil has.

Second Method. Add water to one-half cup of soil until it is like a thick porridge and insert the blue litmus paper without handling the end introduced into the soil. After about an hour remove the paper and rinse only the lower end. If this is intensely red the soil is acid and liming will be necessary. The color is pinkish if much acid vegetable matter is present, but if not, it will be brick red in the case of acid soils.

It is a good plan to test samples of the soil from different places in the field and also from different depths. The acidity of acid soils increases as a rule with the depth, the sub-soil two or three feet down being much more acid than the surface soil.

DANGER OF SOIL ACIDITY.

A Rhode Island Experiment Station report contains the following as to the danger of soil acidity:

"The value of a satisfactory method for determining the relative acidity of soils would seem to be great.

"A dangerous degree of acidity, or at least a fatal lack of carbonate of lime, appears to exist in upland and naturally well-drained soils, and is not confined to muck and peat swamps and very wet lands, as most American and many other writers seem to assume, in view of which it appears that the test for acidity should be more generally applied to such soils.

"That this condition of upland soils has not been more duly recognized heretofore is not surprising, for the reason that the failure, or partial failure, of certain crops, has been attributed to winter-killing, poor germination of seeds, drought, excessive moisture, or attacks of insects or fungi. Upon soils where certain plants are injured only to a limited extent by acidity, others would be expected to thrive best of all, in consequence of which it is not surprising that the cause for the partial failure of certain crops upon them has not been suspected."

The legumes, especially clover and alfalfa, and a number of other plants, like corn, sugar beets, timothy, etc., do not grow well on acid soils, and if a good growth of clover is secured on a piece of land, the chances are that it is not acid and will not need a lime fertilizer. If, on the other hand, clover fails to grow where good crops were secured earlier, it is a good sign that the soil is acid and the test will show it. A heavy growth of sorrel on the land is another indication of an acid condition in the soil and that it needs liming.

If the results of the acidity tests show that a soil is acid, the question comes, how may this be corrected? It is necessary to sweeten the soil or neutralize the acidity by application of a pure alkali or carbonate of lime.

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This is supplied by our marl or Soil Tonic, which is the most valuable neutralizer of acid soils on the market. The use of marl or carbonate of lime is recommended by the Wisconsin Experiment Station in Bulletin No. 204, and by other experts which we shall mention further on in this pamphlet.

When thoroughly and evenly distributed through the soil one ton or more of Soil Tonic per acre will neutralize the acidity of practically all sandy soils not high in organic matter, and it is probable that an application of one-half a ton per acre of this material will be sufficient to maintain these soils in a suitable condition for the growth of legumes for some time. The first application, however, should be at the rate of one ton per acre.

Acidity in soils cannot be corrected by applications of land plaster which is composed of calcium sulphate, but can be corrected by caustic lime (Calcium Oxide), hydrated lime or air-slacked lime, all of which, however, have been used so frequently with disastrous results to crops, due to the burning of the life from the soil or plant by this slacking lime, as to bring lime fertilization into ill repute. But our marl or Soil Tonic is undoubtedly the best and cheapest material for correcting the soil acidity for the reason that it is composed almost wholly of pure calcium carbonate and does not contain hardly any magnesia like the common limestone; it is finely powdered and therefore is in a condition to be directly incorporated into the soil and to quickly correct an acid condition. It does not have the caustic properties, and therefore the destructive action on the vegetable matter of the soil, that quick-lime, hydrated lime or magnesia limestone have, but is milder in its action and neutralizes the acids formed in clay soils, changing their reaction to neutral or alkaline, which is favorable and necessary to the transformation of inert plant food in the soil to available food materials and favorable to the production of large crops. Readers desiring further information concerning the subject of liming and lime fertilizers are referred to Farmers' Bulletin No. 77, "Liming of Soils," by Dr. Wheeler of Rhode Island Station. This bulletin, like all others of the series, may be obtained upon application to the Secretary of Agriculture, Washington, D. C.

CHEMICAL COMPOSITION OF SOIL TONIC.

The following analysis recently made by Professor Woll, Chief Chemist in charge of fertilizer inspection at the Wisconsin Experiment Station, shows the composition of Soil Tonic.

Moisture,	0.08 per cent.
Calcium carbonate,	91.95 per cent.
Insoluble matter,	4.63 per cent.
Organic matter,	1.59 per cent.
Undetermined,	1.75 per cent.

100.00 per cent.

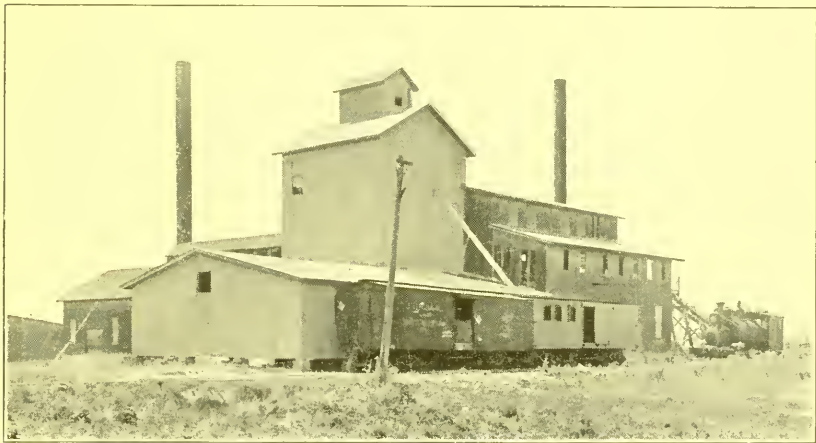
In reporting the preceding analysis, Professor Woll writes as follows:

"The results of our analysis show that the marl is practically pure calcium carbonate, since about 92% thereof is made up of that component. It does not contain any appreciable quantity of clay or

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other inert matter, and at the price which I understand you are selling this 'soil tonic,' it makes a cheap and effective material for correcting soil acidity, for supplying lime to soils that are deficient in this component, and for ameliorating the physical condition of clay, sandy or marshy soils. The importance of lime, and especially of carbonate of lime (marl), both as a soil amendment or tonic, and as a direct fertilizer on certain types of soils, has been brought out strongly by recent investigations, and more attention will doubtless be paid in the future to this phase of the soil fertility problem than was previously the case. Above all, we see more clearly now than in the past the danger of soils becoming acid by continuous cropping and the importance of correcting soil acidity by applications of carbonate of lime compounds, like Soil Tonic."

We have thus far shown the importance of lime fertilizers, and especially Calcium Carbonate in modern agriculture and have seen that "Soil Tonic" supplies the much needed and valuable carbonate of lime in practically a pure condition. We have incidentally given hints as to its application, quantities to be used, etc., but it may be well to add a few words along this line, in order to guard against mistakes and to enable farmers to secure the best possible results from applications of Soil Tonic.



Soil Tonic Plant at Dousman, Wis.

APPLICATIONS OF SOIL TONIC.

"Soil Tonic" is preferably applied in the fall after plowing, except on sandy soil, where it may be added in the spring. It is best handled by sowing it with a lime spreader, or a fertilizer drill. This may be set so as to sow from 500 pounds to six tons to the acre; light applications may be used on sandy soils, and heavier on heavy clay soils where the effect sought is to modify the physical condition of the soil. If a fair supply of Soil Tonic is sown on the field, say at the rate of one ton or more per acre, the application need not be repeated for five or six years. The best plan is to sow the Tonic soon after plowing and to harrow the land vigorously so as to get the Tonic evenly distributed in the soil and in direct contact with the soil particles, thus securing a speedy action of the Tonic and the full effect during the first season.

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Soil Tonic is often spread on rye and other grains in the spring; sometimes on corn after planting, but of course none of these methods are as efficient as a fall sowing on fresh plowing.

Several farmers are using Soil Tonic as a moisture absorber in the manure pits of their stables and then spreading it with the manure on a regular spreader. As Soil Tonic will absorb an extremely high percentage of moisture this is a good method.

Others are adding several bags of Soil Tonic to each load as the spreader is taken to the field.

On our experimental farm we are using from one ton to ten tons per acre, some of the soil having been cropped for years before without treatment until nothing but sand remained. You would be surprised to see the way alfalfa, rye, corn, potatoes, sweet potatoes and garden stuff are growing where others said we could raise nothing.

Last year we placed a few pounds of Soil Tonic around each vine in the garden with a result that we had luscious melons when everything else was parched with drought.

Further suggestions as to the influence and benefits of lime fertilizers, and especially as to applications of carbonate of lime will be found in the extracts given below which have been taken from the writings of the best American and foreign authorities on the subject of soil fertility. These will throw additional light on the question of the maintenance or improvement of the fertility of our farm lands and will show farmers that these experts are united in the view that applications of carbonate of lime are essential on most cultivated soils, for the purpose of putting them in the best possible condition for crop production, as regards both their chemical and mechanical composition, and thus helping farmers to grow the largest crops their land is capable of producing.

VIEWS OF LEADING AUTHORITIES.

Professor Hall. Director of Rothamsted Experimental Station, England (perhaps the greatest living authority on subjects relating to soils and fertilizers):

Clay Soils.—“The difficulty of working up heavy soils is much mitigated if they contain an appreciable quantity of carbonate of lime (Soil Tonic), because that substance constantly dissolves in the soil water which has gathered carbon dioxide from the decayed humus, and thus forms a solution of bi-carbonate of lime which keeps the soil particles flocculated. * * * * Clay soils are very often deficient in carbonate of lime so that dressings of lime are of special value, both in supplying this needed constituent and in bringing about the flocculation of the finest particles, thus improving the texture and rendering the soils drier and warmer.

“Garden Soils.—At the present day the need of some treatment is often seen in old gardens, particularly in old town gardens which are situated upon gravel soils, initially very short of the finer soil particles. The constant breaking of the surface by cultivation, and the use of large quantities of stable manure, which decays and leaves the soil open, result in a continual washing down of the finest particles, until the remaining soil loses all power of cohesion and of resisting drought, falling into dusty powder immediately on drying. A coating of Soil Tonic in the early autumn, or Soil Tonic and clay, is the only method of giving consistency to such a soil, and soon remedies its worst defects, such as susceptibility to drought and rapid fluctuations of temperature, and tendency to produce soft vegetation, very liable to disease.”

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Primrose McConnell, a noted English author and lecturer:

"There are very few soils that do not require a dressing of lime for the purpose of ameliorating their physical condition and of developing their fertility. * * * * Of all the component parts of a soil the most important one is lime, for though it is not so necessary as a plant ingredient itself, yet it is the great controller of fertility in the soil. Wherever limestone predominates in a district we have a 'rich' country,—both the live stock and the crops are heavier and thriving, and one of no lime has a correspondingly disastrous effect."

Professor Wheeler, Director of Rhode Island Experiment Station:

"At a time before the actual mineral requirements of plants were understood, it came to be an adage that 'liming makes rich fathers, but poor sons.' Fortunately the action of lime is now so



Interior View of Soil Tonic Plant

well understood, and its varying effect, dependent on the variety of plant, has been so fully studied, that many of the difficulties in understanding earlier results have now vanished. The well-known action of lime in rendering other substances more easily available to plants, and hence in reducing their quantity in the soil with the natural increase in crop production, explains readily why liming by the father was at the expense of the son. Today it is known to be the best policy to keep the soil in the proper chemical and physical condition by occasional liming, and to supplement the lime with such quantities of the other mineral substances as the crops may require."

Dr. Van Slyke, Chemist of the Geneva Experiment Station:

"What are the effects of lime components in soil? (1) material is furnished to combine with the acids and keep the soils sweet; (2) the work of soil bacteria is favored, especially of those that convert

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insoluble nitrogen compounds into available forms and of those that work on the roots of leguminous plants in making atmospheric nitrogen available; (3) the physical constitution of clay soils is improved by being made more open and of sandy soils by being made less open."

Professor Patterson, Director of the Maryland Experiment Station:

"The effect of shell marl compared with other sources of lime during an experiment covering 11 years are as follows:

"**Total yield of corn per acre during four seasons:** No fertilizer, 97.5 bushels; stone lime, 127.7 bushels; shell marl (Soil Tonic), 154.0 bushels.

"**Three crops of wheat:** No fertilizer, 31.9 bushels; stone lime, 33.6 bushels; shell marl (Soil Tonic), 43.4 bushels.

"**Four crops of hay:** No fertilizer, 5,200 pounds; stone lime, 6,760 pounds, and shell marl (Soil Tonic), 8,580 pounds."

Professor Hopkins, the noted soil expert of the Illinois Experiment Station:

"Three things that are absolutely necessary for the permanent improvement of the level upland timber and prairie soils of southern Illinois should always be kept in mind: They are lime, phosphorus, and humus—lime to correct the acid in the soil; phosphorus to supply an element in which the soil is markedly deficient and which is sold in nearly all farm products, especially in grain and bone; and



Soil Tonic Warehouse at Dousman, Wis.

humus, or decaying organic matter, to be made largely from clover or other legumes, which get nitrogen from the air—humus which as it decays will liberate phosphorus from the cheapest source (rock phosphate) and which will also at the same time liberate potassium and other mineral plant foods from the practically inexhaustible supply in the soil. Without lime clover cannot be grown, and without phosphorus all crops will ultimately fail, so that humus cannot be made—and humus is the 'life of the soil.'"

Professor Whitson, of the Wisconsin College of Agriculture:

Marsh Soils—"Much improvement has been made in the marsh lands of northern Wisconsin by the use of lime in addition to phosphate and potash fertilizers."

Professor Frank T. Shutt, the able Chemist of the Dominion Experiment Farms, writes in the *Farmers' Advocate* (Canada) as follows:

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"Marl is an extremely valuable form in which to apply lime, as excess thereof does no injury to the soil, and in this respect is unlike quick or caustic lime. Of course it cannot in any sense be regarded as a substitute for barnyard manure, nor can it be used in the place of commercial fertilizers—the function of which is to furnish nitrogen, phosphoric acid and potash. It is to be considered as a useful amendment rather than as a fertilizer. Improving the tilth, neutralizing acidity and promoting nitrification are among its chief functions, though it has a distinct value as a supplier of lime (an element necessary for plant growth) for soils deficient in that constituent. It can be used on all classes of soils, but its best results are more commonly obtained from heavy clays and peaty loams."

And finally we quote from Hoard's Dairyman and The Union, edited by former Gov. W. D. Hoard, himself a large user of our Soil Tonic, and one of the leading dairymen and agriculturalists in the country, as follows:

"WHAT LIME WILL DO.—All of the grains, corn and blue grass, the apple and other fruits, and lastly, alfalfa, come to their best estate on soil strongly impregnated with lime. The wonderful blue grass pastures of Kentucky, the Middle Basin of Tennessee, the splendid apple region of Central New York and that wonderful tongue of land in northeastern Wisconsin, lying between Green Bay and Lake Michigan, called Door county, where the apple, the plum, and the cherry grow marvelously, are all based on lime rock. These are things we should not forget. Wherever the lime rock abounds, there alfalfa responds.

"Now, with all that logic of nature before them told, it may be a hundred times, what shall we say for the gimp and intelligence of the farmer, who cannot be made to use * * * * ground marl, on his land, whose mind cannot stretch out far enough to take in this important lesson and yet who really wants to grow alfalfa and make money on his farm? 'How long, Oh, Lord! how long?' said the prophet."

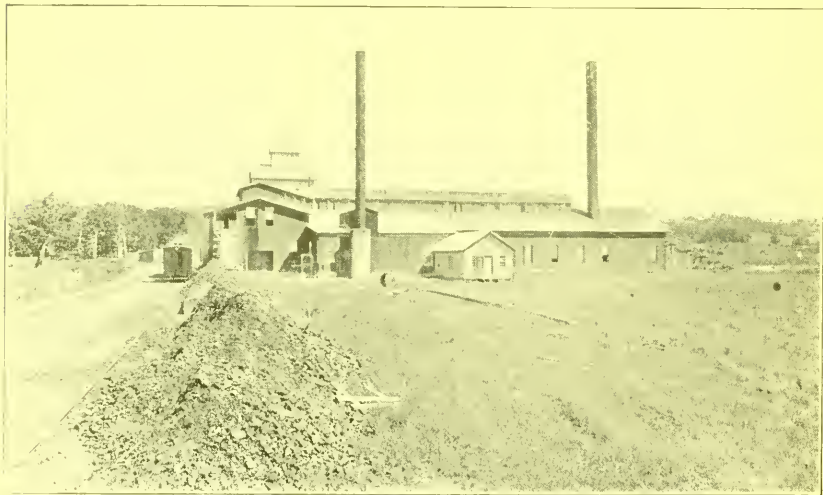
"SOMETHING ABOUT ALFALFA.—As farmers, the more we read, study and observe about the raising of alfalfa, surely the more we ought to know about it. And then, the more we know the better and surer ought our success with it to be. We think that has already been proven true by the farmers of this county. What did they know about the growing of alfalfa twelve years ago? And how much of it was grown then? But now, one can hardly go into any part of the county that he will not see fields of it growing. There are a few things we wish to speak about in a warning way. The severe drouth last summer checked the growth of the third crop very much, but the August and September rains have brought it forward in grand shape. In this climate alfalfa must make a good strong growth in the fall, to protect it during the winter, or else it is very liable to freeze out. That was one of the first things we discovered in our experimental work with it fifteen years ago. But a large number of our farmers are cutting this third crop at the present time, which is too late for the fourth crop to make much of a growth before winter. If we have a late warm fall and plenty of snow during next winter, it may go through all right, but the risk is very great. But suppose the contrary happens, what then? To cut it this late is running the risk of getting a crop now and destroying the chance of three crops next year. That is paying too big a price for this late crop.

"Another thing: Alfalfa is very greedy of lime and phosphate. Now both of these elements must be supplied if the alfalfa gets them. The more there is of lime and phosphate in our soil the more steadfast is the alfalfa and this is just as true of red clover as it is of alfalfa.

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"We wish to suggest to the farmers of this county in particular, that they send out to the Eagle Lime Products Co. of Dousman, Waukesha Co., and buy some of their ground marl and spread it at the rate of a ton to the acre on their alfalfa. Do it this fall so the rains will dissolve it. This prepared marl is about 94% calcium carbonate of lime. This is the best way to put lime on our soil, for unlike quick lime, it will not eat out the humus and thus take out the nitrogen that we so much need. The freight on a carload should be about the same as on coal. Let two or three neighbors combine and get a carload and try it. We have used over a carload of ground limestone on our alfalfa and we believe it has paid us well. The farmers of Jefferson county must commence to put back some of the natural elements of the soil that they have been taking out in all these years. The time to do it is now, before the soil is too badly exhausted. The two elements our land needs most are lime and phosphate. If we supply these it will tell wonderfully on certain crops, particularly alfalfa. Money spent for those things is put out at a big rate of interest. Try it and see if our advice will not come true."

This is plain truth that should interest every dairyman and farmer, and comes from a man whose word is respected among dairymen and agriculturalists and whose principal interest is to develop the farming resources of Wisconsin.



Showing Our Excellent Shipping Facilities

THE MANUFACTURE OF SOIL TONIC.

Our large plant is located six miles South of Dousman, Wis. The raw material from which our fertilizer is prepared is a very high grade shell marl. It is found in an old lake bottom.

The marl is dredged by a large steam dredge, and after being air dried, is taken into our mill and dried in a huge kiln, built especially for that purpose. Two powerful gas producers, under absolute control of one man, supply the proper heat to dry the marl thoroughly without burning it.

SOIL TONIC AND ITS USES

After being passed through a long rotary cooler, the dry marl is distributed by a patent arrangement to our grinders and separators. It is ground to flour so as to be easily applied to the soil and quickly available for plant life. The last step in the manufacture is the packing and shipping. Our Soil Tonic is packed in 100 pound burlap bags.

In addition to the storage capacity of our plant, the Company has erected a large warehouse at Dousman, so as to have on hand a sufficient amount to supply all demands. Farmers in the vicinity can also drive to our warehouse and call for such quantity as desired.

Our plant is in charge of an expert chemist, who is constantly testing and watching our product, and who is pleased at all times to answer special questions relating to Soil Tonic and its uses.

The Company has also purchased two large farms near the plant and is conducting agricultural experiments with its product. Both farms, when purchased, were run down and their fertility long exhausted, but by the application of three or more tons per acre of Soil Tonic, these farms now produce alfalfa, grains, corn, vegetables, melons and even sweet potatoes.

WHICH DOES IT PAY TO USE?

Comparative Analysis of Soil Tonic and Dolomite Limestones.

A Word About Dolomite Limestones.

In comparing our Carbonate of Lime with limestones, we call your attention to some comparative analyses between our Soil Tonic and the less expensive limestones.

SOIL TONIC.		<i>Dolomite Limestones.</i>		
		No. 1	No. 2	No. 3
Silica	1.45 per cent	3.80	.80	1.00
Iron and Alumina Oxides . . . . .	.98	.60	.20	.60
CALCIUM CARBONATE	95.00	53.05	58.01	56.50
<i>Magnesia Carbonate</i>	1.39	37.22	40.33	40.20
Sulphuric Acid . . . . .	.09	.05	.06	.10

Stop for a moment and figure what the Calcium Carbonate of the Dolomite Limestone is going to cost. The other elements are practically valueless to you. Figure the original cost—the cost of hauling, handling, spreading and the long delay due to the slowness of action. Soil Tonic is almost absolutely pure—it comes to you in 100 lb. bags and every pound is of value, fine enough to take almost instant effect on a sour soil.

CONCLUSION.

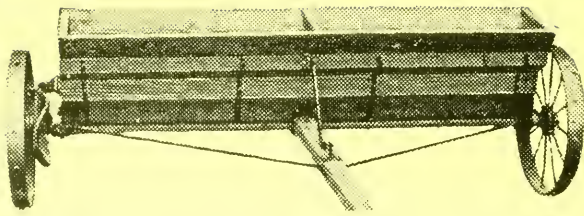
We have endeavored to place before you fairly and impartially the results of experience of lime users in other states and of the investigations of experts in the field of agriculture. You will have to determine your own business policy—whether you will continue as heretofore or will enjoy Better Farming by use of our Soil Tonic on your lands. We guarantee our product to be thoroughly satisfactory. Write us today for further information or send us an order for a trial carload.

EAGLE LIME PRODUCTS CO.,

Office, Pereles Building,

Milwaukee, Wis.

Plant—DOUSMAN, Wis.



The Eagle Force Feed Lime and Fertilizer Sower

is a machine that is perfectly adapted for sowing all kinds of fertilizer, lime, ashes and other substances. It sows them accurately and evenly.

The CAPACITY of the box and hopper is large and holds about twelve bushels.

Each machine is built with a screen that sorts out stone or other foreign matter from the lime or other substance that is being sown, and this does away with the necessity of the screening beforehand of the material to be used. The screen is arranged on hinges, so that the dumping of the undesirable matter is instantaneous and without trouble.

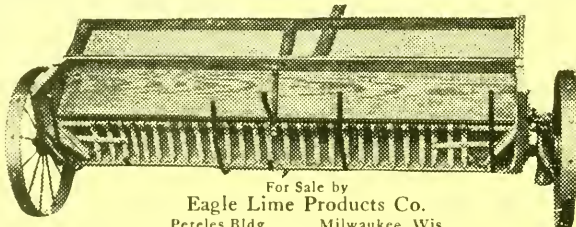
The AXLES are cold rolled steel 1 7/16 inches in diameter and 9 feet long. The axle is free, and aside from the bearings there is no part of the machine attached to it. The wheels are loose on the axle and held on by cotter pins.

Especial attention is called to our AGITATING MECHANISM. This is made of STEEL TUBING and BARS. The bars are bolted around the tubing. The complete agitator is carried back and forth lengthwise of the box by the revolving of the third wheel, which is on the outside and attached to the right hand first wheel and revolves in unison. Each revolution of the wheel, the agitator is carried in either direction covering the entire surface of the bottom of the box, three times.

The OPENINGS at the BOTTOM of BOX, at all times, whether a large or small quantity is being sown, are square. There are twenty-nine different apertures for the material to pass through between the two ends of the machine. The flow is continual whether a large or small quantity is being sown.

The CHANGE OF QUANTITY OF FLOW is instantaneous by simply changing the position of the lever that regulates the slide which is at the rear and bottom of the hopper. This change can be made while in motion or otherwise at the will of the operator. The amount of MATERIAL SOWN to the acre can, at the pleasure of the operator, be regulated to any amount from 25 to 5,000 pounds.

This machine is a practical one at a moderate price for the sowing broadcast of prepared or granular lime, nitrate of soda, commercial fertilizers, land plaster, dry wood ashes and other substances that are to be evenly sown over the surface of the ground. *Write for Prices.*



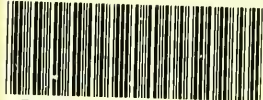
For Sale by
Eagle Lime Products Co.
Perelle Bldg. Milwaukee, Wis.



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