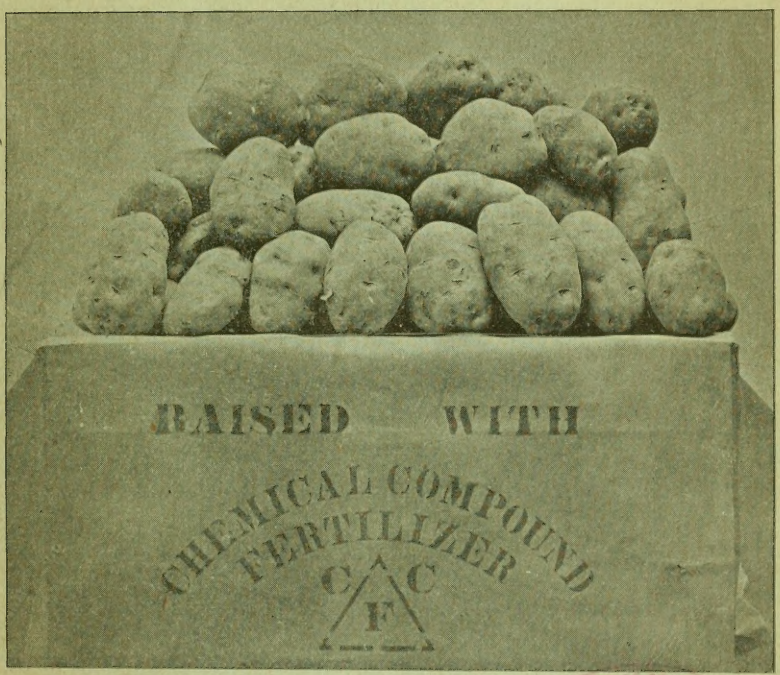
Too good

to throw away!



MASON, CHAPIN & CO.,

Providence, R. I.

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Chemical Compound Fertilizers.

"$25. Against $110."

A. P. POMROY, Suffield, Conn., writes:

Your agent, Mr. Bruck, called upon me to-day to investigate the growth of my tobacco. I took him into the field and showed him several acres. I called his attention to a half acre where I used your fertilizer. I never saw such good color, the size and weight as good as on the same soil where I put

1200 lbs	cotton meal
300 "	plaster
800 "	Canada wood ashes
15 cords	manure

costing in all about $110. against yours for $25. Never in my experience have I raised tobacco costing me so little money. You have the right article for raising tobacco. I will use it next year.

You may add to this letter a good average of seventeen large-size leaves on every stock.

"Proper article for a large crop of Potatoes."

From DELL OLIVER, Perham, Me.

I beg leave to say the Chemical Potato Fertilizer bought of your agents, Messrs. Goodwin & Barton, proved to be the best I ever used. I could see an advance in growth over several other Commercial Fertilizers that my neighbors were using. When I dug my potatoes they were larger than they were when I used other makes of fertilizers, and fully one-third more in quantity.

I shall use the Chemical Fertilizer again, and recommend it to my neighbors, as I am satisfied it is the proper article to grow a large crop of potatoes with, and much cheaper than other Brands.

General Agents: MASON, CHAPIN & CO.,

PROVIDENCE, R. I.

A USEFUL AND INSTRUCTIVE BOOK

FOR FARMERS.

The Chemistry of Farming.

ISSUED BY

The Chemical Compound Fertilizer Co.,

Works at Providence, R. I. and Dighton, Mass.

Experimental Farm, Coventry, R. I.

Office, 53 Canal Street, Providence, R. I.

GENERAL AGENTS,

MASON, CHAPIN & CO.,

Providence, R. I., Boston, Mass., New York, N. Y.

FOR SALE BY

Calendar for 1895.

1895.	Sunday	Monday	Tuesday	Wednes.	Thursday	Friday	Saturday
Jan.	..	..	1	2	3	4	5
	6	7	8	19	10	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
	27	28	29	30	31	..	..
Feb.	..	..	..	..	..	1	2
	3	4	5	6	7	8	9
	10	11	12	13	14	15	16
	17	18	19	20	21	22	23
	24	25	26	27	28	..	..
Mar.	..	..	..	..	..	1	2
	3	4	5	6	7	8	9
	10	11	12	13	14	15	16
	17	18	19	20	21	22	23
	24	25	26	27	28	29	30
	31	..	..	..	..	..	..
Apr.	.	1	2	3	4	5	6
	7	8	9	10	11	12	13
	14	15	16	17	18	19	20
	21	22	23	24	25	26	27
	28	29	30	..	..	..	..
May	..	..	..	1	2	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
	26	27	28	29	30	31	..
June	..	..	..	..	..	..	1
	2	3	4	5	6	7	8
	9	10	11	12	13	14	15
	16	17	18	19	20	21	22
	23	24	25	26	27	28	29
	30	..	..	..	..	..	..

1895.	Sunday	Monday	Tuesday	Wednes.	Thursday	Friday	Saturday
July	..	1	2	3	4	5	6
	7	8	9	10	11	12	13
	14	15	16	17	18	19	20
	21	22	23	24	25	26	27
	28	29	30	31	..	..	..
Aug.	..	..	..	..	1	2	3
	4	5	6	7	8	9	10
	11	12	13	14	15	16	17
	18	19	20	21	22	23	24
	25	26	27	28	29	30	31
Sep.	..	..	..	..	..	..	..
	1	2	3	4	5	6	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30	..	..	..	..	..
Oct.	..	..	1	2	3	4	5
	6	7	8	9	10	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
	27	28	29	30	31	..	..
Nov.	..	..	..	..	..	1	2
	3	4	5	6	7	8	9
	10	11	12	13	14	15	16
	17	18	19	20	21	22	23
	24	25	26	27	28	29	30
Dec.	..	..	..	..	..	..	..
	1	2	3	4	5	6	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30	31	..	..	..	..

The Chemical Compound Fertilizers.

Their Special Features.

We are offering to farmers a series of fertilizers having many special qualities which will commend themselves.

First. In the first place, they are clean and agreeable to handle. Some fertilizers are so offensive in odor that it is impracticable to keep them in a clean storehouse with other goods. Ours are sweet and clean. They contain no gross, filthy, or inferior materials. They will not impart an offensive odor or be otherwise injurious to other goods stored in the same place.

In our fertilizers we use no leather waste or chippings, wool waste, cuttings of buttons, horns, or any such low grade and worthless materials.

Second. Our fertilizers are dry, and thoroughly pulverized, so that they may be readily distributed on the soil. They are easy of application.

Third. They contain the elements of plant food in a soluble and available form, and as such will be found to promptly and immediately stimulate the growth of the crops.

Fourth. Now note the following: and by reason of other inventions of our own, the components of our fertilizers are combined in such a way as to develop the capacity of the soil itself: that is, they unlock the valuable materials in the soil so as to make them available for plant food. Take notice of this feature, because it is a special characteristic of the articles we manufacture. Our fertilizers differ from all others known to us, in these special advantages, and they constitute an important feature. The exact method or the exact way in which

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From a prominent distributer and large manufacturer of Potato starch, in Maine.

From JOHN WATSON, Houlton, Me. Jobber and Retailer of Hardware and Cutlery, and Manufacturer of Potato Starch. Mills at Houlton, Smyrna, New Limerick, Monticello, Me.

In reply to your inquiry on the Chemical Potato Fertilizer sent to me to be placed on its merits with my customers, it has earned a reputation that has proven it to be the right article for our soil. It takes from 50 to 75 per cent. less than all other Commercial Fertilizers, less trouble and cleaner to handle, also a saving in freight and labor for the farmer to apply it on his farm.

Another pleasing feature; being perfectly odorless will make it a favorite.

The reports I received were from honest and reliable men who have bought goods of me for years, and they all claim it has given them the growth and quality, and costs less per acre than any other fertilizer on the market.

I want the agency of your Fertilizer for Houlton and neighboring towns, and hope to be favored with the same.

this is accomplished, is a secret of great value to us and which we do not propose to give away to the public.

Fifth. Our fertilizers are to be applied in the ordinary manner, only the amount we ordinarily recommend is one thousand pounds per acre, without stable manure. But our fertilizers will blend with others; indeed, they will develop the fertilizing substances in stable manure so as to make it more valuable and efficient. Our fertilizers are not for use in hill and drill; they are to be spread broadcast and harrowed in.

Sixth. The farmer can no longer work in the dark, trusting to luck to raise a crop. He must have some knowledge of the laws of chemistry, and must furnish his crops that chemical food which experiment has shown is necessary to them. With a view of giving him some points or suggestions with respect to chemical terms and substances, we have prepared a useful though brief treatise on chemistry which we hope will be of service, and which is embodied in this pamphlet.

Experiment Stations. For a long time experiment stations have been carried on in Germany to the great advantage of farmers all over the world. The Congress of the United States makes annual grants for carrying on agricultural experiment stations in this country. This is the proper thing. *Absolutely the only way of determining the value of agricultural materials is to try them on growing plants.* This is what the experiment stations do. They lay out a series of plots or gardens. They fertilize these gardens with one substance or another for trial. Then they observe how the different crops flourish on these plots. Noting the results at the end of the season, they learn that a certain chemical substance is favorable to a certain crop. This is exactly what the intelligent farmer should do. Trying a certain amount of one fertilizer or another upon his different farm plots, he can see as the season advances which fertilizer does the best work.

This is just what we have done. *We have established an experimental farm and experiment station,* and we have tried various fertilizing substances offered in the market, with a view of determining their value in stimulating plant growth.

Moreover, outside of our private experiment station, a large number of farmers

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"Cheapest Tobacco Grower Ever Used."

JOHN CAIN, Suffield, Conn., writes:

Your Tobacco Fertilizer has done its work so well that I shall surely use it again next year. It is the cheapest tobacco grower I ever used.

"Took one-third the amount, and worked much better."

MRS. R. A. BAGG, West Springfield, Mass., Writes:

I have used it on cabbage, corn, and onions, and liked it much better than the—— ——— Fertilizers. It took only one-third the amount, and worked much better on the corn than the———. I have also used it on the cabbage, which is doing well. I shall recommend its use another year.

have used our goods and have reported to us. This gives us in effect a series of experiment stations in a sort of co-operative way. Of course, the results represent a large series of trials by different farmers on different crops and on different soils. Plainly the favorable effects reported are substantial grounds showing the value of our goods.

What our fertilizer will accomplish as respects quality and quantity of crop and as respects the cost to the farmer to produce results is better shown by the testimonials of the users (shown in this book) than by any words we can add.

"Never Raised Nicer Carrots, Turnips and Corn."

CARL LARSEN, Gardener, East Hartford, Conn., writes:

Your fertilizers for garden purposes are the most valuable I ever used. I never raised nicer carrots and turnips, and especially my corn; the largest crop ever raised. I will certainly use the same fertilizer next year, only more of it. Use my name if you wish, indorsing your fertilizers.

"5 Tons Beets Per Acre With 600 lbs. Fertilizer Per Acre."
"Corn, Thirteen to Fourteen Feet High."

FROM HON. F. S. STEVENS, Swansea, Mass.

In reply to your inquiry regarding your Chemical Compound Fertilizer I have sent you six Mangles Beets grown with it. This will show you the size, color and weight much better than I can write you. Those I send you will weigh twenty-five and one-half to twenty-six pounds each. I have several acres which will average fifteen pounds apiece.

I used only 1200 pounds of this fertilizer for two acres, and in my life's experience as a farmer I never raised or have seen such large beets. It is a beautiful sight to see them in the field. They are attracting much attention, having grown as much as thirty-six inches out of the ground. I think the two acres will weigh from nine to ten tons.

Now in regard to the Corn Fertilizer, I can safely say that the ears are as heavy and large as ever raised in this town; stalks from thirteen to fourteen feet high. I am more than pleased with the results. I can say that it is the best corn producer I ever used. I shall use it again as it is much cheaper than the ordinary Commercial Fertilizer, and much cleaner to use, as i is perfectly odorless.

Points for the Farmer.

Matter and Energy. Any substance that can be weighed, whether solid, liquid, or gas, is a form of *matter*; but scientific men nowadays deal also with forms of *energy*, like heat, light, and electricity. The word *energy* is used by scientific men to express a certain idea which is not easily explained without an elaborate definition. A simple illustration, however, will be of service. A given piece of copper wire contains a certain amount of *matter*. Speaking generally, the amount of matter may be determined by weighing the wire. If this wire is charged with electricity, it is then supplied with a certain amount of *energy*. Its quantity of matter is not increased, for electricity is not matter. The scientific men say, the copper has been furnished with a certain quantity of energy.

Elements and Compounds. While there are a great many kinds of matter known in the world, they are all capable of being classified into two groups, *elements* and *compounds*.

An Element, is a kind of matter that has not yet been decomposed or split up into parts of different kinds. Thus the yellow substance known as sulphur or brimstone, has not been decomposed into anything but sulphur.

A Compound, is a substance that has been, by one means or another, decomposed or split up into matter of different kinds. The substance known as sulphuric acid or oil of vitriol, is composed of a certain proportion of water and a certain proportion of true sulphuric acid. Now the water is a compound and the true sulphuric acid is a compound. Water is expressed by the chemist by the formula H_2O (stated, H two O); and true sulphuric acid is expressed by the chemist, H_2SO_4 (stated H two S O four). Now the formula of water, H_2O, designates that a single small portion of water is made up of two atoms of hydrogen (expressed by H_2) and one atom of oxygen (expressed by O); and a single very minute portion of sulphuric acid is made up of two atoms of hydrogen (expressed by H_2), one atom of sulphur (expressed by S), and four atoms of oxygen (expressed by O_4.)

Important Elements. While chemists know about seventy different elements, a great many of these are mere curiosities. Those that need to be considered in agricultural chemistry are only about a dozen. They are the following (fourteen in number):

Hydrogen, H
Carbon, C
Nitrogen, N
Oxygen, O
Sodium, Na
Magnesium, Mg
Aluminum, Al
Silicon, Si
Phosphorus, P
Sulphur, S
Chlorine, Cl
Potassium, K
Calcium, Ca
Iron, Fe

These will be discussed, and their relations to agriculture more fully shown a little later.

Mixture and Compound. The chemist makes a distinction in using these words. The term *mixture* is applied to a mass of substances produced by merely stirring up, or grinding up, two or more substances together. Thus sand and sugar may be mixed by grinding together; but no chemical compound is formed by this treatment.

In a chemical *compound* two or more substances have united in a very curious and remarkable way. Common salt, called by the chemists sodium chloride, Na Cl, is a chemical compound of a metal, sodium, and a gas, chlorine. Sodium is a soft silvery metal which takes fire when thrown on water. The chlorine is a greenish gas. But when these two things unite, common salt is produced. The sodium loses most of its properties and the chlorine loses most of its. These statements illustrate one of the features of chemical union; namely, *when individual chemical elements unite to form a compound, the qualities of the compound are often very different indeed from those of the elements composing it.*

"Gives Size, Weight, and Color, in Tobacco."

L. O. POMEROY, Suffield, Conn., writes:

In reply to your inquiry on the chemical tobacco fertilizer, I wish to say that it has proved to me the cheapest fertilizer ever used on my soil for tobacco. It has given me the size, weight, and color. I shall surely use it again and recommend the same to others.

"Liked it as Well as Any Ever Used."

R. P. MATHER, Suffield, Conn., writes:

Your chemical fertilizer worked very satisfactorily on my corn. I liked it as well as any I ever used.

Plants. If a plant is thoroughly cleansed from all adhering soil and then tested by the chemist, it is found to be made up of a great many different compounds. If these compounds are further thoroughly tested and decomposed, they are found to be made up of a comparatively small number of elements. The elements found are scarcely more numerous than the fourteen just mentioned.

The growing plant secures the matter which helps to make it increase in size and weight from two principal sources; namely, from the atmospheric air and from the soil. From the atmospheric air it may take up carbonic gas, $C O_2$ (composed of carbon and oxygen); from the soil it may take up compounds of various kinds made from the elements previously listed, and it may also take up water.

The plant is spoken of in a general way as composed of vegetable or *organic parts* and of mineral or *inorganic parts*. The vegetable parts are those which may be burned up, turned into gas, driven off into the atmosphere, when the plant is heated in a red hot crucible or dish of some sort. The mineral parts or inorganic parts, are, generally speaking, those that remain in the ashes when all the more purely vegetable parts are expelled by burning.

The vegetable parts of the plant consists namely of compounds containing carbon, hydrogen, oxygen, and small amounts of nitrogen and very minute amount of sulphur and may be phosphorus. (Sometimes phosphorus remains in combination in the ashes.)

The ashes of plants are made up of compounds containing oxygen, sodium, magnesium, aluminum, silicon, phosphorus, sulphur, chlorine, potassium calcium and iron. But these substances do not exist in the ashes, separate one from another. They usually exist, *combined* as compounds. Thus silicon and oxygen exist either in the combined form as silicon oxide, $Si O_2$, or some more complex compound. So the potassium, sodium, calcium and iron, generally exist, as some complex compounds, containing oxygen, and maybe, other elements.

The ashes of a plant usually contain substances that the plant has drawn as a kind of food, from the soil.

"Finest Field of Corn Ever Raised in This Town."

CHARLES HATHAWAY, Windsor Locks, Conn., writes:

I can claim the finest field of corn ever raised in this town. It will average ten feet high, and many stalks twelve to fourteen feet high. This corn field, standing near the road, seems to attract much attention, owing to the large-sized ears. My tobacco is also doing well, crop much larger than last year. I shall use your fertilizer again next year.

Soils. Soils are generally made up of compounds. While these compounds are varied and numerous, they generally contain oxygen, silicon, calcium, magnesium and several other elements, already mentioned. These are mineral compounds. Soils also contain *organic* compounds derived from the vegetables and animals, (these being the only things in nature that contain true *organs*.)

The fertility of a soil depends upon the substances it contains, and also upon the form or way in which these substances exist.

First, if the soil contains those substances that are specially valuable, as plant food, the soil thereby is rendered more fertile. Second, if the substances just mentioned are in a form readily soluble in water, they are better adapted to be quickly absorbed by the plant; thus, also, the soil is more apt to be fertile.

For example, a given soil might contain a considerable quantity of rock phosphate of lime. This is a valuable plant food, but while it is in the rock form, it does not dissolve readily in water. Thus it is not easily and quickly brought in favorable form to the plant for absorption. On the other hand, if a similar amount of rock phosphate of lime is pulverized and then treated with sulphuric acid, its phosphate is thereby rendered much easier soluble in water. If such soluble phosphate is brought in contact with the rootlets of a plant, the plant drinks it in—dissolved in the water of the soil—and thus the plant is quickly nourished.

Relative Abundance of Plant Foods. Some substances exist in almost all soils in great abundance. While these may be plant foods, they are so abundant that the crops do not exhaust the supply, and thus they do not have to be furnished by the farmer; for example, compounds of silicon containing oxygen and other substances, are abundant in almost all soils. The farmer, therefore, does not have to add them; but compounds of phosphorus, of potassium and of nitrogen, are not abundant in soils, and they are easily exhausted by the repeated croppings; yet they are very important plant foods. It is therefore highly desirable to furnish them to the soil, artificially. This helps to explain why manures and fertilizers must generally be furnished.

Distribution of Elementary Substances in the Plant. With a few exceptions, any compound which, while being soluble in water, contains nitrogen or phosphorus or potassium, is found to stimulate the growth of the plant. When such compounds are placed upon soil, around growing plants, the general appearance of the plants is very much improved. They grow taller and fuller than similar plants, on the same soil, which are not fed in the way stated.

But in this connection there is another very important point. Compounds of

the three elements mentioned, (phosphorus, potassium, nitrogen), are needed to a notable extent by *the more valuable and important portions of the plant.* Thus the *fruit* of corn and wheat, for example, contains more nitrogen and phosphorus, proportionally, than the *stalks* do. Again, in the case of forest trees, the *leaves* contain proportionally, more potassium than the *wood.* Now the fruit of a plant, and its leaves also, are relatively higher in the scale of being, are in a certain sense, more important members, than are the wood and the stalk. So then the fertilizing substances, already referred to, are of value, *first,* in promoting the general growth; and *second,* in contributing to the more important organs of the plant.

Developing the Efficiency of the Soil. Certain fertilizers *not containing potassium, phosphorus, or nitrogen,* may increase the fertility of a soil by making that soil more efficient. THESE FERTILIZERS MAY OVERCOME CERTAIN DEFECTIVE CONDITIONS OF THE SOIL. They may open it or lighten it. THEY MAY RENDER SOLUBLE CERTAIN VALUABLE MINERAL MATTERS which are in the soil, but are not very available because lumpy or insoluble. THEY MAY PROMOTE DECOMPOSITION OF ANIMAL OR VEGETABLE MATTERS existing in the soil, thus favoring their absorption by the plant.

Bacteria. Of late, scientific men have accepted the belief that the air, most liquids and the surfaces of most solids, contain large numbers of microscopic vegetables. Some of these minute vegetables have been named and classified. Without going into details, however, they have in general been called microbes or bacteria or bacilli. (A single one might be called a microbe, a bacterium, a bacillus.) The microbes may be killed by certain processes, such as highly heating, strongly cooling or freezing, and the application of certain chemical substances that poison them. (One of the best of these poisons is the substance called corrosive sublimate or mercuric chloride, $HgCl_2$). Some kinds of bacteria are wholesome and useful, while some are injurious. Some of the good ones aid in processes like animal digestion, ripening of cream and of cheese and certain fermentations. Others when introduced into the animal system, produce special diseases, like typhoid fever, consumption, cholera. Certain bacteria CONTRIBUTE MUCH TO THE DECAY OF ANIMAL MATTERS IN THE SOIL, whereby these matters become useful and appropriate foods for plants.

Certain Terms Explained.

Soluble.—Practically every substance known is soluble in some liquid or other, but when chemists use the words soluble and insoluble, they mean that a portion of a given solid dissolves completely, or else fails to dissolve *in a moderate amount of water*. Thus sugar and salt dissolve in a moderate amount of water; but glass, even when powdered, does not dissolve in a moderate amount of water. At ordinary temperatures a pound of sugar will dissolve completely in one-half pound of water, and a pound of common salt will dissolve in about three pounds of water; but a pound of powdered glass may require for its complete solution at least 100,000 pounds of water. So also ground bone, which consists largely of calcium phosphate (phosphate of lime) demands a very large amount of water for solution; but after bone has been changed into what is called acid calcium phosphate (acid phosphate of lime) it is very much more soluble in water than before.

Many substances that are practically insoluble in water are readily soluble in acids.

Chemical Names. In chemistry the same substance may have several different names. Thus a certain liquid used in chemistry is called both sulphuric acid and oil of vitriol. Another liquid is called both muriatic acid and hydrochloric acid. Moreover, both these substances have yet other names more rarely used.

Acid Anhydride. Most of the *non-metals* of the chemist may combine with oxygen in one or more proportions and thereby produce one or more acid anhydrides. Thus, sulphur is a non-metal. It combines with oxygen, forming a compound called sulphur trioxide (having the formula SO_3) also called sulphuric anhydride; and it is an acid anhydride.

Acid. Most acid anhydrides may combine directly with water. When they do so, they form new chemical compounds called acids. Thus, sulphuric anhydride, SO_3, may combine with water, H_2O, and thus form sulphuric acid, H_2SO_4.

Salt. Most acids may act directly on most of the metals of the chemist and

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thus produce chemical compounds called salts; but when such action takes place, the metal in question displaces or drives out the hydrogen of the acid. Thus sulphuric acid, H_2SO_4, may act on the metal potassium and from a salt, potassium sulphate, K_2SO_4.

Basic Anhydride. Most of the *metals* of the chemist may unite with oxygen, thus forming new chemical compounds called basic anhydride. Thus, the metal calcium may combine with oxygen to form the compound called calcium oxide CaO, which is a basic anhydride. This same substance is called quicklime. It is generally produced by a method different from that just described; that is, it is generally produced by burning limestone.

Base. Most basic anyhdrides may unite with water to form a new compound called a base. Thus, quicklime, calcium oxide, CaO, may unite with water and form a new compound, a base called slaked lime or calcium hydroxide, CaH_2O_2.

Price, Cost, Value. The *price* of an article is the amount of money or of any commodity demanded by the owner of the article before he will part with it to somebody else. Generally speaking, it is easy to learn the price of any article offered for sale.

The *cost* of an article, generally speaking, is expressible by the amount of some kind of money which has been in fact expended, or which might have been necessarily expended, in its production. While the owner of an article forms a general estimate of the cost of an article, it is often difficult even for him to know exactly what it cost. When, however, a person purchases a simple article by a single act, he may know the exact cost.

The word *value* is used in several senses. An article that costs a person a very small sum of money may be of great value to him in saving his life. The true value of an article, therefore, is based on its usefulness. In a great many cases, however, the word *value* is used as meaning about the same thing as the *price* set upon it by the seller, or the *cost* of it to the buyer.

As respects a fertilizer, the manufacturer may feel that its preparation, production, etc., has *cost* him a certain sum per ton. He may offer it in the market at a certain *price* per ton. If properly used by the farmer, it may represent a very large *value* to him, as increasing his crops.

A Few Chemical Elements and a Few Important Compounds.

Hydrogen. This substance is ordinarily a colorless gas, but by powerful pressure and very low temperature it may be changed to a liquid and perhaps, even frozen to a solid.

In a state of combination it exists in a great many substances.

Water, H_2O, is composed of hydrogen and oxygen.

Hydrogen also exists, in a state of combination, in a great many vegetable substances such as sugar, starch, woody fibre. Hydrogen is in nearly all animal substances, but most of these are of very complex composition.

Hydrogen is also a constituent of all acids; for example, it is in sulphuric acid, H_2SO_4; in phosphoric acid, H_3PO_4. Hydrogen also exists in ammonia gas, a compound of nitrogen and hydrogen, NH_3.

Carbon. Carbon is proportionally abundant in nature. It is the most important constituent of coal, of petroleum, and of many other combustible substances. It is also a constituent of most compounds found in animal and vegetable substances. When these substances are partly burned, they become charred; that is, the carbon shows as a black substance after some of the other substances have been driven off in gas or vapor. Carbon also exists as a part of the compound known as limestone. Limestone is calcium carbonate, $CaCO_3$.

In the atmospheric air, carbon is present in a state of combination as a gas called carbonic gas, also carbonic acid gas, also carbon dioxide, CO_2. This last formula shows that a very minute portion of the carbonic gas is composed of one atom of carbon united with two atoms of oxygen.

Nitrogen. Nitrogen is one of the most remarkable elements with which the chemist has to deal. It has been subjected to a vast amount of chemical study, not only with respect to its agricultural relations, but also because of its occurrence in many important vegetable, animal, and purely artificial substances.

When nitrogen exists uncombined, it is ordinarily a colorless gas; but it is very inactive chemically. Nitrogen gas not combined with anything else exists in the atmosphere.

In a state of combination, nitrogen is found in a great many substances.

Nitric acid, HNO_3, is a compound of hydrogen, nitrogen, and oxygen.

The substance known as Chili saltpetre, nitrate of soda, and sodium nitrate, $NaNO_3$, is a compound of sodium, nitrogen and oxygen.

The substance known as ordinary saltpetre, nitrate of potash, potassium nitrate KNO_3, is a compound of potassium, nitrogen, and oxygen.

The substance known as ammonia and ammonia gas, NH_3, is a compound of nitrogen and hydrogen.

Most animal matters contain nitrogen and they also contain hydrogen, as well as other substances; but when these animal matters undergo decay, either in the air or in the soil, they are apt to produce ammonia gas. This kind of change can be understood from the facts already stated; namely, that ammonia gas is composed of nitrogen and hydrogen and that both these elementary substances exist in animal matters.

When ammonia gas is brought in contract with sulphuric acid, a white solid called a salt and more especially designated as sulphate of ammonia or ammonium sulphate $(NH_4)_2\ SO_4$, is formed.

Often animal matters in the soil undergo a process of decay whereby they turn into nitrates. This process is called *nitrification.*

In case of *stable manure* the valuable nitrogenous constitutents are chiefly those of urine.

Tankage is a name applied to a dry shred-like material produced in slaughter houses. It is obtained by *drying* the inferior animal matters, such as entrails, incidental to the slaughtering business. It is rich in nitrogen.

Along the Atlantic coast there are several large establishments using steamers for catching *fish for fertilizing purposes.* The fish are first boiled in large tanks, Next the oil is skimmed off. Next the semi-liquid, semi-solid, mass is strained and the matter remaining on the strainer is dried. This material consists of the fleshy, muscular parts of the fish as well as the bones. When dried it makes a brittle material rich in phosphates and nitrogen.

Not withstanding the abundance of *nitrogen in the atmosphere*, its condition is such, and its properties are so peculiar, that it is of extremely small value as a fertilizer. Very few plants can absorb it from the atmosphere. Chemists do not know how to turn it into plant food artificially. The fertilizer manufacturers therefore must have recourse to *compounds* containing nitrogen, such as animal matters, nitrate of soda, etc.

From what has been said it is plain that ammonia salts, nitrates, animal matters, and indeed other substances containing nitrogen are good fertilizers.

Oxygen. Oxygen is ordinarily a colorless gas. It is the most abundant elementary substance existing on this planet, the earth, as far as chemists know. In the atmosphere it exists free and uncombined, and it is the sustainer of animal respiration; all animals breathe it; it is the sustainer of all ordinary combustions; in the burning of wood, coal, kerosene oil, illuminating gas, it is requisite to carry on that burning. In forms of chemical combination, it exists in a great many compound substances. Thus it is found in such substances as water, most vegetable substances, most animal substances, most of the earthy and rocky materials of the globe; indeed chemists think that about one half of the weight of our globe consists of oxygen in one form or another.

Sodium. Sodium is a metal. It is silvery in color, but it is softer than lead and melts easier than lead. When exposed to the air it easily takes fire. It can be gotten into the metallic form by chemists, though by a difficult process. It is a constituent of common salt, the chemical name of this substance being sodium chloride, Na Cl. (Note that the chemical symbol for sodium is Na.) In some cases, proper addition of sodium compounds to the soil is distinctly beneficial.

Magnesium. Magnesium is a silvery white metal found in trade in the form of ribbon and in the form of powder, (for flash lights). Small portions of it are easily set on fire, and they burn with a very brilliant white light by combining with the oxygen of the air. As the result of this combustion, a white ash is formed. This ash is called, by the chemists, magnesia or magnesium oxide, Mg O.

Aluminum. Aluminum is a metal now tolerably well known. A few years ago it was a scientific curiosity. It has a bluish white color. It is capable under certain circumstances, of combining with oxygen and forming a white powdery ash called by the chemists, alumina or aluminum oxide, $Al_2 O_3$.

Silicon. Silicon is an elementary substance of the class designated by chemists as non-metals. The substance as an element, uncombined with anything else, is difficult to produce, and it is rare; but silicon in various forms of *combinations* is one of the chief constituents of the earth. It is believed that one half of the entire weight of this terrestrial globe is oxygen and that one quarter

is silicon. Silicon exists in the state of combination in most mineral and earthy substances.

The chemical compound of silicon most worthy of mention at the outset, is that called silica or silicon oxide, SiO_2. The substance known as quartz and as "crystal" is practically pure silicon oxide. (Occasionally silicon oxide is called silicic acid. This is an inexact term.)

Silicon oxide, SiO_2, is an acid anhydride.

Silicic acid, H_2SiO_3, is an acid.

Sodium silicate, Na_2SiO_3, is a salt.

A very large proportion of the earthy material of our globe is made up of silicates. These silicates are very complex in their structure, so that they cannot be explained fully here; but we may mention that clay is a silicate, so is slate, shale, felspar, and other minerals.

Compounds of silicon must be classed as plant food. They are almost invariably taken up by growing plants and distributed more or less through the structure. Sometimes the silicates are very important as adding mechanical strength to stalks of plants. Bamboo is an example of a vegetable stalk, which has a glassy shell on its outside, containing a considerable quantity of silicon compounds. But silicon compounds are so abundant in the earth that the farmer never needs to buy them for application to the soil.

Phosphorus. Phosphorus is an elementary substance belonging to the class of non-metals. When pure it is a soft, translucent, waxy solid. If this solid be exposed to the air at ordinary temperatures, it is liable to take fire of itself, uniting with oxygen of the air. In the process of combustion heat and light are produced, and there is also formed a white powdery smoke which may settle on level surfaces as a snow-like deposit. The substance is called phosphoric oxide, phosphorus pentoxide, phosphoric anhydride, P_2O_5. (It is sometimes improperly called phosphoric acid.)

Almost all compounds of phosphorus are of service as fertilizers for plants; but since phosphorus compounds are not abundant in the earth and since growing plants exhaust the phosphates from the soil, it is desirable to furnish *artificially* some phosphorus compounds. To the farmer the question is largely one of price. Now the price of phosphorus compounds varies with their character. Generally speaking, the price is less in case of those compounds that are in large hard lumps and that are but slightly soluble in water. Evidently these are less valuable than those forms in which the substance is finely pulverized and is readily soluble in water.

The chief phosphates available for agricultural use are the following: *First*, the hard rocky deposits found in Canada called apatite. These are not easily absorbed by the plant unless they are very finely pulverized and have been rendered soluble by the action of acid. *Second*, the Florida phosphates and the South Carolina phosphates. The South Carolina phosphates are chiefly in the form of nodules; lumps of moderate size. The Florida phosphates are of two kinds, the rock deposits of the north and the pebble deposits of the south.

Thomas Slag. This is a mineral product produced artificially in certain iron furnaces. Before becoming available for the plant it needs to be pulverized or treated with acid.

Bone. Unground bone is of little value as a fertilizer, although it is rich in phosphate. Unground bone is so little affected by water that it may be called practically insoluble. Bone of this character, therefore, may remain on the soil a long time without nourishing the plant. If the bone is finely ground, it thereby becomes slightly more soluble in water. Ground bone is therefore a valuable fertilizer. Its effects though slow, are lasting. When ground bone is treated with sulphuric acid, the chemical composition changes and the phosphates, become soluble in water. Bone so treated is in common terms called superphosphate. Sometimes it is spoken of as *acid phosphate* or as *available phosphate*. It dissolves so readily in the water of the soil that the rootlets of the plant can absorb it readily. It therefore produces prompt and valuable effects.

Bone black, bone coal, bone char, are names applied to a form of bone used by sugar refiners. After its refining power is exhausted, it is sold to the fertilizer manufacturer. It is evidently a form of bone, only it contains carbon and certain other impurities not present in bone that has been thoroughly burned.

Unburnt Bone. Unburnt bone contains gelatinous matters distributed through it. These are of some value on account of the nitrogen contained in them.

Guano. Guano, which is the dried excrement of birds, is easily pulverized and contains phosphates in a useful form, but its value depends largely on the nitrogen compounds contained in it.

Fish Scrap contains a large amount of bone, and nitrogenous matter in addition.

Phosphates are so valuable for agricultural purposes that the world has been ransacked for the purpose of securing them.

Phosphorus forms a great variety of chemical compounds. Like other non-metals, it forms a certain series of compounds. The following may be mentioned:

An acid anhydride, phosphoric anhydride, $P_2 O_5$.

An acid, phosphoric acid, $H_3 P O_4$.

A series of salts, like sodium phosphate, $Na_3 P O_4$.

The salts of phosphoric acid are too varied and complex to be discussed at length here.

Soluble phosphate is practically any phosphate that is easily soluble in water. Insoluble phosphate is practically any phosphate that is not easily soluble in water. (So-called insoluble phosphate is not absolutely incapable of being dissolved. Very small quantities will dissolve in water, but this is accomplished so slowly and to such small degree, as to be of little consequence to the farmer.) Reverted phosphate is that which has once been soluble, but by reason of certain chemical influences, has been changed to an insoluble form. While it is not easily soluble in water, it dissolves to some extent. In the acid liquids of the soil it often dissolves with tolerable freedom, so that for agricultural purposes, a reverted phosphate is practically as valuable as a soluble phosphate. Reverted, means *turned back or gone back*. It is assumed that all reverted phosphate was previously soluble phosphate.

The term, available phosphate, is one used in agriculture, to include at the same time, the soluble and the reverted.

Sulphur. Sulphur is an elementary substance. It is a non-metal. It is familiarly known as a brittle, yellow solid. By moderate addition of heat it may be easily melted to a liquid. By addition of more heat it easily changes to a vapor. It easily takes fire when heated, by this process of combustion forming a gas having a choking odor, the same as that produced when a sulphur match begins to burn. The gas referred to is a compound of sulphur and oxygen. It is called sulphurous acid, sulphurous anhydride, sulphur dioxide, SO_2.

By special chemical processes, sulphur forms with oxygen, another compound, called sulphuric anhydride, sulphur trioxide, SO_3.

A few of the chemical compounds of sulphur with oxygen may be stated in the following tables:

First Series.

An acid anhydride, sulphurous anhydride, SO_2.
An acid, sulphurous acid, H_2SO_3
Salts, like sodium sulphite, Na_2SO_3.

Second Series.

An acid anhydride, sulphuric anhydride, SO_3.
An acid, sulphuric acid, H_2SO_4.
Salts, like sodium sulphate, Na_2SO_4

Sulphur forms many other compounds, but they need not be mentioned here.

Sulphuric acid is a very powerful acid and is very largely used in chemical manufactures. Great quantities of it are used in the manufacture of fertilizers, for the purpose of decomposing insoluble phosphates and turning them into soluble phosphates.

Sulphur is to a moderate extent a plant food, but the demands of plants for it are generally easily supplied without the necessity of the farmer's supplying it to the soil.

Chlorine. Chlorine is an element. It is a non-metal. When specially prepared by the chemist, it is ordinarily a greenish gas. It has a very choking odor. It has strong bleaching powers. It is an important constituent of the substance called bleaching powder or chloride of lime. The chlorine in the bleaching powder is the efficient bleaching agent. Chlorine exists in the earth in a state of combination in rock salt. Pure common salt is a compound of sodium and chlorine, called sodium chlorine, NaCl.

"Tobacco 2,000 lbs. Per Acre."

GEORGE N. THOMPSON, Suffield, Conn., writes:

With your Chemical Tobacco Fertilizer I have raised nine acres of as large a crop of tobacco as was ever raised along this road. My tobacco will weigh, after being cured and stripped, about 2,000 pounds to the acre. This is several hundred pounds larger than last year. I always used cotton seed with cotton hull ashes, costing about $42. per acre, against yours of only $25. I claim you have the best fertilizer for tobacco on the market. I shall use it again; and you can use my name indorsing it. (Tobacco leaf, thirty-eight inches.)

Potassium. Potassium is an elementary substance. It is a metal. It is light in weight, lighter than water even. If exposed to the air it very easily combines with oxygen from the atmosphere. Potassium compounds exist in the earth very widely distributed, almost everywhere in fact; *but the amounts in any one place, with one exception, are very small.* The exception referred to is the region about Stassfurt in Germany. At Stassfurt are mines yielding large quantities of potassium compounds, mixed or combined with other substances. It is from these mines that the so-called German potash salts are derived. The material taken out of the earth is brought to the surface and subjected to chemical processes which accomplish a purification of it. Then these potash salts in various forms are sent into commerce for use in agriculture.

The principal commercial forms of German potash salts are the following:

	PER CENT. OF POTASH.
Kainite,	13.54
Muriate of potash,	51.48
Sulphate of potash (high grade),	33.40
Sulphate of potash and magnesia,	25.50
Sylvinite,	16.65
Carnallite,	13.68

Since, as has been said before, potassium compounds exist in the soil in very small quantities, and moreover since they are essential to plant growth, it is highly desirable that they should be supplied to the soil in the form of artificial fertilizers. The agricultural chemist has ransacked the world for cheap supplies of potassium compounds for these purposes. Practically the only original sources are the German potash salts and the various kinds of wood ashes. In commercial fertilizers, potassium salts are introduced by the manufacturer, his source of supply generally being German potash salts.

Potassium forms a great many compounds. Only a few can be mentioned here:

A basic anhydride, potassium oxide, K_2O.

A base, potassium hydroxide, KOH.

Salts like potassium sulphate, K_2SO_4.

Potassium carbonate, K_2CO_3.

(Observe that the chemical symbol for the metal potassium is K.)

Most land plants, when burned, contain a moderate amount of potassium compounds in the ashes. These compounds have been withdrawn from the soil

by the growth of the plant. The soil has thereby been impoverished. If the ashes are returned to the soil, the potassium compounds are also returned to serve for new crop.

The seed of the cotton plant, which was formerly thrown away, is now fully utilized. The first process is removing the hulls. The second process is pressing the kernel, so as to extract the oil and to leave the "pomace" or "cake." The hulls are burned and *they leave an ash, rich in potassium compounds*, and useful as a fertilizer.

The oil is clarified and bleached, and is largely used in cooking as a substitute for lard. It is also used as a salad oil.

The cake or pomace is used as a food for cattle.

The various portions of a tree or other plant contain varying amounts of potassium compounds. The *more highly organized parts*, such as the seeds, fruits and leaves, contain relatively more than the lower organized parts such as the wood. The percentage is usually expressed in terms of potash, an old-fashioned word, but still largely used. The exact chemical substance meant by this term potash, is named by the chemist, potassium oxide, K_2O.

	PER CENT. OF POTASH.
Ashes, wood, leached,	1.27
Ashes, wood, unleached,	5.25
Cotton hull ashes,	22.75
Seaweed ashes,	1.50
Spent tan bark,	2.04
Tobacco stalks,	5.02
Tobacco stems,	8.20

Calcium. Calcium is a metal. It is difficult of manufacture and has in the metal form few if any commercial uses. It is the metallic basis of limestone, and limestones are very abundant in the earth. Limestone is called carbonate of lime or calcium carbonate, $CaCO_3$. While it contains calcium, that metal is held in

such a form of chemical combination that its metallic qualities are for the time being lost.

Limestones, and other lime materials containing calcium, are plant foods, but they are so abundant that they rarely have to be added to the soil by the farmer. There are two forms of calcium compounds that are considerably used, and to great advantage. The first is burnt lime, called quicklime, also calcic oxide, CaO. The second is gypsum, called land plaster, and calcium sulphate, $CaSO_4$.

Calcium forms a great many compounds known to chemists but only a few need mention here:

A basic anhydride, calcium oxide, lime, CaO.

A base, calcium hydroxide, slacked lime, $CaO_2 H_2$.

Salts, like calcium sulphate (gypsum) $CaSO_4$.

Calcium carbonate (limestone), $CaCO_3$.

Iron. Iron is a metal which is well known in the arts in several forms such as wrought iron, cast iron, steel. All these differ in slight but important chemical features from the purest metallic iron of the chemist. Iron compounds exist widely diffused through the soil. Indeed they are the common coloring matters of almost all rocks and soils. That iron compounds are plentiful, is proved by the fact that the ashes of almost all plants contain iron compounds; but it is practically never necessary for the farmers to supply such compounds to the soil.

Clean, White, Powdered, Odorless.

FERTILIZERS

MANUFACTURED BY

The Chemical Compound Fertilizer Co.,

Of New York, Boston, Providence, R. I.,
Dighton, Mass., Coventry, R. I.

Chemical Compound Tobacco Fertilizer.

Chemical Compound Corn Fertilizer.

Chemical Compound Vegetable Fertilizer.

Chemical Compound Lawn Fertilizer.

Not for use in hill and drill;
To be spread broadcast and harrowed in.

We also furnish other Agricultural Materials, such as:

MURIATE OF POTASH, *KAINIT,*
SULPHATE OF POTASH, *SYLVINIT,*
DOUBLE MANURE SALT, *KIESERIT,*
AND OTHER POTASH MANURE SALTS;
GROUND BONE; NITRATE SODA;
SULPHATE AMMONIA, ETC.

Calendar for 1896.

1896.	Sunday	Monday	Tuesday	Wednes.	Thursday	Friday	Saturday
Jan.	..	..	..	1	2	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
	26	27	28	29	30	31	..
Feb.	..	..	..	..	..	..	1
	2	3	4	5	6	7	8
	9	10	11	12	13	14	15
	16	17	18	19	20	21	22
	23	24	25	26	27	28	29
	..	..	..	..	..	..	..
Mar.	1	2	3	4	5	6	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30	31	..	..	..	..
Apr.	..	..	..	1	2	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
	26	27	28	29	30	..	..
May	..	..	..	..	..	1	2
	3	4	5	6	7	8	9
	10	11	12	13	14	15	16
	17	18	19	20	21	22	23
	24	25	26	27	28	29	30
	31	..	..	..	..	..	..
June	..	1	2	3	4	5	6
	7	8	9	10	11	12	13
	14	15	16	17	18	19	20
	21	22	23	24	25	26	27
	28	29	30	..	..	..	..

1896.	Sunday	Monday	Tuesday	Wednes.	Thursday	Friday	Saturday
July	..	..	..	1	2	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
	26	27	28	29	30	31	..
Aug	..	..	..	..	..	..	1
	2	3	4	5	6	7	8
	9	10	11	12	13	14	15
	16	17	18	19	20	21	22
	23	24	25	26	27	28	29
	30	31	..	..	..	..	..
Sep.	..	..	1	2	3	4	5
	6	7	8	9	10	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
	27	28	29	30	..	..	..
Oct.	..	..	..	..	1	2	3
	4	5	6	7	8	9	10
	11	12	13	14	15	16	17
	18	19	20	21	22	23	24
	25	26	27	28	29	30	31
	..	..	..	..	..	..	..
Nov.	1	2	3	4	5	6	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30	..	..	..	..	..
Dec.	..	..	1	2	3	4	5
	6	7	8	9	10	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
	27	28	29	30	31	..	..

Chemical Compound Fertilizers.

"$20. Per Acre Cheaper Than any Other."

L. J. DENISON, Ware House Point, writes:

Your Tobacco Fertilizer gave me as good a crop as any fertilizer I ever used, and $20. per acre cheaper than any other tobacco fertilizer used this year. My tobacco has a good color, large leaves. I shall use it again next year in preference to all others.

"Corn Fertilizer is a Rusher." "Finest Crop of Tobacco in the County."

B. W. LORD, Ware House Point, writes:

I am glad you called to see my crop before I cut it down. I think it is the finest crop of tobacco in this county. I have given the fertilizer a fair test. It will raise tobacco cheaper than with cotton seed and hull ashes, and save me $21. per acre. Your corn fertilizer is a rusher. I shall use more of your fertilizers next year.

"Is going to be the favorite Fertilizer in this County."

From JAMES H. GLENN, Caribou, Me., Dealer in Hardware, Iron, etc.

Some of the best farmers in this town gave it a fair trial in connection with the other Commercial Fertilizers, and thus far reports received convinces me it is going to be the favorite Fertilizer in this County, as it produces the quantity and quality.

will more than double my order next year, and will handle no other but the Chemical.

"I shall hereafter use no other."

From C. B. WEAVER, Ashland, Me.

I have used your Potato Fertilizer on my beans, and am pleased to say it showed good results. I am satisfied it has increased my crop, and shall hereafter use no other.

General Agents: MASON, CHAPIN & CO.,

PROVIDENCE, R. I.

It beats all!

One Beet Weighed 25 1-2 lbs., from soil,
—Length over all, 4 ft. 11 inches,
—Length of beet, 36 inches.

MANGLES

raised with

Chemical Compound Fertilizer.