The Ensilage of Maize.

M. AUGUSTE GOFFART.

THE NEW SILOS AT BURTIN.

THE

ENSILAGE OF MAIZE,

AND OTHER

GREEN FODDER CROPS,

BY

M. AUGUSTE GOFFART,

Chevalier de la Legion d'Honneur, Member of the Central Agricultural Society of France, &c.

PARIS, 1877.

TRANSLATED BY

J. B. BROWN.

Together with a History of the Introduction and the Present Condition of the Art in the United States.

NEW YORK:
1879.

Entered e year 1879,

Published by

J. B. BROWN,

In the O 55 Beekman Street, New York Washington.

STEREOTYPED AND PRINTED BY
THE NATIONAL PRINTING COMPANY,
16, 18, 20 AND 22 CHAMBERS STREET,
NEW YORK.

TO THE

MEMBERS

OF THE

Société Centrale d'Agriculture

DE FRANCE.

It is to you that I dedicate this little book; to you who have received so favorably my early efforts in this matter.

You will see that the author has not slept upon his first success, and that during the past two years he has made much progress.

It is for you to judge if the end is entirely attained, as he believes it to be, or if he should continue to seek further improvement in this art which he considers now perfectly acquired in agricultural practice.

At any rate, he now submits his work to your impartial judgment.

AUGUSTE GOFFART.

CONTENTS.

APPENDIX.

VOCABULARY OF FRENCH WORDS,

PRESERVED IN TRANSLATION, SOME OF WHICH SHOULD BE ADOPTED INTO OUR OWN LANGUAGE.

Centimetre.—$\frac{3379}{10000}$ inch; about $\frac{4}{10}$ inch.

Centime.—$\frac{1}{10}$ of English penny, or $\frac{1}{5}$ American cent.

Ensilage.—The act of compressing into pits, trenches, or compartments called silos; also the green crops so preserved.

Franc.—$18\frac{6}{10}$ cents.

Hectare.—$2\frac{471}{1000}$ acre, or 100 French ares.

Hectolitre.—22 gallons; $2\frac{3}{4}$ bushels.

Kilogramme.—$2\frac{2055}{10000}$ lb. advoirdupois; about 2 lb. $3\frac{1}{4}$ oz.

Litre.—$1\frac{76}{100}$ pint; 61 cubic inches.

Maize.—The corn-plant.

Metre.—3.2808992 ft.; about 3ft. $3\frac{1}{3}$ inches.

Silo.—Excavation, pit, or trench, hollowed in the ground (Littré), or any compartment used for storing green fodder in an air-tight manner.

PREFACE.

In beginning, four years ago, my publications on the subject of ensilage, I did not deceive myself, nor hide from the world that my success was far from being complete, and that my task was not on the eve of being accomplished. Since that time I have worked incessantly to perfect my early methods. I have rectified, one by one, my erroneous ideas as to the modifications that the fodder undergoes in the silo, and in consequence I have made various changes in my early processes. Since my first writings I have been compelled to renounce certain views which I believed to be indisputable. It is important to be able to confess to ourselves when we are mistaken, and, above all, to confess to others, without self-love, and with no other desire but for the truth. Thanks to this freedom from the prejudice of preconceived opinion, I have corrected my early erroneous views, and I can to-day recommend to my agricultural brothers a complete system of ensilage, applicable to all green crops without distinction, and can guarantee to them an entire success if they will follow to the letter all my directions. For many years I have been interested in agricultural as well as industrial and commercial affairs. At the age of 24 years I built, in Belgium, the high furnaces of Monceaux, one of the most important estab-

lishments in the country, and for forty years I have been one of the directors. In 1846 I acquired the domain of Burtin in Sologne, which contained about 1,200 hectares. Since that time my life has been divided between agricultural and industrial pursuits. It was at Burtin, in 1852, that I commenced to study practically the important problem of the preservation of fodder.

The great passion of my whole life has been work. It will only be extinguished with my life. To that passion I owe the honor of having attached my name to an agricultural system of which the importance will be each day better appreciated, and will increase without ceasing.

Culture and Ensilage of Maize,

and other green fodder.

CHAPTER I.

ADVANTAGES TO BE DERIVED FROM THE PRESERVATION OF GREEN FODDER BY ENSILAGE, OVER THE METHOD OF PRESERVATION BY DRYING.

If there is one fact recognized by all agriculturists, it is that a certain quantity of grass, which, consumed in a green state represents an ascertained nutritive value, loses a considerable portion of that value in passing into the state of hay intended for the winter sustenance of animals.

The cow, which gives us in summer, while feeding on green grass, such excellent milk, and butter of such agreeable color and flavor, furnishes us in winter, when she eats the same grass converted into hay, an inferior quality of milk, and pale, insipid butter. What modifications has this grass undergone in changing to hay? These modifications are numerous. It is sufficient to cross a meadow at the time when the new-mown grass is undergoing desiccation in order to recognize that it is losing an enormous quantity of its substance that exhales in the air in agreeable odors, but which, if they remained in the plant, would serve as a condiment, facilitating digestion and assimilation.

All stock-raisers, those of Sologne especially, know how rapidly our young cattle increase in weight in summer on green pasture, which, converted into hay and devoted to their

nourishment in winter, scarcely keeps them in *statu quo;* hay given judiciously does not always prevent them from becoming lean.

Therefore the sole fact of desiccation accomplished by fine weather, in the best conditions, causes the loss of a considerable part of essential substance. This loss, added to the physical modifications which render mastication and digestion of the hay more difficult than of the grass, and consequently assimilation less complete, merits the most serious attention on the part of those who are interested in agricultural affairs.

The losses which I have mentioned are far from being all that result from our method of transforming grass into hay.

Rains, ofttimes prolonged, coming upon the harvest, the absence of sufficient heat in autumn, are powerful causes of deterioration of hay.

What agriculturist has not seen a hundred times his hay, injured by rain, deprived of its richest and most assimilative elements? The rain prolonged, the hay is invaded by a species of nauseous rot, which disgusts cattle and causes formidable maladies when hunger forces them to eat it. If these things occur to the common fodder crops—clover, lucern, sainfoin, etc.—what would happen to the fodder crops of high growth and great yield, such as maize and sorgho? Never in our temperate climate could we obtain for these a sufficient desiccation by the sun.

These are the grave inconveniences which from time immemorial have induced agriculturists to seek some new method of preservation for their fodder. It is nearly a century since the German, Klapmayer, called the attention of the agricultural world to his system of conversion of grass into hay, and which still bears his name—"Brown hay, Klapmayer method." This method, which made a great noise at the time of its appearance, has had its seasons of popularity. It has been successively taken up, abandoned, again taken up; but it has in fact never been firmly implanted into agricultural

practice. For my part, at the commencement of my agricultural career, more than thirty years ago, I pursued some experiments perseveringly through two campaigns, in which I followed faithfully the directions of Klapmayer. How many times have I arisen in the middle of the night, with one of my workmen, in order to satisfy myself, thermometer in hand, that my grass, gathered in cocks larger or smaller, did not exceed the degree of heat prescribed as the extreme limit to insure excellent preservation. I never succeeded, and I doubt if any other persons have been any more fortunate.

A few years later I gave my attention to the culture of maize, and I began to seek for it a system of preservation by ensilage. I have therein entirely succeeded, but only after thousands of experiments, which have continued not less than a quarter of a century. It is that all agriculturists may profit by the experience acquired, often at my cost, upon this important subject, that I have written this Manual.

II.

VARIETIES OF MAIZE.

In order to have early fresh maize to give to cattle in summer, I sow in May a half hectare of forty-day maize. This is a variety of early maize, but of moderate yield. Its precocity is its principal and nearly its only merit. For my ensilages I only cultivate the large foreign maize, which I will describe.

The maize of Nicaragua holds, evidently, the first place; its great height, the great number of large leaves, which cover it from root to top; the product in weight, superior to all, constitutes an incontestable superiority. Next comes the maize of

Algeria, recently imported into our African colony under the name of Caragua, and cultivated by M. de Bonand, the skillful agriculturist who presides over the Society of Agriculture of Algiers. This maize is excellent in every respect; the sprouting sure, the product considerable. It is to be desired that Algeria should prepare to send it to us in large quantities. I have sown no other kind the past year.

TRANSLATOR'S NOTE.—M. Goffart devotes several chapters to the consideration of the subject of procuring seed from Central America, which is rendered difficult by the flies that infest tropical grain. It would seem that in order to have large corn-stalks in France it is necessary to use imported seed. As the United States produces some very tall corn-stalks, I have written him to know why the inventive ability of the farmers of the United States has not been set at work to produce a seed corn that would yield large and tall stalks in France.

The author speaks of a Hungarian maize which exceeds three metres in height and twenty centimetres (or eight inches) in circumference. He also mentions Dent de cheval (horse-tooth) as being sold at a moderate price. This is doubtless our Dent corn (the word dent originally meaning a tooth). He seems to give preference to the seed raised in Algeria, of American origin, and called Caragua.

III. AND IV.

LANDS SUITABLE TO THE PRODUCTION OF MAIZE.

I DO not pretend that all soil is adapted to a profitable culture of maize. There are certain indispensable conditions of the physical, hygrometric and chemical state of the soil, the absence of which will render impossible the profitable culture of this fodder crop; but in most instances it will answer to increase, for the first two crops, the manuring and dressing, in order to obtain a large production, which will give a sort of impetus to the new culture, and will be the point of departure of a most happy transformation. As in a machine, however well constructed, it is necessary to overcome at first the force of inertia.

At Burtin my soil possesses some qualities very favorable for this culture, but for four years my processes left much to be desired, and within two years I have made more progress than I had obtained during twenty years preceding. The large quantity of maize that the increase of this culture and my perfected processes have placed every year at my disposal has permitted me to double the number of my stock; then each animal which formerly produced 13,000 kilogrammes of dung has produced, since it has been better nourished, nearly 20,000 kilogrammes. Therefore, if my maize requires abundant manuring it causes a production of manure more than sufficient. In fact, a hectare of maize, properly treated and successfully preserved, yields a product of more that 50,000 kilogrammes of manure, and absorbs hardly one-third of this quantity. It is necessary to add that each week I spread upon my dung-heaps 100 kilogrammes of phosphate. This practice gives excellent results, above all in Sologne, where our soil, naturally very poor in phosphoric acid, requires that we should furnish it in every possible form. Some foreboding people predicted four years ago that I would lose all my stock if I continued to feed them exclusively on maize throughout the year. I have continued to do so, and all my animals enjoy excellent health, without even a shadow of a malady. One of the most valuable properties of maize is the power of self succession almost indefinite. Some of my finest maize occupies a field which, during the past eighteen years, has borne fourteen harvests of that plant without giving any signs of weariness; on the contrary, the later yield is better than the former. All the requirement is to give to the land suitable manuring, restoring each year the equivalent of that which is taken off. Potash is the predominating component of maize. Animals consuming it assimilate very little potash, and the dung-heap restores to the soil nearly all of it that has been removed in the crop. Another plant, much cultivated in Sologne, the hemp, possesses also the property of eternalizing

itself upon the same field. Each farm has its hemp field, which, for centuries, occupies the same ground.

The soil which is best adapted to the culture of maize is of medium consistency, rather light than heavy, moist without being wet, rich in alluvial matter, and therefore of a dark color. It is remarkable that our poor Sologne possesses an abundance of this kind of land, as if Heaven had wished to give it some sort of compensation for all its other inferiorities. Heavy soil is equally well adapted to produce very fine maize, but requires more labor; for it is necessary to bring it to a state of fine pulverization, at the risk of the seed not sprouting, which is always difficult in compact earth. In general terms, maize will succeed wherever beets do well, with the same conditions as to manuring and top-dressing. But maize cannot, of course, have the pretension to compete with advantage against such a rival; above all, in the rich countries where for so long a time it has been cultivated as a plant that is both valuable in commerce (sugar) and for fodder. In those parts maize can only make for itself a modest place, as a means of varying a little the food of our animals.

But in those countries, such as the South of France and Algeria, where the excessive heat causes the beet to fail, there maize will render immense service. Preserved by ensilage, it will assure at all times to the cattle sufficient food, instead of those alternations of abundance and scarcity which often have such sorrowful results.

V. AND VI.

METHODS OF CULTURE.

FORMERLY I planted my maize in ridges, which has been the sole method practiced for a long time in the fields of our Sologne. The ridge in shallow soil but little dug up is an excellent method for protecting the fall seeding against the wet, so destructive in winter. But as a spring crop it is necessary to give up the ridges entirely, and to replace them by beds more or less extensive. These, by yielding less evaporation, provide better than the ridge against the dryness of summer. Another motive, more serious, pleads also in favor of beds. When well compressed by a heavy roller, they protect the seed, more effectually than the ridge, against one of the most to be dreaded plagues of this culture. At the moment when the little shoot makes its appearance out of the earth, the birds come in crowds, in order to pull up and eat the grain which adheres to and comes out of the soil with it, especially when the soil is light, as it commonly is in Sologne. I have lost several times a third, and sometimes a half, of my maize, devoured thus at the birth, by crows, pies, and pigeons, which swarm in our fields. A good rolling of my beds with a heavy stone roller is an effective preservative against the danger which I have mentioned. When the earth has been well packed down by the roller, the bird that pulls up the shoot of maize finds that it breaks off near the ground without being followed by the grain, which is all that has any value to him. Deceived in his hope, the bird gives up very quickly an ungrateful labor which refuses him the reward upon which he had reckoned. Besides this, the roller is an instrument of security for our light soil. It strengthens the hold of the plant upon the soil, and it has saved, twenty times, my crops that were in danger by being laid bare.

The use of the seeding machine is the surest and least

costly method. It economizes the seed, which often costs so dear, and it gives regular and equal lines, which render the after cultivation very easy. For want of a machine, I have obtained very good results in distributing the seed by hand, by women, who follow the laborer and only put the seed in every second furrow. I obtained thus wider rows, but regularly spaced and easily cultivated.

NOTE.—The translator supposes that the gang-plow is used in this case. The French plow of this kind excelled even our American plows at the Paris Exposition, and is to be introduced into this country. The remainder of this chapter is devoted to comparison between drilled and broadcast sowing, which is omitted as valueless to the American farmer. The mechanical genius of the United States and Canada, fostered by the Patent Office and rewarded by the immense demand for its results, has settled this question to the great relief of the arms and backs of the laborers.

VII.

YIELD OF MAIZE.

THANKS to the care that I have specified, I obtain from my maize an enormous yield. In the past five years the minimum has been 75,000 kilogrammes per hectare, and the maximum 415,000. The average yield has been 90,000 kilogrammes per hectare.

NOTE.—About 40 tons to the acre.

VIII.

FOOD VALUE OF MAIZE.

IT is only by experience that we can solve the question of the alimentary value of maize. I can assert, however, that at my home at Burtin, in the way in which I prepare it, maize with one-tenth of its weight of oat straw maintains my

animals in perfect condition. It would be, I confess, going too far to say that maize alone has the faculty of making very fat animals for fairs, or for high quality butcher stalls. Cows which are not being milked quickly take a condition entirely satisfactory to our country butchers, who are, as a class, less exacting than those of the city. But for perfect fattening it is necessary to add other aliments to the regular ration, such as beet-pulp. I have tried the experiment of fattening five animals with my preserved maize, and an addition in the commencement of four kilogrammes per day of oilcake. They became fat with surprising rapidity. At this time seventy-three horned animals live only upon maize and straw on my farms at Burtin and Gouillon, and my stables are always open to visiting farmers. Maize poorly preserved is a poor nutriment for animals, and may even become a poison for them. We should not lose sight of the fact that in the condition of the preserved fodder there are an infinite number of degrees to which the nutritive value corresponds; the method of cutting, the chemical modifications to which it is subjected, cause it to vary from single to double the nutritive power.

Says one person to me, "I can use but one-half maize in my rations; otherwise my beasts would perish." Another says, "One-third is the maximum quantity that my beasts can stand in their rations." Another pretends that a quarter is hardly endurable. Gentlemen, only make good ensilages, and all will change with you, as it did with me. The ensilages of my first attempts were no better than yours. Little by little I have made them better, and therefore better supported my animals—that is the whole question. My much regretted relative, Louis Pilat, who held for many years the first rank in the art of fattening sheep, when pressed by me to divulge his secret, replied, "My secret: I have none; it is only a question of fare. Induce the animals to eat abundantly by a large choice, variety, and good preparation of food; that is all there is to it."

Now is maize by itself a rich food? Evidently not. Without the analyses more or less exact that have been published, one fact proves its lack of richness in nutritive principles, and that is the large quantity that animals eat in order to keep them in good condition. This fact I have recognized and published twenty times. No one would pretend that a kilogramme of maize could be made to take the place of a kilogramme of lucern, clover, or French grass (sainfoin); but by supplying in quantity what it lacks in richness, we can maintain our animals by maize as well as by the richest grasses. The question is to compare the selling value, or rather the price that returns from the two kinds of fodder, and to ascertain if twice the quantity, or even thrice, does not cost less than the products that it replaces. To me, the affirmative is not in doubt. The question is simpler when we apply it to countries, too numerous indeed, which, like Sologne, produce good crops of maize, but are rebellious to the culture of rich fodder, lucern, sainfoin, etc. In such places the cultivator has no choice; he has only to avail himself of the benefits of maize, and he is spared all embarrassment. One important point that a long practice has put for me beyond doubt is that the same green maize placed nourishes better, the weight being equal, when it is cut short than when it is fed whole, and that its nutritive power increases when it has been softened by lying several weeks in a silo, then undergoing a light commencement of alcoholic fermentation a few hours before being fed out. I estimate that with young animals acclimated, the increase of weight at eighty centimes per kilogramme (7 cents per lb.) will pay upon an average about 20 francs per thousand kilogrammes of preserved maize (about $3.50 per ton). I consider this price as so nearly regular that I adopt it as a point of departure when I wish to reckon up my farming operations.

Fattening by means of preserved maize, with an addition of cake of arachide *(earth-nuts)* has given me excellent results. I have fattened this winter eight animals from my stables

which I wished to part with on account of old age, sterility, deformity, under size, or mischievous disposition. Their value on foot before fattening was 55 centimes per kilogramme. They sold for 70 centimes per kilogramme; there was an increase of weight of 447 kilogrammes, and in value 845 francs 25 centimes. These animals consumed during their fattening, averaging 58 days, 2935 kilogrammes of oilcake, costing 10 centimes per kilogramme, or a total of 293 francs 50 centimes. The maize therefore paid me about 45 francs per 1,000 kilogrammes, which is indeed a high price, better than one could obtain either by milk, the increase of young animals, or other products of the stables. Preserved maize has also the merit of exciting to its highest point the appetite for oilcake, which is at first repugnant, especially at the commencement, if it is fed alone, without being mixed with maize, which has so much attraction for them. A third experience, viz., the nutritive value of maize in view of the raising of sucking calves, resulted in paying me 40 francs per 1,000 kilogrammes of maize.

Numerous experiments will be necessary in order to settle these questions. I have wished simply to indicate them and to put them in some sort of order before recommencing them. The advantages that I have enumerated are not the only ones that belong to this culture. These plants have large and numerous leaves which exercise a happy influence upon the health of the country where they are cultivated.

They absorb miasms which arise from the earth at the critical moment in certain countries where the crops of grain and fodder have just been removed. The maize in full vegetation at that moment replaces, as an absorbent, the other vegetation. Planted in gardens near habitations they play at first a hygienic role; then gathered and dried, if need be near the hearth, and the stalks cut in pieces of eight to ten centimetres long, placed in a close vessel filled with warm water, they quickly produce an agreeable drink much appreciated by workingmen.

IX.

THE PRICKLY COMFREY OF THE CAUCASUS.

Mr. Christi has sent me from London this winter three hundred stalks of this plant, in which the agricultural world begins to take an interest. They were planted in April, in a field prepared to receive the maize, upon large ridges, spaced one metre; the distance between each plant was also a metre upon the ridge. Thus each plant occupies one square metre, and the hectare would contain ten thousand.

The soil is excellent. It is situated in my valley, and is surrounded by ditches in which I can keep water at the height which I judge necessary in order to insure suitable moisture. I have already (August, 1877) cut this forage twice, and probably shall cut it twice more before the end of the season. The yield increases at each cutting, owing to the development of the plants. Without being able to give yet the precise figures, I believe that the total yield will be in weight very little less than that of maize. My plants will not attain their fullest development till next year, when the yield will exceed all the other forage crops which are cut successively. My animals eat it without avidity, but without repugnance. I will mix it with my maize at the time of ensilage, and I hope to obtain some good results. The comfrey seems to exceed the maize in nitrogenous substance, and the maize will aid the comfrey by its great richness in certain very useful principles which are much desired by animals. Maize contains only on an average 1.20 to 1.25 per cent. of nitrogenous matter, while recent analyses attribute to the comfrey 2.70 per cent.—that is, more than double. These two plants, instead of concurring, complete each other, to the great advantage of agriculture.

The comfrey, by its manner of growth and of successive

cropping, which commences with the spring and only finishes with the autumn, seems to me especially called for in aid of small farming. This will accommodate itself better than large farming to the frequent attentions that the comfrey requires, and of the time relatively considerable that this crop demands from day to day.

X.

PROCESSES BY WHICH I HAVE SUCCEEDED IN ASSURING THE PRESERVATION OF GREEN MAIZE FOR AN INDEFINITE TIME.

The end to be attained is to prevent all kinds of fermentation before and after ensilage; for the way to avoid bad fermentation is to not permit any. It is by not having discovered sooner this fundamental principle that so many seekers like myself have lost so many years in barren experiences. We wished to preserve maize by fermentation; that is to say, we turned our backs on the solution of the problem. Fermentation preserves nothing. On the contrary, it is always a preliminary step towards a decomposition more or less putrid, towards a real destruction. I have had this experience a thousand times: when my maize had contracted in my imperfect silos alcoholic fermentation, I hastened to have it eaten up as soon as possible rather than to see it pass to acetic fermentation, and soon after to lactic or putrid fermentation. These experiences, so often repeated and always fruitless, had finally discouraged me. For a long time I had resigned myself to only require from my silos a temporary preservation of a few weeks at the most; that is to say, the time that lapsed between the ensilage and the appearance of putrid fermentation. I had, however, from that time, at my disposal all the elements

of a complete success. In 1853 I had established at Burtin a complete factory for preserving—a powerful feed-cutter from England, which has admirably performed for me, for more than twenty years; a hydraulic power, eight-horse, to work the feed-cutter; then at two steps from the feed-cutter, four silos, hollowed in the ground, plastered with Portland cement, and perfectly water-tight. I cut at that time my maize in pieces of three to four centimetres long; I mixed a certain proportion of short straw (always too much), and I filled successively my silos by pressing down the layers of the mixture by one, and sometimes several persons treading upon it. After this pressing down with great pains, I placed on the top a layer of short straw about ten centimetres long, and above all a layer of loam, beaten with care, in order to prevent all contact between the ensilaged maize and the air outside. During the following days I stopped up the fissures which appeared on the surface. When I proceeded, several weeks later, to open the silo, I found invariably a vacuum of several centimetres between the maize and the superincumbent clay. Notwithstanding the force of the compression that was produced during the ensilage, the maize had undergone another settling, and its upper part presented an alteration which would communicate rapidly to the lower layers. In order to avoid this result I had no other means than to feed it out as quickly as possible. Later I abandoned the clay as a covering for my silos. Immediately after having pressed in my mixture of cut maize and straw, I applied above all a covering of plank fitting exactly the opening of the silo, and descending with the maize as it shrunk down. This simple change produced a perceptible amendment, but it was quite insufficient still. The alteration was but little retarded, but I was on the right track. To-day I still use the same silos, and I obtain a preservation indefinite and complete. In what then have I modified my processes? Instead of cutting my maize in pieces of three or four centimetres in length, I cut them one centimetre only. Instead of

mixing a quarter and sometimes a third in weight of short straw, I never exceed the proportion of one-tenth, and oftener I bury the maize without any mixture. Finally, and here is the principal difference: I pile on the cover of my silo when it is filled, four or five hundred kilogrammes of stones or blocks of wood per square metre of surface. By my first processes I obtained only a temporary and incomplete preservation; with my last I obtained a preservation indefinite and absolute. How have these three simple modifications led to such marvellous results? To explain this will be the object of the following chapters.

XI.

HOW THE MAIZE SHOULD BE CUT.

Agriculture does not generally appreciate at its full value the advantages that can be derived from the cutting of fodder as affecting the nourishment of cattle. Even besides the preparation for ensilage, these advantages are considerable. The feed-cutter with its cutting-knives and the fluted cylinders which precede them, and which act in some sort as molars, work certainly better and more economically than the jaws of our animals, especially when it is moved by water, by steam, or by horse-power. (I do not speak of the arms of men, which have become too scarce, and therefore too dear for that service.) The labor of mastication is an expenditure of force which the animal does not perform gratuitously. I leave to our skillful professors of mechanics the care of determining scientifically the effort that animals make in grinding the different food that is presented, and which proportionately requires an addition to its ration in order to represent that ex-

penditure. I have seen in former times in my stables, when I caused my beasts to eat maize uncut, that they were fatigued by their incessant efforts to tear to pieces the large stalks, and were so exhausted as to fail to profit as they have done since by this excellent food when presented in a form more favorable for its absorption. Imagine two men obliged to support themselves, one upon the wheat in grain, and the other upon the same quantity reduced to flour. You may be sure that these two men would not profit equally from their respective food, which, however, is chemically the same. The same maize produces food very different in its effect, according to whether it has been only cut, or cut and softened by the commencement of fermentation, or offered to the animals in whole stalks more or less dry. The fineness to which I cut my maize at the moment of ensilation is extremely important in view of good preservation. Cut in disks of only one centimetre thick, the maize packs better in the silo, it occupies less space, and takes the form and consistency of a species of pulp, leaving in its mass the least possible amount of air. In proportion as the length is increased, the preservation becomes less perfect, and finishes by being entirely defective. Last year a cultivator of the valley of the Loire, took from me the dimensions of my elliptic silo, and reproduced it exactly on his own farm. He filled it in the autumn, and when he opened it during the winter, he took out a poorly preserved product, which his beasts only eat with repugnance. Greatly disappointed, he brought to me a sample of his maize that he had cut in lengths of five to six centimetres, instead of one or two at most, as I had advised him. I recognized at once the cause of his failure, and asked him why, contrary to my advice, he had cut it so long. He replied, "I was not able to procure a steam engine which I expected to use, and I had to use a horse-power; the work did not get along fast enough, and in order to hasten it, I decided to cut it in such long pieces." He was surprised at the excellent preservation of the maize at

Burtin, and he carried home a hundred kilogrammes; his cattle were thus enabled to appreciate the difference. I cite this fact because it contains a valuable lesson.

XII.

PROPER PROPORTION OF STRAW.

At the beginning of my ensilages I had as principal resource for the sustenance of my stock a great quantity of wheat, oat, and rye straw, etc. In order to induce my cattle to eat it, I mixed all that I could with my maize and my green cut rye, but I was not slow to notice that this mixture kept much less time as the proportion of straw was greater. A fiftieth in volume, or a tenth in weight, was the maximum of what the maize could carry without being exposed to an early alteration; when I increased this quantity, the time that it kept always diminished, and at last did not exceed forty-eight hours. I attribute this to the fact that the straw, being very dry, absorbs from the maize too much of its water. The moist condition of the ensilages, instead of being a cause of deterioration, is, on the contrary, to a certain extent, indispensable to the good preservation of the whole matter.

Maize in its normal condition contains about eighty-five per cent. of water; when the addition of dry straw has caused the mixture to decline to an average holding less than seventy-five per cent. the good preservation is much compromised, and quickly becomes impossible if we try to go below it. Besides the too great dehydratation that the presence of the straw may cause, it also offers another serious inconvenience, especially rye straw. This straw when cut forms a great quantity of little tubes, the envelopes of which resist decomposition for a long time; these tubes inclose an appreciа-

ble quantity of air, which is the most dangerous enemy of ensilage. Oat straw, or others of softer texture, are less dangerous in this respect than rye straw. While I used at first the short straw from my threshing, always troublesome on account of the amount of room that it occupies, henceforth I shall bury my fodder almost without any mixture. Sometimes, however, it is well to mix short straw with maize without passing suitable limits. Such a case presented itself at Burtin, in the autumn of 1876. When maize has been cut before the frost, and arrives in good condition to the cutting-machine and then to the silo, it does not yield its water easily, even when it is submitted to a considerable pressure. But it is not the same when this fodder is too old, and has been exposed to the rains and frosts at the end of autumn.

On one occasion, in October, 1876, I found, for lack of sufficient silos, that it was impossible to bury all my crop of maize. I was obliged to improvise a new silo, in an old building, in order to place the surplus, and this ensilage was not completed until the first days of December.

The stalks, touched by frost, had become very soft and weak. The cutting was difficult, but, most unfortunate of all, the layer of cut maize had scarcely attained in the silo two metres of thickness, when, by reason of the pressure upon the first layer, the juice began to run out freely through the opening, and this discharge continued for several days. This was a serious loss, which I could have avoided by mixing some cut straw with the overripe maize. Except in this case, my maize has never lost in this way any of its water; at the disinterment the bottoms of my silos have always been found nearly dry, barely moist.

XIII.

COMPRESSION OF THE SILOS.

It is indispensable to superimpose four or five hundred kilogrammes per square metre of heavy materials upon the covering or movable planks of the filled silos. I meet here the most important question—that which I have had the most trouble to solve, and which I have only really solved quite recently. When a silo has been filled, it does not answer only to prevent the external air from penetrating it; it is necessary at once to seek means for expelling the mass of air that it incloses between its disks and in its cells. It is here that the heavy materials with which I load my silos become important; it is necessary that the air inclosed in the silo should find between the joints of the covering planks an outlet; it is necessary that a strong compression should compel this air to pass out quickly and to quit the place where it would cause most serious damage if it remained. It is necessary that this powerful compression should continue during several months, because the tramping of the workmen is insufficient, for the following reasons: At the moment when the green maize is cut, it is all alive, and is so elastic that it reacts forcibly against the momentary pressure of the feet of the workmen. It is not the same several days or weeks thereafter, but its elasticity diminishes, or, in other words, its compressibility increases in considerable proportions; it is then that the heavy superimposed materials follow the maize down in its softened condition, continuing to press it in proportion as its compactness increases, and brings it to that state of density that is necessary in order to put it out of reach of all alteration.

XIV.

THE PROPER HYDROMETRIC CONDITION OF MAIZE AT THE TIME OF ENSILAGE.

A FAULT which I often committed at the commencement of my experiments, was to leave my maize upon the field in order that it might undergo a partial desiccation before the ensilage. This is to be avoided absolutely. When the water evaporates from the cells of the maize, it is immediately replaced by air; that is to say, by the most active agent in all alteration. Let the maize keep all its water, if you wish to preserve it by ensilage.

All the directions which I have laid down as proper for the ensilage of maize, apply to all other fodder without distinction, and insure the same success. If I speak more particularly of maize, it is because I have found in that wonderful plant all the elements of a new and boundless agricultural wealth, from the day when I arrived at the assurance of its indefinite preservation by ensilage for the nourishment of my cattle throughout the whole year. Before this time it had hardly nourished them during three months, while it was possible to feed it to them green.

XV.

EFFECTS OF ENSILAGE UPON FODDER.

My maize, my green rye, my fodder of all kinds, have scarcely changed color, after eight or ten months of ensilage; fed exclusively to my animals, they produce exactly the same effects, the same abundance of milk and butter, the same flavor, and the same color to the butter. These qualities, so important to

butter preserved through the winter by the ensilage, are in my eyes the true touchstone, when we seek to appreciate the respective merits of the different processes of preservation of fodder. Let a farmer show me the butter that his ensilage gives him during the winter, and I will have no need of other means of investigation in order to arrive at his skill. "A workman is known by his work."

I opened in April, 1877, my last elliptic silo, which contained nearly 100,000 kilogrammes of maize, ensilaged in October, 1876, more than seven months. It disclosed a very compact mass of a brownish green color; the temperature did not exceed 10 degrees (Réamur); there was no appreciable odor; taken in the mouth it was really insipid, and this freedom from odor and taste produced at first an almost disagreeable sensation.

I detached from the mass several hundred kilogrammes, intended for the next feeding of my animals. It was hardly exposed to the air when it underwent a veritable change: the brownish color became sensibly green, the beginning of alcoholic fermentation took place, without exceeding the limits which that fermentation ought never to pass. That silo was not completely exhausted until the 10th of August, and the maize remained in good condition until the last day. My forty-days maize reached at that time the point where it was suitable to be cut for fodder; it had attained its full height, and in the month of August my animals eat it green; they were only ten days without maize during the year 1877.

My silos of rye will be consumed during the winter. I do not need to say that green rye is much richer than maize, and a much smaller quantity will go as far; the mixture of these two kinds of fodder is an excellent diet.

My animals, fed upon maize ensilage during the whole winter, scarcely drink when they are loosened in the middle of day to quench their thirst at the river which crosses my farm; nearly all return to the stable without having approached it.

Their excrements, of medium consistency, denote a very favorable pathological condition. We must conclude that maize ensilage in the matter of retaining water is a well balanced food, since it furnishes to animals, in most suitable proportion, food and drink. Each one of my ensilages may be regarded as an immense cylinder, and its covering of plank, a gigantic piston, whose surface exceeds fifty square metres; the heavy substances which I superimpose act as a motive power, causing the piston to descend and compress the ensilage, leaving between the planks an outlet for the air, which the compression is intended to drive out. My large operations I have frequently repeated in a small way, with a glass jar 27 centimetres in diameter and 50 centimetres in height; a wooden disk, surmounted with a faucet, furnished with a rubber tube, acts as a piston; I load it with a certain ascertained weight in order to compress the matter in the jar; a second faucet is put in the bottom, when the pressure commences to lower the piston. The air in the ensilage escapes by the two faucets, and I easily ascertain the quantity. In the beginning the faucets give out pure air, the volume of which is exactly equal to that the mass has lost; afterward, if the compression has been insufficient and has left a certain amount of air in the mass, it is no longer pure air which comes out when I open the faucets; there have been some very interesting modifications produced in the mass, interesting to follow and well worth the study of the chemist.

"But," as has been kindly said to me, "you are making sour-krout; that was made long before you did it." If I am making sour-krout, or anything resembling it, I make it without cabbage and without pickle, with different kinds of fodder, and my sour-krout cost but ½ centime a kilogramme; it is sour-krout for animals, who show themselves very grateful for it. This sour-krout is a complete agricultural revolution.

XVI.

HOW TO BUILD A SILO.

With my new stables at Burtin finished, I shall be able to house one hundred horned cattle. My ensilages of 1877 only permit me to feed seventy, but with those of 1878 I expect to be able to feed one hundred. I have just finished three united silos, which form a part of the plan of my new stable.

The form of the silo exercises a great influence upon the results. It should avoid all angles, and should offer the least possible resistance to the packing down of the ensilage. The elliptic silo with vertical walls is the best form both for use and for durability. It is important to have them as large as possible compatible with the conditions of easy and economical use. The preservation of the ensilage in small silos is always less perfect than in large ones. No matter how much care is used and how much weight is applied, I have always found the portion which is farthest from the walls to be the best preserved, and that close to the walls there is always some alteration, not serious, but which it is important to reduce as much as possible. Small receptacles offer proportionally much more surface for contact. A rectangular silo, for example, of one metre each way, containing one cubic metre, presents five square metres of contact surface, while one of ten cubic metres, with 1,000 cubic metres of contents, presents only 500 square metres of contact surface, diminishing nine-tenths the evil indicated. But I do not advise silos of such dimensions as this. At the commencement of my experiments I recommended small silos, in order that when opened they might be quickly consumed before they became a prey to the slow combustion which the contact with the air produced, with as small an entrance as possible for the air, of which the first effect was to raise the temperature, and then produce fer-

mentation, first alcoholic, next acetic, and then putrid. But the day that I discovered the new process of a movable weighted covering, so that I was able to maintain in the mass a continuous density whereby the penetration of the air became impossible, I abandoned the small silos. Since then I have made them as large as possible, and they are only limited by the economy of the different operations of ensilage.

XVII.

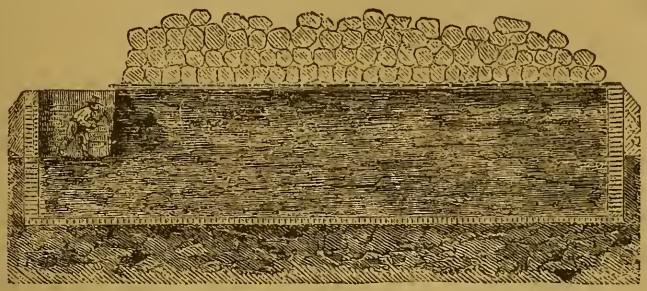
HOW TO FILL A SILO.

It is necessary to procure, either by purchase or rental, a motive power and a powerful feed-cutter. Large farms are generally provided with these machines, but the average farmer will have to hire. It may be that the travelling contractors for threshing will become contractors for cutting maize for ensilage, with a machine that possesses sufficient weight to be solid, and is also portable. Filling the silo should be done as rapidly as possible, and the layer of maize should be kept level all the time. The greater the compression the better will be the preservation. The packing along the walls (which should be as smooth as possible) should be attended to carefully. A woman turning continually as near as possible to the walls will accomplish this very well.

When the silo is filled to the top and carefully leveled, spread along the surface short straw four or five centimetres thick, then place on top of this boards fitting close together. These should be put across the silo in order that when it is being fed out they may be taken off one by one, as the silo is cut down vertically. Upon this flooring there should be piled abundance of weight, such as stones, bricks, logs of wood, or old bags filled with dirt, etc. At Burtin I have aban-

doned using loose earth as a means of compression, as it infiltrates into the ensilage, and adhering to the walls a vacuum forms as the maize settles away, which is destructive.

NOTE.—The translator lost his first investment in ensilage by depending upon earth covering, which arched by freezing and left a vacuum.



A filled Silo being emptied by vertical slicing.

Any ridge on the silos is objectionable, as the ensilage cannot be sufficiently compressed, and the dry rot soon attacks it and communicates to the material below.

As to using salt in the silos, it is not very important, and I often omit it without any bad result; but I believe the moderate use of salt is favorable to the health of animals, and I sometimes mix in my ensilage one kilogramme to a cubic metre of maize, the average weight of which, after being packed, is 812 kilogrammes.

When the ensilage is fed out it should be exposed to the air fifteen or twenty hours, in order that the alcoholic fermentation may commence. The proper time depends upon the temperature, but if kept longer than this, the fermentation becomes excessive and injurious. The spontaneous heat which is produced in the feed should never exceed 35 or 40 degrees (R.). Two years ago I had no silos at my farm at Gouillon, and I carried every other day from Burtin what was necessary. From the second day the heat exceeded these limits, and the alcoholic vapor abundantly emitted indicated the seri-

ous loss that was going on. The acetic acid was not slow to join the party. In the north, the beet pulp that is fed in winter is nearly always quite sour; it is to this circumstance that I attribute the poor quality of milk and butter obtained from the animals kept on this food.

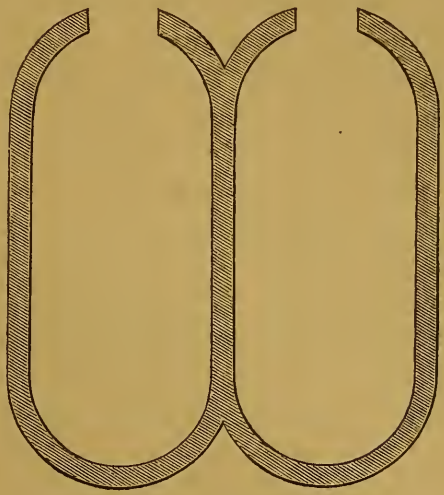
XVIII.

THE NEW STABLES AT BURTIN, AND THEIR SILOS.

My new stables are a square of twenty-four metres on each side, divided into two compartments, each of which has a central passage between two rows of stalls. These passages are connected with the silos by a small railway, which makes it convenient to bring the feed before each animal. The maize and the other ensilaged fodder is carried in willow baskets all of the same size, which are frequently weighed in order to keep account of the weight of the rations given to each lot of cattle. My silos are elliptic in form, with perpendicular walls as smooth as possible inside, five metres wide and the same height. Should I modify them in any way in future it will be only to increase the height.

My farm at Burtin presents exceptional difficulties for building silos. Everywhere the water is met at one metre below the surface, and as I want to sink my silos nearly two metres, because the part below the ground preserves in summer more moisture than that part above the ground, I am obliged to first dig a ditch lower than the excavation all around it, and then to cement the lower part, which causes a considerable expense. I put concrete on the bottom, and upon this I build the vertical walls of the thickness of two bricks (45 centimetres) to the top of the ground. Above the ground I reduce the thickness to one brick and a half (about 34 centi-

metres.) I coat the walls with Portland cement sufficient to insure their perfect impermeability. My triple silos have cost me 4176 francs, and their total capacity 812.45 cubic metres, about 5 francs 14 centimes per cubic metre. I intend next year to raise the walls of my silos another metre, so that their capacity will be about a thousand cubic metres. I postpone till that time my decision as to a special cover for them.



Plan of united Silos.

Most agriculturists are more favored in the profile of their soil; many of them have a hillside in the neighborhood of their barn, in which they can open silos that will always be dry, and in some places can dispense with masonry by having solid rock. Those who wish to imitate me will have less hesitation when they know that Burtin is a particularly bad place for building silos, and that they can obtain the same results with much less outlay.

In making use of such large silos as these it is necessary of course to have a cutting-machine with a six-horse power engine at least, and an elevator to raise the cut fodder over

the walls of the silos. I estimate that with these instruments one silo can be filled in three days at most without difficulty. This rapidity is necessary in order to assure the success of ensilage. When the elevator and cutter are combined in the same machine, the process will be simplified.

As to the average farmer, as I have already said, it will be better to employ the threshing-machine contractors, who will find it to their interest to adapt themselves to this business also. It is above all the duty of the wealthy agriculturists who have entered upon the way that I have indicated, and from whom I receive every day so many grateful letters, to assist the willing farmers around them, and who have need of their advice. For my part, I shall hold myself in the future as in the past always at the disposal of farmers who think they need to recur to my experience.

I engage to pay a prize of 500 francs to the first threshing-machine contractor who will prove to me that he has ensilaged in this way at least 2,000,000 kilogrammes of fodder.

XIX.

CONCLUSIONS.

I said in 1873, in one of my first pamphlets, "My profound conviction is that the culture and ensilage of maize is destined to cause a complete agricultural revolution; it ought in ten years to double the number of animals supported on our soil." Was this a chimerical hope? God has preserved me from all discouragement on this point. In the last four years the progress that I have made at Burtin has exceeded all my hopes. Upon my reserve of thirty-five hectares I have kept during the winter of 1876 forty-three horned cattle, and I shall keep during the winter of 1877 seventy,

with the assurance of going much beyond this at the end of 1878.

Here are facts more conclusive than any argument. The great establishment that I have finished, and shall inaugurate in October, 1877 (to which I invite all agriculturists), proves my firm faith in my work. I have spared no pains nor expense to assure solidity in my buildings in dear Sologne, which may be considered as the cradle of this new industry, and they represent the point of departure of an immense agricultural progress. Perhaps I may, without too much pride, inscribe upon them the words of the great Latin poet, "*Exegi monumentum, aere perennius.*"

EFFECTS OF FROST IN SEPTEMBER, 1877, AT BURTIN.

I had hardly finished this little work when I was surprised, as were all my confrères, by a meteorological circumstance that was exceedingly injurious. A heavy frost in the nights of the 22d and 23d of September and following, stopped short the vegetation of my maize, which at the bottom of my valley had the appearance of having been burned down to the roots. My maize on higher ground suffered less, but the growth is also stopped, and the crop will be much smaller. When such a misfortune occurs, the most effective way to lessen it is to cut the maize and proceed with the ensilage immediately. Thanks to the prompt measures taken, the frost caused me little other damage than a diminution of the crop, according as it had more or less attained its full development. The maximum height of my stalks was 4.72 metres, and from that down to 3 metres.

HISTORY OF M. GOFFART'S INVENTION.

From his Speech at Blois, May 8, 1875.

In 1850 I made some experiments in the ensilage of wheat at Versailles, since which time the preservation of fodder has become my favorite occupation. In 1852 I constructed four underground silos, with masonry, and cemented, each having a capacity of two cubic metres; these silos I have filled and emptied several thousand times. Maize, Jerusalem artichokes, beets, sorgho, turnips, potatoes, straw, I have experimented upon with more or less success. Straw, in the scarcity of fodder, has several times saved my stables. Some years ago I had in the autumn more than 80 horned cattle, and my hay crop would not have permitted me to support 10. One should be an agriculturist of Sologne to know what such a trouble means. In rich countries when the hay crop fails, it means that instead of harvesting 5,000 or 6,000 kilogrammes to the hectare, there are only 3,000 or 4,000, but in Sologne it means that there is no crop at all. In such difficulties the enterprising cultivator must use more intelligence and more industry. "What the man is worth, that the land is worth," is an old proverb, but I will improve upon it by saying, the man should be worth more, as the land is worth less.

I got through safely that year by having 50,000 bundles of wheat, rye, and oat straw. I cut them up, and with 35 kilogrammes of rye flour, which I fermented each day in large tubs, and in which I soaked the straw, I obtained food that was softened by fermentation, which my cattle ate freely and digested easily. Thus I reached the following spring without being obliged to sell my cattle at a low price. I must acknowledge that at the end of winter my beasts were in a sorry condition, but the first grass quickly restored them, and I was not compelled to replace them at a high price in the spring;

and now, the two years of scarcity which my fellow-agriculturists have passed through have been for me—owing to my silos—years of unprecedented plenty. What I have done can be done by thousands of others, and my earnest desire, my sole ambition, is to enable them to imitate me as soon as possible. Until 1872 I only expected from my limited ensilages the means of prolonging for three weeks, or at most a month, the use of maize, so desirable a food for my cattle. To that end I made many experiments. I have mixed my cut maize with various proportions of straw, in order to find which would give the best result. I have made silos without cover, burying the ensilage under bundles of straw, then with earth (never sand). I have filled my four silos with every possible mixture, which would sooner have put me upon the road to a positive success if I had not been too easily alarmed by slight alterations on the surface, and which I caused to extend all through by too frequent examinations.

In 1873 I had a real success, due mainly to accident; and it is to be recognized that chance nearly always plays an important part in the happiest discoveries.

Until this time I had hardly believed that the preservation of green maize for a long time was possible, and I had very little confidence. I hesitated a while, and should have probably hesitated a good while longer if I had not been in a measure compelled to do something. The year 1873 had been exceptionally favorable for the culture of maize. At Burtin the crop was enormous. After having fed my cattle abundantly until October, besides having all that they could eat while green till December, I found that I had more than 170,000 kilogrammes that would be lost if I could not keep it at least till the following March. I went resolutely to work, and I have described elsewhere the means that I used and the result that I obtained. The difficulties were greater than one would believe, on account of the lack of faith of my employees. One day I had to leave my workmen for a while, but my return was sooner than they

expected. The work had ceased, of course. They were talking together, and I overheard my foreman say to the workmen, "This work that we are doing is all foolishness; M. Goffart had better throw his maize into the dung-heap at once, because that is where it will go to at last." I said nothing, but redoubled my watchfulness, knowing how little zeal I could expect from people so convinced of the uselessness of their labor.

A silo built upon the ground gives the best result during the cold season from December to March, but as the temperature rises fermentation develops rapidly. The underground silo with masonry walls is better; the temperature does not rise even in April, and at Burtin at this time (May 8) it is nearly in the same condition as at the time of ensilage, seven months ago. I would advise that the silo be sunk two metres in the ground, with masonry walls, and raised two meters above the ground. During the cold weather I would feed out the ensilage in the upper half, and reserve for the warmer months the lower half.

The experiment of an underground silo, but without facing the walls with masonry, has also given a favorable result, in the sense that the loss has only been one per cent of the whole, but such a silo soon falls down when it is empty, and consequently is much inferior to the former. There is another method, the simplicity of which is a dangerous temptation to the inexperienced. That is to pile the cut maize upon the soil, and to cover it with a layer of earth. I can assert that such a silo has never given good results. The packing down, which is essential to good preservation, cannot be applied to such a silo. Those who recommend this method of ensilage manifest a culpable ignorance, and cause great loss to those who follow their advice. When one loses half his capital in an operation, he is not successful; he makes a disastrous speculation. I proscribe this method in the most positive manner.

I once buried, for experiment, a thousand kilogrammes of corn-stalks, uncut, under a stack of straw, forming a layer 25 centimetres thick. In eight days it went to the dung-heap.

The cost of gathering and ensilaging 226,000 kilogrammes of maize has been as follows:

	Francs.
57 days of men, at 2 francs	114.00
9 days of women, at 1 franc 10 centimes	9.90
5 days of 2 drivers and 4 horses, at 16 francs	80.00
5 days of engine, from contractor, at 10 francs	50.00
Old wood for engine, 3 francs per day	15.00
Total	268.90

Making cost of 1 franc 18 centimes per 1,000 kilogrammes (about 20 cents per gross ton). About 40 per cent of this expense was for the cutting and putting in the silos.

We should not lose sight of the fact that the crushing of the food saved to the cattle by the cutting is in itself an important saving of food.

It is above all important to avoid all kinds of fermentation during and after ensilage. Fermentation can be produced whenever desired, and a few hours suffice to give all its useful effects. Take each evening from your silo the maize required for the next day's feeding, and 15 or 16 hours after, however cold and free from fermentation when taken out, it will be quite warm, and in full fermentation, and the animals will eat it greedily. Eight hours later it will have passed the proper limits, and it will rapidly spoil.

This first fermentation increases the facility of digestion, and therefore the nutritive or assimilative power of the food. For instance, when cattle live on fresh maize in the summer, they eat large quantities, and are always big-bellied, which shows that they are obliged to supply what is lacking in quality by an excessive consumption; but when they live on ensilaged maize which has fermented, their bellies are smaller, they eat less, and their whole condition is more satisfactory. To study all things, to try all things, to be always willing to change the system when one finds himself in the wrong—

such is the duty of the agriculturist, whose lot perhaps is too much envied.

For my part, I have had in my agricultural career some hard experiences.

In January, 1871, when I returned to Burtin, after having taken part in the defence of Paris, I found my stables entirely empty; the typhus had carried off in a few days 63 horned animals out of 64. By successive increase with Norman bulls, which I had changed every two years, I had created for myself a new and very fine race, and my stables were justly renowned in Sologne. In ten days I had lost the fruit of twenty years' labor. The blow was severe, but I hardly felt it. What was the loss of a few thousand francs compared with the great national grief which was causing all our hearts to bleed? I began again my work with courage. I bought young animals to replenish my stables, which continually improve, but I am aware that time will fail me to replace what I have lost. Let us strive courageously. Perhaps the most obscure of the pioneers of agriculture brings you to-day an effective means with which you can charm away the dearth of fodder, which is one of the greatest plagues of agricultural industry.

Do not deny to this poor but interesting Sologne the honor of having been the cradle of a system of ensilage that is effectively preservative, and of having given an example that the richest countries will not be slow to imitate. This is my earnest prayer and brightest hope.

APPENDIX.

I.

REPORT TO THE CENTRAL AGRICULTURAL SOCIETY OF FRANCE BY A COMMITTEE OF THE SECTIONS ON LIVE STOCK, PHYSICO-CHEMICAL AND HIGH CULTIVATION, UPON THE SUBJECT OF THE ENSILAGE OF GREEN CUT CORN FODDER.—SEANCE APRIL 7, 1875.

Your committee considered that the question of the preservation of a fodder so productive and so desirable as maize deserved to be studied, and if the results should be found as satisfactory as M. Goffart has announced, it should be brought to the attention of the agricultural public; therefore, I have been directed to present to you our report upon this important subject.

All methods of preservation of food interest deeply the farming community which produces it, and the whole nation that consumes it. It tends to reduce losses by deterioration and by waste; it mitigates the deplorable alternations of low prices for crops, which ruin the agriculturists, and of high prices, which weaken every portion of the commonwealth. Finally, it insures regular food to animals and men, which increases the energy and adds to the productive power of the nation. The preservation of maize in a green state lends a special interest to the value of that fodder for milch cows, because the crop is so variable, according to the season, and the time for consuming it in the autumn is so short if not preserved. When the heat and moisture of the season favor the vegetation, it produces such large crops that it cannot be con-

sumed before the frost destroys it, while the dried leaves and stalks are of very little value. Many agriculturists who have introduced this excellent fodder in their business have tried various ways of preserving for the winter what could not be consumed in the autumn, with results more or less satisfactory, but oftener the latter. There have been many precedents of a nature to justify these efforts. The preservation of grape leaves green near Lyons for the food of cattle and goats has made a high reputation for the cheese called Mont Dore from time immemorial. Apple pomace has been preserved in silos with good results. In various parts of Germany the preservation of vegetables of all sorts—turnips, cabbages, and different kinds of leaves seasoned with celery for feeding cows—runs back as far in the night of time as that of sour cabbage (sauer-kraut) for the food of men. In the north of France, several large agriculturists have preserved for twenty years in silos the leaves of beets, also the beets cut across, which have kept better than the whole beets in cellars. The pulp of beets, from distilleries or sugar factories, also makes excellent fodder when kept in silos. The world is so old, necessity has so long compelled the efforts of human beings, that we may find precedents in every line of improvement. But all experienced men who know the great difference that separates a happy suggestion, or even a successful attempt, from a practice well enough confirmed to become the base of a regular business, will admit that these precedents do not destroy the merit of any man who, like Monsieur A. Goffart, has accomplished a continued success. If the cultivation of maize and the method of ensilage have given the results that he claims, and the samples submitted indicates, he merits our eulogies.

M. Goffart states that he commenced to experiment with maize and ensilage in 1852, and what we have seen at Burtin proves that his experiments have led him to a practical success. We have been very favorably impressed by the silos that were

located in the old distillery which had been used for the daily feeding of the cows. These silos were made by lateral walls of two and a half metres in height, without any excavation, and the maize piled upon the ground as high as the floor above permitted. M. Goffart had thought best to cut the maize fine before ensilaging it, for the following reasons: First, a more uniform mixture of short straw with leaves and stalks; second, a division of the stalks in short pieces makes them more easy for the animals to masticate, and with less waste; third, a packing down more regular and more effective in the mass.

NOTE.—The further description of the process of ensilage is omitted, as the preceding directions are the result of later experience, by which the author learned to avoid *all* fermentation.

The fodder has an alcoholic odor, quite marked and slightly acid. It is eaten with avidity by the cows, and constitutes their sole food since the commencement of winter. We were struck by the healthy appearance of the 28 or 30 cows—their eyes were bright, the skin soft, and they were in good condition. But the point that above all attracted our attention was the sucking calves, which are the most delicate, and are always the first to suffer from any deficient or bad food given to their mothers. We did not see a single one that had hair in bad condition, or that was scouring. The fodder that produced this excellent result contained neither salt nor oilcake, and one would naturally inquire if it would be sufficient in all cases. It is probable that for very good milkers, where the quantity per day is 25 to 30 litres, it would be necessary to add some meal or oilcake to the ration of maize which we saw distributed, and which weighed 28 kilogrammes per day; but for the cows in the stable of M. Goffart, weighing alive 400 to 500 kilogrammes, this ration seemed to be sufficient for them and their calves. In order to show the importance of the preservation of maize, I will give only one figure, which is, that a crop of 120,000 kilogrammes per hectare corresponds to about one-fifth its weight of dry

substance per hectare—a magnificent result, superior by far to that which can be obtained even with beets raised for food of cattle in the lands similar to those of the domain of Burtin. The stock produces a great mass of manure. These facts have had a very happy influence upon the business at Burtin, and which perhaps will serve as an example to a country which, notwithstanding the immense amelioration which it has derived from railroads, by bringing to it marl and phosphate fertilizers, has need to pass beyond the uncertainty in which it has for a long time languished. We have not thought best to enter into a discussion as to net profits, always quite delicate, because the price varies so much, according to the commercial circumstances of the locality, and the local management of each business. It is evident that a cultivation of maize which produces 60,000 to 100,000 kilogrammes of stalks per hectare, which must be carried to the machine, cut, carried, and packed into silos, and afterward taken out, involves a considerable expense. But it is evident also that a plant which produces such quantities of excellent fodder is the base of a profitable cultivation. It is not less evident that, if the business is laid out in a judicious manner, so as to avoid all unnecessary manœuvres and portage, as is observed by factories, the cost can be reduced to an almost incredibly small figure.

It is not well to advise farmers, whose means are often already insufficient, to invest an important part of their capital in constructions; but we should call their attention to the consequences of the continual elevation of the price of hand labor, and the scarcity and increasing worthlessness of farm hands. We cannot operate to-day as we formerly did, because the successive operations of opening and covering the silos in a distant field, the time lost in going and coming without overseeing, and the force wasted in transportation in bad weather, have become too costly. We see no reason why a silo under shelter may not be constructed with such economy

that the ensilage of 1,000 kilogrammes of fodder may net as low a cost as in silos made in the ground.

We hope also to report soon to the Society some figures which concern another sort of granary, and which prove that 1,000 kilogrammes of oats may be kept in chests of iron, which protect it from all risks at less cost than in the usual grain bin.

Finally, our conclusion can only be very favorable to the efforts of M. Goffart. We find that he has made a remarkable success, in having created a business based upon the cultivation and preservation in silos of maize fodder. He has created in the midst of poor Sologne a type of agriculture which should be cited as an example, even to those parts of the country that are better conditioned. He merits, therefore, the thanks and congratulations of the Central Agricultural Society of France.

These resolutions were put to vote, and unanimously carried.

NOTE.—One of the expenses incident to this culture in France does not apply to the United States, viz., the purchase of seed-corn, which there must be imported, as in the South of France, where the grain matures, there is no more produced than is needed for local consumption.

II.

EXTRACT FROM THE JOURNAL DE L'AGRICULTURE, OCTOBER 23, 1875.

As we had announced, we visited, Oct. 18, the farm Burtin of M. Goffart, to assist at the ensilage of maize. We met there the General Inspectors of Agriculture, the Vice-President of the Agricultural Commission of Blois, the Director of the Agricultural Colony of St. Maurice, the Baron of Coriolis, several members of the General Council, several engineers of arts and manufactures, and other agriculturists. We watched

the operation for half a day, and we are able to render an account of the work. A steam-engine, heated with wood, ran a feed-cutter, near to which a cart brought the maize as it was cut in the field.

Two workmen fed the maize to the machine, which cut it one centimetre in length. One shovelled cut straw upon the cut maize in the proportion of about one-sixth in volume. Two men shovelled the mixture into the silo, where two more spread and packed it. Including the fireman and teamster, nine men were employed in the cutting. Besides these, two other teams were employed in bringing from the field, where four women and two men were cutting and loading. Thus seventeen persons were employed at the work, and about 5,000 kilogrammes were ensilaged per hour. We brought away for analysis some samples of maize cut before us, and also some that we cut in the field. From the weights and measures that we have taken, M. Goffart, who has made four hectares of maize, Dent de Cheval, will harvest at least 100,000 kilogrammes per hectare. On one field that we visited the product will be 15 kilogrammes per square metre. In thirteen stalks that we measured, weighing $15\frac{1}{2}$ kilogrammes, the average length was 3.07 metres.

We shall return to this subject when we shall have analyzed the maize, and afterward when we have returned to Burtin, in order to take some of the maize from the silo that we saw filled.

III.

EXTRACT FROM THE JOURNAL DE L'AGRICULTURE OF MAY 27, 1876.

We have been invited, May 16, to visit and state the condition of preservation of maize, cut green, of which we saw the ensilage in October last, in company with many prominent agriculturists.

With such men the discussions could not fail to possess a lively interest, and we will return to them. At present we only wish to state three things.

First.—The perfect preservation of the maize cut green, after seven months of ensilage, without any elevation of temperature, without fermentation of any kind, the rapidity with which it takes, upon exposure, the alcoholic odor, the avidity with which the bovine beasts proceed to eat it, even when it is offered to them by the side of new-mown grass.

Second.—Putting in silos 2,000 kilogrammes of rye, cut green, and cut in machine.

Third.—The excellent condition of the animals which had been exclusively fed on the ensilaged maize.

We congratulate M. Goffart upon the remarkable results that he has obtained.

IV.

THE ANALYSIS AND COMPOSITION OF MAIZE CUT IN GREEN STATE.

From a letter to M. A. Goffart, from J. A. Barral, Perpetual Secretary of the Central Agricultural Society of France, editor of *Journal de l'Agriculture:*

You do not seek to produce a fermentation in the cut fodder. You propose to maintain all its parts in a condition as near as possible like that of the plant at the moment that it is cut. I have undertaken the solution of a question of vegetable physiology which presents a scientific interest, and also a practical interest of the first order.

It is important to ascertain what is the distribution of mineral and organic matter in the different parts of the stalk of maize. When it is cut for the silo it becomes a mixture of all

parts of the plant in such a manner as to give to the stock those that are richest in nourishment as well as those that are poorest. This is one of the advantages of the method which you have used so many years. If you give the corn plant to the stock in the natural state, they will eat first the tender parts, and will leave the hard parts, which offer the most resistance to the teeth and which have the least flavor.

I have taken thirteen stalks of maize, weighing altogether 16.^{795} kilogrammes, and have cut them up into six lots, as follows: Each of these lots has been desiccated at 100 degrees (R.). The stalks were cut into three parts. The length of each portion was, Upper part, 0.65m.; middle part, 0.88m.; lower part, 0.80m.; the average total length of each stalk, without tassels, being 2.33m.

	Weight in green state. Grammes.	Weight after desiccation. Grammes.	Water, or Loss, per cent.
Leaves	4.805	1.315	72.63
Tassel	.102	.047	56.07
Ear, with stem	3.026	.752	75.14
Upper part of stalk	1.270	.125	90.15
Middle part of stalk	2.446	.341	86.06
Lower part of stalk	5.146	.661	87.15
The thirteen stalks	16.795	3.241	80.76

Thus, the water was quite unequally distributed in the stalk. They were more watery at the upper part, but the flowering portion was much less; the grain was still milky. The relations between the different parts of the plant are found to be as follows:

	Normal state.		Dry state.	
Leaves	29.20		40.57	
Tassel	.66	47.87	1.42	65.19
Ear, with stem	18.01		23.20	
Upper part stalk	7.56		3.85	
Middle part stalk	14.86	52.13	10.52	34.81
Lower part stalk	30.01		20.44	
	100.00	100.00	100.00	100.00

This shows that the stalks, when fresh, surpass in weight the remainder of the organs of the plant. They contain, however, a less proportion of dry matter, and less than the leaves, which have in the fresh state a much less weight. I have analyzed separately each of the six lots, and I have obtained the following composition in organic substance and ashes, or mineral substance:

	Leaves.	Tassel.	Ears.	Stalk—Upper.	Stalk—Middle.	Stalk—Lower.	Entire Plant.
Organic substance.	89.01	94.80	98.30	95.43	97.31	98.26	94.26
Ashes or mineral substance	10.99	5.20	1.70	4.57	2.69	1.74	5.74
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Thus it is seen that the mineral substance is accumulated in the leaves and upper part of stalk.

Here are the exact proportions of the mineral substance in the different organs of maize:

Leaves	77.70	Middle part of stalk	4.87
Tassel	1.22	Lower part of stalk	6.29
Ear and stem	6.79		
Upper part of stalk	3.13		100.00

Thus, more than 77 per cent of mineral substance is accumulated in the leaves, more than 14 per cent in the stalk, and only about 6 per cent in the ear.

We will now ascertain the composition of the different parts of the plant, as appears when desiccated:

	Leaves.	Tassels.	Ears.	Stalk.—Upper.	Stalk.—Middle.	Stalk.—Lower.	Entire Plant.
Nitrogenous substances.	6.28	6.27	11.09	4.34	3.86	3.37	6.47
Fatty matter soluble in ether	1.30	1.90	2.50	1.00	.40	.30	1.28
Saccharine matter soluble in alcohol	6.50	4.70	8.30	17.50	20.60	21.00	11.77
Starch	64.33	25.23	73.51	39.49	38.65	35.79	56.35
Cellulose	10.60	56.70	2.90	33.10	33.80	38.00	18.37
Mineral substance	10.99	5.20	1.70	4.57	2.69	1.74	5.74
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Nitrogenous (per cent)	1.004	1.004	1.775	.694	.617	.540	1.033

The ear is found, as we would expect, much richer in nitrogenous substance than the other parts of the plant. The nutritive power, as it is agreed to define it, by the relation of azotic substance to the sum of the fatty matter, sugar, and starch, is quite inferior in the stalks to that of the other organs, as the following table shows:

	Taking the ear as unity, the proportionate nutritive power is as follows:	Nutritive value of whole plant.
Leaves	.66	2.54
Tassel	1.49	.09
Ears	1.00	2.57
Upper part stalk	.57	.17
Middle part stalk	.49	.41
Lower part stalk	.45	.69
		6.47

The stalk, however, shows that it is very rich, and, above all, the leaves, which therefore should be taken care of for the cattle. The fatty matter is concentrated in the leaves and in the ear; the saccharine matter in the leaves and stalk, and mostly in the lower part of the stalk.

The following table indicates the concentration of saccharine matter in the leaves and stalk:

	Each part contributes	The different parts to whole.
Leaves	2.64	22.36
Tassel	.07	.59
Ears	1.93	16.41
Upper part stalk	.67	5.69
Middle part stalk	2.17	18.45
Lower part stalk	4.29	36.50
	11.77	100.00

Cellulose substance is, as we would expect, in large proportion in the stalk, and mostly toward the lower part of it. It is principally in the leaves and ear, with stem, that the

starch and the other principles which are neither cellulose nor nitrogenous nor mineral, are found.

CENTESIMAL COMPOSITION OF THE ASHES OF EACH PART OF THE PLANT, AND DISTRIBUTION OF THE SAME.

	Entire Plant.	Leaves.	Tassels.	Ears.	Upper Part Stalk.	Middle.	Lower.
Phosphoric Acid	7.17	3.97	10.01	33.50	9.07	14.02	7.17
Sulphuric Acid	3.81	3.21	6.13	3.58	5.61	8.65	3.81
Chlorine	1.35	1.04	2.73	3.52	2.15	trace.	1.35
Potash	4.41	1.23	7.88	27.11	14.61	2.41	4.41
Soda	8.26	6.78	10.37	21.36	12.57	8.39	8.26
Lime	12.96	13.78	11.87	3.46	10.29	14.31	12.96
Magnesia	6.60	5.64	15.03	7.04	10.52	8.73	6.60
Iron	0.51	0.46	0.11	trace.	2.08	0.63	0.51
Silex	54.75	63.76	35.83	0.34	29.83	41.37	54.75
Carbonic Acid and Waste	0.18	0.13	0.03	0.09	3.27	1.49	0.18
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

The above table shows that the ears are the richest in phosphoric acid and potash. These also contain the largest percentage of soda, the least of lime and silex. As to the distribution of each mineral element in the different parts of the plant, it is necessary, in order to study it thoroughly, to enter into a more detailed and separate examination. Phosphoric acid or phosphorus plays an important part in agriculture, not because it is more indispensable to vegetation than several other elements, but because nature has not distributed it with so much profusion in all lands or in the atmosphere as certain other elements that on that account are considered secondary. Indeed, there is not any one element in vegetation of any greater importance than another, and if any person judges otherwise it is because he places himself at the point of view of an agriculturist who, having need to produce certain crops of a special kind, needs to accumulate such elements as enter specially into their organization. Therefore, in order to obtain abundant food, in order to produce with rapidity domestic animals, whose organs require much phosphorus, it is

necessary to seek methods for increasing the supply of phosphates, more or less assimilable, that the plants may find in the bed where their roots develop. To indicate the sources of the supply, whether in the residuum of factories or of the household, or in the numerous repositories, has been one of the greatest services rendered in modern times to agriculture by chemistry and geology. But there our knowledge ends. We are entirely ignorant as to how the phosphorus distributes itself in the vegetable, by what processes it penetrates and circulates, and accumulates in certain organs, or exactly what these organs are.

As to the relative distribution of these elements, the following tables show, as far as concerns maize fodder intended for green preservation by ensilage:

PHOSPHORIC ACID.

	Amount in each part.	Proportion in different parts.
Leaves,	Grammes, 0.177	42.96
Tassel	" 0.007	1.70
Ears	" 0.132	32.04
Upper part stalk	" 0.020	485
Middle part stalk	" 0.026	631
Lower part stalk	" 0.050	12.14
Whole plant, dry	" 0.412	100.00

SULPHURIC ACID.

The role of sulphur in vegetation is nearly unknown. All that we know is that it is absolutely necessary. It is generally found in less proportion than phosphorus; in maize as 88 to 180.

	Quantity in each part.	Proportion in different parts.
Leaves	Grammes, 0.144	65.75
Tassel	" 0.005	2.28
Ears	" 0.014	6.39
Upper part stalk	" 0.009	4.11
Middle part stalk	" 0.016	7.30
Lower part stalk	" 0.031	14.17
Whole plant, dry	" 0.219	100.00

CHLORINE.

By the conclusive experiments of Prince de Salon-Horstmar, we know that chlorine is indispensable to the regular operations of the different phases of vegetation, but the most complete obscurity rests upon its real action.

	Quantity in each part.	Proportion in different parts.
Leaves	Grammes, 0.047	60.26
Tassel	" 0.002	2.56
Ears	" 0.014	17.95
Upper part stalk	" 0.009	11.54
Middle "	" 0.006	7.69
Lower "	" traces	traces
Whole plant dry	" 0.078	100.00

POTASH.

Berthier's saying, "No plant without potash," has become a maxim.

	Quantity in each part.	Proportion in different parts.
Leaves	Grammes, 0.055	21.94
Tassel	" 0.006	2.27
Ears	" 0.107	42.29
Upper part stalk	" 0.036	14.23
Middle "	" 0.041	16.20
Lower "	" 0.008	3.17
Whole plant dry	" 0.253	100.00

SODA IN MAIZE.

In the whole plant dry, 0.475 grammes, of which two-thirds is accumulated in the leaves, and one-sixth in the ears.

LIME IN MAIZE.

Lime has been considered necessary to plant growth from a very ancient period. More than four-fifths are found in the leaves, only two per cent in the ear, and the quantity increases in descending the stalk.

MAGNESIA IN MAIZE.

The role of magnesia in vegetation has been but little studied. There is no doubt, however, after experiments made in Germany, that its presence is indispensable to plants. Two-thirds of it is found in the leaves, and the remainder equally divided in the other five parts of the plant.

IRON IN MAIZE.

Iron is evidently of great importance to the life of animals who are nourished by vegetation; as with sulphur, chlorine, soda, lime, and magnesia, the greatest accumulation is in the leaves. But it is a noticeable fact that it is absent from the ear, which would seem to explain the opinion of physicians as to the insufficiency of corn-meal for exclusive human food. As to maize harvested green in order to be fed to cattle after ensilage, the lack of it in the ear is equalized by its presence in the other parts of the plant.

SILICA.

It is probable that all silica enters the organs of vegetation in the soluble state. The quantity found is very considerable.

	Quantity in each part.	Proportion in different parts.
Leaves	Grammes, 2.843	90.45
Tassel	" 0.026	0.82
Ears	" 0.001	0.03
Upper part stalk	" 0.042	1.33
Middle "	" 0.084	2.67
Lower "	" 0.147	4.70
Whole plant dry	" 3.143	100.00

Thus the stalk contains only about one-tenth part of the amount contained in the leaves, which contain 90 per cent of the whole plant.

V.

EXTRACT FROM THE REPORT OF THE AGRICULURAL CLUB OF ROMORANTIN, Oct. 12, 1876.

By M. Rousseau.

The discovery of the phosphates was a happy event for Sologne, but that depends upon our taking for an objective point the production of grass. Their misuse without this remedy would lead us quickly to sterility. It is necessary for us to produce from grass fodder for stall feeding. The two years of terrible drought that we have just passed through demonstrates this necessity. Until the present time our resources in fodder were limited to our natural meadows, clover, and ray-grass. Our natural meadows, where we cannot irrigate them, yield very feebly, and the grasses that they produce possess a very moderate nutritive quality. The clover, puss-grass and ray-grass leave us very often in embarrassment. Our soil is light, retains but scantily the moisture that is necessary for the abundant production of fodder; we have seen this sad experience this year, for in all the farms that we have visited, the greatest production that we found was only thirty to thirty-five wagon loads. These results are afflicting, and would retard indefinitely any progress in agriculture, if some supplementary resources were not just now offered to us. A distinguished agriculturist of Sologne has brought to us a complement to our needs.

Since M. Goffart has demonstrated by works and experiments for more than ten years that maize fodder, easily cultivated, gives in our lands an abundant crop, which, in his case, has exceeded 120,000 kilogrammes to the hectare, we can truly say that our country is safe from the scarcity of fodder. Since he has shown by repeated successful efforts that this mass of vegetation was not only a resource for the

summer and autumn, but by ensilage it can be made almost an inexhaustible provision for the winter, we can say that the agriculture of Sologne has found its proper direction. The beet, which does not do well with us, is the wealth of the departments of the north. It permits them to support and to fatten a great number of animals, and thereby to produce a great amount of fertilizers by which to maintain and to increase the fertility of their soil. Since the beet fails us, we will have the maize; and if we give it abundant manure, and that which it prefers above all, superphosphates, if we are wise enough to make use of the process that has been shown us (ensilage), we will see a second agricultural movement which will have a wider scope, without the same danger, as the discovery of the phosphates.

VI.

EXTRACT FROM THE REPORT TO THE CENTRAL AGRICULTURAL COMMITTEE OF SOLOGNE, Oct. 31, 1875.

By M. Julien, President of the Club of Romorantin.

Gentlemen: The question of maize fodder, and above all of its preservation by the means of ensilage, has made too much noise in the agricultural world to permit this club to remain a stranger to it. You have learned of the profit that the country might draw from this innovation, and it will not be one of your least titles to the public gratitude to possess among you the pioneers who have aided to find the methods for bringing into practical use an idea that is destined to work a revolution in the agriculture of central France. One of the greatest difficulties that is presented to the enterprising agriculturist in a country analogous to ours is the uncertainty of

the crop of fodder. Our irregular climate, passing from great humidity to extreme dryness, puts his enterprise always in peril. He can never count upon the resources which he has prepared so long in advance. To-day, however, thanks to the introduction of maize fodder in our variety of crops, the live stock will find a provision as sure for the winter as for the summer. Maize is for our central departments what the beet is for the countries with rich soil, and like that precious sugar bearer, it places at our service an immense supply of pulp. [The description of the processes and of the silos is omitted, as the improvements made by M. Goffart, in 1876–7, antiquates it.]

The maize may be ensilaged without cutting it, but it is necessary to use more precaution to obtain a proper compression; there may remain some air inclosed, which necessarily causes some of it to be more or less injured. It is better to cut it before ensilage, which also dispenses with doing it afterward. It is not necessary to choose fine weather for ensilage; on the other hand, humidity is rather an advantage than otherwise. The introduction of salt is not necessary. It aids nothing in the preservation, which is due rather to a sort of slow boiling produced by the high temperature that is developed in the silo.

NOTE.—This idea was proven to be a mistake by later experience.

It is unnecessary to add that this method of preservation is also applicable to many other kinds of fodder, such as rye, rape, buckwheat before maturity of the straw, the stalks of Jerusalem artichokes, the leaves of beets, even clover and lucern, but above all, the aftermath, which it is sometimes impossible to cure.

It is indeed a new era opened for poor countries. Let us hope that our Sologne will profit by it more than all others, which would be its just right, since from its bosom the impulse went forth. We can also congratulate ourselves that this rev-

olution is due to the successful and persevering efforts of a member of our Society, M. Auguste Goffart.

VII.

EXTRACT FROM THE SPEECH TO THE CENTRAL AGRICULTURAL COMMITTEE OF SOLOGNE, JUNE 25, 1876.

By M. Boinvilliers, President.

The preservation of maize as a green fodder by ensilage is a fixed fact, thanks to the persevering and happy experiments of our colleague, M. Goffart. It is an immense benefit accrued to France, and especially to our Sologne; therefore I have asked from the Minister of Agriculture for M. Goffart the decoration of the Legion of Honor. This reward, so well deserved, was not delayed.

(This news was received by prolonged and unanimous applause.)

INTRODUCTION OF ENSILAGE IN THE UNITED STATES.

By Mr. Francis Morris,
of Oakland Manor, Howard County, Maryland.

I have been requested to give my experience in growing corn fodder, preserving it in silos, or trenches, and feeding it to stock.

In the early summer of 1876, I received from France a newspaper containing an account of the plan they had adopted of raising maize, or Indian corn, cutting the same when in tassel, and burying it in trenches, covering it with earth, and feeding it out to their stock in the following winter or spring. This statement induced me to make the experiment. I sowed, on the 1st of August, 1876, about five acres, in drills three feet apart, and about a bushel of corn to the acre. This was worked twice with a cultivator, and was in tassel in the first days of October. We cut the same with a mowing-machine, carried it in wagons to the feed-cutter, cut it up in one-inch pieces, and added to it an amount of wheat straw, cut up in the same manner, equal to one-fifth of the corn fodder. I had three silos bricked up inside a stone barn. The silos were about ten feet deep and four feet wide, and twenty-four feet long. The fodder was well packed down by trampling while the mixture was put away, and then covered with boards with large and heavy stones upon them. After the weights had pressed it down very considerably, they were taken off, the boards covered with straw, and then with clay; the latter were thoroughly packed, and the whole was made a perfect protection against the oxygen of the atmosphere penetrating through the clay or earth. The first silo was opened for use on Christmas, and I fed all my milking cows with the same. Two of them refused to eat their portion, and when they left their stalls the other cows ate it; and from that day I have

never fed it to an animal that has refused it—horses, mules, oxen, cows, sheep, and pigs will all leave any other feed and eat this by choice.

In the year 1877, from want of personal attention and from a very dry time, my corn fodder was not as large a crop as it should have been, but it was sufficient to feed nearly a thousand head of stock for over two months; it was equally good in quality as it was in 1876.

For this year I have more than double the quantity of this fodder. I have made and filled a very large silo out of doors, which will probably hold from fifty to seventy-five tons, besides filling the three silos in my barn. I have a very large herd of stock dependent on my corn fodder for their winter feed, and I feel every confidence that it will furnish me all the feed I require.

In a very long experience in raising stock, I have found corn fodder preserved as above stated the best food for milking cows that I ever used. It is equal if not superior to June grass, and its cultivation is so easy, its preservation so inexpensive, that to-day no one can estimate its advantage to the agriculturist. The average hay crop of this State (New York) is not equal to one ton per acre, and every farmer knows what a costly crop it is to raise, to cure, and to preserve after it is raised, while our Indian corn crop will grow and flourish and tassel with the most ordinary care and tillage. Twenty-five tons to the acre, with a light dressing of barnyard manure, and working it twice with a cultivator, is a small crop. Add to the barnyard manure a dressing of guano, and more than double that quantity can be raised to the acre—I am almost afraid to state the quantity that can be raised per acre. Suppose, however, we put the produce down to twenty-five tons per acre—and every one who has raised corn sowed broadcast will recognize that this is a small crop—what will be the result in this good State of New York if one-tenth of her arable land is used in this way? Where is the stock to feed

upon the new supply of food? It is not here. We should have to double the number of our horses, cows, sheep, and all our stock, and after we have done that we should have to double them again. In fact, the amount of stock that could be maintained is so great that we should be wholly independent of the West, for the most liberal supply of beef and mutton will be supplied by the cultivation of our own lands. The beef that we shall have when we make a proper use of preserved green food will be very different from the beef fatted on slops procured from the whiskey stills of Chicago and other cities of the West. The old adage, "No cattle no corn," is fully verified by our wheat production in this State. The lands are all so indifferent in quality that he must be a bold farmer who now sows a field of wheat; but the corn-fodder, which it is now proposed to raise, will give such a yearly amount of manure as will enable every farmer to get a wheat crop of thirty to forty bushels of wheat to the acre, and succeed that by good clover. After that is done, his progress to a maximum yield of cereals will be very rapid, and I have every confidence that the crops of this country, blessed with its tropical sun, will exceed in value and importance that of any other agricultural country that can be named.

FRANCIS MORRIS.

December, 1878.

[Translation.]

LETTER FROM MONS. GOFFART.

BURTIN, December 4, 1878.

Monsieur J. B. BROWN, *at New York:*

I learn with pleasure that you have undertaken to translate into English my Manual on Ensilage. I have never had but one desire concerning it: that is to see the greatest possible publicity given to my work, and I devoutly hope for the suc-

cess of your translation. Since I commenced my crusade in favor of maize, and of my method of ensilage, the cultivation of that gigantic grass has increased more than ten-fold in France, and the commerce of New York will find with us an immense channel of export, if it can deliver to us seed in good order; for too often the maize coming from America has been heated by a long sojourn upon the ship, and has more or less lost its germinative power. Whoever can guarantee us against that damage, and insure the sending us the best species, that is to say, the variety that is most productive as forage, will render us an immense service. See if you can come to our aid in this matter.

My latest experiments have induced me to mix my fine straw and my cut straw with the maize at the time of ensilage. Mixed at the time of consumption, these straws are eaten without difficulty by the stock, but a very large proportion of them is to be found in the manure. It is not so when the straws have been softened and decomposed by a sojourn of a few weeks or months with the maize in the silo. I do not exceed, however, five per cent of the weight of the maize.

Sheep and cattle fatten with wonderful rapidity upon maize ensilage, with the addition of 8 to 10 per cent in weight of oil-cake meal.

Two of my disciples cut and ensilaged last autumn, one 120,000 kilogrammes of maize, the other 125,000, in one day's work. The more rapid the work the less it costs; and in America, where farming operations are upon an immense scale, there will be needed powerful cutters that will exceed 12,000 kilogrammes per hour.

I continue to publish from time to time articles upon ensilage, which can be found in *Le Journal d'Agriculture* of Paris. Be pleased to accept, Monsieur, the expression of my distinguished sentiments.

AUG. GOFFART.

CONCLUSIONS OF THE TRANSLATOR.

In England, all cereals used as food for man are called "corn," but those who first landed in America from that country found a new cereal used as food by the aborigines. They added it to their catalogue of corn with the prefix of Indian. It is raised from Canada to Patagonia; in Africa from the Mediterranean to the Cape of Good Hope; in Central Asia; in Australia; in Europe, in Hungary, France, and Spain. No other cereal, except rice, is so extensively cultivated, and in every part of the world alike the most valuable portion of the plant has been wasted.

It is remarkable that the corn plant, after having been cultivated mostly for its fruit since its discovery in America, should have been, so to speak, rediscovered in Central France. For it seems by the foregoing that far more animal as well as human life can be supported by the culture and preservation of the whole plant than by the fruit alone. The dried or partially dried stalk that our farmers have endeavored to compel their animals to eat, by adding to it labor and meal, is a pitiful nourishment as compared with the sweet, fresh, juicy, preserved plant that they might have had for all these centuries, if they had only happened to think of it. It was a veritable inspiration that came to Monsieur Goffart when he piled upon his ensilage the stocks and stones, and solved the problem by means of *continuous pressure.* These two words should become as famous as the Eureka of the Greek philosopher. The first notice of this matter in this country seems to have been made in the *American Agriculturist* of June, 1875, with illustrations of the best methods then known, and quite a full description; but at that time Monsieur Goffart had not made his final discovery of continuous pressure, and my own experience, as well as I doubt not that of many others (and the author of the article himself was exceedingly doubtful as to the extent of the

preservation or the value of the method), was that green fodder laid down in that way was sure to be more or less spoiled; at any rate the loss would be sure to discourage anybody. Mr. Morris seems to have come at once very close to the correct method, and by frequent trampling down he expelled sufficient air to very nearly prevent the forming of alcoholic fermentation; but if Mr. Morris had happened to have made his experiment in such a way or in such a climate that the superimposed earth had frozen too hard to settle, it would have been some time longer (if ever) before the world would have heard of his success. By such small accidents are great discoveries hastened or retarded in every field of evolution. A frozen arch of earth, from which the green-cut forage has settled away, is not the proper way to preserve ensilage, as the writer has learned to his cost. The outdoor silo, as well as the indoor, should be so made and covered that the air can be expelled by continuous pressure, and rain and surface-water kept out; and a thatched roof will be found better than any other kind.

And now that the proper way has been found, adapted to all countries wherever the plant can be grown—and no other has a wider domain—and which is also adapted to every other species of green crop that is capable of compression, what a future seems to be opening before the human race! If he is held honorable who causes two blades of grass to grow where but one grew before, how much more should we honor the man who has shown us the way to make four animals thrive where scarcely one did before? A cow to an acre is a reasonable result of the practice of ensilage. The labor of mere existence seems to have been almost annihilated. Our barns are to be turned upside down, and our mows located in the cellar.

The unlimited production of meat, butter, cheese, milk, hides, horns, and all other animal products, ought to produce an immense increase of human comfort, population, and the knowledge, science, art, cultivation, and refinement that can only come from leisure and freedom from carking care.

And now, lest the universal Yankee nation (and the Southern people are nowadays quite as proportionately prolific in inventions as the Northern) shall seek to load this discovery with patents and patent rights, and patent lawsuits, I would say that I have invented, and give freely to the world, every possible method of extracting air from the ensilage, whether by suction or pressure, chemical or mechanical exhaustion. Sheathing paper above the covering straw beneath the planks, has been used by Mr. Morris with excellent result. Baling, under pressure for transportation, with chemically-prepared cloths, has also been suggested, and I believe tried.

As one of the greatest of its results, may we not look forward for a speedy advance in the value of real estate, for a levelling up of the value of lands to the mortgages that rest upon them? True, there will not be so much of it needed, as the cattle upon a thousand hills can be supported in a few valleys; but with increasing wealth, the desire of ownership may return to the people here as it is in England. And as the happiest of its results, may we not look forward to the use of this new-found leisure in the improvement of our politics, in the wresting of all our governments from the trading politician, who pretends to represent one constituency while robbing every other, and assisting to rob his own?

Without a governing class or family, with legislators who are patriotic rather than professional, and with office-holders who are servants rather than rulers of the people, may not this whole nation look forward to lighter taxes and an easier life as the grand ultimate result of the great invention of ensilage? Those of our people who have been driven by dire necessity to remove to Texas, Florida, and other outposts of civilization, may return to live again in the older sections of the country. We can raise cattle in New York cheaper than they can be driven in Texas to the railroad shipping point.

A growth of farming villages, with all the social privileges, rather than a stupid life in scattered farm-houses, may be an-

ticipated as one of the happy results of preserving the summer fatness of our land, hitherto wasted.

The heat and hurry of haying will be avoided, for our new crop can be harvested on a wet as well as on a dry day. The danger of lightning to the fresh-filled steaming hay-barn will be avoided; the incendiary's torch will not avail him on this stored wealth; the tramp, indifferent to the danger, can no longer smoke his pipe in the warm hay-mow.

The grass crop of the United States has been of late years esteemed as more important and valuable than the cotton crop. "Grass is king," is sometimes said. But for half the year its throne has been the dry and dusty hay-mow. How much more royal will be its position henceforth, when fifty to one hundred tons per acre of juicy food can be surely and safely stored away each and every autumn? The cattle fed unlimitedly will respond with sleek and well-fattened sides, and the excess of supply can be returned with little waste of labor to the field that bore it.

The simplest and surest of all agricultural processes is the production of the stalk, and the use of this part of the plant for food, except by grazing, is quite modern. Tide-water meadows were until within a few generations the principal reliance for winter food of cattle by the farmers of the Coast States, and still are so in Florida and other Southern States.

The ownership of a tide-water meadow was considered a very valuable adjunct to any farm; the farmers along the Hudson River made quite a point of owning one not many years ago. I conclude that the proper winter sustenance of cattle in cold climates is a modern improvement.

It may be found that the increase of pastoral life (history repeating itself with improvements) is the sole and true escape from the cloud of poverty and misery that seems to be settling down upon the richest and oldest as well as the poorest nations of the earth.

Civilization, pushed too rapidly in the direction of mechanism and commerce, languishes. A complement is needed in an improved and widely adaptable agricultural system. At this epoch the world is startled with the news of a method for placing untold pastoral wealth, hitherto wasted, at the door of every rural dweller of the temperate zones. Does it not seem like the harbinger of better times, with ample food and clothing for all?

COMPOSITION OF MAIZE (GRAIN).

	Water.	Fat.	Albuminoid or Flesh forming.	Sugar, Starch and Gum.	Cellulose or Wood.	Ash or Minerals.
Mass. Golden 8-rowed	1251	494	1025	6937	135	158
Mass. White Flint	1361	362	910	6910	313	135
Mass. Red Flint	1134	460	881	7290	128	107
Illinois	1022	340	922	7425	147	144
Kansas	1195	340	1206	6947	202	110
Burr's Sweet	1068	777	1169	6270	494	222
Stowell's Evergreen Sweet.	1086	766	1110	6586	263	189

EXTRACT FROM AMERICAN AGRICULTURIST, JAN., 1879, SHOWING THE DISADVANTAGE OF DRYING CORN-FODDER.

By the Author of "Walks and Talks on the Farm," "Harris on the Pig," etc.

A LARGE farmer in Michigan writes that he has 20 acres of clover which it will not pay to mow. He wants to put it in wheat next fall, and asks, "How would it do to drill in corn for fodder previously? Can it be cut with a reaper and *cured* in time to sow wheat?"—I wrote him, "No." Corn-fodder can be cut with a reaper, better and far cheaper than by hand. But it cannot be cured and *removed from the land* in time for wheat. Some time ago I made a few stacks of corn-fodder to see how

it would keep, and we are now feeding it. I cannot recommend the plan. We never had a dryer and hotter or better time to cure corn-fodder than the past fall. The fodder was cut with a reaper and made into sheaves like wheat, and stuck up in small stooks to cure. Nicer fodder I never saw. It was as dry as we can ever hope to get it. Two or three acres of it was on low land, and we drew off the fodder and put it in six or seven stacks. It was in prime order. But it *heated* more or less in the stacks. The cows eat it with avidity, preferring it to hay, but the sheep do not like it as well as hay, while the corn-fodder that is now standing in large stooks in the field is highly relished by the sheep. I conclude, therefore, that the only way to preserve corn-fodder is to make it into large well-shaped stooks in the field where it grew, and draw it in as wanted during the winter. Or rather, draw in enough at a time during favorable weather to last a week or ten days.

FOOD INGREDIENTS—CHEMICAL TERMS EXPLAINED.

Water.—If a piece of wood or wisp of hay be dried some time in a hot oven, more or less water will be driven off. The water in feeding-stuffs varies from 80 or 90 lbs. in every 100 lbs. of young grass or fodder-corn, to only 8 or 10 lbs. to the 100 in dry straw or hay.

Organic Substance.—If the dried wood or hay be burned, most of it will pass off as gas, vapor, or smoke. The part thus burned away is the organic substance. The residue,

The Ash contains the mineral matters—that is, potash, lime, phosphoric acid, etc., of the plant. The most important part for our present purpose, is the organic, the combustible matter. This consists of three kinds of ingredients: albuminoids, carbohydrates, and fats. The main point in economical

feeding is to secure the right proportions of these at the lowest cost.

Albuminoids; also called protein compounds, proteids and flesh-formers, contain carbon, oxygen, hydrogen and nitrogen. They thus differ from the carbohydrates and fats which contain no nitrogen. The name albuminoids comes from albumen, which we know very well as the white of eggs, and it is found in milk. The fibrin of blood and muscle (lean meat), and the casein (curd) of milk, are also albuminoids. Indeed, the solid parts of blood, nerves, lean meat, gristle, skin, etc., consist chiefly of albuminoids. In plants they are equally important. Plant albumen occurs in nearly all vegetable juices, especially in potatoes and wheat, casein or legumin in beans and peas, and fibrin in the gluten of wheat, the basis of what farmer-boys call "wheat gum." Clover, bran, beans, peas, oil-cake, and flesh and meat scrap, are rich in albuminoids.

Carbohydrates consist of carbon and hydrogen. The most important are starch, sugar, and cellulose (woody fibre). They make up a larger part of the solids of plants, but only a little of them is stored in the animal body. Potatoes, wheat, poor hay, straw, and corn-stalks consist largely of carbohydrates.

Fats have more carbon than carbohydrates, and, like them, have no nitrogen. Fat meat, tallow, lard, fish oil, the fat (butter) of milk, and linseed oil are familiar examples of fats. Indian corn, oil-cake, cotton-seed and linseed, are rich in fatty matters.—*From American Agriculturist, Jan.*, 1879.

FARMING FOR PROFIT.

The most profitable farming is that which gives the largest returns for the smallest comparative outlay. This statement is based on business principles, but it is not always apparently true, for sometimes a farmer gets large crops with small out-

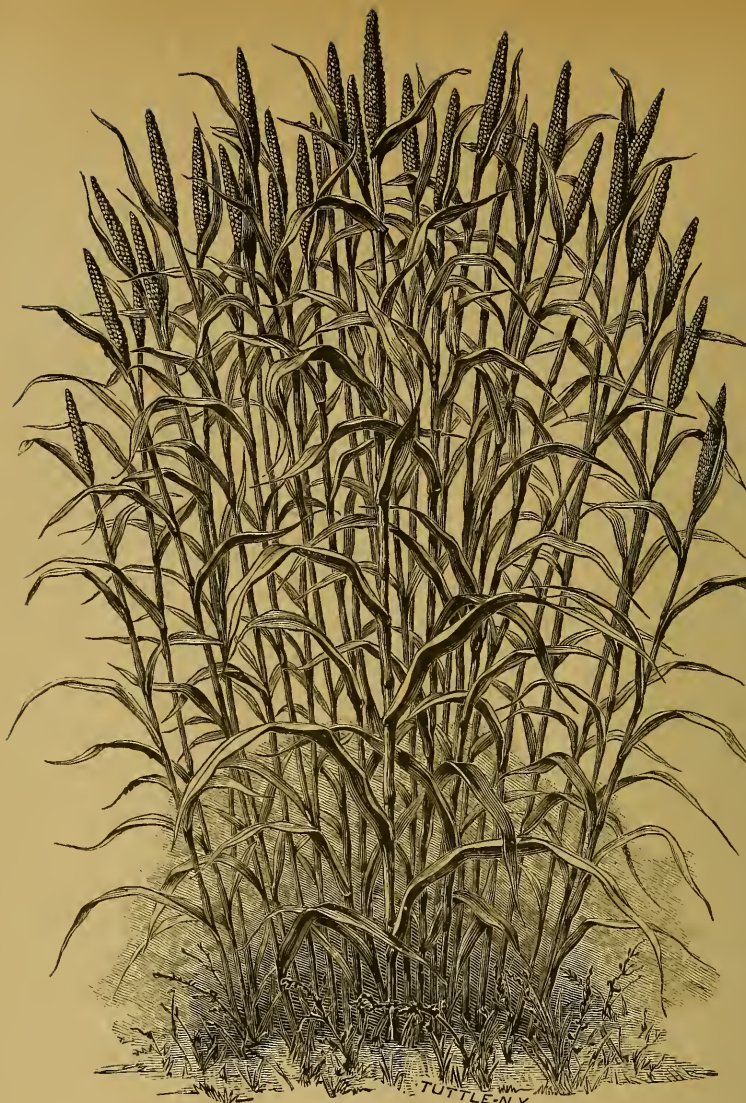
lay by the use of means which draw heavily upon the reserve forces of the soil. The latter should be reckoned into the expense account, but usually is not, though if such a course is continued, it results in exhaustion. To revise the first statement then : that kind of farming is most profitable which gives the largest returns for the expense incurred, without decreasing one's capital by exhausting the soil.

English agriculture dates its rise from the beginning of the fattening of animals for market. The most fertile farms in the Eastern States to-day, are, as a rule, those that are devoted to stock and dairy-farming. The production and sale of large crops of grain, potatoes, and other field crops, without any return of fertility, has caused the present sterility of the many thousand acres of comparatively exhausted farm lands, West, South, and East. If their owners had kept live stock for the consumption of the crops, and sold only the animal products and the surplus grain, etc., they might have been even more productive to-day than in the beginning. The growth of plants does not exhaust the soil, but on the contrary makes it richer, so long as the mineral and nitrogenous elements of plant-food are returned to the land. The action of the roots is to extract food material from the rocks (as we may regard the inorganic matter of the soil), and of the leaves to draw it from the air, and to store it in the soil; but if more than the material thus obtained is removed and not returned, exhaustion necessarily follows.

By feeding crops to animals, the larger portion of the essential mineral and nitrogenous portions are returned to the soil in the resulting manure; particularly is this the case in fattening mature animals, and in the production of butter and pork. An animal extracts from its food, nitrogen for its muscles, phosphate for its bones, some potash, and the vegetable oils and other carbonaceous matter for its fatty tissues and for respiration. The nitrogen, phosphates and potash, we must supply to the soil, as plants seldom obtain these materials from

natural sources so rapidly as we remove them in crops sold; the material for oils, sugar, starch, and other carbonaceous matters are furnished to the plants from air and soil in ample quantities to meet all demands. Now, a growing animal stores up the first three of these food materials. A mature animal, on the contrary, only uses enough of them to make good the wastes of the body, but these wastes are all found in the excrements; so that practically a fattening animal removes *none* of those constituents of its food that are valuable for manure. We can, therefore, feed the home-grown crops and purchased food to mature animals, and get nearly or quite its full value twice over, in beef and in manure for the production of more crops.

Similar principles apply in feeding swine. Pork is for the most part composed of the fatty matter which costs nothing in the crop. Hence the value of hog-manure, with which every farmer is familiar. In butter-making also, very little if any fertility is removed from the farm in the butter sold, at it is composed wholly of fatty compounds. This fact is illustrated in practice by the exceptional fertility of butter dairy farms, which, instead of becoming sterile are continually growing more fertile. These facts indicate that the profitable farming of the future in many sections, is to be, as it is to-day, in increased attention to fattening animals and dairying.—*From American Agriculturist, Jan.*, 1879.



PEARL MILLET.

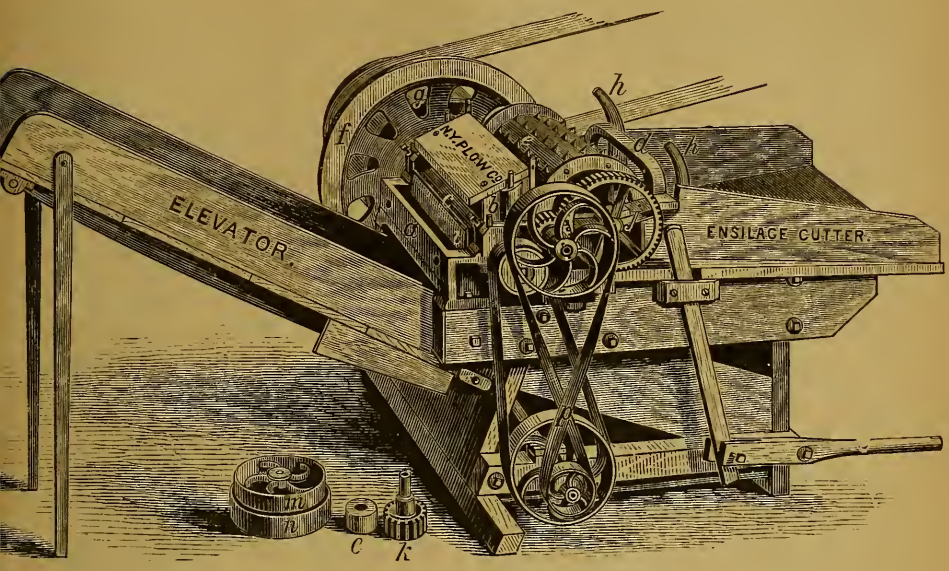
This new fodder plant may be found to be even more productive than the corn-plant, on account of the several cuttings that may be made in one season. If properly ensilaged it will doubtless be more attractive and nutritious than if dried; and the same method will undoubtedly preserve this also.

The following article is from the pen of the well-known Horticulturist, Peter Henderson:

Pearl Millet has been cultivated for some years as a forage plant in some of the Southern States, as "African Cane," "Egyptian Millet," "Japan Millet," and in some places as "Horse Millet," but little was known of it at the North before last year, and then only in such small quantities as to hardly allow of a fair trial. From what we saw of it in 1877, we determined to give it a thorough trial this season. A piece of good strong loamy ground was prepared as if for a beet or turnip crop, by manuring with stable-manure, at the rate of 10 tons to the acre, plowing 10 inches deep, and thoroughly harrowing. The Millet was then sown in drills 18 inches apart, at the rate of 8 quarts to the acre. We sowed on the 15th of May; in 12 days the plants were up so that a cultivator could be run between the rows, after which no further culture was necessary, for the growth became so rapid and luxuriant as to crowd down every weed that attempted to get a foothold. The first cutting was made July 1st—45 days after sowing; it was then 7 feet high, covering the whole ground, and the crop, cut 3 inches above the ground, weighed, *green*, at the rate of 30 tons per acre; this, when *dried*, gave 6½ tons per acre as hay. After cutting, a second growth started, and was cut August 15—45 days from time of the first cutting. Its height was 9 feet; it weighed this time at the rate of 55 tons to the acre, *green*, and 8 tons dried. The *third* crop started as rapidly as the second, but the cool September nights lessened its tropical luxuriance, so that this crop, which was cut on October 1st, only weighed 10 tons green, and 1½ ton dried. The growth was simply enormous, thus: 1st crop in 45 days, gave 30 tons green, or 6½ tons dry; 2nd crop in 45 days, gave 55 tons green, or 8 tons dry; 3d crop in 45 days, gave 10 tons green, or 1½ ton dry. The aggregate weight being 95 tons of green fodder in 135 days from date of sowing, and 16 tons when dried to hay. This exceeds the clover meadows of Mid-Lothian, which, when irrigated by the sewerage from the City of Edinburgh, and cut every four weeks, gave an aggregate of 75 tons of green clover per acre. There is little doubt that Pearl Millet is equally as nutritious as corn-fodder, which it resembles even more than it does any of the other Millets. We found that all our horses and cattle ate it greedily, whether green or dry. If sowing in drills is not practicable, it may be sown broadcast, using double the quantity of seed—say 16 quarts per acre. The ground should be smoothed by the harrow, and again lightly harrowed after sowing; if rolled after harrowing, all the better. I know of no farm crop that will better repay high manuring, but so great is its luxuriance, that it will produce a better crop without manure than any other plant I know of. In those parts of the Southern States where hay cannot be raised, this is a substitute of the easiest culture, and being of tropical origin, it will luxuriate in their long hot summers. Even though our Northern seasons may be too short to mature the seeds, our experiments in New Jersey this summer show what abundant crops may be expected if the similar conditions are secured. Pearl Millet as a fodder-plant presents a new feature in our agriculture, and I feel sure that within ten years we shall wonder how we ever got on without it. Besides our own testimony given above, we have received the most satisfactory letters from experienced men in different parts of the country to whom we sent seed of Pearl Millet for trial, and all are unanimous as to its enormous productiveness and great value. From all we have seen and can learn, we are fully convinced that Pearl Millet is to be one of the great fodder plants of the future.

THE ENSILAGE CUTTER

OF THE NEW YORK PLOW COMPANY.



This machine has been arranged especially for the purpose of cutting large quantities of green crops, such as green corn-stalks, millet, &c. It can be run with a good two-horse power or with portable engine, and do a great amount of work.

Of course smaller cutters can be used, with more or less execution, but in providing the proper machinery for the new method of preserving winter fodder, it is all important to have it operate rapidly, and therefore economically.

This machine feeds itself, without danger to the operator, and is so strong that it cannot be broken or worn out with honest usage. It will cut seven different lengths, from $\frac{1}{16}$ to 3 inches, by changing the pulleys in accordance with the directions attached. It will cut four to five tons per hour of green corn-stalks of the length of $\frac{1}{100}$ of an inch. It will also cut one to two tons per hour of dry fodder. It is also valuable in cutting straw to spread upon land for manure.

THE ENSILAGE CUTTER.

INSTRUCTIONS FOR CUTTING FODDER DIFFERENT LENGTHS.

All the pulleys in this list go on the end of pulley shaft next to 12½-inch pulley.

2½	inch	pulley	will make the machine cut	⅛	of	an	inch long.
3⅛	"	"	"	¼	"	"	
4⅛	"	"	"	42-100	"	"	
7⅛	"	"	"	¾	"	"	
9½	"	"	"	1	inch	"	
12½	"	"	"	2	inches	"	

The machine is set up to cut 42-100 of an inch long.

Further information supplied by the NEW YORK PLOW COMPANY, 55 Beekman St., New York.

RECENT IMPROVEMENTS IN PLOWS.

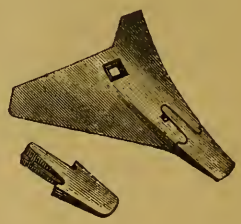
The improved American plow holds a high rank among the implements of modern husbandry, not only at home, but in the foreign market. In form, materials and construction, it appears to be all that it is capable of being, and yet there are constant developments of new points of excellence. The most obvious improvements within the last few years consist in the use of hard metal, first for the edge, and later for the entire wearing surface. Chilling the edges and point of the share and the bottom of the land-side, was the first step in the line of progress, made about thirty years ago, but within the last ten years attention has been directed to the importance of reducing the friction of the mold-board. Hardened steel was introduced for this purpose, and is still recognized as the best material where soil is wholly free from grit, but it was found that a chilled surface of cast iron, in combination with the chilled share and land-side, was more easily and economically kept in repair in all soils containing grit. The well-known process of chilling first resorted to, consisted in running the molten metal against the surface of cold iron. This method, while rendering the metal harder, made it correspondingly brittle, and required great care in the mixture of the iron to make the chill penetrate uniformly. This plan also required a method of annealing, sometimes with hot water, or by building fires on the back of the mold-board, and sometimes by covering with heated sand.

Later improvements in mixing metal have been successfully made, so as to secure entire hardness throughout, without the chilling process. Plows made in this way are usually known by appropriate names, such as "Adamant," &c. We learn through a large plow-making establishment in New

York (the New York Plow Company), that long experience has taught them that steel in a certain condition will mix with melted pig iron, and with the addition of certain chemicals will make a homogeneous metal by pouring it into molds at the right time, which time is ascertained by means of its color. In this way the result is "hardness, uniformity and strength."

In former years, plows made of cast iron were so rough that farmers were severely tried in keeping them bright. As plows have grown harder, the polish is more difficult to produce, as well as more durable, and on the metal here referred to, is said to suffer little from corrosion. As the friction of the plow is equal to about thirty-five per cent of the whole force of the draught, every expedient to reduce it is important to the plowman.

A still better improvement in this direction was recently achieved by the introduction of a reversible point in the share, which thus becomes self-sharpening, and enables the farmer to keep the bottom of the plow level, thereby avoiding the friction that arises from a projection of the point of the share below the general level. It has been found that the effect of a sharp point is to sharpen the wing also. Among other improvements is the setting of the beam in the centre instead of one side of the line of resistance, which is adjustable at the standard so as to produce a balance, avoiding side draughts.—*From Iron Age.*



N. B.—All these improvements are contained in the **Adamant Plows** of the New York Plow Company.

THE WORKS OF THE NEW YORK PLOW COMPANY.

Office, 55 Beekman Street.

The Main Building is 400 feet in length, heated by steam, with steam elevator, gas and water. It contains an entire outfit of new and improved Machinery and Tools for iron and wood working. In the rear of this building are large Foundries, Forge shops, Engine building with 250 horse-power engine, and large storage buildings for finished goods.

JUNE 1, 1879

ADDENDA

To accompany "ENSILAGE OF MAIZE," by J. B. BROWN,
55 Beekman Street, New York.

EXTRACT FROM JOURNAL DE L'AGRICULTURE, October 19, 1878.

M. A. Goffart, desirous of making known the remarkable results that he has obtained from the cultivation and preservation of maize-forage, invited to his celebrated farm at Burtin, on Oct. 12, many agriculturists who are interested in this important question. A hundred accepted his invitation, and they received at Burtin the most generous hospitality. Among those present we should mention the Prince Catacuzene, a large agriculturist of Southern Russia and Russian Commissioner to the Exposition; M. Fernandez de Neda, Commissioner from Spain; M. Rob Runèberg, Commissioner from Finland; M. Deutch, large agriculturist in Hungary; M. Boitel, Inspector-General of Agriculture of France; M. J. A. Barral, Secretary of National Society of Agriculture of France; and the officers of eight other agricultural societies of France. There were also a director of a school-farm, a director of a penal colony, proprietors of estates in different parts of France, mayors of cities, manufacturers of agricultural machinery; also Monsieur de Fontenailles, a distinguished silvi-cultivator (forest tree cultivator, a branch of industry now attracting much attention in Europe, as a remedy for drought). We left Paris in the morning by special train to Nouan-le-Fuzelier. A few minutes' ride by carriage and we are at Burtin, where a magnificent banquet, prepared under an elegant tent, awaits the guests. The first toast is to M. Goffart, the last to Sologne, "too little known, and which the skillful pioneers of the thirty years last past have so happily transformed." After the banquet came the more important business. The operation of gathering and ensilaging the maize had been under way for several days. One of the silos was already full, the second was being filled. The gigantic maize is brought from the field in wagons, which stop just behind the feed-cutter. The stalks are fed to the machine, which is run by a steam-engine. They are cut into disks of one centimetre long (about 4-10 inch), and carried by an elevator above the wall of the silo, and fall within it. A man spreads the layer, a woman tramples around the silo. When it is full it will be covered with plank, which will be loaded with large stones about 400 kilogrammes (about 900 lbs.) per square metre (about 10½ square feet). It will be perfectly preserved, without fermentation, until the time when it is needed for use. In the month of May we took from the last silo at Burtin the last layer of maize. It had the same temperature that it had at the time of ensilage, and it presented not a trace of any deterioration. There is no doubt that the result will be the same this year. All the agriculturists

who have followed exactly the directions of M. Goffart have obtained the same result, and their numerous testimonials bear witness to it. (For full description of M. Goffart's process, see Ensilage of Maize, &c.) There are three silos for maize, and one for oats, cut green, which was filled in the Spring, and which has been fed out to the working animals.

M. Goffart has to-day 68 horned cattle in his stables, six horses, and one mule. With his resources of maize fodder, he can not only support for seven months 150 horned cattle, but also put them in condition for the butcher, upon 32 hectares (about 79 acres). After having visited the fields of maize, the numerous guests departed, delighted with what they had seen.

THE CULTIVATION AND PRESERVATION OF MAIZE-FODDER.

Letter from Monsieur A. Goffart, April 28, 1878.

My last silo, more than 300 cubic metres in capacity, will be emptied by May 10th. You will remember how my frosted maize last September had to be cut as quickly as possible, when it had only attained two-thirds of its growth. The frost had completely stopped its growth, and the blackened stalks would have fallen to the ground at the first rain. I cut it, as I always do, one centimetre (about 4-10 inch) long, and I ensilaged it without any addition of salt or straw or cut hay. The preservation has been, and is still, *perfect;* not a kilogramme of it has been wasted. Having been cut when so very young, it has produced a very tender fodder, the nutritive power of which was evidently superior to that of my previous ensilage. The question arises, whether this increase of nutritive value compensates for the loss of weight in a crop cut prematurely. I do not think it does. It would need to be 30 per cent. at least superior to that of maize cut when the ear is in the milky state, for the loss of weight is at least in that proportion.

Comparative experiments and analyses of our skillful chemists will soon enlighten us on this important subject.

Another very remarkable effect upon ensilage by frosted vegetation is this: while maize ensilaged in ordinary condition takes on the alcoholic fermentation in twelve to fifteen hours after contact with the air, the frosted maize required two, and sometimes three days. The farmer, therefore, need not be alarmed at these premature frosts, but should be ready to ensilage his crop immediately upon their appearance. I find that the tall Mexican corn becomes exceedingly hard, and quickly dulls the knives of the cutting machine. I shall not use that kind again.

Feb. 1, 1879.—I now give you the facts which I have gained from the experience of the past year, at my farm at Burtin. I find that I was mistaken when I advised that the silo should be filled as quickly as possible. The shrinkage or subsidence which takes place in the first few days of the compression, is so considerable that the upper half of our silos are soon empty, and therefore we lose one-half of the capacity, and the expense of establishing them is just doubled. I now advise that the silos should not be filled too quickly. In recharging a silo that has been commenced with a layer

of fresh maize of fifty centimetres (20 inches) each day, you will keep sufficiently ahead of the fermentation during the ensilage, and the spontaneous shrinkage will have been sufficient at the end of eight or ten days, of daily refilling, so that the subsequent subsidence will not exceed one-tenth of the total height. My silos, filled this Autumn, are more than five metres high, and only show a void at the top of half a metre. By having two or several silos of a certain capacity, the work can go on continuously. Some farmers have ensilaged this year 100,000 to 120,000 kilogrammes per day (220,000 to 264,000 lbs.).

My maize is cut in the field by women, with sickles. They have great skill in the use of that implement, and eight women will cut easily one hectare a day (2½ acres). They receive 15 francs per hectare, and therefore earn about two francs a day each. I found a difficulty in roofing over my three united silos, on account of the great size of the group thus formed. On this account I would prefer to unite only two silos, and increase the length, while preserving the other dimensions, so as to obtain the same capacity. Something would be gained also by replacing the semicircular ends with arcs of a circle of a greater radius, which would diminish the expense of roofing, and increase the capacity, without, I think, endangering the preservation of the maize.

The proximity of the silos to the stables is important, as to economy of labor, but it is an advantage sometimes to put them at a distance, as the land may be more suitable. The solidity and the smooth working of the cutting-machine are of great importance. The French machine, with eight horse-power, will cut 100,000 to 120,000 kilogrammes per day, in pieces of one centimetre long (4-10 inch), and costs 800 francs. If water invades a silo, whether it enters from without or from compression upon maize that is very wet at time of ensilage, it should not be wasted; cattle will drink that kind of grass-soup with great avidity.

When I opened, last October, the silo in which I had enclosed in May about 60,000 kilogrammes of green rye, I found it darker in color than usual, and it exhaled a disagreeable odor, indicating the presence of butyric acid. Although this odor is disagreeable to man, it does not cause to animals the same repugnance, and my rye was eaten entirely, and without the least hesitation. Never before had my ensilaged rye presented this kind of alteration. The alcoholic fermentation, though less than in maize, had always before developed sufficiently to make it agreeable, both in taste and smell, to both man and beast.

There was, therefore, an abnormal effect, a special alteration, which it is important to avoid, since, when it passes certain limits, it will disgust the animals and also injure their health, if we persist in feeding it to them. At the time this rye was cut down for ensilage it had been *fallen* for a long time, and the foot for more than eight inches had yellowed; it was already undergoing the commencement of decomposition. To prevent this I used salt in considerable quantity, but it had not served to neutralize the effect of the evil; the butyric fermentation had already invaded the ensilaged vegetation, and this fermentation remained, notwithstanding the presence of the salt. I believe, however, that in this case salt was useful, suspending by its antiseptic qualities the decomposition, and assisting to excite the appetite of the animals, who, perhaps, without the salt, would have refused it, since the more important condiment, alcohol, was absent.

I ensilaged in September several wagon loads of clover that was fully ripe and had fallen for several weeks, and though I took special care with it, and compressed it very energetically, and mixed salt with it, viz., 3 kilogrammes to the thousand, on discharging the silo at the end of December, I found a blackened mass, viscous, and nearly insipid.

This ensilage was entirely eaten by the animals without any aversion, but it quickly contracted butyric acid, and if it had been exposed to the air for a considerable time the animals would have manifested an increasing aversion, and finished by refusing to eat it. I have frequently observed this in ensilaging whole maize. I give this explanation with hesitation, because so much obscurity still rests upon the science of fermentations. When the butyric fermentation permeates an ensilaged mass, and this mass is exposed to the air, does there not form, to the detriment of the nitrogen contained in that mass, a liberation of butyrate of ammonia, which impoverishes the alimentary matter and finishes by taking away all its nutritive power? The animals thereupon refuse to take into their stomachs a food which is fictitious, its nourishment being exhausted.

Vegetation which has been attacked by butyric acid, before cutting, in the field, needs also to be covered and compressed *at once*, or the air that is not expelled will increase the activity of the pre-existing acid. Prickly comfrey, notwithstanding great pains taken, I have found refractory to alcoholic fermentation, and when exposed to the air quickly becomes invaded by butyric acid, requiring quick consumption in order to save it. While this plant is a very excellent fodder, it is well known to be poor in saccharine matter. Therefore, alcoholic fermentation may fail in two cases: when sugar is not abundant in the ensilaged material; when a considerable alteration existing at the time of ensilage prevents its development.

EXTRACT FROM A LETTER OF M. De BEAUQUESNE,

One of the Most Distinguished Agriculturists of France.

December 17, 1878.

"I am preparing a series of articles on ensilage. I send you the part relative to the cost. I have a feed-cutter, with three knives, cost 800 francs ($160). I tie the stalks in bundles of about 10 kilogrammes, using for that one of the stalks. Two men take the maize from the unloaders and place it on a narrow table prolonging the box of the cutter; another man passes it along to the man that feeds it to the machine. I have two men in the silo. Thus I make the cost:

Five laborers at 35 cents	$1 75
One mechanic at cutter	50
One engineer	70
Coal, 330 lbs.	1 50
Oil	15
Use of engine	2 00
Use of feed-cutter	1 00
Incidentals	40
	$8 00

"Ten bundles pass easily per minute, making 225 lbs. or 13,500 lbs. per hour; but as there is time lost in oiling and examining knives and removing them to sharpen, I only reckon 9,000 lbs. per hour as regular result. This gives a net cost of 20 cents per 2,250 lbs. *Ce n'est rien.* I have not tried with a horse-power, but I have it from a neighbor that it costs 60 cents for 2,250 lbs. This is still endurable. I am about to make an experiment to determine the comparative nutritive value of hay and ensilage. One of my milch cows has fed a month on the latter. I believe that its nutritive value is more than one-third, and I shall not be surprised if 220 lbs. of maize are worth at least 110 lbs. of hay, and probably more.

"I have just let a farm on shares, and the party stipulated that I should let to him my steam-engine and feed-cutter, because there was a silo, and it was only for that reason that he took the place. I say frankly that I believe we have made a mistake in our successive plantings of maize, in order to feed it green. It would do better to harvest it all at the same time, and ensilage it all. There would be more economy, and the maize that we should use, after being three weeks in the silo, would be more nourishing. I shall do it so next season. The later planting often gives bad results, and the ground is not so easily worked."

Monsieur Goffart remarks upon this letter: "My ensilages the past year reached more than 132,000 lbs. per day, and the cost per ton was 25 per cent. less than his figures, which can be explained by the fact that my machinery was more powerful than his.

"I agree with M. de Beauquesne as to the relative value of ensilaged maize and hay. Ensilaged maize at Burtin is worth in nutritive power one-half that of hay; but our hay in Sologne is poor, and in other countries the relative value of maize may decline to one-third.

"M. de Beauquesne, after giving in detail the different expenses of ensilage, adds, 'it is nothing.' I will go farther than he, and I will say, this expense constitutes a considerable saving. The expense of cutting and ensilaging a million of kilogrammes of maize is, at most, a thousand francs. Instead of proceeding, from day to day, to cut up the maize for the day's sustenance of your animals, you prepare in 15 days the food for 200 days; you have put your maize in such a condition that the stable-man has no other trouble but to fill his basket in the silo and empty it in the manger. Here are some figures in proof of this statement.

"On a farm in the valley of the Loire are fattened each winter a certain number of animals, with beets, hay, and oil meal. Twelve animals on this diet require the steady work of a strong laborer, who washes and cuts the beets and chops the hay or straw. This laborer is paid 45 cents per day. He receives, therefore, 3¾ cents per head. At Burtin, with the ensilage at three steps from the stable, two men, at the same wages, take care of 80 animals, making a daily expense of 1⅛ cents per head. The difference in favor of Burtin is more than 10 francs per day, and this saving is more than double the sum expended for ensilage.

"The last paragraph of the letter, relative to the advantage of feeding only ensilaged maize, even in summer, agrees perfectly with my ideas. I wrote in 1875, in one of my pamphlets, 'It should never be lost sight of that to cut, and to ensilage in a way to obtain a good fermentation, is to increase enormously the alimentary value of maize; and I ask if, even in autumn, when the fresh maize is abundant, it would not be an advantage to pass it through the silo.'

"In order to settle this question careful and intelligent experiments are necessary, and no one is better able to resolve it with authority than M. de Beauquesne."

FROM M. GOFFART'S SECOND EDITION.

Great care should be taken in the construction of silos. The walls should be capable of resisting the pressure from the loaded mass when full, and from the surrounding earth when empty. Too much economy in their construction is unprofitable. When the underground portion is cemented (which costs only half as much as brick wall), great care should be taken as to the material as well as the workmanship. Those who have a convenient declivity can save much expense by building the silo so that the upper portion will be level with a platform on which the loads can be discharged, and on which the cutter can be set up, so that the cut fodder can fall into the silo, thereby avoiding the expense and use of an elevator. The entrance to each silo I formerly closed with boards fitted in grooves in the masonry, but I now close them with a temporary wall of dry masonry plastered inside, to be removed when the silo is opened for use. One hour of a mason to each port is sufficient.

The most important question is the covering of the ensilage. It should be a layer of dry straw not cut, six to twelve inches thick, spread evenly. Do not use aftermath or short, soft straw, as it is liable to become impermeable and to imprison any vapor which may issue. Rye straw is best; after that, wheat and oat. It is important that the vapor should escape, as there always will be more or less from the upper portion of the mass.

Boards are more suitable than planks to lay upon this, because they conform more readily to the inequalities of the surface in settling; the centre always becomes more depressed than the portions near the walls. But I expect to use bricks instead of boards, so as to form a compact layer, and of sufficient height to give the necessary weight. Iron weights with a ring cast in will be still better, in those countries where iron is cheap, on account of convenience of handling. When removed they should not be thrown down, but piled on the walls. I shall also use sacks of phosphates intended for manure.

EXTRACT FROM A LETTER FROM M. GOFFART, MAY 13, 1879.

The fields of France present at this time a sad aspect. We shall apparently harvest in 1879 little hay and very little grain. I have lost by water all the rye that I intended to feed green this spring, but I find that I have sufficient ensilage to last till August. I have fattened this winter 43 animals, which I have sold in the markets of Paris and Orleans. They are of the large races of Nivernaise and Charolaise, and have averaged 1,800 lbs. I added to their rations of ensilaged maize 10 per cent of palm, peanut or cotton-seed cake. I feed also $2\frac{1}{4}$ lbs. per day to the milch cows, which has wonderfully increased the yield of milk, and about $1\frac{1}{8}$ lb. per day to animals under 18 months. In America you can use to good advantage distillery grains for this purpose. Say to your countrymen that such of them as would like to visit France, and study the ensilages of Burtin upon the spot, may feel sure of meeting a kind reception there.

EXTRACT FROM LETTER OF EDWARD H. KNIGHT,

AUTHOR OF MECHANICAL DICTIONARY, COMMISSIONER TO PARIS EXPOSITION.

WASHINGTON, March, 1879.

"Your book came safely to hand. I have read it through, and although I had seen the models of the silos at the Paris Exposition, and heard a great deal of occasional chat on the subject, I had no adequate idea of its importance. I have a farm on a river bottom, and buildings in which silos can be conveniently erected, and I am heartily glad that I met a leading spirit."

REMARKS.

One question that cannot as yet be answered by experience is the degree of cold that a silo filled above ground can be subjected to without injury. I presume that the chemical action which exists even in the compressed material, will be sufficient to prevent any injury from this cause, but probably a small protection on the outside, or north side of wall will insure its safety.

It is probable that maize sown broadcast is not proper matter for ensilage, as its saccharine capacity is less developed than when planted in drills; no sugar, no alcohol. There is a French maxim, "Who has hay has bread." Since fodder supports cattle, cattle yield manure which brings fertility to the soil and abundance to the harvest. The one thing lacking to the South and East of this great country is cattle. I believe that "silos" and "ensilage" will supply this lack, and that everywhere and all over, cattle raising and fattening will take the front rank in agricultural industry.*

The price of Ensilage Cutter is $125 at New York. It is strong enough for any kind of power, while it can be run even by one horse. Weight about 1,000 lbs.

I shall be happy to receive and to print any additional facts that may be ascertained upon this subject. It certainly seems to promise to contribute more to the happiness of the human race than any other physical discovery that has ever been made. The suggestion that green grass or green fodder is not the most economical or profitable food for cattle in the summer season is certainly a revolutionary idea.

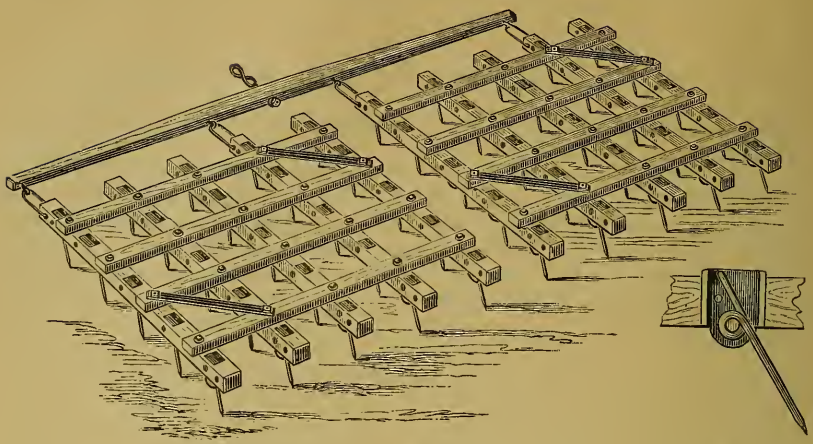
M. Goffart states that the processes which have been recommended by a certain French writer, and which were unfortunately published extensively in this country, were defective, and have caused the loss of much money to several agriculturists in France, who to-day do not like to hear the subject mentioned. It is greatly to be desired that American agriculturists should start on the right track and not be misled or discouraged by careless or superficial articles on the subject.

Ensilage may be not only a store for winter use, but against drought as well.

J. B. BROWN,
55 BEEKMAN STREET, NEW YORK.

* Kansas exhibited, at Centennial Exposition, a stalk of maize 21 feet high. A man, by reaching up with umbrella or cane, could touch the lowest ear.

THE NEW YORK PLOW CO.'S



ROCKING-TEETH SMOOTHING HARROW

And BROADCAST WEEDER.

PATENTED JUNE 25, 1878.

When drawn from one end, the teeth are perpendicular; it is then a pulverizer. When drawn from the opposite end, the teeth incline backward, which makes it a smoothing harrow; hence, it is of double the value of other smoothing harrows.

Other smoothing harrows have fixed teeth, which flatten and bevel off on one side and do not cover seed or clear themselves as well as these rocking-teeth do.

The teeth of this harrow are made of ½-inch round steel, tempered in oil, and coiled around a stud, which gives them sufficient elasticity to prevent breakage even in rough land. They are attached to the frame by bolts, and can be easily removed if necessary. The frame is made of the best white oak or ash, well braced, and bolted together so that any piece can be easily and cheaply replaced.

By means of the adjustable draft bar, this harrow can be adjusted so that the teeth will have a greater or less angle to the line of draft; *i. e.*, they will cut under more or less as desired. On this account it is better adapted to both weeding and pulverizing than any other harrow.

Single Frame, width of track 4½ feet, weight 115 lbs.....$15.00
Double " " " 9 " " 220 lbs..... 25.00

It is very easy to save the cost of this Harrow by the increased yield of grain or clover in a single day's work. We send the Double unless ordered Single.

MANUFACTURED BY

THE NEW YORK PLOW CO.,
55 Beekman Street,
NEW YORK.

THE NEW YORK PLOW CO.'S

ADAMANT PLOWS.

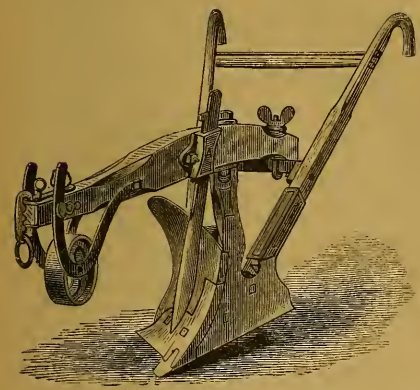
Hard Metal, but Not Chilled, and Not Brittle.

ADJUSTABLE BEAM. BALANCED CENTRAL DRAFT.

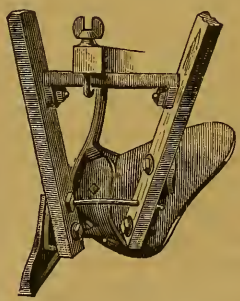
Excelling in Scouring Qualities Lightness of Draft, and Perfect Fitting Repairs.

THE METAL, of which they are made, is of uniform hardness—SO HARD that it CANNOT BE DRILLED OR FILED—SO FINE in GRAIN that it will polish like a mirror. The polished surface of the mold-board will not roughen any more than glass. Rust does not eat into it; and when coated with rust it will re-polish in the ground in two minutes as bright as silver. One mold-board of this metal will wear at least as long as three of steel. The *hardness* of this metal causes these plows to *draw* much easier than ordinary cast-iron or steel plows. The metal is uniform, and not liable to soft spots, as chilled plows always are; a piece suspended rings like a bell.

We have abundant testimony that this metal will clear itself in soil where some steel plows will not work at all.



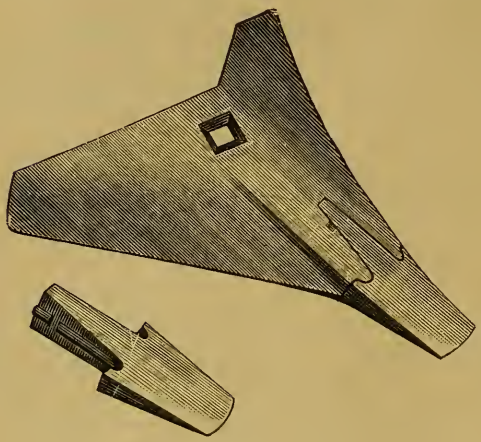
FRONT VIEW OF ADAMANT PLOW.



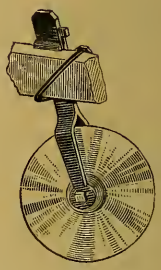
REAR VIEW OF ADAMANT PLOW.

A NEW PRINCIPLE.—The BEAM is placed in the MIDDLE OF THE WORK, giving the plow a CENTRAL DRAFT, and avoiding all underneath and side friction. This is also desirable for one-horse plows, as it permits the horse to walk in the furrow. The beam being movable at the points of attachment, the central draft can always be kept perfect. The adjusting is done at the heel of the beam, which can be moved from or to the land, as desired, which brings the work under exact control of the plowman. Even if the beam *warps* or *springs*, he can correct it. This adjustment is a great advantage in plowing among trees and through rows of corn. The beam is easy to replace if broken. The handles are straight, and can be easily replaced by the farmer. It is high

under the beam and not liable to choke. The landside sloping inward relieves the pressure, and when in use, the plow glides through the soil with great ease, and with such steadiness, that when properly adjusted, a child might hold it. The adjustment of the IRON BEAM PLOW is made at the slotted clevis; both the WOOD and IRON BEAM PLOWS, when properly adjusted, run so steady as to scarcely require holding at all.



SHARE OF ADAMANT PLOWS.



ROLLING COULTER.

The slips, by being reversed when worn, restore the level and the land.

REVERSIBLE SELF-SHARPENING SHARES enable the farmer at all times to make his plow run level and true.

The effect of a sharp point to a plowshare is to sharpen the wing also. These reversible slip points sharpen themselves by being reversed, saving at least one-third the draft, as the plow does not require to be tipped up.

The effect of a sharp and level-bottom share is to make the bottom of furrow level, and to save draft by cutting instead of scraping with the edge of wing.

These shares are so constructed that the point (which we call slip) can be detached from the main body of the share, into which it is fastened with a common cut nail driven in as a key, with the wedge of the nail driven up and down the share, which draws the slip up tight, and broken off top and bottom downwards. It can be readily driven out from the bottom with another nail. This enables the plowman to turn it over at any time.

These shares being always sharp do not require the hollow or dip which is necessary in the solid shares in order to make them penetrate when dull, and which not only requires more power, but more labor to hold the plow; at first, to keep it from running IN, and when dull, to keep it from running OUT. Every plowman will appreciate this.

These shares also preserve the wing as the plow runs level, and the wing wears sharp instead of growing thick and dull, as they must do in all plows that do not run level. Where the plowman uses the precaution to wear one side of two or three slips before turning any of them, and thus preserves the correct lines, the wing of the share has a cutting edge as sharp as if ground on a grindstone.

Reversing the slip also keeps it true on the landside corner.

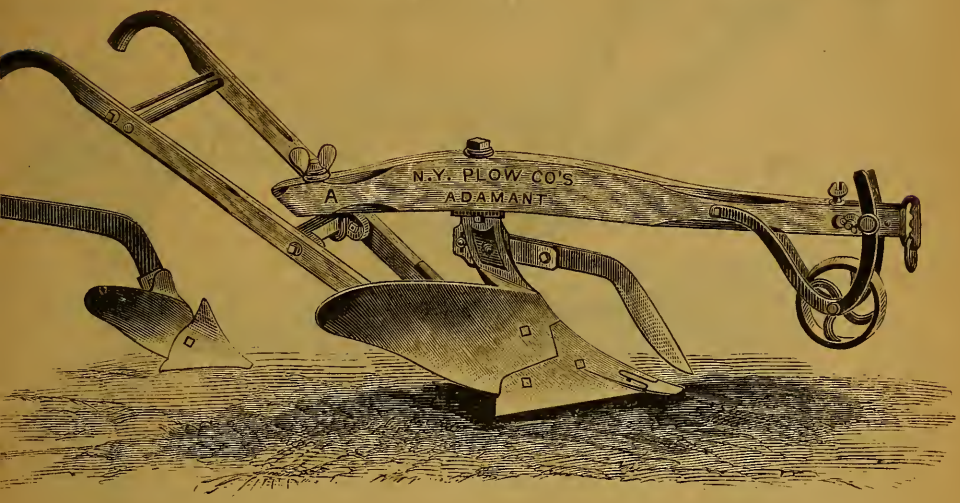
With sharp shares and level running plows, land is more thoroughly broken up, with a saving of labor and time, and with a uniformity of depth which is not possible with a solid share, consequently a larger yield of crops.

The wings of these shares are wider, and thinner, and harder than usual, and level on the bottom.

By actual test we know that there is more service in one of these **Reversible Slip Shares** with three extra **Slips**, than in eight solid shares, while the draft of the plow is reduced at least one-fifth, and the cost of shares about two-thirds.

ADAMANT A.

Two-Horse.



This is a LARGE TWO-HORSE PLOW, suitable for both SOD and STUBBLE GROUND, and for both SMOOTH and STONY LAND. It is sufficiently strong for an ox team or for three horses. It makes a furrow 12 to 14 inches wide by 7 to 8 inches deep. Height under beam, 17¼ inches.

Its draft is about as light as that of the PEEKSKILL PLOW—19½—which makes a furrow 4 inches narrower than Adamant A, and is known as an exceedingly light draft plow for two horses.

It turns the furrow slice well over, pulverizes and loosens the soil, and covers weeds, manure, etc., in a manner that surprises a man using it the first time. It is a cheap plow to keep in repair, and saves at least one-fourth of the power required to operate other plows. It catches in quick in stony soil. It has slip shares, as also do all sizes. The Coulter and Jointer are attached to standard, so as to be adjustable.

Sent with wheel and coulter, UNLESS OTHERWISE ORDERED. The wheel is good on sod ground. A CIRCULAR COULTER is recommended for rooty or very stiff sward. The JOINTER or SKIM PLOW is desirable in burying clover, &c.; it does not increase draft. The cross-brace is of wrought iron.

Stubble molds sent on A and K, without extra charge, when so ordered, instead of regular molds. Stubble molds are 2 inches shorter and 1½ lower, and a little less curved in rear.

The CUTTER SHARE is better for stony ground than the coulter.

We also make A and B with a special thick front standard, 20 inches high under beam, for choky lands in Virginia, &c., called VIRGINIA ADAMANT.

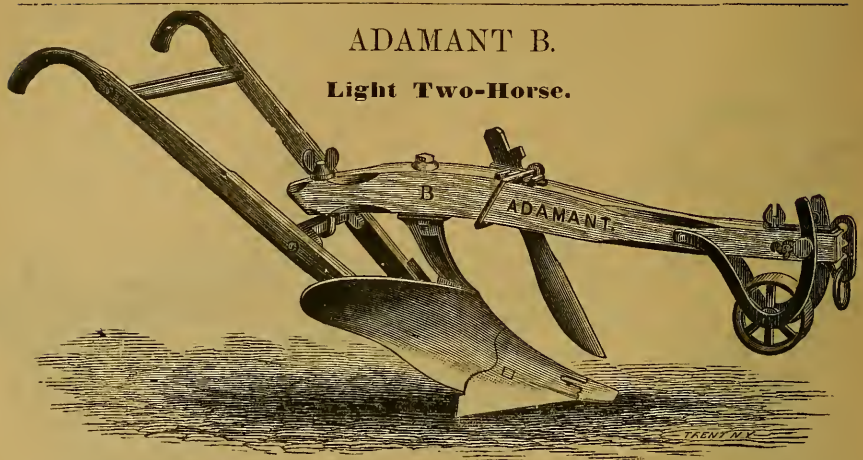
Weight, plain, 110 lbs.; cut, 10½ inches.

Adamant K, LEFT-HAND, same size and price as A.

N. B.—We always send RIGHT-HAND plows, unless ordered LEFT.

ADAMANT B.

Light Two-Horse.



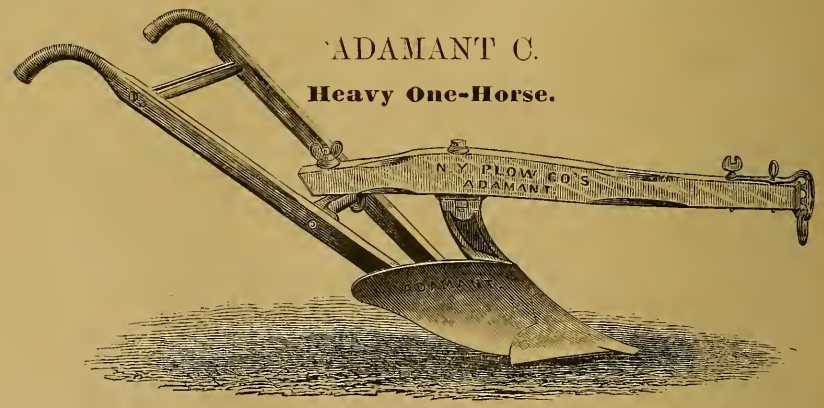
Adamant B is a very light draft two-horse plow (can be drawn by one stout horse), and at the same time is strong enough for all land that is free from fast rocks. It is very light to handle, and turns a very clean, flat furrow 13 by 6 inches. Height under beam, 16 inches It is a plow that will give better satisfaction in the light lands of Long Island, New Jersey, and elsewhere, than any STEEL PLOW whatever. Sent with wheel and coulter, unless otherwise ordered. All of these plows only require the proper adjustment of beam, coulter, traces and whiffletrees to do the work with the utmost possible ease to man and beast. The Coulter and Skim Plow are attached to standard as shown in cut of A. Weight, plain, 80 lbs.; cut, 9½ inches.

Adamant M, Left Hand, same size as B.

Adamant T, Right hand, size between A and B, same shape as B.

ADAMANT C.

Heavy One-Horse.

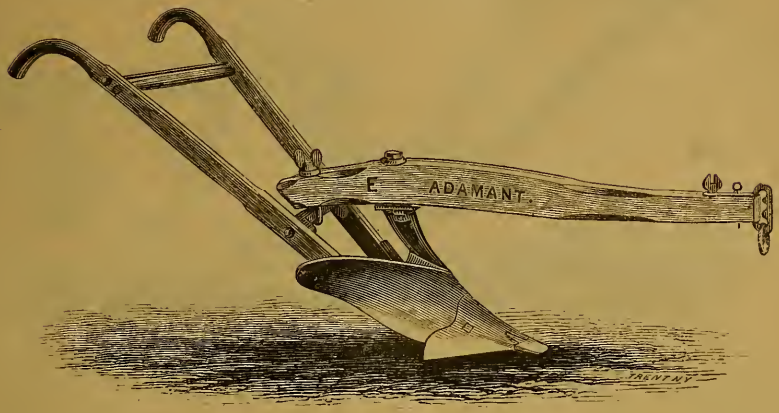


The draft of this plow is about the same as that of Peekskill No. 19, but it does much more work, viz., making a furrow 5 to 6 inches deep, 11 to 12 inches wide, which is nearly as MUCH WORK AS ORDINARY TWO-HORSE PLOWS do; in fact, the increased ease of draft, on account of HARD METAL, SHAPE, and STEADINESS, is very nearly a *saving of one-horse power*. It runs so steadily that it can be held by a small boy, and does not FRET THE HORSE. With traces and whiffletrees the right length, and beam set to proper land, it *will do the work*. It is a surprise, doing so much work; at one trial 6½ x 13 inches, in heavy, tough sod, draft only 450 lbs. With it, a man has a corn plow and breaking-up plow in one. The horse walks in the furrow.

Height under beam, 15½ inches; weight, 66 lbs.; cut, 9 inches. This plow has R. S. share also.

ADAMANT E.

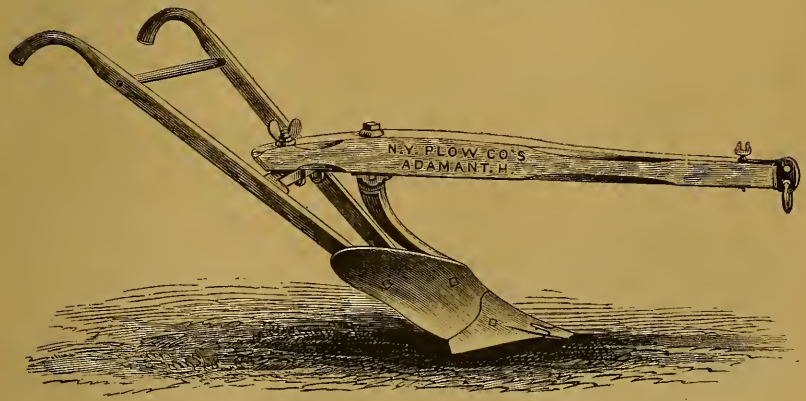
Light One-Horse.



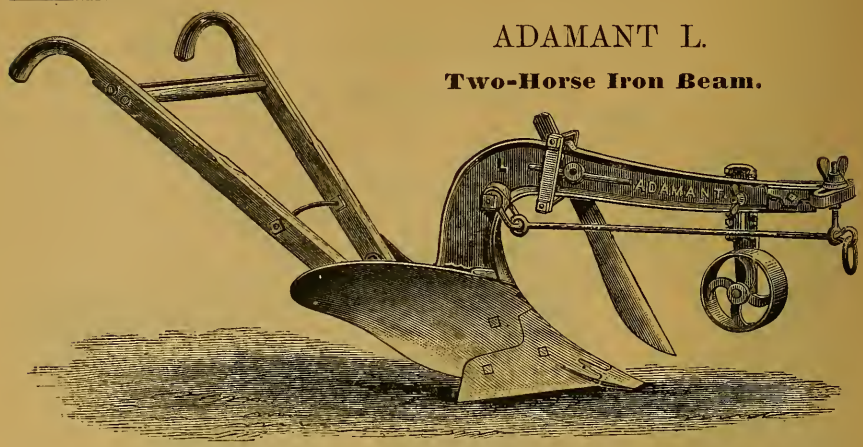
Weight, 54 lbs.; cut, 8½ inches; turns furrow 10 to 11 inches wide and 5 to 6 inches deep. Height under beam, 16 inches.

ADAMANT H.

Light One-Horse.



Adamant H and **E** are more satisfactory than any of the CAST-IRON and STEEL PLOWS used in the SOUTHERN STATES, as they will scour in the stickiest soils, have a very high standard, and are light and durable. They are also excellent CORN PLOWS for the NORTHERN STATES, making a good furrow without any choking or sticking in any soils. The central draft principle enables the horse to walk in the furrow, which is a great improvement on common one-horse plows with straight standard. Height under beam, 16 inches. H is also made with *cut-off mold* for cabbage plowing. They both run very steady and light. Weight, 48 lbs.; cut, 7 inches. They are also made with wrought standards and stationary side attached beams, when so desired.



ADAMANT L.

Two-Horse Iron Beam.

This plow is very handsome, and it works as well as it looks. The adjustment of both land and pitch is done to perfection by a slotted clevis in connection with a gauge bolt. It draws quite as easy, as steady, and makes about the same size furrow as Adamant A: the beam is about six inches shorter. The draft-rod prevents breakage of the beam, and by its elasticity protects all parts of the plow from breakage. We have made furrows with it 15 x 9 inches, 14 x 8 inches, 12 x 6 inches, running with great steadiness. Changes are made in a moment, by adjusting the clevis. The standard is very high. It is exceedingly satisfactory in tough, heavy sod, or sticky soil, and is a perfect pulverizer in stubble ground. Weight, complete, 125 lbs. Sent without *wheel* and *coulter*, unless otherwise ordered. Height under beam, 17 inches. Weight, plain, 113 lbs.; cut 10 inches.

REDUCED PRICES, SEPTEMBER, 1878.

	Plain Plow.	Plow with Wheel.	Plow with Coulter.	Plow with Wheel & Coulter.
Adamant H, Light One Horse	$5.00	....	....	....
" E, Medium	6.00	....	....	....
" C, Heavy	7.50	$8.50	$9.00	$10.00
" B, Light Two-Horse	10.00	11.00	11.50	12.00
" T, Medium "	11.00	12.00	12.75	13.50
" A, Heavy "	12.00	13.00	14.00	15.00
" M, Light " Left Hand	10.00	11.00	11.50	12.00
" K, Heavy " " "	12.00	13.00	14.00	15.00
" L. Heavy Two-Horse, Iron Beam.	11.00	12.00	13.00	14.00

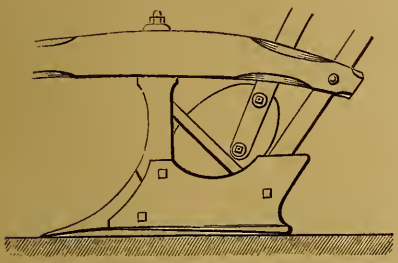
REPAIRS.

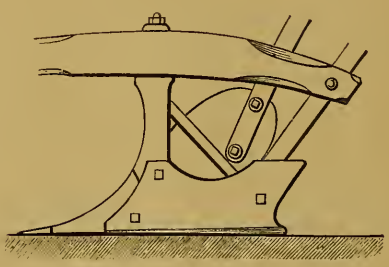
No. PLOW.	Size Slip.	Plain Slip Share.	Coulter Slip Share.	Slip.	Wheel.	Wheel Frame.	Coulter.	Skim or Coulter Clamp.	Mold.	Landside.	Cross Brace.	Clevis.	Standard.	Handles, each.	Beam.
Adamant H...	½	.35	..	8	..	..	...	..	.75	.35	.30	.30	1.25	.30	.60
" E...	½	.50	.60	8	..	..	...	..	1.00	.40	.30	.30	1.25	.30	.75
" C...	2	.60	.70	.10	.30	.70	1.00	.50	1.50	.60	.40	.40	1.50	.40	.85
" B...	2½	.65	.80	.12	.30	.70	1.00	.50	2.00	.70	.50	.50	1.75	.40	1.00
" T...	2½	.70	.90	.12	.30	.70	1.25	.50	2.25	.80	.60	.50	2.00	.50	1.25
" A...	3	.80	1.00	.14	.30	.70	1.50	.50	2.50	1.00	.60	.60	2.00	.50	1.50
" M...	2½	.65	.80	.12	.30	.70	1.00	.50	2.00	.70	.50	.50	1.75	.40	1.00
" K...	3	.80	1.00	.14	.30	.70	1.50	.50	2.50	1.00	.60	.60	2.00	.50	1.50
" L...	3	.80	1.00	.14	.30	.70	1.50	.50	2.50	.80	..	..	...	.50	3.00

Plain plow is without wheel and coulter. Plow complete includes wheel and coulter. We put skim plow in place of coulter on A, L and K, when ordered, without any extra charge. All plows have an extra slip. Extra long sod mold for A, and K, $3. Rolling circular coulter for B, A, L, M or K, $3. A, K, B and M are also made with EXTRA HIGH STANDARDS for trashy land, called Virginia Adamants. A and K are made with higher molds and arranged for three horses, $1.50 extra. Truck mold for H, 50 cts. All of the above plows have adjustable beams. We also have a CABBAGE PLOW, $5.00; this metal is very desirable in garden soil.

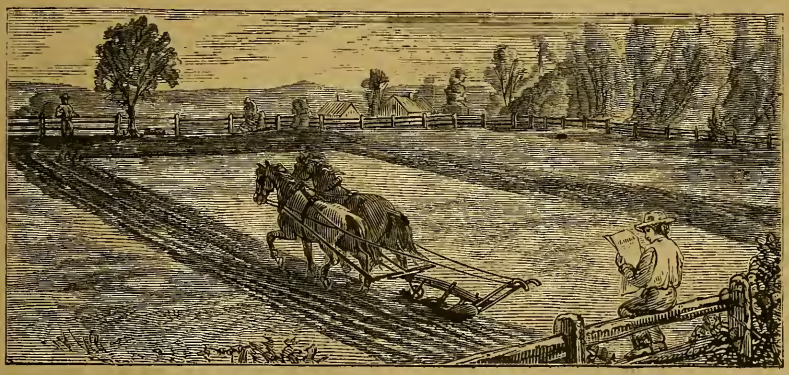
All repairs GROUND ready for use.

Adamant SLED SHOES ground, 5 cents per lb. These have the same advantage over common iron sled shoes as to saving of friction.





These cuts show the bottom line of a solid point and a slip share plow, the former requiring a hollow under the point to compensate for the rounding up of the point, which in the slip share is sharpened by turning over.



ONE METHOD OF PLOWING WITH ADAMANT PLOWS.

UNSOLICITED.

"BROADWAY, WARREN CO., N. J., September 5, 1878.

"I have thoroughly tested the Adamant plow with reversible slip shares. I have broken up twenty-five acres of sod and fallow, also plowed eight acres of corn, with the one *share* and eight *slips* (including the one on the share), which I have sent you. My soil has more or less grit, part is very gravelly and fast underground stone, which is hard to plow in dry time. I have tried other improved plows this summer, but prefer the Adamant. N. WARNE."

This share and slips are to be seen at our office.—N. Y. P. Co.

EXPERIENCES.

"WESTBURY, L. I., 4th mo., 5, 1878.

"At thy request I herewith give thee an account of the working of the plow. I have used the Adamant A in a sod, a part of the field generally unscourable with a cast-iron plow of ordinary construction, but with the Adamantine I saw no difference in this sticky soil or in the more sandy places, clearing itself perfectly all the time, and I am highly pleased with its working in every respect. In draft, very easy, considering the depth and breadth of furrow, also easy for the holder.

"I have had a great many different kinds of plows in my time, but I think I never had one so much to my liking as this. Respectfully, WM. P. TITUS.

"P. S.—I did not need a two-horse plow when I bought this, but I liked the looks of it so well that I could not go away without it."

"OFFICE AMERICAN AGRICULTURIST,
"NEW YORK, May 7, 1878.

"I promised to let you know how the Adamant plow works. I tried it in wet sticky clay where I was opening some drains, and it turned a perfectly clean furrow even in that soil without any adhering to the mold-board. I don't think it would clog in any soil; it draws very easily and handles very nicely. It is certainly the best plow I have used. The arrangement for adjusting the line of draft and width of furrow works very well. I am very, very much pleased with it.

"Yours, very truly, H. STEWART,
"*Assistant Editor American Agriculturist.*"

"CLOSTER, N. J., June 12th, 1878.

"I have been using the share with reversible point for all the plowing I have done this season, with great satisfaction. My soil is a sharp, gravelly loam which cuts away plowshares at a great rate, so that a share is virtually ruined in half a day's

plowing sometimes. We wear them longer of course, but add not a little to the labor of the horses; your one share has worn up to this time, wearing out several slips and the whole share is still sharp and sound. It has struck heavy stones repeatedly, and the beam has been carried away once by such a collision, but the share is all right. It is an invaluable 'institution.' Truly Yours,

"M. C. WELD."

"HOPEWELL, N. J., June 1st, 1878.

"I cannot speak too highly of the plow (Adamant B) I bought of you this spring; it far exceeds my expectations. I have tried it in both sod and stubble, and find it to be the easiest and nicest working plow I have ever used. A son of mine, who would hardly have managed another plow, did the most of my plowing in the very best manner. One of my neighbors borrowed it to plow a tough sod very heavily manured, and the way it turned every particle of grass and manure under, entirely out of sight, was surprising. The Adamants are certainly superior to any plows ever made. The centre draft and reversible points are the greatest improvements ever made in plows. The better a farmer plows and pulverizes his soil, the better his crops will be; therefore, I believe it will pay them to lay aside their old-style plows and use the Adamants. ASHER H. SNOOK."

"HOPEWELL, N. J., June 6th, 1878.

"The pair of Adamant Plows I bought of you one year ago last March, give the best of satisfaction; I used them all last season, have done all my plowing with them this spring, and find them to be the best plows I have ever used. I can do one-third more work with them, with the same amount of labor for the team, than any plow I have seen or used. They are easy to handle: any boy can manage them; they are so well balanced that they need no guiding; they turn the sod and manure well under, and thoroughly pulverize the soil, leaving it so mellow that it saves much labor in harrowing. Last season I used three plows in plowing a field of sod for corn—the two Adamants and one ———. I could see a difference in the corn the whole season; where I used the Adamants, the crop was considerably the best; it was also less labor to work. I can heartily recommend them to any farmer wanting a good plow. What they will save in horse-flesh and repairs will soon pay for a plow. The reversible slip shares, I think, are a wonderful improvement; by using them you not only save in cost for shares, but have a sharp and level running plow all the time. If I could not get others like them, I would not take five times for them what they cost me.

"JOHN S. VANDYKE."

"MONTANA, WARREN CO., N. J., May 25th, 1878.

"I have fully tested your Adamant Plow with the reversible point, and take pleasure in recommending them to the farmers of this community for good work, lightness of draft, easy on plowman, save fifty per cent. on repairs. I plowed ten acres, wore out two points, and commenced on a third one, while the share is not more than one-half worn out. My ground is a greasy, sticky, and stony soil, very difficult to get a plow to scour, but the Adamant does scour in it without difficulty.

"JAMES P. KENT."

WROUGHT BEAM DOUBLE MOLD PLOW.

WITH SHOE.

For Cultivating and Ridging or Hilling Corn, Potatoes, &c.

Holds easy, runs steady, and is not liable to clog. Works different widths of rows by using long and short wings. The centre piece increases the height of the mold-board when desired.

In the cultivation of the potato, *hand hoeing can be entirely dispensed with.* Even quack-grass, however troublesome, can be subdued without the use of the hoe, and a large crop of potatoes realized by pursuing the following course, which is no experiment, but an established method, which is now being generally adopted by farmers who prefer this way to any other, believing that a *better* crop can thus be realized with *less* labor.

After the ground is plowed and *thoroughly* harrowed, let the furrows be made deep and of as equal distance apart as possible, and when the potatoes first make their appearance, or when they are one or two inches high, use the double-mold plow arranged wide enough, and, if necessary, with the centre-piece in, to bury the potatoes *entirely under* by passing once between the rows; but if the sod is very stiff and unrotted, it may be necessary to use an ordinary two-horse plow, turning one furrow on the top of each row of potatoes, then with the harrow drag over the same way (no danger of injuring the potatoes), which leave the ground freshly plowed and harrowed, and very soon the potatoes will again make their appearance, free from grass, and with as much ground on the hill as is necessary. Then cross-plow with the double-mold plow as often as desirable, keeping the ground well stirred, and a large crop of potatoes will be the result.

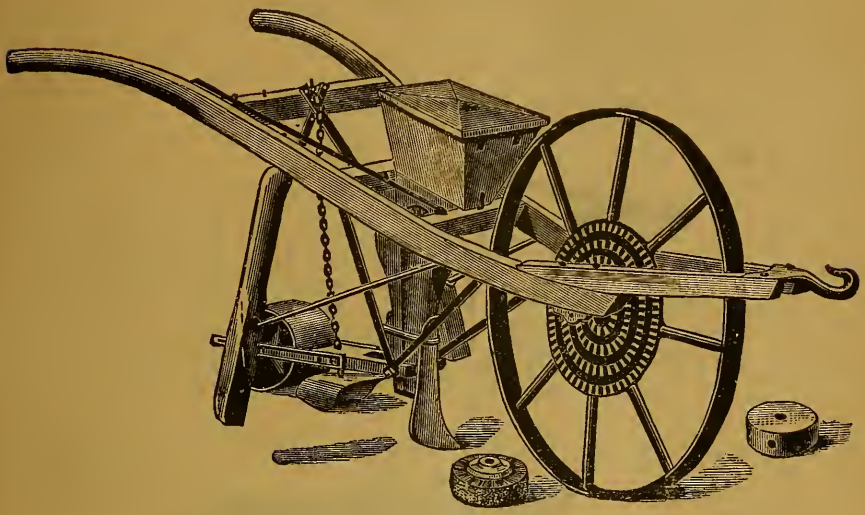
Where potatoes are planted in drills, the same course is pursued in burying them under when they first make their appearance above the ground, and then dragging; after which an ordinary corn-plow is run as near the row as convenient, throwing the ground *from* the row; or a cultivator may be used for this purpose. The double-mold plow is afterwards used for throwing the ground toward the row. Let this operation be repeated, and the result will be satisfactory.

IT WILL SAVE ITS COST BY A FEW DAYS' USE.

Price, complete.....$8 00

Extra shares, 50 cents.

THE NEW YORK CORN AND SEED PLANTER.



One man and a horse can plant from seven to ten acres of corn in a day with the planter, at a cost of from $3.50 to $5, while to plant the same by hand would cost $25 at least.

This **Planter,** at ONE PROCESS, OPENS its furrow, GAUGES, DROPS, COVERS the seeds and ROLLS them down. Also MEASURES and MARKS OFF the DISTANCE for the next ROW or DRILL to be planted.

It WILL PLANT ALL KINDS of SEEDS, from corn, beans, peas, etc., to the SMALLEST KINDS of GARDEN SEEDS, in HILLS or DRILLS, at ANY DISTANCE between the seeds or hills, from one inch to seventy-two inches. Also MEASURES the QUANTITY of seeds to the hill, drill, or acre.

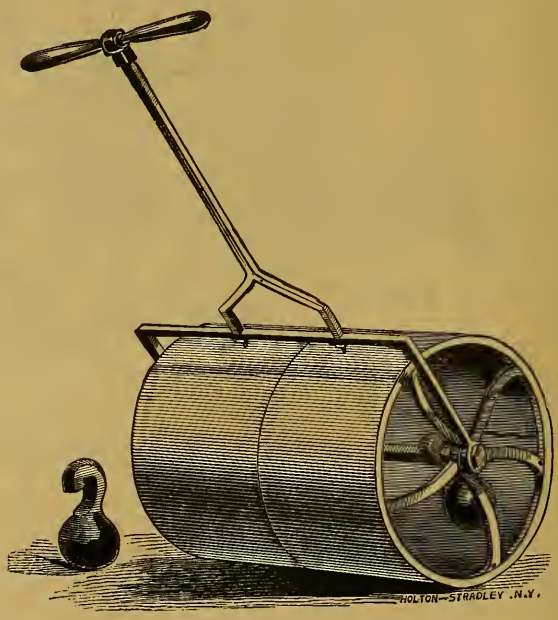
Any of these changes may be MADE IN FIVE MINUTES' TIME to adapt it to the work required, and the SEEDING ACTION MAY BE INSTANTLY THROWN OUT OF GEAR and STOPPED in turning at head-lands, or for moving from field to field. By being careful about throwing out of and in gear, at the end of the rows, the hills may be made to row both ways.

Recent improvements have increased its strength and quality of workmanship.

Price $20 00

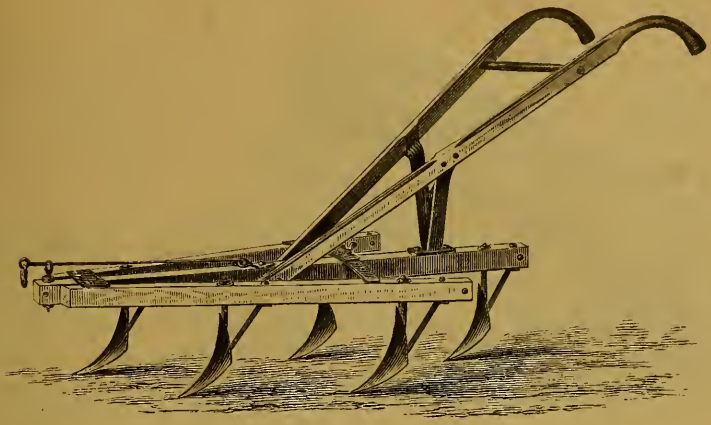
GARDEN ROLLER.

Weights Keep Handle Erect.



2	Sec.,	7½	inch	face,	15	inches	diameter,	with	weights	about	125 lbs.
1	"	12	"		20	"	"	"	"	"	140 "
1	"	20	"		20	"	"	"	"	"	220 "
2	"	12	"		20	"	"	"	"	"	300 "
3	"	12	"		20	"	"	"	"	"	450 "
1	"	12	"		24	"	"	"	"	"	200 "
2	"	12	"		24	"	"	"	"	"	400 "
1	"	12	"		28	"	"	"	"	"	250 "
2	"	12	"		28	"	"	"	"	"	500 "
3	"	12	"		28	"	"	"	"	"	700 "

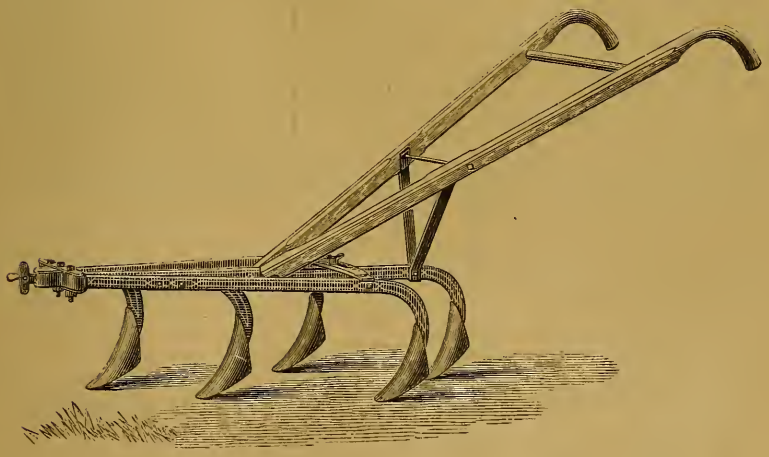
WOOD FRAME JERSEY CULTIVATOR.



It is made with wrought-iron standard, polished reversible steel plates, and adjustable draft-rod. It is light to handle, draws steady, easy for the horse, and loosens and pulverizes the soil.

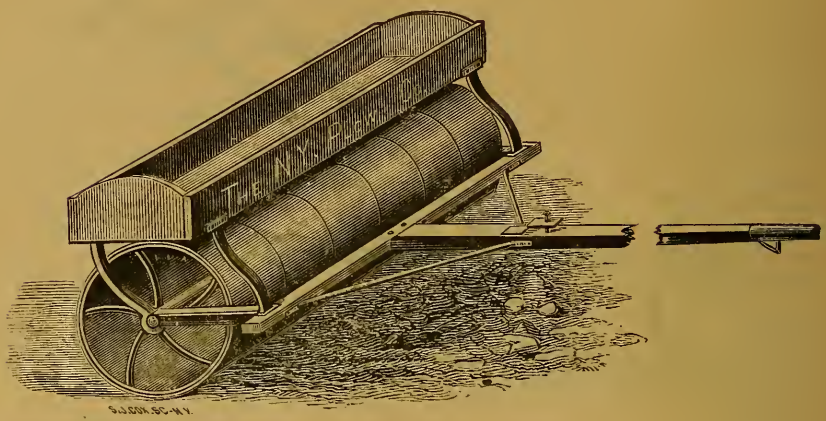
Weight.....48 lbs. Price.....$6 00

WROUGHT-IRON FRAME JERSEY CULTIVATOR.



It is made in a thoroughly workmanlike manner, of the very best materials, is strong, very durable, and superior to the wood frame, as it is not liable to clog in foul or weedy ground.

Weight.....46 lbs. Price.....$7 00

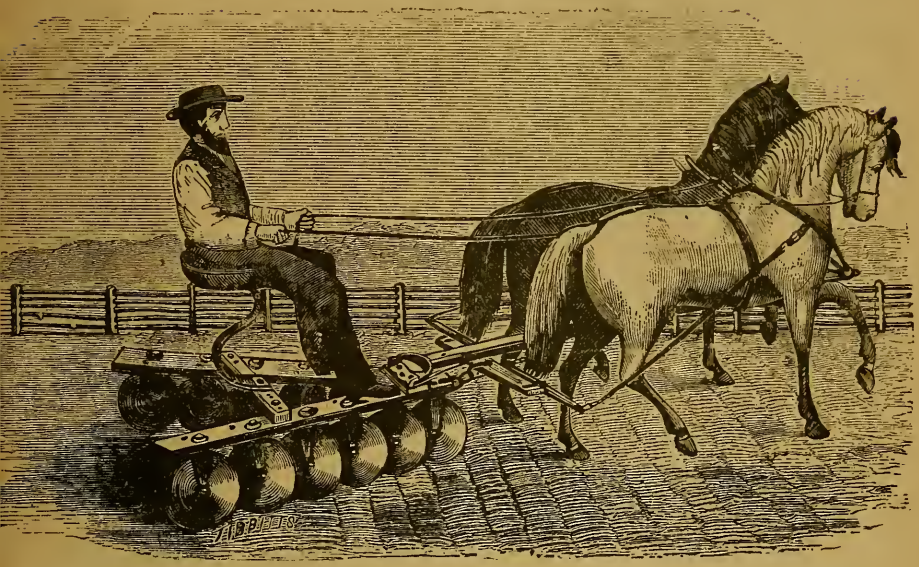


THE FIELD ROLLER

Is a valuable machine for crushing sods and lumps remaining after the harrow has passed, pressing down stones, and rendering the field smooth for the mowing-machine, &c. By pressing the earth close about the seed, a more sure and quick germination is effected. This iron roller is the most approved kind, as it clears better and is more durable than the wooden roller. The stone box is convenient for taking off loose stones. By rolling early in the Spring, the heaving effect of frost is repressed.

3	Sec.,	12	inch face by	20	inches	diameter,	weight	about	550	lbs.
4	"	12	"	20	"	"	"	"	650	"
5	"	12	"	20	"	"	"	"	750	"
4	"	12	"	24	"	"	"	"	850	"
5	"	12	"	24	"	"	"	"	1,000	"
6	"	12	"	24	"	"	"	"	1,200	"
4	"	12	"	28	"	"	"	"	950	"
5	"	12	"	28	"	"	"	"	1,150	"
6	"	12	"	28	"	"	"	"	1,350	"
4	"	12	"	36	"	"	"	"	1,400	"
5	"	12	"	36	"	"	"	"	1,700	"
6	"	12	"	36	"	"	"	"	2,000	"

THE NISHWITZ HARROW.



The **Disk Harrow** is the only harrow fit for sod and the best in use to prepare land for seeding. It is a thorough cultivator, which implies pulverization of soil and intermixture of fertilizers, and CULTIVATES before the crop is put in, which is the best time to do it.

It consists of a series of revolving, sharp-edged, circular, concave disks, set at such an angle in relation to the line of draft, that they fully pulverize the soil by cutting, lifting, and turning it over in fine, small furrows. The frame consists of two pieces of wood, hinged together in front, which are secured at any desirable distance apart by means of a cross-bar, bolted across the centre of the frame. To this cross-bar is attached a comfortable spring seat. For purposes of storing or transportation, the frame can be folded together. It is extremely simple in construction, and not liable to get out of order.

The disks are now held on by journals headed, and not by scrapers only, as formerly made. This is a great improvement, saving friction and wear; the wearing parts being pins and washers are replaced at very small cost.

The advantage of this **A** shaped harrow, with the disks following each other over those, like those where disks are arranged nearly on a line, is, that in crossing the furrows they do not all strike at once, and therefore draw more uniformly. The steel journals, which are readily replaced when worn, are the very cheapest kind of journals to keep in repair, though not looking so durable as larger cast-iron axles, and they are not so liable to clog in sticky soils. The journals can be replaced by any blacksmith. The disks last a long time, and, being concave, are not liable to break.

By means of a scraper, against which the concave circular disk or tooth revolves, it is kept clean or scoured in the most adhesive soils.

It will not catch weeds, stubble, coarse manure, or roots, and clog up like a common harrow or cultivator, but will cut and mix them with the soil.

It will not turn up the sod when using it on sward land.

It will thoroughly prepare land for the seed drill.

It will work on wet land where no other implement will, and save much valuable time in putting crops in the ground in proper season.

It will more than save its cost in preparing five acres of sward land for corn.

It will produce a better crop, by thoroughly loosening and mixing the soil.

It will actually save plowing in many instances.

Land plowed in the Fall can be prepared for crops in the Spring without re-plowing.

It is the best implement for pulverizing newly-broken land.

It is just the thing for summer-fallowing land; it will work up the soil, and is sure to kill all weeds.

It is a good clod-crusher.

Most important of all, in putting in grain, covering it well, leaving it in little drills, and at the proper depth for germination.

For cross cultivating prairie sod, those who use them say they save $1 per acre in one cultivation.

The tongue is desirable on large fields, and is useful when cultivating corn or grapes, which is done by removing the forward disk so as to straddle the rows, for which this harrow is very highly recommended; while the clevis without tongue is desirable in small fields.

Nos. 3 and 4 Harrows are very large, with 15-inch disks, used with three or four horses, principally for general cultivation on the largest farms, and on the Western prairies, in place of second sowing, to cut up the prairie sods, and on the Southern plantations as a gang plow, where it does the work of many plows, saving much time and expense.

For Flax Ground.—One agent sold over one hundred in the flax regions of Indiana in one season.

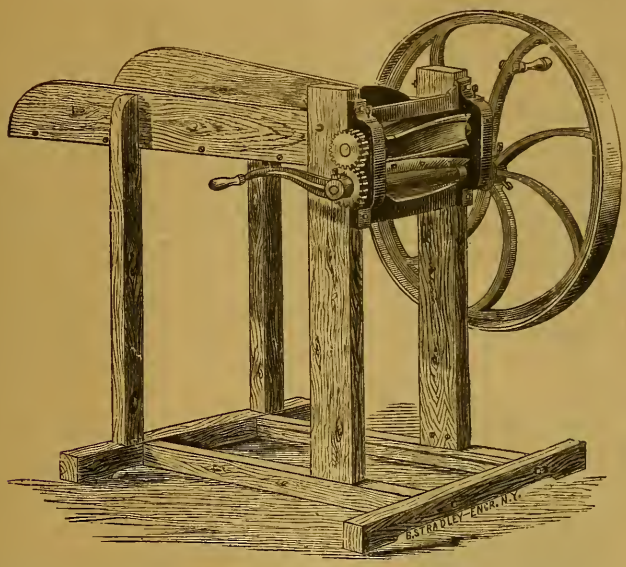
Land infested with corn or cotton stalks, grass, clods, or roots, is by the use of this harrow nicely prepared for cultivation. The harrow is adjustable both for width and depth of its track.

For harrowing between rows of sugar cane they are exceedingly satisfactory.

Size.	Horses required to operate it.	Number of Disks.	Diameter of Disks.	Weight Complete.
No. 1	2	11	11 in.	200 lbs.
" 2	2	13	11 in.	225 "
" 3	3 or 4	11	15 in.	400 "
" 4	4	13	15 in.	450 "

The No. 1 (11 disks) Harrow without pole, is the most popular size for all general purposes, and is the size we sell the most of, and always send unless specially ordered otherwise.

THE COPPER STRIP FEED CUTTER.



This is undoubtedly the easiest cutter by hand power, because it has excellent momentum without being speeded up. The 5½, 8, 9, will cut stalks as well as hay about two inches in length, and accomplish more than can be done by hand power on any other principle. These sizes can also be run by power if desired.

By means of cutting against flanges, instead of a roller, it is made perfectly self-feeding, and a large volume of feed is allowed to pass the knives without clogging the machine.

These flanges enable the smallest sized machines to cut the largest corn-stalks as easily as hay or straw, whereas a roller (raw-hide or other), by choking up the throat, passes but a small depth of feed and clogs.

As the machine is turned the flanged cylinder and knife grasp the feed, draw it forward, and cut it off as the two meet; cutting a volume of feed three to six inches deep, of uniform length without clogging, and without the friction that arises from the use of a multitude of gear wheels.

All parts of the machines are easily and cheaply replaced by the farmer, and the knives and coppers are made so that, if they are ever broken or worn out, they can for a few cents each be duplicated and put on at home.

The Copper does not dull the Knives, and is Durable.

We make a variety of sizes from $9 to $35. Descriptive circular sent on application.

THE BEST LENGTH TO CUT FEED.

On this subject the Editor of the *American Agriculturist*, December number, 1865, page 371, says:

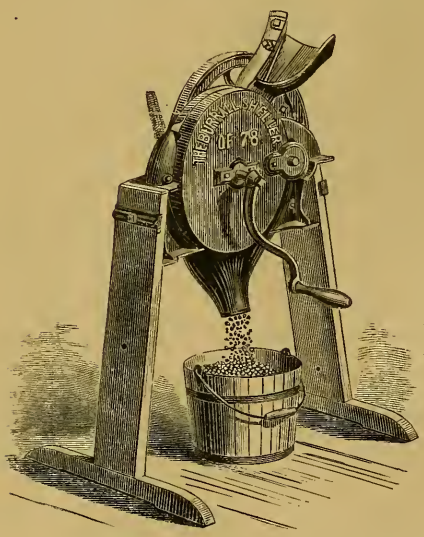
"It is not necessary to cut corn-stalks as short as some have recommended. For fourteen years the writer has been accustomed to cut all his corn-stalks, and for several years some were cut about half an inch long, though, for the most part, two inches was the usual length. Neat cattle and horses will eat them quite as well when cut two inches long as if half an inch long. And it is much safer to cut them two inches long than half an inch, because, when short, hard pieces are often crowded endwise between the teeth of animals, will wound the gums, making the mouth so sore that animals sometimes will suffer with hunger before they will venture to eat cut stalks. Moreover it is highly probable that these thin, short, flinty edges injure the intestines."

In the Report of the United States Commissioner of Agriculture for 1866, page 280, the Commissioner says:

"A large number of devices for chaffing coarse fodder have been patented, but the number of cutters that are likely to come into general use, or give satisfaction, is exceedingly small. Many good machines are too complicated for common farmers and their laborers, who possess only ordinary ability to keep machinery in running order, and to operate such implements with skill and efficiency.

"*Some manufacturers have erred seriously in constructing fodder cutters, by not understanding what is required of a machine* for cutting stalks, straw and hay. Men who have a correct understanding of the management of domestic animals, and of preparing their food, know that the fodder cutter that cuts hay or straw finest or shortest is by no means the most effective cutter. Experience proves that fodder digests much better after being macerated by the teeth of animals than when it is reduced so fine by a straw-cutter that they swallow it without first crushing it between their teeth. The stalks of Indian corn or sorghum should never be cut less than two inches long."

THE BURRALL CORN SHELLER OF 1878.



WROUGHT SHAFTS. RIGHT-HAND.

This Sheller Separates the Cobs from the Shelled Corn.

It has wooden (instead of iron) legs, which are not liable to break, and are more easily repaired when broken.

IMPROVEMENTS FOR 1878.

SEVERAL NEW PATENTS APPLIED FOR.

Open front hopper makes it *right-handed. Wrought Shafts.* (Cast shafts always break.) *Excellent improved spring. Runs smooth and easy. Longer legs,* which make *sheller* several inches higher than formerly. *Flat balance wheel;* can use belt, if desired.

The swell at the throat in combination with the patented spring-plate admits larger ears without clogging, and without scraping or breaking the cob. *It shells clean.* The *gearing* has been changed, making it *stronger*, and causing it to turn very much easier than any other *sheller* in the market, and much easier than those that we made last year. The spreading of the feet causes it to stand entirely firm, and the increased weight adds much to its durability.

These improvements make it entirely satisfactory for every section of this country and other countries.

Weight.....125 lbs. Price.....$8 00

NEW ENGLAND ROOT CUTTER AND TEARER.

The cut represents a machine which every farmer should have.

It is strong and durable, very simple in its construction, and not liable to get out of order.

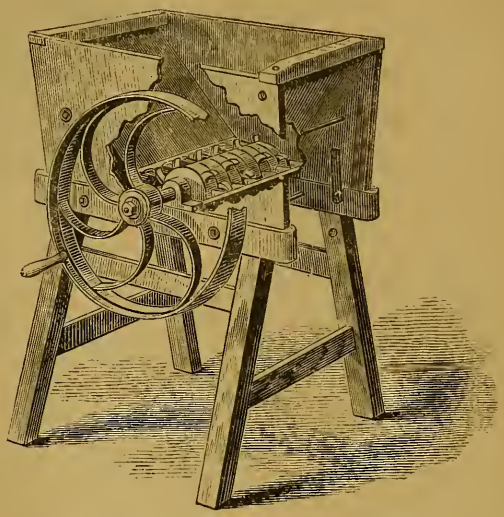
The cylinder or cutting apparatus is composed of a number of hooked or flat curved teeth, which, in revolving, pass between stationary knives, and catch hold and tear to pieces the roots, etc., in small sections for safety.

The hopper holds about a bushel of turnips, which can be cut in one minute.

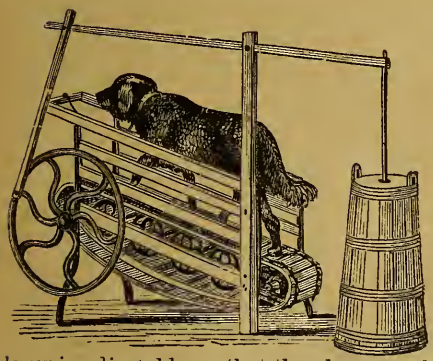
With this machine Pumpkins, Turnips, Beets, Carrots, etc., can be cut and fed to Horses, Cattle, Sheep and Calves, without danger of choking.

Weight.....120 lbs.

Price.....$12 00



ENDLESS CHAIN DOG POWER.



This power is intended principally for dairy purposes, but can be made use of wherever a light and portable power is desired.

The principle of construction is materially the same as that of the large railway powers, with such modifications, diminution of friction, etc., as are needed to fit it to be moved by small animals.

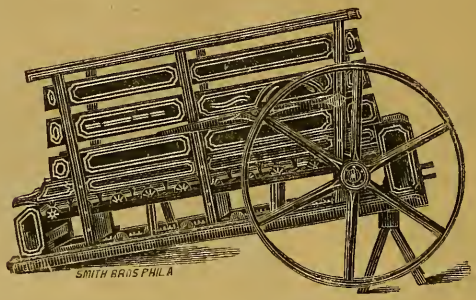
A dog, sheep or goat is sufficient to work it. The wheels are larger than in other dog powers, and are of iron instead of wood. This power runs with less friction, and is more durable than any other. The floor is matched and grooved, which dispenses with the clumsy buttons, which are liable to break and come off. The lever is adjustable, so that the churn can be placed in any position. It is not desirable to have the churn under the dog's mouth.

It has also a belt wheel.

It is three feet and nine inches high, five feet and nine inches long, and two feet wide; weighs 110 lbs.

Price, complete $20 00

RAILWAY HORSE POWER.



This power, ELLIS PATENT, we have proven by actual tests, gives more power with same elevation and same weight of animals than any other horse-power yet invented.

The seven recent patent claims are very important. It has a ratchet gear instead of the common spur gear, with the advantage of increased firmness; the uniform length and width of lags, in connection with the ratchet gear, gives steadiness and firmness to the whole track, which is not the case with spur gear. The new arrangement for oiling the rods on which the carrying wheels revolve, is a labor-saving feature. These improvements are new, and they reduce the friction, and therefore increase the driving power to an extent hitherto unknown in any kind of animal power.

One-horse power, with patent governor, belt, wrench, oil-can and extras	$100 00
Two " " " " " " "	150 00
Three " " " " " " "	200 00

PLOWS FOR SPECIAL PURPOSES.

FOR ROOT CUTTING we have a Steel Plow with steel share, that can be ground to a sharp edge, $15 00; Wheel and Coulter, $3 00; Circular Coulter, $4 00.

FOR VERY STONY GROUND, where better plows are not profitable to use, short and catching quick, Rough and Ready, No. 2½, Cast Beam, $7 00; Rough and Ready, Wrought Beam, $9 00.

SIDE HILL or SWIVEL PLOWS, Leveler Wood Beam, No. 2	$8 00
" " " " " " " No. 3	10 00
" " " " Automatic Iron Beam, with Coulter	12 00
" " " " Wrought Beam, without Coulter	9 00
" " " " One-Horse, also cheaper qualities.	

DOUBLE-MOLD PLOWS for Ridging, Hilling and Cultivating Corn, Potatoes, &c., Wrought Beam	8 00
" " " Wood Beam	4 00

Subsoil Plows, Deep Trenching Plows for Asparagus, Ditching, &c., Road Plows, Garden or Hand Plows, Potato Diggers; Cast-Iron Plows in infinite variety from $1 50 upward.

MACHINES FOR SPECIAL PURPOSES.

Riding Hay Rakes, Cider Mills, Lard Presses, Wine Presses, Farmers' Boilers, Ice Crushers, Horse Radish Graters, Seed Drills, Grain Drills, Corn Planters, Garden, Field and Road Rollers, Lawn Mowers, Horse Powers, Threshers and Cleaners, Windmills for Pumping, &c., Fanning Mills, Dog Powers, Corn Shellers, Road Scrapers, Root Cutters, Wheelbarrows, Water Drawers, Stable Furniture, Wagon Jacks, Hand Cultivators, Cultivator and Pulverizer Combined.

We ask *dealers* and *cultivators of the soil* to examine carefully the peculiarities in construction of the Champion Hoe in all of its varieties, including the Centennial Double Blade, the Centennial Common, the Centennial Planter's and the Centennial Garden, of which we represent a full line, decide on their merits, whether our claims to superiority over all others in use *are or are not* well founded.

By a new process our steel is all rolled heavier in the shank and tapering towards the edge, giving strength where most needed and symmetry of form.

THE CHAMPION HOE is the *common hoe* radically improved. For the first time the *tubular principle* is applied to the Hoe, giving immense strength without unnecessary weight of metal, both to the large and small blades. The entire implement, including the *socket* or ferule, is made of a *single piece of the best crucible steel,* so that the usual difficulty of the shank getting loose is entirely obviated. Thus we combine great strength with lightness, utility and durability.

THE CENTENNIAL HOE combines the leading principle of the Champion Hoe with other marked improvements. The ferule is cut, like the Champion, from the same piece of steel of which the hoe is formed, completing it for the handle without *weld* or *rivet;* there is, therefore, nothing to give way. The steel is of the best quality—of trowel temper and rolled by a new process—strong in shank and tapering towards the edge, giving the greatest strength where most required. In cutting out the ferule the perforation is made where the earth always collects and adheres, thereby remov-

ing a great inconvenience and preventing clogging next to the handle. Of the Centennial we make

FOUR LEADING VARIETIES.

First.—THE TWO-BLADED CENTENNIAL (Figs. 7, 8, 9).

Which comprises two sizes, six inch and seven inch. This hoe is admired by all who have used it, for the ease and facility with which the operator can execute all kinds of hoeing in *farming*, *gardening* or in the nursery, the sides as well as the ends being brought readily into use. The perforation prevents the adhesion of the soil.

Second.—THE PLANTER'S HOE (Figs. 1 and 12).

Six, seven and eight-inch blade.

This hoe is *heavy*, *strong* and made of the best steel, which takes a good cutting edge; warranted to the *dealers* and to the *purchaser*.

Third.—THE SINGLE BLADE CENTENNIAL HOE (Fig. 2).

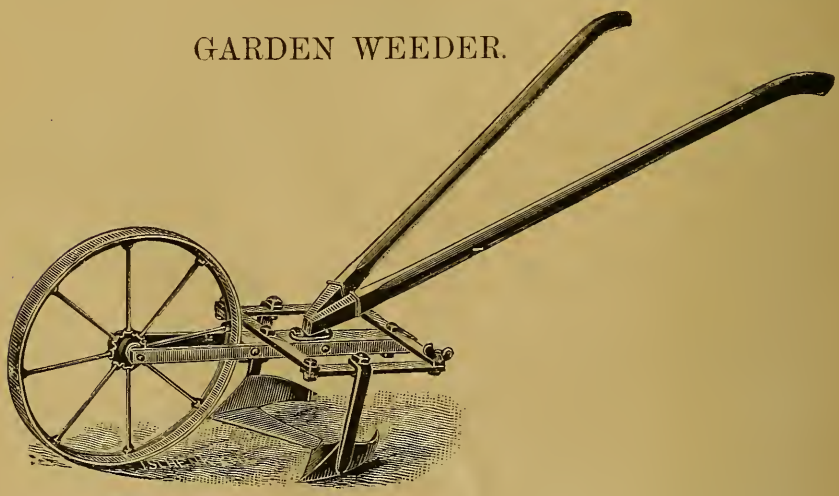
Six-inch and seven-inch blades, warranted of the best material and workmanship.

Fourth.—THE CENTENNIAL GARDEN HOE (Figs. 4 and 11).

A glance at this hoe will satisfy the *gardener* or the dealer that it is incomparably the best article of the kind in use. There are two varieties, one with a forked, the other with a pointed end.

N. B.—All of our hoes are of the same kind of steel, and that of the best quality; all are rolled to order, tapering towards the edge, giving strength and perfection of form. All are warranted. All of them have been carefully perfected, and all objections and defects suggested by practical men removed.

GARDEN WEEDER.



The simplicity, cheapness, and practical utility of this weeder places it ahead of all the hand cultivators. It will pay for itself, in the saving of labor, several times over in a year.

The frame is of wrought iron, light, strong, has the parallel adjustment, can be readily opened and closed as desired, also has the same style of slotted teeth as the one-horse cultivator.

The handles are inserted in sockets, and can be easily taken out, making it very compact for shipment.

THE JOHNSON

PARALLEL EXPANDING CULTIVATORS and PULVERIZERS,

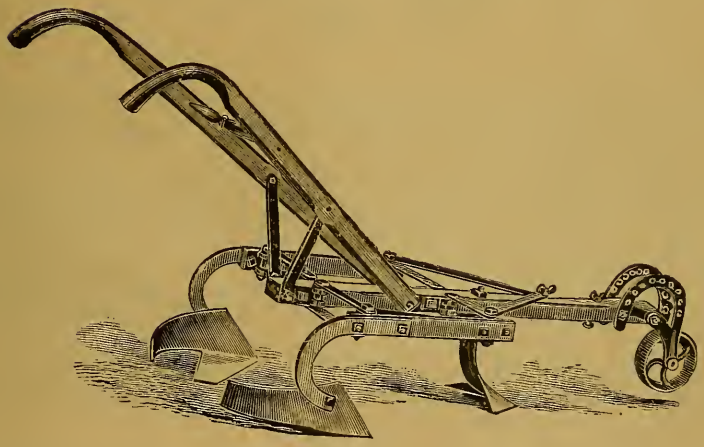
NEW AND IMPORTANT INVENTION.

MANUFACTURED BY

THE NEW YORK PLOW CO.,

55 BEEKMAN STREET, NEW YORK.

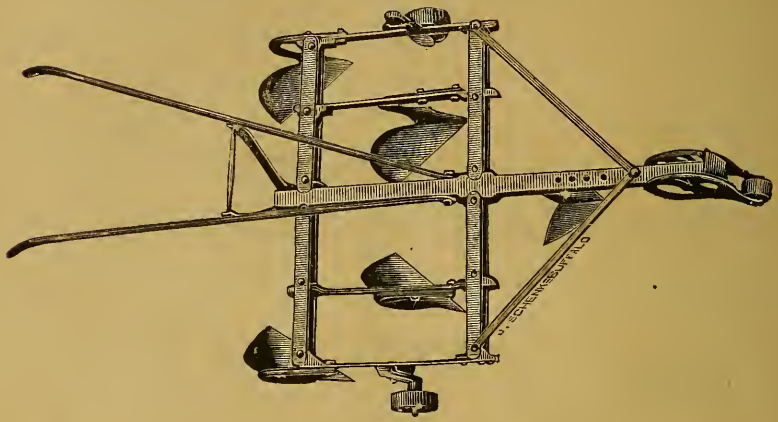
ONE-HORSE CULTIVATOR.



The frame consists of a centre beam and side wings to which the teeth are attached. The wings are hinged to the beam, so that they swing back and forth, parallel with the beam, narrowing or widening as the space requires, keeping the teeth always in the same line of draft. Either side wing can be moved independent of the other, back or forward, or one back and the other forward, the teeth then being in line. The wings are held in position by means of two draw braces, one end of which is attached to the wings, the other to the centre beam, changed at pleasure, thus varying the width as the cultivation requires. For cultivating in very narrow spaces, move one wing forward and the other backward as much as required, and remove the front tooth.

It is thus adapted to the cultivation of corn, potatoes, beans, cotton, tobacco, turnips and other growing plants. It is also peculiarly adapted to the cultivation of nurseries and orange groves, which require shallow cultivation. The teeth being slotted and curved with sharp cutting edges they cut the weeds and grass, and thoroughly break up and pulverize the soil in one operation, and without endangering the roots. The wheel regulates the depth for shallow or deep cultivation.

TWO-HORSE PARALLEL EXPANDING PULVERIZER OR GANG PLOW.



This is made on the same parallel folding principle as the one-horse cultivator, with extra side-beams and teeth; and with side-wheels to regulate the depth. The wheels are secured to the side-wings, and open and close with the frame. It is easily adjusted to any desired width.

Although called a pulverizer for convenience, it is, in fact, a *new implement*, performing, in most cases, the work both of a Gang Plow and a Cultivator, and doing a larger amount of work in much greater perfection than either the Gang Plow or old-fashioned Cultivator, or both combined.

For the work accomplished it is of remarkably easy draft. It is readily adjusted for running near the surface of the ground, cutting and destroying every weed and thistle; or for entering the ground to the depth desired for pulverizing. It works up and pulverizes the soil to a greater degree of perfection than any other implement known to the cultivator of the ground.

It can be readily folded into a small compass for shipping or storing.

These implements all have slotted teeth which, in shallow cultivation, move the weeds from their bed, and in deep cultivation throughly pulverize the soil. They are all well protected by patents.

PRICES.

One-Horse Cultivator	$8 00
One-Horse Cultivator with Hiller	11 00
Hand Weeder	4 50
Two-Horse Pulverizer	20 00
Extra Teeth for One Horse, per set	2 00
Extra Teeth for Two Horses, per set	5 00