# FARMING

WITH

# GREEN MANURES,

ON

# PLUMGROVE FARM.

BY

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SECOND EDITION. REVISED AND ENLARGED.



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# PREFACE.

In publishing these pages I have two objects in view—the assistance of those who need advice and the instruction of my foreman on the farm, that he may understand the reason why he is required to do certain things. But how should I know any better than he does the laws of vegetable life and the best course to pursue to obtain remunerative crops?

He is supposed to be practically acquainted with the whole art of agriculture. Now, the fact must be plain to every one that no man, in his short life, by his own experience and observation, can become master of this art, because it takes a whole year to try one experiment. From

this fact, his progress in knowledge must be very slow indeed.

Well, then, besides the actual trials on the farm to improve his mind, the next best thing to do is to study carefully the recorded experience of other farmers and the writings of the able investigators of the chemistry of plant-life. To do this with profit he should be acquainted, to a certain degree, with every science which has shed any light upon the subject.

Now, the working farmer is generally too much engaged to acquire this knowledge. Well, then, if he will please to lay aside all prejudice against me, we will read for him and report a few of the grand truths which we find scattered through the vast tomes of other times and the periodicals of our own rushing, busy century.

Whether I shall ever receive any thanks for this is a very small matter.

The consciousness of having done good to others will amply repay me for all my trouble.

I sincerely believe that he who tills the soil is helping God to feed the world, for without tillage the earth could not support one-tenth of its present population. Therefore, what I can do in this good and noble cause it is my duty to do. And I may as well confess that to me it is no tiresome labor, because I love the art, and ever have loved it from my boyhood to the present hour.

C. H.

708 Market Street, Wilmington, Del.,
November 28, 1876.

# PREFACE TO THE SECOND EDITION.

THE first edition of this little work being nearly exhausted, I feel under obligations to the farmer to prepare a second, revised and enlarged with care and attention.

The work has been spread broadcast, but rather too thinly sown over a large portion of the United States.

The result has been that letters have come to me, not only very complimentary, but asking for more minute information and more extensive elucidation of the different subjects mentioned in the first edition. From this cause I am now better able to know what is wanted by the agricultural community.

I see plainly that an author, in writing upon the art and science of tillage, should remember

that he is talking to all classes of society, to all shades of mental development and to all grades of a scholastic education—that many of his readers, though deeply versed in mathematics, in astronomy, in mercantile science and in general literature, have but a very limited knowledge of farming. Yet they will be tillers of the soil.

Hence they want plain, practical and common-sense instruction, and always sufficiently minute that they can practice it themselves without the necessity of learning any part of it from hired men.

As an illustration I will mention one case. A gentleman-farmer, who may be learned and wise enough to be a member of Congress, wrote to me to know how he should work his potatoes under a mulch a foot thick.

Now, who would suppose that any one could be found who would think of *working* potatoes in that condition?

C. H.

July 17, 1880.

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# FARMING WITH GREEN MANURES.

## CHAPTER I.

### NITROGEN, PHOSPHORIC ACID AND POTASH.

STUDY the profound works of Professor Johnson, *How Crops Grow* and *How Crops Feed.*

Read with close attention the broad and practical wisdom of Joseph Harris in his *Walks and Talks on the Farm.*

Devote long hours of patient thought to the thirty years of untiring experiments of Lawes and Gilbert, and you will be perfectly convinced, that *Nitrogen* is the most precious, the most important, and the most costly element which the farmer needs to produce a heavy-paying crop.

And next to this in value is phosphoric acid, and then potash.

Other minerals and elements are required, but they generally exist in the soil in sufficient quantity, or can be added to it at much less expense.

Then comes the great question, from all civilized countries: How shall we obtain *nitrogen?* Must we buy it in nitrate of soda, in sulphate of ammonia or in guano, at thirty cents a pound? Certainly not, unless we cannot obtain it in any cheaper form.

Four-fifths of the atmosphere is nitrogen. Does not Nature convert a portion of this every day into nitric acid and ammonia? If not, whence comes that lavish profusion of these compounds discovered by the chemists?

"The Rhine," says Professor Johnson, "daily removes from the country supplying its waters an amount of nitric acid equivalent to two hundred and twenty tons of saltpetre. The Seine carries daily into the Atlantic two hundred and seventy tons, and the Nile pours eleven hundred

tons into the Mediterranean every twenty-four hours."—*How Crops Feed,* p. 270.

Here is a waste of this element which is incomprehensible if we have no means to save it. Only *three* rivers carry away as much nitrogen every year as there is in one hundred and seventy-four million bushels of wheat or Indian corn!

Our farms are in the same condition as the lands drained by those streams.

The annual rains percolate the soil, dissolve the nitrates, and bear them off to enrich the waters of distant oceans. But all is right. There is a way to save these golden treasures, if we have the wisdom and the will to do it.

Phosphoric acid, when needed on the farm, can always be obtained from bone, either ground fine or as superphosphate of lime.

Potash, according to the researches of Mr. Lawes, "is generally found in sufficient quantities in the soils, and the artificial supply is not required."

But, notwithstanding this fact, we should use all the wood-ashes we can procure at a reasonable price, particularly on sandy land, for potash is often greatly needed on that kind of soil.

In 1875 I compiled a table showing the amount of nitrogen in a ton of different crops as compared with some of our standard fertilizers. It was very kindly published by Mr. Harris in his *Walks and Talks, No. 141*, in the *American Agriculturist*. It is as follows:

| | Nitrogen in one ton. |
|---|---|
| Hungarian Millet, in blossom | 20 pounds. |
| Green Clover | 12 " |
| Green Rye | 11 " |
| Barnyard Manure | 10 " |
| White Mustard | 9 " |
| Green Buckwheat | 8 " |
| Green Corn | 6 " |
| Turnips | 4 " |
| Ground Raw Bones | 100 " |
| Peruvian Guano | 280 " |
| Nitrate of Soda | 300 " |

I have made *one* alteration in this table. I have ascertained, from a recent analysis, that

green corn contains 6 pounds of nitrogen, instead of 4 pounds in a ton.

Now let us examine into the real value of this wonderful element, and also of the other two, whose merits are not far behind it.

"Professor Johnson, after a very careful consideration of the whole subject, estimates the value of the ingredients of manures as follows:

| | |
|---|---|
| Potash | 7 cents per pound. |
| Nitrogen | 30 " " " |
| Soluble phosphoric acid | 16¼ " " " |
| Insoluble " " | 6 " " " |

"Taking Prof. Johnson's figures, the potash, phosphoric acid, and nitrogen in a ton of clover hay would make it worth $17.57 for manure. Bran would be worth $22.10; peas, $22.84; malt dust, $31.30; linseed oil cake, $33.76; and decorticated cotton-seed cake, $47.56 per ton for manure."—*Walks and Talks, No. 101.*

Now, if I understand the revelations of chemistry, nitrogen exists in all of these sub-

stances, only in the form of albuminoids. And nothing but the complete decomposition of these protein bodies, and the conversion of their nitrogen into nitric acid or ammonia, will render them available as plant-food. Taking this view of the case, Professor Johnson most certainly never intended to convey the idea that nitrogen in clover hay, etc. is worth 30 cents per pound.

If it is worth that much in dry hay, it is worth 25 cents per pound in green corn. Yet Joseph Harris ridiculed this idea in 1875 with unaccountable severity, considering that he taught the same doctrine in 1872.

The Hon. George Geddes says: "When we read in *Walks and Talks on the Farm* that the manurial value of a ton of clover hay is $15.82, we are silent out of respect to the high source from which we received the information."

That is decidedly wrong. No man should be silent if truth must suffer in consequence of that silence.

Is it disrespectful to point out the dark spots in the sun? or must we only notice the dazzling splendor of his golden beams and for ever praise his all-pervading power?

But enough of this. The opinion of another great man I must criticise in the interest of truth and science.

When Liebig published his immortal work, *Chemistry applied to Agriculture and Physiology*, he taught the true value of nitrogen in manure. But soon after this, by reasoning upon a subject which can only be properly examined by observation and experiment, he jumped to a false conclusion—that "ashes represent the whole nourishment which vegetables receive from the soil."

Hence in using manures he says: "Would not their effect be precisely the same in promoting the fertility of cultivated plants if we had evaporated the urine and dried and burned the solid excrement?"

This was his sincere belief. And year after year, in every subsequent work, he would not

bend a line from his tangent, but struggled hard by most ingenious argument to carry the whole agriculture of the world with him.

Lawes and Gilbert subjected his theory to a most rigid investigation. The *ashes* of fourteen tons of barnyard manure were applied for thirty years in succession on the same acre, and produced each year only two bushels of wheat more than the continuously unmanured acre. The artificial mineral manures were also used in the same way on another plot, and with the same result.

Besides all this, able chemists have demonstrated, by growing plants in distilled water, that to produce a good crop there must be nitrogen in the soil or in the water.

They have dissolved the ashes of plants in pure water, and then, by adding a few grains of nitrogen in the form of a nitrate, have produced a luxuriant vegetation; but without the nitrogen only a *very feeble* growth could be obtained.*

* See a beautiful plate in illustration of this subject in the *American Agriculturist*, March, 1876.

The fact is, Liebig saw a great light illuminating the heavens of his beloved science, and not having the patient research of less gifted minds, he uttered premature thoughts, grand in their conception, but too deeply colored by his excited imagination. He discovered what seemed to him a vast storehouse of ammonia in the air, and supposing that all plants could absorb through their leaves from that source alone all the nitrogen they needed, he made a positive declaration that there is no necessity of collecting the elements of the atmosphere in the soil.

Now, we regard this question as settled, that the nitrogen of the air, though all-sufficient, must in some way be oxidized and become a constituent of the earth before plants can receive and assimilate it and make it a part of their structure.

## CHAPTER II.

### COVERING THE SOIL.

WHEN green crops are raised to improve the land it is not indispensable that they should be ploughed in to accomplish this object. You need not turn them in till you are under the necessity of doing it to prepare the ground for a future crop. But if the green dressing should be Hungarian millet or white mustard, or anything that might seed the ground at an improper time, you can either plough it in or cut it down when in blossom, and it will improve the soil in proportion to its ability to shelter it.

Cuthbert W. Johnson says: "An English farmer inadvertently left for some months a door in his fallow field; for several years after the crops were particularly luxuriant where the door

had been lying—so much so that one would have said that some rich manure had been applied to that spot."

Anderson, an eminent Scotch writer, says in his *Economy of Manures:* "Every practical farmer knows or ought to know, for the facts are constantly before his observation, that land can be made exceedingly fertile without manure. He must have noticed that if any portion of the soil has been covered, either accidentally or designedly for some time, by water, stone, plank, logs, chips, brush, rails, corn-stalks, straw, buildings of every description, with hay or straw ricks, leaves or clover—and in fact, that under any and every substance which has covered its surface closely—it (the surface soil) invariably becomes exceedingly fertile, and that the degree of this fertility is totally independent of the covering substance."

After reading these remarkable statements of Johnson and Anderson, both men of extensive observation and intelligence, we can more fully

credit the experiments of Gurney in England upon his fields of grass.

Green grass covered with straw gave him in one month five thousand eight hundred and seventy pounds per acre. The same kind of grass uncovered produced but two thousand two hundred and seven pounds. No rain fell during this experiment. Another plot gave in one month, when covered, three thousand four hundred and sixty pounds per acre, while the rival lot, not covered, yielded but nine hundred and seventy pounds. Clover that was covered grew six inches, while that uncovered grew but one inch and a half.

And where a certain quantity of stall dung would double the crop of grass the mulch spread on top of the manure would increase the crop six times. He used about one ton and a half of straw per acre.

"Boussingault found upon comparing water obtained by melting two portions of snow—one taken immediately as it fell upon a stone terrace,

and the other (from the same fall), after it had lain for thirty-six hours upon the soil of a contiguous garden—that the second contained ten times as much ammonia as the other. It is well known that snow has a most beneficial effect upon soils, and, amongst other causes, Boussingault believes that it may act in preventing ammoniacal emanations from the soil."—*Journal of the Royal Agricultural Society of England.*

Now, we can believe there is much truth in the old proverb, that "Snow is the poor man's manure."

Not having straw nor any barnyard material to top-dress his wheat, he has often noticed that his crop was much better when kind Nature covered it for him.

Does not this investigation of the great chemist reveal to us *one*, if not more, of the deep and far-reaching causes why mulching is so beneficial to the land?

Professor Johnson says: "The ammonia of the soil is constantly in motion or suffering change,

and does not accumulate to any great extent. In summer the soil daily absorbs ammonia from the air, receives it by rains and dews, or acquires it by the decay of vegetable and animal matter. Daily, too, ammonia wastes from the soil by volatilization, accompanying the vapor of water which almost unceasingly escapes into the atmosphere."—*How Crops Feed*, p. 247.

This is a revelation of scientific truth which cannot be misunderstood or explained away. Was ever a stern necessity to do anything more clearly demonstrated to the world? We must keep the soil covered to promote and retain its richness. But how often do we strip the ground naked, and then bake it in the ever-burning sun!

Col. Waring, of Ogden Farm, says: "I had read so much about top-dressing that it was determined to try it on this apparently forlorn hope, and the land was well covered before the heavy rains that fell early in May. The result was almost magical. While that portion

which had looked so promising as to seem not to need manure did not yield 1000 pounds per acre of poor hay, ox-eyed daisy and red sorrel, this poorer part, solely as an effect of the top-dressing, produced fully 4000 pounds per acre of very fair hay."

## CHAPTER III.

### SURFACE MANURING.

NOT many years ago it was the universal custom to plough in manure the very day or hour that it was spread upon the field. Farmers became irritable and had but little to say if anything prevented immediate ploughing after the precious contents of the barnyard were spread broadcast before their eyes. It was a prevalent opinion that nearly all the richness would dry out in a few days if exposed to the weather.

They had often noticed that manure under cover was about twice as good as that which lay out of doors all summer, but they did not discover that the great injury which it had received was owing to the leaching rains, which

dissolved and carried off its richest elements, and not to the sunlight which occasionally fell upon it.

When manure is spread it soon becomes dry, and then all chemical changes cease; fermentation is arrested; it will decay no more in that condition. And when the dews settle and the rains descend upon it, it will dissolve, day after day, and a peculiar dark rich coffee will saturate the soil beneath it so effectually that Alderman Mechi could hardly do it better with his steam-engine and his pipes and hose in every field.

John Johnston writes to the *Country Gentleman:* "If I only had Col. Pratt here for five or six months I could convince him that surface manuring is the true way, and will, before ten years from this, be the way generally that manure will be used."

And in the *Genesee Farmer* he says to Joseph Harris: "I am not surprised at your correspondent, Buckeye, being opposed to surface

manuring. I would have been so myself had not experience taught me better. I have used manure only as a top-dressing for the last twenty-six years, and I do think one load used that way is worth far more than two ploughed under on our stiff land."

Nearly ten years after this was written he speaks, if possible, with even a stronger faith than ever in defence of his favorite practice.

Harris writes in *Walks and Talks, No. 112*, that "John Johnston, who has a far heavier clay soil than the deacon, says he has found by actual trial that one load of rotted manure applied as a top-dressing to grass-land in the autumn, and the land ploughed up and planted to corn in the spring, is worth as much as three loads of fresh manure ploughed under."

Major Dickinson, another able and extensive farmer, declares: "I hold that one load of manure on the surface is worth two loads ploughed in."

Charles B. Calvert, a distinguished farmer of Maryland, "is a strong advocate of the application of stable manures *upon the surface*, instead of ploughing them in."—*Cultivator.*

Mr. Bright writes in the *Gardener's Monthly:* "The practice of top-dressing or of surface manuring has long been the favorite method employed by all intelligent gardeners within the circle of my acquaintance. A piece of soil heavily shaded by surface manuring actually decomposes like a manure-heap; that is, it undergoes a sort of putrefaction or chemical change which sets free its chemical constituents, unlocks, as it were, its locked-up manurial treasures, and fits its natural elements to become the food of plants. Manure, then, I say, chiefly upon the surface. Do not waste your manures by mixing them deeply with the soil. Surface manuring and mulching are the true doctrines. I am sure of it."

In Todd's *Young Farmer's Manual* I find the following statement: "James M. Garnet,

a Virginia farmer, an excellent writer on agriculture, says: 'I began penning my cattle late in the spring, and continued it until frost in pens of the same size, moved at regular intervals of time, and containing the same number of cattle during the whole period. These pens were alternately ploughed and left unploughed until the following spring, when all were planted in corn, immediately followed by wheat. The superiority of both crops on all the pens which had remained unploughed for so many months after the cattle had manured them was just as distinctly marked as if the dividing fences had continued standing; it was too plain even to admit of the slightest doubt.'

"A near neighbor, a young farmer, had made the same experiment on somewhat different soil the year before, but with results precisely the same. Similar trials I have made and seen made by others with dry straw alternately ploughed in as soon as spread, and left on the surface until the next spring. In every case

the last method proved best, so far as the following crop would prove it.

"The same experiment has been made by myself and others of my aquaintance, with manure from the horse-stables and winter farm-pens, consisting of much unrotted corn-offal, and without a solitary exception either seen by me or heard of the surface application after the corn was planted produced most manifestly the best crop.

"Upon these numerous concurrent and undeniable facts my opinion has been founded, that *it is best to apply manure on the surface of the land.*"

An able writer in the *Cultivator* in 1843 says: "I have seen spots where cattle had been penned at night for a month or two; for *six years* afterward, the vegetation was double on those spots to any other part of the field, although all the manure had been carefully removed and scattered about. Now, nothing but the liquid could have gone into the earth, and yet the rains

of six years never washed away the beneficial effects."

Now, if the valuable material of the barnyard will not suffer waste when spread upon the open fields, and is better there than anywhere else, then the green crop, whatever it may be, that is raised to improve the land, should be mown down in summer and in autumn, and should be left upon the surface as long as possible—to prevent evaporation, to disintegrate the soil, to retain moisture, to be leached by rains and dews, and finally to enrich the ground by its total decomposition.

## CHAPTER IV.

### WATER AS A SOLVENT.

THE mineral constituents of the bones of man and animals are but the *ashes* of our daily food.

Every year from the rock and soil these ashes come, decomposed and dissolved by water, carbonic acid and oxygen.

Green manures, by their ability to collect and preserve moisture on the surface and in the soil when cut down or ploughed in, render an immense assistance in the growth of the organic world. Water is the *blood* of vegetation. It carries nourishment from the ground to the stem, to the leaf, to the seed. In its solvent action rocks become the food of man.

When the soil is *dry* no mouldering down to

a finer dust, no disintegration of minerals, no decay of any kind, can be discovered; every atom, apparently stationary, seems fixed and firm as adamant.

Travellers tell us that in the dry air of Egypt the old monuments erected thousands of years ago are just as fresh and smooth in outline as if the chisel had finished them but yesterday. But when some of these relics of the past were transported to Paris, in the moist climate of France they soon began to change, and atom by atom to crumble away.

Dr. Youmans says: "It has been shown by extensive experiments that no species of rock whatever will resist the solvent action of water impregnated with carbonic acid."—*Atlas of Chemistry*, p. 50.

What an instructive lesson! How valuable to the farmer! Such knowledge, how exceedingly useful!—that in our daily effort to convert the earth upon which we tread into a flourishing vegetation we *can* combine and concentrate the

forces of nature by covering the ground, that *moisture* and *carbonic acid* may do a great work for man.

Yes, so vastly important is the benefit that may be derived from mulching with green manures that we not only see it in the augmentation of our crops and the improvement of our tillable soil, but it may be observed in the condition of the forests around us. Those that have a deposit of leaves undisturbed for years about their roots make an annual growth much greater than those which have been robbed of their carpet of dead foliage by the winds or by the hand of man.

"The fallen leaves," says Liebig, "contain such trifling quantities of potash and phosphoric acid in comparison to their mass that it is difficult to account for the injurious consequences arising from the raking up and removal of the fallen leaves in woods."

It *is* difficult only when we forget the conditions existing in the woods. There the protec-

tion of the soil, the perpetual moisture, and the carbonic acid constantly forming, work without ceasing beneath the mulch, crumbling and mouldering the minerals into an impalpable and soluble state, ready to be absorbed by plants or trees.

Liebig admits that "the injury is perhaps rather attributable to the fact that the remains of leaves and plants constitute a lasting source of carbonic acid, which, carried by the rain to the deeper layers, must powerfully contribute to disintegrate and decompose the earthly particles."

These substantial truths should establish the advantage, if not the necessity, of shelter and *moisture* to improve the soil, and also to promote the growth of our crops.

Yet there is no scarcity of water in our favored country.

We have a rainfall of four thousand tons per acre every year. But what becomes of it?

Professor Johnson says: "According to the observations of Dickinson at Abbot's Hill, Hert-

fordshire, England, and continued through eight years, ninety per cent. of the water falling between April 1st and October 1st evaporates from the surface of the soil, only ten per cent. finding its way into drains laid three and four feet deep."—*How Crops Feed*, p. 197.

This, we presume, is about the amount of evaporation in the United States. Then what a magnificent prospect is here presented!

Mighty rivers are pouring, not down the deep valleys, but upward from our broad fields to the blue sky above us.

Yes, every square mile of territory sends a constant flood, rushing, though invisible, to the vast seas in the viewless air.

Could all the streams from a single State be concentrated into one torrent, it would outroar Niagara as it dashed against the clouds.

But what becomes of the poor little ten per cent. of water that goes sparkling down the ravines to its ocean home? Is it allowed to depart in peace? No; the farmer at great ex-

pense cuts channels along the hillside to irrigate the sloping plains, and proves that it will pay to do it. And then many calculations are made, and the time predicted when engines will be used to pump back the water again to revive the parched and dusty soil.

All this is done while the ninety per cent. of fluid is passing away without an effort made to save it. We do not need it all—no, not the half of it. We know by covering the land we can retain enough for all the wants of vegetation.

To have a vigorous and uninterrupted growth we must have moisture in the soil, and we must retain it there from rain to rain, or we will have a partial failure in our crops.

Professor Johnson says: "The great deserts of the world are not sterile because they cannot yield the soil-food required by vegetation, but because they are destitute of water."

He also says: "Poor soils give good crops in seasons of plentiful and well-distributed rain

or when skillfully irrigated, but insufficient moisture in the soil is an evil that no supplies of plant-food can neutralize."

The cause of this will be plain on a moment's reflection. Plants can only take up their food in a fluid condition.

Mr. Lawes proved that an acre of wheat in five months and eighteen days evaporated through its leaves three hundred and fifty-five and a quarter tons of water. Now, every drop of this water was more or less instrumental in transporting a little atom of food from the soil to some part of the plant, and when the deposit was made, being no longer needed, the water passed off through the leaves.

Liebig also teaches this doctrine. He says: "Though the soil be ever so rich in the elements of food for plants, still the latter will not grow in hot weather if there be a deficiency of moisture in the soil, for the moisture in the soil is the channel through which mineral food has to reach the interior of plants."

The reader who has not been a careful observer of the changes in nature and the amount of rainfall year after year will be very likely to suppose that drouth is a plague that very seldom visits our much-favored land, and hence he may consider it useless to spend much time in devising means to remedy the evil. But what are the facts?

The *Cultivator* says: "Seasons of drouth of more or less severity are of frequent occurrence in our climate. Weeks, and even months, pass with little or no rain; the scorching glare of the sun drinks up our summer brooks and turns the fields to dust or brick-like clods beneath its influence. The growing crops are shrivelled and dwarfed by the heat."

This strong picture received an alarming confirmation of its truth only a few years ago in the new State of Kansas. No rain fell during all the spring nor in the first month of summer, and there was a total failure in the crops of wheat. Dr. Armor, an able farmer

in that State, who called on me the same year, said he made no attempt to gather the few grains of wheat which grew on little stems only three inches high, but gave an order when he left home in July to plough up the fields for reseeding in autumn.

Indeed, water is so indispensable in the process of vegetation nutrition that only a fortnight of dry weather apparently checks the vigor and freshness of the green world around us.

## CHAPTER V.

### TILLAGE A MANURE.

IN estimating the expense of raising green crops for manure we must not deduct the cost of ploughing and harrowing from the value of the green dressing, because tillage is manure, and often the very best manure which we can apply to many fields, particularly to heavy clays.

Liebig says: "The influence of the mechanical operations of agriculture upon the fertility of a soil, however imperfectly the earthy particles may be mixed by the process, is remarkable, and often borders upon the marvellous."

The truth of this declaration has often been established by the experience of many observing farmers. Here is one case.

"I knew a farmer," says Mechi, "who took a good farm wretchedly out of condition and full of weeds. He fallowed every acre of it, taking care to allow time between each ploughing for the vegetation of the seeds. The result was a crop of wheat averaging five and a half quarters (forty-four bushels) per acre, and other crops in proportion. He was a wise man."

Now, in connection with this good tillage had he put on the field somebody's "nitrogenized superphosphate of lime," it is very likely all the credit would have been given to it, and we might have had his certificate that forty-four bushels of wheat per acre were actually obtained by using only three hundred pounds on each acre of this wonderful fertilizer.

With such facts before him, we are not surprised that Mechi says: "Frequent tillage is our best and cheapest manure."

The farm of Joseph Harris has enough of clay in the soil to require frequent ploughing and harrowing to bring out and unlock its

highest productive capacity; hence he has discovered the great benefit of thorough pulverization. He says: "That tillage and manure are one and the same thing is a great truth."

Taking this natural and rational view of the subject, it would be very unjust to any green crop which is intended for manure to charge it with anything but the seed. And this will reduce the expense of this mode of improvement to a very low figure.

Harris also says: "On heavy land we have not yet been able to dispense with summer fallowing."

John Johnston, rich as he has made his land, is yet in the habit of summer fallowing more or less every year.

His practice has been to top-dress his clover-land in the fall, and the next spring to plough it up and prepare the land for wheat by ploughing it twice more, with repeated harrowings, rolling, etc. In other words, he manures the land in the fall and then gives it a good old-fashioned summer fallow.

Here, you perceive, are *three ploughings* and enough of harrowing to seed the ground with two green crops and to turn them in when grown without any extra expense. And this tillage is never done all at once. It is said that there should always be six or eight weeks between each ploughing. This method would be very accommodating to nearly all kinds of green manures.

Observe how careful Johnston is to neglect nothing that will ensure him a large crop of wheat. No wonder he often raises fifty bushels per acre! We see here that the whole of one year is devoted to the preparation of the soil.

He does not confine himself entirely to this mode. Under another heading we will show that he ploughs in clover in June for wheat. And, notwithstanding he makes from five hundred to a thousand tons of the very best manure every year, he does not compel his fields to produce a crop of either grass or grain, to be

removed every year. And that is the true philosophy of farming—every other year devoted to the entire restoration of the soil. On light, sandy land much tillage is not required, only to subdue the weeds, and for this purpose, to assist the plough and hoe, there is nothing to be compared to green crops.

The way these act in the destruction of weeds is not as freely acknowledged as it should be, because not clearly understood.

When a quick-growing crop is put in the ground, all weed seeds that are on or near the surface sprout and make a feeble growth, but do not mature enough to form a blossom or a seed. In this way tens of millions of noxious weeds will germinate and perish beneath the dense shadow of a green crop.

## CHAPTER VI.

### GREEN MANURES.

ALDERMAN MECHI says: "I have noticed a very money-getting farmer in my neighborhood who never keeps any live-stock except a couple of cows, and who never buys any feeding-stuffs or manures.

"*He keeps his land clean and fertile by ploughing in green crops,* which require no hoeing or labor, and only one ploughing. I know he makes money, for he often purchases land. It is the opinion of some knowing hands that this farmer manages to get better profits than his neighbors who adopt the ordinary system."

This testimony comes from one who has no superior as an honorable and upright man and able farmer. Therefore his words are worthy of

a most careful study. Look at the full weight and meaning of these expressions:

"*A very money-getting farmer. I know he makes money, for he often purchases land.*"

There is not a farmer in the wide world who would not be glad and happy if his good neighbor could say that about him.

Whence comes this undoubted prosperity? Does he keep thousands of sheep or hundreds of milch-cows of the purest grades? No. Does he sell Essex pigs or choice calves for almost their weight in silver? No, nothing of the kind.

The whole cause of his *certain success* is told in two words—*green manures.*

Well, if one man has accomplished so much in this mode of farming, have we no details of actual experiments on record to confirm such statements? Yes, we have. Here is one of great value, because the facts are clearly given and are undeniable.

"In October, 1819," said the late Dr. Browne of Gorlstone, in Suffolk, "a violent gale of wind

drove to this part of the coast an unprecedented quantity of seaweeds. These were eagerly scrambled for, and, from my greater vicinity to the beach, I collected twenty-seven cart-loads—each as much as four horses could draw. I spread mine fresh and wet upon little more than an acre of bean stubble, instantly ploughed it in, and dibbled wheat upon it.

"On the 6th of October I then salted the adjoining land with three bushels per acre, manured it with fifteen loads of farmyard-dung per acre, and dibbled it with wheat on the 15th of November. The result was that the seaweeded portion gave three times the produce of any equal part of the field."—*Farmer's Encyclopædia*, p. 582.

How did it happen that this *green* manure produced *three* times as much wheat as the dung from the barnyard? Certainly the nitrogen in this weed was available. It could not be otherwise. And it is very probable it was much more so than that in the yard-manure.

Now comes the interesting question: In what condition does nitrogen exist in seaweed? In the form of albuminoids, there is not a shadow of doubt, just as we find it in clover, in Hungarian grass and in all vegetation. And we have the authority of Boussingault that there is less nitrogen in seaweed than in clover, and we know there are less phosphoric acid and less potash in the former than in the latter plant.

Then would not the same amount of clover or Hungarian grass, with salt, have brought the same result?

And what a vast difference in the cost of these plants! All the doctor could get would only cover a little more than an acre. To obtain any more of it he would have had to buy it. What it would cost in England we do not know. In this country it is about the price of good manure.

Col. Waring says that seaweed costs three to four dollars per cord on the beach. While this price continues, of course it can only be used to advantage by those living near the coast. We

advise every one who can raise a good crop of clover with bone-dust and plaster to depend on it, unless he can get the weed at a much less figure than three dollars per cord.

We feel deeply interested in this experiment of Dr. Browne. We hope it will satisfy all manure-makers that green plants can be converted into plant-food without undergoing the process of digestion in the stomachs of cattle.

And, more than this, it should be noticed that solution and oxidation can take place in full time to furnish all the nourishment required to produce a good crop of wheat.

And that the conversion of vegetable matter into manure in the barnyard is not necessary may be proved by another careful experiment:

"The following I know to be a fact. A person brought up as a farmer in Scotland was sent to an estate in one of the Windward Islands to improve the system of tillage. Not being able to manure a field of six acres that had been much exhausted by frequent cropping, he resolved to

give the pigeon-pea a fair trial; he accordingly sowed them so thick that in a few months the ground was effectually covered to the height of six feet. He then cut down this mass of vegetation, and immediately buried the whole under the large banks that are raised in digging cane-holes. His first crop gave him but six hogsheads of sugar. Instead of allowing the canes to shoot up again, as they will, he planted the pigeon-pea and proceeded as before; this second crop yielded twelve hogsheads of sugar, as the benefit of the first decayed bushes was then felt. He tried the peas a third time, and his crop was eighteen hogsheads. Finding the improvement was so wonderful, he resolved on a fourth trial, and the six acres yielded twenty-four hogsheads, which is considered a *first-rate crop*, equal to one hundred bushels of corn in this country."—*Cultivator*, 1842.

We believe that corn will take a high position among green manures when the best way to use it is properly understood. A farmer in Ken-

tucky sowed corn on a field of thirty-seven acres, and the result was so favorable that he says: "Were my only object the rapid improvement of my soil within the shortest space of time, I would not seek further or better means than first sowing down thick with rye, which I would plough under just before the time of ripening, to prevent its seeding the ground, and upon which I would sow one bushel and a half of corn per acre, thus in the same season ploughing under a heavy coat of rye and corn, which in the short space of twelve months will equal, if not surpass, any benefit which can be derived from clover in two years."—*Cultivator*, 1843.

One more vote in favor of corn I wish to record from a good writer and practical farmer.

S. E. Todd says in his *Farmer's Manual:* "Some farmers contend that clover ploughed under is the cheapest manure that can be made. It is a great fertilizer; but I believe that a soil can be renovated sooner and at a less expense with Indian corn than with clover, because a

much larger quantity is turned under yearly of corn than of clover. By being expeditious in business when a crop of wheat, oats, or barley is taken off in July, as they are many times, if the soil is ploughed immediately and Indian corn sowed, it will grow large enough in ordinary seasons before the autumnal frosts to plough under. But when clover is raised no other crop can be grown the same season."

These are very high recommendations in favor of green corn. And are they not true? Whatever is undoubtedly beneficial as food for animals most certainly will be good manure. Why is clover so much better than wheat straw, for animal food? Because it contains more than four times as much nitrogen as the straw. And that is the very reason why it is so much better for manure.

Without nitrogenous food we can have no flesh. Without nitrogen in the soil we can raise but little food that will make flesh. In other words, nitrogen is an absolute monarch who can never be dethroned while life exists upon the globe.

## CHAPTER VII.

### GREEN CORN AS A PROTECTION AND MULCH FOR WHEAT.

ONE ton of green corn contains six pounds of nitrogen, two and a half pounds of phosphoric acid, nine pounds of potash, and sixteen hundred pounds of water. I find by years of experience that it is better to plough in two crops of corn in one year than one great heavy crop which has grown all the spring and summer.

I have several times turned in from thirty to forty-five tons per acre. The great objection to this mode was pointed out to me by the ploughman. The surface-roots formed such a dense, compact, and tough mass along each furrow that the plough could not cut them, and it became

necessary to run under them; hence the ploughing was much deeper than desired.

Two crops in a year, each containing in tops and roots about twenty tons per acre, will manure the land well.

Let us compare these with the contents of the barnyard. At this rate on twenty acres we may have eight hundred tons of green manure. To equal this dressing in nitrogen, phosphoric acid, and potash will require about five hundred tons of stable manure. And that will cost to buy it at least five or six hundred dollars, even if you could find that much for sale anywhere within a reasonable distance of the farm.

Having ploughed in the first crop of corn about the middle of July, what shall we do next? I will tell you my plan, and if it does not meet your full approval do not follow it. Or if doubtful of its value, try it on a small plot and you will lose but little if it fails.

About the first of August, having the land in good condition, put in the corn in furrows six or

seven feet apart and seven or eight grains to the foot. Keep the ground mellow and free from weeds with the cultivator while the corn is growing. This you ought to do if there was no crop to work in preparing the land for wheat. Now, when the time comes to sow wheat you will find the sown corn from three to four feet high, according to the quality of the soil and the warmth and wetness of the season. Then sow the seed between the rows and fluke it in.

Now mark the result.

No blasting winds in winter nor in the early spring can injure the wheat. The drifting snows will be retained and help to shelter it. The soil, powdered by freezing and drying into fine dust, will not be blown away. No droughts will check its growth. The ground will always be found moist and mellow beneath the shelter. Even the rows of corn which may only be a foot high will attract the surface-roots of the wheat to banquet in the moist and mouldering dust beneath their dense shade. And when it decays in the warm

days of spring, the rains will leach out its soluble elements and saturate the soil with them, and do more good to the ripening wheat than the same amount of green fodder fed to cattle and the residue returned to the field.

To establish these high claims for Indian corn, and the great necessity of shelter for winter wheat, I will quote a few words from John Johnston, the great apostle of agriculture, whom we have already presented as the powerful advocate of surface manuring.

He says: "Wherever the wheat was exposed to the west and north-west it is greatly damaged, and I fear considerable of it is ruined. I have eighteen acres of Soule's wheat, about five of which are sheltered by growing timber from the west and north-west. Those five acres look as promising as any wheat I ever saw; the other part of the field is weak, and I think cannot make a full crop, although much better than much I see around me. The Maryland wheat of which I wrote you was sown immediately,

east of the orchard. So far as the shelter of the orchard extended it looks pretty well; beyond that it is quite feeble. Had my orchard been on as high land as the wheat-field, I have no doubt it would have sheltered all the wheat-field.

"I have thought it would pay to plant quick-growing timber to shelter fields that are exposed to the west or north-west. We have no hard blows from due north or anywhere easterly to injure crops, but often from the west. It was only three years ago that half of the wheat in the State that was exposed to the north-west and west was killed by a hard frost and hard blow on the eighth of March. I feel quite sure that it would pay to have plantations for shelter wherever winter wheat is the staple crop. A top-dressing of manure, or even straw, would have a tendency to protect it in such seasons as this has been. *This I know.* One inch of straw put on after sowing the wheat would have saved it, I have no doubt; and fine manure would be still better. Where the wheat is sheltered by our

rail fences it is safe as far as that shelter extends, though one would not suppose there was much shelter from a rail fence; but it has been enough to protect the wheat on that severe day, the 17th of February."—*Country Gentleman*, vol. 23d.

Probably no man was ever more successful in raising wheat, or ever gave the subject a more patient investigation, than John Johnston; hence these words will be received as instructive truths by all who know his exalted worth.

The wheat-plant has many enemies. The midge, the mildew, and the Hessian fly too often nearly ruin it; but according to the authority of Lewis Bollman of Indiana, "*Freezing out* is perhaps more destructive to the wheat-crop than all other misfortunes to which it is incident."—*Agricultural Report*, 1862.

S. E. Todd says: "In every wheat-field may be seen in spring plants growing in little hollows sheltered by lumps or banks from the

cold wind, but enjoying the benefit of the sun's rays. The difference between the growth of these plants and others which have not the benefit of shelter is remarkable."—*Wheat Culturist*, p. 212.

Again he says, on page 226: "The more we can protect the wheat-plants from piercing winds and intense cold, the better crops of grain we may expect to raise."

In corroboration of these statements we have seen reports of stumps in the Western States saving little patches of wheat all over the field.

Sidney Weller of North Carolina was in the habit of scraping up the pine leaves in the forest and covering his wheat in the fall with much care and trouble. He says: "By four years' trial I have now found it always benefits the wheat—sometimes increasing the product one-half at least—and even guards the clover against the misfortune of burning out in hot, dry summers."—*Cultivator*, 1843.

What a contrast between the labor of spreading straw or pine leaves upon a large field, and the ease and rapidity by which you can roll down a luxuriant growth of green corn where it grew!

This method of raising wheat will not prevent you from using stable manure as a top-dressing.

Any time before sowing the wheat, or afterward if you wish to do it, you can drive between the rows of corn and spread the manure from the wagons. You remember that Gurney says that manure does six times more good under a mulch than when not covered with anything.

In the first edition of this work the farmer was advised to roll down *in the fall* the corn which had been planted in drills to protect the wheat. Careful experiments since that time have proved to my satisfaction that this is not necessary, and that it is better to leave the corn standing till spring and then roll it down.

Since the discovery that drilled wheat is seldom injured by freezing, and that careful rolling of light land is another great source of protection, it is only in very exposed situations and in the Northern and Western States that you will have to resort to other means to secure an ample shelter to your fields of grain.

It is very probable when planting corn for this purpose that it would be better to have the rows wide enough apart, that the drill may be used in putting in the wheat. I suppose that six or seven feet would be about the distance required; however, this is a matter for every one to decide for himself. Another point will need more careful experiments to work out the right number. That is, how thick to sow the corn.

Would it be better to scatter in the furrow fifteen or twenty, or only six or eight, grains to the foot in preparing a shelter and protection for the crop of wheat?

## CHAPTER VIII.

### HUNGARIAN MILLET.

ONE ton of Hungarian millet in blossom contains twenty pounds of nitrogen, two and a half pounds of phosphoric acid, seventeen pounds of potash, and thirteen hundred and sixty pounds of water. When the clover-seed which was sown among the wheat has failed to grow, you had better seed the field in the spring with Hungarian grass; that is, if you intend to alternate a green and grain crop in succession.

As soon as all danger is over from frosts sow one bushel per acre of the Hungarian seed when the ground is in good and mellow condition, and then roll it in. As soon as this crop comes in blossom, sow over it a half bushel

more of seed per acre. Then with your mowing-machine cut it down and leave it on the ground. Being cut so early, it will sprout up, and with the last sowing you will have two crops growing together, and, being shaded by the first, will be equal to it in weight and value.

The bushel and a half of seed per acre will cost about three dollars.

These two crops of green manure will make together twenty-five tons per acre, and this will amount on a field of twenty acres to five hundred tons. Then this green dressing will cost twelve cents per ton. The ten thousand pounds of nitrogen in it will cost less than one cent per pound.

Let us compare this with barnyard manure. It will take one thousand tons to furnish as much nitrogen as we have in the twenty acres of Hungarian grass. If you can buy the manure and haul it home and spread it for one dollar and fifty cents per ton, it will cost you fifteen hundred dollars.

Peruvian guano contains two hundred and eighty pounds of nitrogen per ton, and at the old price of sixty dollars it would cost nearly twenty-one hundred and sixty dollars to obtain as much nitrogen in that way as we get for sixty dollars in the twenty acres of Hungarian grass.

Nitrate of soda is another highly-concentrated manure, because it contains three hundred pounds of nitrogen per ton. But I do not know where you can buy the pure article for less than ninety dollars for two thousand pounds; therefore it will cost you three thousand dollars to get as much nitrogen as we obtain for sixty dollars in twenty acres of green millet.

After looking at the subject through these calculations, does it not seem exceedingly strange that English, and even American, farmers will purchase nitrate of soda and sow from one hundred to two hundred and fifty pounds per acre on their wheat?

Why *will* they do it? Because they want *available* nitrogen. They want it in such a condi-

tion that it can be taken up by the plants the moment it is sown. Green manures must decay: a complete decomposition is necessary to convert the nitrogen into nitric acid and ammonia.

But let us have patience; there never was a pile of hay or grain or grass that would not rot down, and in reasonable time make manure.

But how shall we hasten this decay to the best advantage?

By keeping the material upon the surface. Dr. Voelcker discovered that hay or new-mown grass lost more than half of its richest elements when left on the field and exposed to leaching rains for a short time.

Unless the soil is very loose and sandy, vegetable matter will not decay when ploughed in as soon as it will upon the surface.

Combustion is a rapid condition of decay, and the whole process of decay is a slow combustion—in both cases a union of oxygen with carbon and hydrogen. Cover your fire with ashes or earth and it will not burn as brightly

as when uncovered. Bury half-rotten manure or straw or wood so deep that air will be *entirely* excluded, and no further decay can take place.

Stirring the soil promotes the slow burning (decay) of the vegetable matter in the ground. A pile of clover hay may lie for years apparently but little changed by decomposition. But a careful examination will disclose the fact that nearly all its valuable constituents have been carried into the soil. The shell remains, but the oyster has been extracted.

Minute division favors oxidation. A substance dissolved by water and deposited on the soil has its atoms in a state of great refinement, and will soon be converted by a chemical change into *available* plant-food. Hence the unquestionable advantages of cutting down green crops in midsummer and leaving them to cover the ground as long as possible. At the same time another green one may be encouraged to grow up through the mulch.

## CHAPTER IX.

### GREEN CLOVER.

ONE ton of green clover contains twelve pounds of nitrogen, two and a half pounds of phosphoric acid, nine pounds of potash, and sixteen hundred pounds of water.

We may by good management have fifteen tons by the middle of June to cut down or plough in for wheat. If left on the surface as a green dressing, a second crop will grow up, and the two together will amount in tops and roots by the middle of August to twenty-five tons per acre. That will be five hundred tons on a field of twenty acres. This amount of green manure will contain six thousand pounds of nitrogen.

One peck of seed per acre, at ten dollars a

bushel, will make the nitrogen cost less than one cent per pound and the green clover ten cents per ton. That is fifty dollars for five hundred tons of green manure.

Now, it will take six hundred tons of barnyard manure to furnish as much nitrogen as we get in the twenty acres of clover. If you buy stable manure and haul it home and spread it at a cost of one dollar and a half per ton, you pay nine hundred dollars for a pile that contains no more nitrogen than we can obtain for fifty dollars.

To this you may reply that when we purchase manure it is all a clear gain, but that the clover only contains what was already in the soil and air. This would be very plausible reasoning—indeed, it would have great weight—were it not an established fact, as we have already shown, that land does not retain its nitric acid, but allows the dissolving waters to carry it off almost constantly.

With this knowledge accepted as a great truth, the careful farmer will always employ a trust-

worthy collector of Nature's manurial treasures. Among these he will find by long experience that red clover stands in the highest rank.

It will always be profitable to raise clover in every field on the farm whenever other crops will permit it. And whenever the crop is not heavy we should assist the land by a free use of bone-dust and plaster or super-phosphate of lime.

Were all the merits of red clover emblazoned in letters of gold on a large canvas, it would fail to convey to the mind a full estimate of its true value.

The Hon. George Geddes says: "The agriculture of Onondaga county is based on the red clover plant. It is used for pasture, for hay, and for *manure*. Strike this plant out of existence, and a revolution would follow that would make it necessary for us to learn everything anew in regard to cultivating our lands."

Joseph Harris says: "Raise your own clover-seed, and sow it with an unsparing hand. You

cannot raise too much clover. It is the grand renovating crop of America."

Allen says of clover in his *American Farm Book*, "*It is as a fertilizer*, however, that it is so decidedly superior to other crops. In addition to the advantages before enumerated, the facility and economy of its cultivation, the great amount yielded, and lastly the convenient form it offers for covering with the plough, contribute to place it far above any other species of vegetation for this purpose. All the grains and roots do well after clover; and wheat especially, which follows it, is more generally free from disease than when sown with any other manure. The introduction of clover and lime in connection has carried up the price of many extensive tracts of land from ten to fifty dollars per acre, and has enabled the occupant to raise large crops of wheat where he could get only small crops of rye; and it has frequently increased his crop of wheat threefold where it had been previously an object of attention."

In 1843 *The Cultivator* said: "We know an extensive farmer, and a most successful one, who avers that he can manure his farm cheaper with clover than he can with manure, could he have it for only the carting from his yard and spreading."

Among experienced farmers a great diversity of opinion exists regarding the most profitable way of using clover. Some can hardly be induced to plough it in, or anything else which can be used as forage; among these we may number Joseph Harris, yet even he says: "In certain circumstances it may be better to plough under the clover instead of feeding it to stock on the farm. It is a *quicker* way of enriching the soil." —*Genesee Farmer*, 1863.

Now, is not this a great concession? He is such an eloquent advocate for feeding every straw that I almost thought if he were to see an ox eating his jacket he would give him his coat also.

Ten years after this was written he speaks still more favorably upon this subject in *Walks*

*and Talks, No. 116:* "'We shall have to go back to the old-fashioned plan of ploughing under clover,' says the deacon; and, as usual, he is more than half right."

What a great satisfaction it would be to see the strong and powerful pen of Joseph Harris engaged in full faith in defence of green manuring!

Here is another example showing how little it cost to enrich land with clover:

D. D. T. Moore sowed clover-seed with barley, and the next spring, on the 8th of June, ploughed in the clover for corn. He says, to ascertain the weight of the crop of clover thus turned under, he cut a square foot of the sod, shook off the soil, and found the weight of clover and its roots to be two pounds and a quarter. This would give forty-nine tons per acre.

Hence he obtained five hundred and eighty-eight pounds of nitrogen for one dollar and a half, the reported cost of the seed per acre!

Now mark—and remember well this astounding fact—that we have a green manure which costs but a trifle over three cents per ton, and which is more valuable, ton for ton, than stable manure! And not a cart nor horse nor fork of any kind was required to spread it evenly over the whole field!

When I first read this account in the *Cultivator* for June, 1854, I was inclined to suppose that there was some error in the report.

That such a mass of clover could grow in less than fourteen months, and part of that time in the winter and with barley, seemed beyond all common experience. But after this, most fortunately, I came across the following careful estimate of the amount of vegetable matter which can grow upon an acre, and that reconciled me entirely as to the correctness of Mr. Moore's statement:

The Hon. George Geddes says: "Professor Kedzie, of the Michigan Agricultural College at Lansing, took a square foot of June grass-turf

and washed away all the soil in running water, and then weighed the roots and surface grass to determine the amount of green manurial matter usually contained in a heavy green sward, and found it to be five pounds to the square foot, or at the rate of more than 100 tons to the acre."

It certainly is unnecessary to dwell any longer on clover as a means of enriching the soil.

But when and how to use it will require some attention.

Will it ferment and become sour when turned in in a green state? Some farmers say it will.

For thirty years John Johnston ploughed it in about the middle of June. How is it that we hear nothing from him about souring the soil?

The Hon. George Geddes says it is ready to plough in as soon as it comes to full maturity. Now, without any exaggeration we may say that there is not another person in the United States who has had such a long and large experience in the use of clover as a green manure as this distinguished farmer of New York.

He writes to the *Tribune* that he has on his farm in Central New York a field which from 1799 to 1873 has had no manure except clover grown on it and ploughed under, and that wheat, corn, oats, barley, meadow, and pasture have been regularly taken from the land in five years' rotation, the closing crop being winter wheat, with timothy and clover sowed. The clover has been regularly treated with gypsum for fifty years. He has particularly noticed it of late years, and says the land is more fertile now than it was twenty-three years ago.

Yet we hear nothing from him of any injury to the soil from this lifelong use of clover as a green manure. But such has not been the case everywhere.

Dr. Joseph Henderson of Mifflin co., Pennsylvania, says: "Experience here is adverse to turning down green crops as fertilizers, and few, I believe, have repeated the experiment. In two instances in my immediate neighborhood wherein heavy crops of clover were ploughed in, in full

bloom, upon land of excellent quality, the immediate effect, at least, was highly pernicious, as evinced in an almost total failure of the succeeding crop of wheat."—*Agricultural Report*, 1864.

Here is another case from the same report: Joshua S. Keller says, "Clover, after growing up a few years, ought to be turned under when fully ripe with a good plough. Let those who advocate the green state do so to their hearts' content. I have the experience of both the dead-ripe and the young green, and would by no means suffer the latter if I could prevent it."

And here is another from an able writer whose name I have forgotten: "But powerful as are the effects of green crops ploughed in, it is the experience of some practical men that one crop allowed to perfect itself and then die where it grew, and then turned in dry, is superior to three turned in green."

What can be the cause of this? The crop that is left to ripen and fall where it grew shades,

protects, and mulches the soil. And it may be that half its substance is leached out and enriches the surface with liquid manure.

If this is the case, certainly no better way could be adopted to use clover to improve the land. Yet I would modify this treatment by following the advice of Joseph Harris, that is, to cut down the clover when in full bloom, and let the second crop grow up through it, and also cut the second when ready, and let it decay a while before ploughing for wheat.

This mode would effectually *head off* all weeds that might be among the clover. But with regard to the crop becoming sour if turned in green, that is another matter. If you are careful to plough in the green dressing very shallow, and the soil is mellow and loamy, there will be no danger of acetic fermentation. If you are afraid of it, sow lime or salt over it before ploughing, and that will prevent it and be a benefit to the wheat.

Clover has but one fault. In its infancy it is

very tender and feeble, and cannot always stand the atmospheric changes. It may be that we are to blame. We may not know when to sow the seed to ensure a perfect germination. One farmer will tell you to sow very early, even on the last fall of snow; another will say, Wait till May; and some will declare that they never fail when they sow in June. Yet failures will take place.

In 1870, Joseph Harris writes: "Nearly all the spring-sown timothy and clover in this section is a comparative failure, and farmers are ploughing their wheat-stubble and going to sow wheat again."

He sowed about fifty acres, and says: "It is apparently an absolute failure."

In 1872, Mr. Straub of Maryland wrote to Harris that "for the last two years the clover crop has proved almost a total failure."

This is a serious matter, because it is always a double loss: you lose a crop of clover and all the money invested in the seed.

Have we no remedy? There is but one cause

for all this trouble—the want of moisture in the surface soil.

Sidney Weller of North Carolina found that when he covered his wheat with pine leaves, even on his sandy soil, the clover never failed, no matter whether he sowed the seed in the fall or in the spring.

When the wheat is protected with green corn, as recommended in Chapter VII., the clover will find a moist bed to grow in all the year.

If you wish to raise clover independent of any other crop, sow it with buckwheat in the spring, and when the buckwheat is in blossom cut it down, and it will mulch the clover and ensure a good crop.

## CHAPTER X.

### GREEN RYE.

ONE ton of green rye contains eleven pounds of nitrogen, four and a half pounds of phosphoric acid, twelve and a half pounds of potash, and fourteen hundred pounds of water.

When we compare it with barnyard manure its great value as a green dressing becomes apparent. I have seen fifteen tons per acre growing on the 8th of May, and this was ascertained by careful measurement. Then on a field of twenty acres you could have three hundred tons of manure at very little expense, all evenly spread on the ground and ready to plough in.

The most careful analysis is worth nothing if green rye is not equal, ton for ton, to stable manure, with one small exception. The latter has

half a pound of phosphoric acid per ton more than the former.

Now, what will it cost you to cover a field of twenty acres with three hundred tons of manure? Can you buy it, haul it, and spread it for less than four hundred and fifty dollars?

The rye will cost you for the seed one dollar per bushel, and two bushels per acre will be forty dollars. That is, it will cost more than twelve times as much to improve with barnyard manure, at one dollar and a half per ton, than to use green rye.

The tillage always pays for itself.

And remember this: the rye grows at a time when you cannot use the ground for any other crop but wheat.

Mr. Root of Illinois regards this fact of the very highest importance in using this grain as a green manure.

Besides this great merit, it protects the field from washing during the winter.

It absorbs the soluble minerals and the am-

monia and nitric acid that might under other conditions be lost.

For barnyard manure you can claim no superiority over this plant but its partial decomposition. It is more available, because a part of it is oxidized.

The rye must undergo this change before its albuminoids can be of use to growing vegetation. But look at the ample time that it has to decompose, and then you cannot but acknowledge its value.

It may be ploughed in for a crop of corn, or may be cut down just as it blossoms and left as a mulch on the ground. A second crop will then grow up nearly as large as the first, and may then be ploughed in, and Hungarian grass or white mustard or buckwheat or green corn be sown, and make a third crop for turning in for wheat. If corn should be the third crop, I should prefer to use it as a mulch, as already explained in Chapter VII.

J. B. Root of Rockford, Ill., writes in the

*American Agriculturist*, 1875: "The labor of applying evenly forty loads of manure per acre is considerable. All this is done more evenly by the green crop. Seed and labor together cost me but three dollars and a half per acre. I cannot say that it adds as much fertility to the soil as forty loads of manure, but I do say that in our droughty seasons it produces as great an increase of crop as do forty two-horse loads of good manure. It certainly pays to practise it, and to practise it largely, even on the land well supplied with stable manure."

Every one acquainted with the writings of Joseph Harris for the last twenty-five years will suppose, of course, that clover is the only green crop which could obtain such a high recommendation from a practical farmer.

But such is not the case. Mr. Root makes but little use of it. He says: "Rye has been my most profitable green manure."

Harris thought it just as useless to plough in cereal crops for manure as to attempt to carry

buttermilk in a basket. He believed they spilled the most of their nitrogen while growing. He has now changed his views, and is conscientious enough to acknowledge that for twenty-five years he was in error.

He now writes: "I thought then that wheat, barley, oats, corn, and other cereals during their growth gave off nitrogen into the atmosphere, while clover, peas, beans, vetches, and turnips retained all the nitrogen they got from the soil and from dews and rains. The theory was simple and plausible, and the practical deduction safe and sound. But more recent investigations failed to sustain this view."

## CHAPTER XI.

### GREEN BUCKWHEAT.

ONE ton of green buckwheat contains eight pounds of nitrogen, three pounds of phosphoric acid, and eleven pounds of potash.

It stands very high as a green manure. Two large crops can be raised in one year to plough in for wheat. In 1875 I raised in fifty-one days twenty-seven tons per acre of green buckwheat. It was sown on the 14th of July, and cut and weighed on the 3d of September.

Besides its value as a manure, it will make excellent hay. In July you should make an estimate of the forage on hand to keep the stock through the winter, and if you need more, instead of cutting a second crop of clover, better sow one or more acres of buckwheat and top dress

it with plaster and bone-dust or super-phosphate, unless the land is already good; and before the equinoctial storms of September you may have from the buckwheat three or four tons of good hay per acre. It contains two-thirds as much nitrogen as clover hay, and more phosphoric acid and more potash.

If wet weather should prevent you from making it into hay, you can plough it in for wheat, and no loss will occur.

Even buckwheat straw, after you have thrashed out the grain, should be saved for hay. It contains four times as much nitrogen, four times as much potash, and three times as much phosphoric acid, as wheat straw.

John Johnston once said to Harris: "I should have made more money if I had found out the value of straw for fodder fifteen years earlier."

He alludes, of course, to the straw from his immense crops of wheat.

No wonder farmers cannot raise corn after buckwheat, when seed and straw have all been

removed! They say it poisons the land. So does a check on the bank when it removes all your deposits. But plough the money into the bank, and it will antidote all the poison.

That buckwheat is beneficial as a green dressing the following may be relied upon:

"We cannot," says the editor of the *Theatre of Agriculture*, "too much recommend, after our old and constant practice, the employment of this precious plant as a manure. It is certainly the most economical and convenient the farmer can employ."

The *American Agriculturist* for 1867, p. 253, says of buckwheat: "It affords one of the most valuable green manure crops to be used on light leachy lands, for with 100 to 150 pounds of good guano, or three to five hundredweight of bone-dust, a heavy crop of manure may be produced on almost any soil."

It also says, on p. 285: "When this grain is sowed the 1st of August it will be in condition to plough in for a rye crop the last of September.

We have seen rye taken from a field four years in succession, with no other manure than buckwheat turned in at the time of sowing the rye. There was a constant increase in the yield of the grain, showing the benefit of the green crop."

Here we see what a number of green crops may be turned in for wheat every other year. Of one fact we may be certain—that no person ever made money by raising small crops of wheat. Hence every effort should be made to prepare the ground and enrich it, so as to ensure a large crop of grain. The cheapest and best way to accomplish this is to plough in three or four green crops in one year for wheat. And in this way it may be done: Where the clover has failed, as soon as the wheat is off in July plough and sow rye and buckwheat together. When the latter is in full blossom cut it down on the rye. Here we have two crops on the field all winter. One acts as a mulch to the other, and both together protect and improve the soil. By the middle of May the rye will be in blossom, and should be carefully cut down, and

then a second will spring up, and in six or eight weeks may be as large as the first. Then plough all in together, and by the first of August put in sowed corn as a mulch for wheat, as directed in Chapter VII.

Take notice of this remarkable fact—that we have four green crops, and the wheat actually put in the ground, with only two ploughings.

If your soil should be a heavy clay, and you wish to plough it three times, the rye may be turned in about the middle of May, and Hungarian grass or some other quick-growing plant be sown for the third crop.

To conclude this subject, let us examine the relative value of green buckwheat compared with barnyard manure. In the three crops which you can plough in between two crops of wheat it will be safe to estimate them all together at forty-five tons per acre.

Then on a field of twenty acres you will have 900 tons, containing 7200 pounds of nitrogen, 1700 pounds of phosphoric acid, and 9900 pounds

of potash. Now, it will take 720 tons of stable manure to yield as much nitrogen as we get in our triple crop of buckwheat, and nearly as much for the phosphoric acid and potash. If the last crop of buckwheat should absorb any material from the mouldering ruins of the first, it may be possible that we only gain from the soil about two-thirds of the amount above given. But that will be amply sufficient for a good crop of wheat.

## CHAPTER XII.

### WHITE MUSTARD.

ONE ton of white mustard contains nine pounds of nitrogen. In two months it will produce fifteen tons per acre of green manure. Two crops may be raised from May to September, to be ploughed in for wheat. On a field of twenty acres you may have 600 tons at one-tenth the cost of stable manure, and nearly equal to it in value, ton for ton.

Joseph Harris says: "On sandy soils that are not specially enriched by summer fallowing mustard could undoubtedly be used to advantage as a green manure for winter wheat or for Indian corn the next spring."

Again he writes: "The experience of the heavy-land farmers of Suffolk is in favor of sowing about

a peck of white mustard on the long fallows in August or early in September, and ploughing in the herbage about six or eight weeks from the time of sowing. The effect upon the barley crop is considered by practical farmers as equal to half a coat of farmyard dung obtained at a cost of 2s. 6d. for the seed. Upon a clay loam, the mustard being sown after peas and ploughed in for wheat, the difference in the crop was visible to the eye at a considerable distance from the field. At harvest the wheat where the mustard had been ploughed in was six inches higher, and ripened ten days sooner, than wheat on adjoining lands where no mustard had been sown, but otherwise treated in a similar manner."—*Walks and Talks, No. 100.*

We see by these extracts that white mustard may be used to advantage on either sandy or heavy land.

It is also stated by Harris that super-phosphate will greatly stimulate the growth of mustard.

If the seed were cheaper I would frequently use it, and sow two or three crops for wheat.

I had fifteen tons per acre of white mustard ploughed in early in July, and had the lot seeded down in buckwheat, and when it was in blossom had it turned in for wheat. The crop was nearly equal to another field which produced twenty-four bushels per acre, and which had been dressed with good stable manure and super-phosphate of lime.

## CHAPTER XIII.

### TURNIPS.

ONE ton of turnips contains four pounds of nitrogen, one and a half pounds of phosphoric acid, six and a half pounds of potash, and 1818 pounds of water. One ton of turnip-leaves contains seven pounds of nitrogen. Twenty tons per acre are considered a good crop. The tops weigh about eight tons. The two together furnish 136 pounds of nitrogen.

It will require nearly seven tons of Hungarian grass, or eleven and a half tons of green clover, or thirteen and a half tons of barnyard manure, to yield as much nitrogen as this crop of turnips.

Yet we cannot obtain as much benefit from these manures as the English farmer gets from his turnips. The reason may be, we do not be-

stow as much labor and material on our green crops as he does to make them available.

Alderman Mechi says: "It seems very ungracious that when you have grown a splendid crop of turnips at an expense of thirty-five to fifty dollars the acre, the sheep are to consume it, leaving you nothing but the price of the hay and cake you gave them with it; but it is a system that can't be avoided until you find some cheaper source of manure."

That is, you may sell the fat sheep for enough over their original cost to pay for the hay and cake you gave them. But how can they afford to give so much for the nitrogen in the turnips? Is it because the turnips are eaten on the ground, and that makes all the nitrogen available? And besides this, the manure from the cake and hay and phosphates is all deposited on the soil. No liquids are lost.

Mechi also writes: "At this moment (March, 1857) you cannot buy lean sheep under seven shillings per stone of eight pounds (net dead

weight), whilst the price of fat sheep is only six shillings per stone; so that probably those who purchase lean stock now will have to give away their root and green crops without return, except the manure."

The fact is, it takes so much labor, so much bone-dust or super-phosphate or other manures, and so much time, to grow a good crop of turnips and to feed them on the land, so that none of the liquid shall be lost, that we in our cold climate must look for a cheaper source of nitrogen than by raising turnips to feed to sheep or cattle. We must give more attention and more labor and more manure to other green crops to secure a heavy yield, and then they will show their power whether we plough them in or leave them on the surface, or feed them to animals and save all the residue.

The profit from keeping all kinds of stock in England is very little indeed.

Mechi says: "What the turnips cost to grow is another affair; but the price singularly con-

firms Mr. Lawes's experiments, that one ton of turnips (without any other food) only produced five pounds, net dead weight, of mutton."

This is a positive proof that all the labor and expense bestowed upon this plant is directed to one great and grand object—the production of nitrogen. Without it, they know that they cannot raise large crops of wheat.

"Mr. Lawes's experiments furnish correct data on this subject, and show that after paying for purchased food *nothing* was left for the turnips, although we know they cost ten shillings per ton or more."—*Mechi.*

That is, two dollars and a half for a ton of turnips that will make five pounds of mutton, which they sell at eighteen and three-quarter cents per pound.

A good English farmer once said to Joseph Harris: "Ensure me a crop of turnips, and I will ensure you every other crop in the rotation. The rotation is—first, turnips; second, barley seeded with clover; third, clover; fourth, wheat;

and then turnips again; and so on. A good crop of turnips eaten on the land by sheep means good barley and good clover. Good clover means good wheat. The turnips and the clover may not yield much profit, but the extra yield of barley and wheat more than compensates for the great labor and expense bestowed on the turnip crop."

Here is the whole secret of the great success of the English farmer. A green crop *always* comes in between two grain crops.

With bone-dust or super-phosphate of lime we can raise turnips as well as they can in England, and we need not feed them to sheep; we can plough them in, and get more manure than they would yield if eaten by animals. Then what else is needed? We miss the nitrogen from the oil-cake. If more is required, we must make that up some other way. Is not nitrate of soda as cheap as oil-cake? If not, then let us plough in two green crops or top dress the wheat with good barnyard manure.

## CHAPTER XIV.

### BARNYARD MANURE.

ONE ton of barnyard manure contains ten pounds of nitrogen, five pounds of phosphoric acid, twelve and a half pounds of potash, and 1500 pounds of water.

It may be that you live so near to some town or city that you can get manure for one dollar and a half per ton, and can haul it home and spread it for fifty cents a load.

Now, as we have more faith in clover than in any other green manure, let us compare these two together. You must put 360 tons of manure on the twenty acres to get as much nitrogen as we have in the single crop of clover. That will cost you $540 for the manure, and that will be nearly twenty cents per pound for the nitrogen.

I say "nearly," for we must allow something for the minerals. But how much? Harris says that "all the *mineral matter* in a ton of barn-yard manure could be purchased for twenty-five cents."

This is too low an estimate for manure that has never been leached by rain, but may apply very well to any that has been exposed to the weather all summer and has lost by drainage nearly all its soluble elements.

Great care should be observed in purchasing manure. Its value depends entirely on the kind of material of which it is made and the care bestowed upon it afterward. If it has lain in a dry place, and become fire-fanged and white and mouldy, and so light that it feels on your fork like a bunch of dry leaves, it is hardly worth hauling home at any price; and if it is made of nothing but straw, although it may look well, do not pay much for it.

But if preserved in a cellar or covered yard, and been kept moist with urine or drainage

from the yard while rotting, and the animals while making it have been fed two or three times a day on grain or bran or oil-cake and good hay, and the pile is well concentrated by decay, then it is good manure and worth hauling several miles to your home.

On Plumgrove Farm I have all the liquid which settles in a tank at the lowest corner of the yard pumped up and sprinkled over the manure under cover, and the process of decomposition goes on so regularly that it could not be made better any other way. Yet with all the care we can bestow upon it, it seems almost impossible to save all the liquid in the stables.

Barns are not properly constructed for this purpose. Stalls should be eight or ten feet high from the floor to the joists above, so that three feet deep of manure may be left under the animals all the time. And when the stables will hold no more they may be cleaned out to the bottom, and then re-bedded with one foot of sods and turf, and a light coat of straw or any kind of litter over

them. This way is nearly as good, and not so costly, as gutters behind the stalls to carry off the urine.

When in search of manure in the village or town near you, the most important question is not what kind of animals produce it, but how much and what kind of feed has been given to them. Joseph Harris says that one bushel of Indian corn will make twenty cents' worth of manure. And Lawes considers the residue from one ton of clover hay worth over nine dollars.

Now, when you find a pile under cover, and a reliable man assures you that it was made by feeding 200 bushels of corn and ten tons of clover hay, with a moderate amount of straw for bedding, then you may safely offer him two dollars per ton for it.

It will not do to buy everything that is called manure. Let me give you an example that is worth remembering.

Col. Waring of Ogden Farm says: "As I drive along the road I daily meet able-bodied men

crawling along beside snail-like ox-teams with loads of stained straw from the private stables in which the summer residents of Newport keep their horses 'up to their knees' in litter. The cart holds about a cord of the stuff (128 cubic feet), for which five dollars or more have been paid in town, and to get which occupies the best part of a day's labor of man and team."

You see he will not even call this manure. What a Conrad-like sneer must have curled his proud lip as he inspected these loads of "*stuff*," as he calls them!

Is it any wonder that our wisest men declare that the art of agriculture is only in its infancy?

## CHAPTER XV.

### FEEDING GRAIN FOR MANURE.

MANY farmers really believe that it is always profitable to raise and fatten cattle; and of course they continue the business from year to year.

Very valuable manure can be made by it; and this is most fortunate, for it too often happens that they get nothing else for all their trouble and expense.

They are anxious to make the farm very rich, for they are wise enough to know that in no other condition will it pay, and having full faith in the contents of the stable and barnyard, they purchase thousands of bushels of corn to feed to all kinds of stock. In other words, they want to gather

up as much nitrogen in the stable as we have collected in our twenty acres of clover.

Indian corn contains one pound of nitrogen per bushel. Therefore they must purchase 3600 bushels of corn to get as much nitrogen as we have in our twenty acres of clover.

At the present time Indian corn brings sixty cents per bushel. Hence, they must pay $2160 for 3600 pounds of nitrogen, 230 pounds of phosphoric acid, and 140 pounds of potash. That will be paying over $2000 for as much nitrogen in corn as we get for fifty dollars in green clover; that is, provided they make nothing on the cattle and all the profit must come from the manure.

Now, how stands the case with experienced farmers?

Alderman Mechi, the most progressive and one of the most enlightened farmers of all England, says: "I have no doubt this statement will startle many a practical farmer, and will raise a storm of indignation among stock-feeders and stock-breed-

ers; but the naked truth is best told, which is, 'That live stock are necessary evils, mere manufacturers of manure, and unattended with any direct profit.'"

This is not his opinion only. Many able men freely endorse it. Here is one whose opinion cannot be misunderstood: "A friend of mine," says Mechi, "a close calculator, who on 1500 acres does not keep a bullock, says those who keep many bullocks will never want to make a will."

Then why does Alderman Mechi fatten any cattle? why keep so many sheep? Why does he fatten about 400 hogs every winter?

He says: "I know by long and large experience that pigs pay better for purchased food than any other stock; and even *they* will by no means 'clear their teeth.'"

His object is manure. He has no other motive. He buys 8000 bushels of Indian corn or barley in a single year to feed to his animals, and looks to his great tank full of rich manure for all his profit.

We have many other cases of this kind on record. Here is one: Mr. Burritt visited the farm of Samuel Jonas in England, consisting of 3000 acres. He says: "I was surprised at one fact which I learned in connection with his economy. He keeps about 170 bullocks, buying in October and selling in May. Now, it would occasion an American farmer some wonderment to be told that this great herd of cattle is fed and fatted almost entirely for the manure they make."—*Genesee Farmer*, 1864.

Can we do any better in this country?

The Hon. Geo. Geddes of New York says he would keep no stock of any kind if he could help it; he always lost money by them. "You rear a steer till he is a thousand days old, and in ordinary times he is worth forty dollars. You get four cents a day for your time, labor, and the food consumed. Will that pay? He keeps sheep to get rid of his straw and tread it into manure."—*Genesee Farmer*, vol. 25.

With the highest deference and respect for his

opinion, I must say that this is a very poor excuse for keeping sheep. If he will send out all his straw in the fall which he does not need for bedding, and have it spread on the field to be ploughed for corn the next spring, he will never afterwards complain that he cannot get rid of his straw.

John Johnston says: "Land must have a covering of grass or clover while resting."

How it is possible to have more straw than you can profitably make use of I cannot see.

Some years ago I raised 905 bushels of potatoes to the acre by planting the sets on ploughed and mellow ground a foot apart, and covering them with straw from twelve to eighteen inches deep. I would always raise potatoes in that manner if I could spare the straw to do it.

And when your corn-fodder is hauled in, cover the field where it grew with ten, or even five loads, of straw to the acre, and the spring crop that follows it will reward you well for your trouble.

The very day that you spread straw on a bare

field it begins to pay you an interest, it may be of six or ten per cent., on the investment.

But if you expose it in the barnyard to rot, you may lose a part of it by leaching, and get no interest from the balance for six to nine months to come.

## CHAPTER XVI.

### FORAGE FOR THE HORSES ON THE FARM.

WHEN we have concluded to use green crops for manure, of course we should leave all the clover and all other vegetation stand for this purpose, and cut as little as possible to feed to animals.

It will not do to take the clover or the Hungarian grass or the sowed corn from the fields intended for wheat.

We should have a clear understanding of the amount of forage which our stock will need, and then make ample provision for them.

What is the experience of the best farmers upon this subject?

Colman writes in his *European Agriculture*, "It is estimated by many intelligent farmers in

England that the horse-teams require for their maintenance full one-fourth of the produce of the soil."

Again he says: "Indeed, so far as my observation goes, there is no single source of expense, none which abstracts so much from the profits of farming, and none of which the farmers in general are so little aware, as that of horse-teams."

Alderman Mechi says: "This brings me to the fearful question: What portion of the acreage of this kingdom do farm-horses consume? I answer, Nearly one-fourth of all the arable land in the kingdom."

This is a very discouraging picture — that one-fourth of all you raise will be devoured by the horses which are required to work the farm!

Is there no way to remedy this? Certainly there is a way. We must raise enormous crops of forage; nothing else can save us from this great expense.

Joseph Harris, speaking of John Johnston, says: "Last summer he wrote me that he had

raised a great crop of timothy, but that the story was too big to tell. I asked him about it yesterday. He top-dressed a piece of timothy grass with a compost of hen droppings, chip manure, and cow dung. The timothy was nearly six feet high and as thick as wheat straw, with heads almost a foot long. He weighed several of the cocks and estimated the crop at five tons to the acre!"

In 1860 a friend of mine cut and weighed and sold to his neighbors *nine tons and a half* of timothy and clover hay from a two-acre lot which had been manured from his slaughter-house.

We should learn two useful lessons from these examples:

First, that top dressing is all that is required to ensure a big crop of timothy; and second, that a little land can be made rich enough to furnish us with all the hay needed on the farm. Hay from Hungarian grass has no superior when well made.

"A correspondent of the *Prairie Farmer*, Mr.

Philips of Butler county, states that the premium acre at the last fair of that county yielded eight tons and two hundred pounds of well-cured hay."—*Cultivator.*

Colman says of millet: "I wish my countrymen were more impressed with the extraordinary value of this plant. I know few plants which make a more abundant return, or which, when it is well cured, give a more nutritious forage or one more relished by stock."

In 1854, Lawes and Gilbert sowed some clover-seed in a rich garden. They say: "The estimated total amount of green clover obtained from this garden soil in six years, without further manure, is about 126 tons per acre, equal to about twenty-six and a half tons of hay.

"Fourteen cuttings have been taken without any re-sowing of seed."

Why was no re-seeding required during the six years? It was either because the soil was so very rich, or because it was cut so often and so early that no seed could mature; and it may be

the nature of clover to live on till seeds are developed.

Besides the plants above mentioned, I advise you to have one, two, or three acres of orchard grass, and to use every available means to make the land very rich. It will be ready the first of all to mow in the spring. By top dressing it in the fall or very early in the spring it will never fail, never run out.

All the plants above mentioned have peculiar merits of their own; hence the great advantage of having a patch of each near the barn, for summer soiling as well as for winter forage.

It is said that the Hungarian is "so deep-rooted that severe drought does not affect it in the least, and it may be sown upon the highest and driest soils without fear of failure," and that it will yield, when kept for seed, twenty to thirty bushels per acre. Hence, the seed need not cost more than fifty cents to a dollar per bushel.

Let me say a few words about making hay. Dr. Voelcker has discovered that rain will leach

out of hay while being made nearly one-half of its best material.

Therefore, how very unwise to cut grass in rainy weather, as many do to be ready to make hay when it clears up! Far better to mow on a clear morning, and put it up in well-made cocks in the evening should there be any appearance of rain; then it will be comparatively safe. Should even a heavy shower come, all that can fall on each cock cannot leach through it, and hence no damage will be done.

Another arrangement is worthy of your attention. Have your permanent hay-field as near the barn as possible, and then you can haul in three or four loads in less time than you could go to the back field for one load. This is a matter of the highest importance in stormy weather.

One or more acres of sowed corn will make a grand addition to the winter provender, provided you need any.

A brief notice of what others have accomplished with it I think will be acceptable.

David Miller of Fayette co., Pa., writes to the *Cultivator* in 1842: "I have generally had from about sixty to seventy tons of green food to the acre, and think it decidedly better than grass for either beef or milk."

H. L. Ellsworth, Esq., says: "I sowed four and a half bushels of common corn per acre broadcast, and harrowed in the same. Having soaked the corn in saltpetre, it took a rapid start, overtopped the weeds, and covered the ground with a forest of stalks. Being anxious to ascertain the quantity, I measured a few square feet of the stoutest. I found I had five pounds of green fodder per square foot—that is, 108½ tons per acre. I cut the first crop the early part of July, and ploughed and sowed the land again, and took a second crop two-thirds as large."—*Cultivator*, 1842.

Here we have 172 tons of green fodder per acre in one year. Of course this large amount of provender could only be obtained on rich land.

Mr. Peters says: "The amount of corn-fodder

which will grow upon an acre is truly fabulous, and no one will believe it until they have had ocular demonstration. It is not a very large thing to grow 200 tons of green fodder to the acre. I think it possible to grow 250 tons with care and a good season."—*Genesee Farmer*, 1865.

"Gustavus Harmoir, president of the Agricultural College of Valenciennes, has been experimenting with Indian corn as a soiling crop. The variety used was the 'giant maize of Caraqua.' The seed was drilled May 31st in rows about three feet apart and eighteen inches in the drill. By the 15th of August the stalks were fourteen feet high, and the yield was over 450 tons per acre."—*Genesee Farmer*, 1863.

We have no higher authority on the value of green corn as a food for cows than Col. Waring of Ogden Farm, and so perfectly is he satisfied with it that he exclaims in the *American Agriculturist*, "Corn never! corn-fodder always!"

Again he says: "Throughout nearly the whole country there is no crop that can at all compare,

when we consider both its value, pound for pound, and the enormous yield that may be obtained from an acre with corn-fodder. Whether the purpose be to make butter, cheese, or beef, or to keep young stock in thrifty growing condition, it is at once most profitable and nutritious."

Colman, in estimating the value of different kinds of forage, says: "I have some doubts, however, whether for the purpose of soiling, for milk, or for fattening any product can be found equal to that of Indian corn cut green."—*European Agriculture.*

It is said that if we sow forty to fifty grains to the foot in drills three feet apart we will have one-third more fodder than with twenty grains to the foot. I have raised it for more than ten years on Plumgrove Farm, and for winter fodder I prefer about six stalks to the foot, because it will then grow eight and ten feet high, and can be cut when ready, independent of all weather, and put in shock, and will stand well till November, when it may be put in the barn.

For feeding through the summer to horses, cows, and pigs I care not how thick it is planted; even fifty grains to the foot will be better than any less amount. But you will find this much more troublesome to save for winter provender, because you will have to cure it in the same way that you make hay, and may be very much annoyed with wet weather.

To conclude, remember the *great secret* of *success* in agriculture is the *concentration* of manure and labor. A poor soil with little labor, little tillage, and no manure will never produce a large crop of green corn or any other kind of forage.

## CHAPTER XVII.

### LOSS OF MANURE.

WHILE making vast piles of manure by feeding grain and green crops, are you able to save all the residue?

Certainly not; that would be impossible.

How much of it do you lose?

Alderman Mechi declares: "Upon a careful investigation we safely assert that twenty per cent. of ordinary farmyard manure is wasted. An examination of ten farm-homesteads, consecutively taken, has fully established this supposition."

Manure is the farmer's capital. What business can be carried on with profit if you are obliged to borrow money at an interest of twenty per cent.? And if you lose twenty per cent. of your capital

every year, where is the difference between you and the reckless borrower?

Does Mechi save all the manure? Yes—we may say all of it. It is made over water-tight troughs, and is carefully washed into a great tank, from which it is pumped by a steam-engine through three-inch iron pipes over all the farm. But this is not all he saves by the operation.

It will cost you at least fifty cents a ton to haul and spread the contents of the barnyard on any distant field. It costs him but four cents per ton to spread in a liquid form all the manure he makes. Hence his profit as a farmer on all his great investments is fifteen to eighteen per cent. He very truly says, "It is the filling, carting, turning over, refilling, carting, and spreading, and wasting, that run away with the farmer's profit."

He has abandoned green manuring, which he once followed extensively. In fact, his great outlay will not justify it now, even if he wished to do it.

Notwithstanding all this, he says: "If stock

is too dear, or you are short of capital, plough in green and root crops, particularly on heavy land."

So much for England's model farmer. Now for the greatest light in our own country.

John Johnston says: "I have suffered an immense loss from the liquids running from my barnyards, but I never could contrive a plan to prevent it."—*Cultivator*, 1861.

Probably no man ever estimated manure nearer its true value, or ever had a more striking experience of its power, than John Johnston; and how passing strange it is that even he, with all his wisdom and ability, could not save the whole of it!

It is an established fact that the liquid is the most valuable portion of the manure.

Joseph Harris, in alluding to its great waste, say in *Walks and Talks, No. 49:* "As ordinarily managed, however, the liquid either runs away or soaks through the crevices of the planks into the ground, and is lost."

The *American Agriculturist*, 1872, says: "The

value of liquid manures is not sufficiently realized. It is safe to say that not one-thousandth part of this is ever saved for use, but nearly the whole is allowed to go to waste."

Now, as it is almost an utter impossibility to save all the liquids unless we adopt Mechi's costly plan, what an overwhelming argument in favor of green manures! For all the liquid of any value in grain or in manure originally came from the green stalk.

There is a way of saving the urine which should not be overlooked. Erect a temporary fence around a piece of ground which you can till, and keep your animals on it. Let them remain there till the cold weather obliges you to put them in the barn. You can keep the cattle there all the time, if the lot is large enough to require all their manure, during the warm season, or you may let them pasture in the field by day and feed them at night in the enclosure with green corn, Hungarian grass, clover, rye, cabbage, and everything eatable.

If you will sprinkle over this pen more or less straw or corn-fodder, it will be an advantage. But do not plough it up till you want to sow or plant some kind of crop. Better have two or three acres that are very rich than ten that are very poor. Cows may pasture among rocks and stumps and on hillsides where you never plough, and may return at night to enrich the pen; and this will pay you well for their night and morning meal. Mechi says: "1500 sheep folded on an acre of land for twenty-four hours (or 100 sheep fifteen days) would manure that land sufficiently to carry it through a four years' rotation." By this wise arrangement they save all the liquid as well as the solid residue. This is a matter of vast importance.

## CHAPTER XVIII.

### JOHN JOHNSTON AND OTHERS ON RAISING WHEAT.

IN 1874 one of the editors of the *Country Gentleman* after a visit to John Johnston said: "Mr. Johnston showed us a field upon which he had raised wheat for more than thirty years every alternate year, the average yield constantly increasing. His plan was to fallow-plough about the middle of June; plough again about September 1st, and top dress heavily with manure and sow wheat. Early the next spring he sowed on clover-seed and plaster. After harvest, if the clover grew large enough to head out, he pastured it more or less, but if no blossoms appeared he put no stock on it. The next spring he pastured the clover lightly until it blossomed,

when it was turned under as before. He had found this two-crop rotation very successful."

Now, can there be any objection to the addition of one more green crop as a top dressing to this very successful mode of raising wheat? You recollect how strongly he is in favor of some kind of protection to save the crop from the blasting winds and other injuries. After ploughing in the clover there would be ample time to raise ten or fifteen tons per acre of green corn, and to cultivate and clean the field as effectually as if nothing was growing on it.

We should notice this fact—that he "top dressed heavily with manure." Yet even that did not prevent the wheat from being killed when exposed to north-west winds.

If the free use of the very best manure will always ensure a heavy crop of wheat, his crops should never fail. He was in the habit every winter of feeding many tons of oil-cake and about 1500 bushels of corn and a large amount of hay. With such a mass of rich material why

should he need or use anything else? Yet he ploughed in clover. And such clover! How rank it must have grown after the top dressing such as he gave the wheat! Yet how careful he was only to pasture the clover lightly before turning it in! In fact, he made use of every means in his power to ensure heavy crops of wheat.

Joseph Harris, in his celebrated lecture on *Wheat-Culture in Western New York*, gives us Johnston's views on the use of salt and lime.

"On rich land," says Harris, "salt has a tendency to check an excessive growth of straw. In some experiments made recently on the farm of the Royal Agricultural Society the unmanured plot of wheat produced twenty-nine bushels per acre, and the plot dressed with three hundredweight of common salt thirty-eight and three-fourths bushels, or an increase of nine and three-fourths bushels per acre.

"A few years ago I was on the farm of John Johnston of Seneca county. He had dressed a

part of a field of wheat with a barrel of salt per acre, and the effect was most decidedly beneficial. The wheat was heavier and the straw much brighter and stiffer. It also ripened several days earlier, and escaped the midge in consequence. Mr. Johnston is here with us to-day, and he has just informed me that he thinks there is nothing like salt for stiffening the straw on rich lands. He sows a barrel per acre on the fallows just before sowing the wheat. He has sown as much as seventy-five barrels in a year on his wheat.

"Lime is also a splendid manure for producing plump heads of wheat and a stiff straw. There is nothing like it. Mr. Johnston says if he were a young man he would lime every acre of his farm. In 1844 he applied 200 bushels of lime on two acres before sowing the wheat, and it was a magnificent crop—over fifty bushels per acre; and he says he can see the effect of that lime on the land to the present day."—*Genesee Farmer*, 1863.

After reading this shall we be afraid to plough

in green manure, lest it should make weak straw and cause the wheat to fall? Here we have a certain remedy in salt and lime. But we must be careful not to use too much lime. There is an old proverb—the lesson, we presume, of observation and experience—

> "That too much lime and no manure
> Will make the farm and farmer poor."

The reason is plain enough. Lime contains very little plant-food. A good crop of wheat of thirty-four bushels per acre takes from the soil only one pound of lime, and the straw about seven pounds. Salt and lime act as solvents of the soil and of the vegetable matter in it. Hence, the more green crops and stable manure we plough in, the longer the land can stand the dissolving action of these minerals.

Alderman Mechi found salt to be indispensable on his rich land. He says he salted all his wheat at the rate of four to eight bushels per acre, *and was determined to use much more.* He

knew a gentleman in Northamptonshire whose wheat crop could scarcely ever be kept from going down until he used salt, which had effectually kept it standing.

When putting in wheat it is a matter of great importance to have the land in the right condition to receive the seed. If you plough in a very heavy green crop and sow at once, you may have an almost total failure and raise but a few bushels of wheat. The reason is plain. If dry weather should come on and continue for several weeks, there will be a nearly complete separation between the surface and subsoil. The wheat cannot grow in the dry crust, and as no moisture can arise from capillary attraction to soften this crust, the seed may perish, or make but a feeble growth till the ensuing spring. From a careless disregard of these facts even large crops of clover ploughed in have been apparently injurious, and the whole system of green manuring has been condemned and abandoned.

We find some very excellent advice upon this

subject in the foreign correspondence of the *Country Gentleman*. The writer says: "We want the ground to settle before sowing. Never sow wheat or rye on new-ploughed land if you can help it, but give it the last furrow from six to eight weeks before sowing-time. This is of the highest importance. The soil then becomes thoroughly pulverized by the alternate action of rain and sun—it rots; ay, it will rise (puff) like well-made dough—I can describe it in no other way. The land must look as if yeast had been put into it, which had done its work well. Then is the time to sow."

Here you see the ground must *settle*. Now, it cannot settle in dry weather if piled on top of green manure of any kind. In some seasons there will be so much rain just at the right time that all seeds will grow, no matter when or how carelessly they are put in. That we may never fail to raise a good crop of wheat, I prefer to have Indian corn for the last green dressing, and to keep it on top as a mulch, as directed in Chapter VII.

*On spreading lime and other fertilizers* I wish to say a few words. I have so often noticed the utter impossibility of spreading anything evenly with the shovel that I was induced to *invent*, and then take out a *patent* for, a machine which will sow from three bushels to three hundred per acre of material as fine as plaster or as coarse as the grains of Indian corn. Its cheapness, simplicity, and durability will recommend it to every one. It consists of a hollow cylinder or drum from six to twelve feet in length and from two to three feet in diameter. It is formed of long boards or vanes, which have one edge fastened by a hinge at each end to a drumhead, and also by a hinge to a drumhead in the middle. The free edge of every board overlaps the hinged edge of the vane next to it. By means of movable bolts the space between the overlapping edges can be adjusted to the thirty-second of an inch, or to a whole inch if desired. A shaft runs through the drum and has a wheel at each end. One wheel is fastened to the drum to turn it.

## CHAPTER XIX.

### THE PRESERVATION OF HEALTH ON THE FARM.

THE human body is composed of fourteen elements. These are carbon, hydrogen, oxygen, nitrogen, phosphorus, sulphur, calcium, magnesium, potassium, sodium, chlorine, iron, fluorine, and silicon.

All our flesh and bones, the brain and nerves and blood, are made of these elements in a state of combination.

Perfect health consists in the *perfect* preservation of the relative proportion of these compounds.

If the mineral matters should predominate for some time in the blood, the capillary system—that is, the blood-vessels which are as fine as hair

—will become clogged up and premature old age will soon appear.

If carbon and hydrogen should be in great excess in the blood, as they are the heat-producers of the world, whether in or out of the system, then there is danger of fevers, boils, abscesses, bilious disorders, and eruptive diseases of the skin.

Now, the object of this chapter is to teach you how to prevent all kinds of sickness. We shall say nothing about the medical treatment when you are sick; we leave that to your family physician.

Bread contains more bone—that is, more mineral matter, more *ashes*—than any other kind of food.

Besides this, bread and butter furnish more carbon and hydrogen to the system than any other kind of diet except sugar and *fat* meat. Yet there is nothing more healthy or more strengthening to the body than bread. It is the *disproportion*, the *excessive use of bread*, when

compared with other things, which does all the mischief and lays a sure foundation for nearly every malady.

In ancient times, when they had no mills that would turn out a hundred barrels of flour a day, and they had to grind their grain by hand, there was very little danger of eating too much bread.

They had to live more upon flesh, fish, fruits, and vegetables; and as this kind of diet did not introduce an *excess* of carbon and hydrogen, nor too much *ashes*, into the blood, they lived to be very old, and were clear-headed and as active when a hundred years of age as our young men of twenty-five.

Now, let me give you a few well-known illustrations to establish the truth of these statements.

Plutarch says the ancient Britons only began to grow old at one hundred and twenty years. They lived on acorns, berries, fish, flesh, and fowl.

Herodotus tells of a people of Ethiopia who lived on flesh and milk one hundred and twenty years.

An ancient sect of India lived on fruit and vegetables one hundred and fifty to two hundred years.

The Egyptians lived on fruit and vegetables one hundred and thirty years.

Henry Hastings lived on vegetables one hundred and ten years.

A native of Bengal lived three hundred and seventy years on a very low diet, principally fruits and vegetables.

Margaret Patton lived one hundred and thirty-seven years, mostly on milk.

Charles Macklem lived one hundred and seven years on flesh, fish, fruits, and vegetables.

Ann Bannerman lived one hundred and five years on vegetables.

Mrs. Watkins lived one hundred and ten years, and the last thirty entirely upon fruits and vegetables.

Owen Carollan lived on potatoes, buttermilk, and cherries one hundred and twenty-seven years.

Elizabeth Macpherson lived on buttermilk and greens one hundred and seventeen years.

Mr. Dobson lived on flesh, fruits, milk, cider, and vegetables one hundred and thirty-nine years.

Francis Confit lived on a very low diet, principally on new-laid raw eggs, one hundred and fifty years.

Philip Loutin lived on one meal a day one hundred and five years.

Paul Barrot lived on vegetables one hundred and six years.

Mary Rogers lived one hundred and eighteen years, and the last sixty entirely upon vegetables.

John Wilson lived one hundred and sixteen years, the last forty on roasted turnips for supper.

Thomas Parr always proportioned his food to the amount of exercise, and lived one hundred and fifty-two years.

John Murphy lived on potatoes and milk one hundred and six years.

Henry Jenkins lived on cold meats and salads one hundred and sixty-nine years.

In the African desert a man was found by

Captain Riley who lived four hundred years on milk alone.

How can we account for these remarkable cases of longevity? There is one cause, and only one, which touches every case, and that is the extreme temperance in the use of bread. They differ in everything else. Climate, age, sex, condition, and situation appear to have no effect upon the general result. All come out alike, and reach their centennial by observing one rule.

Have we anything in the history of the lower order of animals to corroborate these deductions? Yes.

The wild hog lives three hundred years on acorns, fruits, herbage, roots, and small animals, and, it is very probable, never has a full supply of them. The domestic hog lives on grain from ten to twenty years. The eagle lives five hundred years on fish and flesh. The parrot in its wild state lives on fruits five or six hundred years. Our common fowls are crammed with grain, and will live only from ten to twenty years.

Here we may conclude this subject with a declaration which cannot easily be refuted—that to enjoy a long life of uninterrupted health, with a clear memory, a bright and cheerful heart, and a strong arm, our bread, butter, lard, sugar, and fat must bear a wise *proportion* to the lean meats and to the fruits and vegetables in daily use.

During a practice of more than forty years this subject has engaged my attention. Hence it is no sudden conclusion that induces me to say that our *combustible* diet of carbon and hydrogen has more influence in predisposing the system to disease than all other things combined.

## CHAPTER XX.

### THE RESTORATION OF POOR LAND BY GREEN MANURES.

FARMS that have been worked by tenants or by careless owners for a long course of years generally become so poor that very little more than the seed sown is obtained in the yearly produce.

Now, it is a vital question to every farmer, What change has taken place in the soil that it will no longer yield a remunerative crop? If the minerals have been entirely exhausted, he may be living where he cannot procure ground bone and other fertilizers at any reasonable price, and hence he must abandon the farm and leave it to time and Nature to restore.

But, most fortunately for man, this is very seldom, if ever, the case.

Many well-established facts are on record that prove that the loss of power to produce even a small crop is owing to the consumption of nitrogenous compounds and vegetable matter in the soil. I call it a consumption because it is a positive burning up by oxidation of everything in the ground that had been deposited there by the growth and decay of organic matter.

And the more you plough and harrow and loosen up the soil, the faster will this destruction take place. Then you will please remember this plain truth, that fire and tillage with the plough and harrow act in the same way and accomplish the same object—the exhaustion of the farm. In corroboration of these views let me give you a very interesting and instructive fact to verify them.

Joseph Harris, in the *Genesee Farmer* of 1863, says: "Thirty or forty years ago the oak-openings in Western New York were considered far in-

ferior to the heavily-timbered land and to the lowlands on the borders of the Genesee River. The Indians had for years burnt over this land, and consequently it was to a great extent destitute of organic matter. On this soil plaster and clover acted like a charm. Large crops of clover have been raised for years and ploughed under. The plaster stimulated the growth of clover, and the clover when ploughed under furnished the soil with large quantities of organic matter; and the result is that this land, which was formerly considered poor, is the best and most productive in the State."

Here we have reliable and satisfactory proof that poor land can be restored to a productive condition without purchasing artificial manures beyond one or two bushels of plaster per acre once a year. Now, if we ask the chemist what must that soil contain to yield fine crops of grain, he will tell you, "The ash of agricultural plants consists of the phosphates, sulphates, silicates, and carbonates of potash, soda, lime, and mag-

nesia, with small quantities of oxide of iron and manganese and alkaline chlorides."—*Johnston.*

Then all but the sulphates must have been in the soil, but were not available for some cause. What was that cause?

What was indispensable to enable them to become active? The earth was comparatively destitute of atmospheric food. There was the great and only deficiency.

The rich manure so much needed was floating in an invisible state above the poor fields. That is a gaseous but solid fact. The chemist tells us that "When a vegetable is destroyed by burning it is mostly resolved into air. On the other hand, when it is formed by growth its substance is mostly derived from air."

This being the case, it is imperative on us to introduce the elements of the air into the soil and convert them into plant-food. How shall we do this? We must loosen up the earth, and keep it moist and mellow during all the growing seasons of the year.

To accomplish this effectually and in the cheapest manner, we must cover the land with green crops, and keep them upon the surface as long as possible, and then plough them in when grain or anything else must be sown. To be satisfied that they are all-sufficient we have only to study their wonderful effects. When the ground is loose from the presence of humus—that is, vegetable matter in a state of decay—the air is freely admitted, and its nitrogen is to a certain extent converted into nitric acid and ammonia; and, most fortunately, these compounds are retained by the moisture and the absorbent power of the organic matter. And besides this, a large portion of the nitrogen contained in the green dressing also undergoes the same chemical change and is treasured up for future crops.

The incomparable merits of green manures are not all the qualities that make this mode of improvement the great sheet-anchor of the practical farmer.

The roots of growing plants have great power

over the minerals of the soil in breaking up their texture and reducing them to powder. And here let me say, Have no fear of getting too much humus into the soil. An acre of land twelve inches deep weighs 2000 tons. If you could plough in 100 tons of green manure every one, two, or three years, that would only be mixing the one-twentieth of vegetable matter with nineteen-twentieths of the earth a foot deep. Would one gold dollar among twenty copper cents make the pile of money look too rich?

Even on the dark prairies of the West the immense amount of good derived from the preservation and frequent replenishing of organic matter in the soil has been noticed and recorded by many practical farmers.

C. W. Babbitt of Metamora, Woodford county, Illinois, says in the Patent Office Report of 1855: "It would seem that the prairies here might be continued in their virgin richness simply by annually ploughing under the stubble of

our grain-fields and the stalks of Indian corn, never allowing them to be consumed by fire. A short distance south of this resided two farmers, one of whom every year gathered up his corn-stalks and burnt them, and also burnt over his stubble-fields before ploughing. The other never allowed a stalk or a straw to be burnt on his land, but always ploughed them under. After some fifteen years had elapsed the farm of the former yielded on an average some fifteen bushels of corn less to the acre than when he commenced cultivating it, while that of the latter produced as abundantly as at first."

It is a matter of astonishment that a prairie soil, which is dark with the decayed remains of an old vegetation, should show in the comparatively short period of fifteen years any neglect to restore to the ground the humus it had lost by the production of grain.

David A. Wells, in his *Book of Agriculture*, 1855 and 1856, says: "It is estimated by intelligent farmers in Indiana that their river-bottoms,

which used to produce an average crop of sixty bushels of corn to the acre, now produce only forty. In Wisconsin, which is younger still, it is estimated that only one-half the number of bushels of wheat are now raised on the acre which were raised twelve years ago."

Here we have whole districts suffering from the same cause—the exhaustion of organic matter, and which can be restored with little labor and little cost. If the loss of productive power was owing to the exhaustion of mineral food, this could only be renewed from the subsoil and rocks by a long rest or by purchasing the lost material at great expense.

Is it necessary to say anything more upon this subject? Is not every one convinced that raising wheat would ruin one-half of all the farmers in the world if the diminution of their crops arose from the loss of minerals in the soil? Why? Because one-half of them are living where they cannot obtain artificial manures at any reasonable price. I cannot close this subject without the

presentation of one more argument, which has already been before the public for some time.

"An incendiary reduced to ashes a pile of barley-stacks from some twelve to fifteen acres of barley. The ashes were scattered over about half an acre of ground adjoining the stacks, thus concentrating the mineral constituents to about one-twenty-fifth of the land from which they were taken.

"A turnip crop, a barley crop, and a crop of seeds taken subsequently from this half acre showed no perceptible superiority over the rest of the field, neither portions of the land yielding more than ordinary products."—*Cultivator*, 1853.

This grand and useful experiment proves beyond cavil that the nitric acid and ammonia in the air are not sufficient to supply all the available nitrogen which is needed to produce a luxuriant vegetation.

Did these compounds of nitrogen exist in the air or in the soil in ample abundance, what immense crops would have been produced on that half acre!

Suppose the farmer had spread this pile of barley-stacks, with all the grain in them, on half an acre of ground, what would have been the result? Twelve to fifteen acres of barley, even at twenty-five bushels per acre, would be from 300 to 375 bushels of grain in the stacks. Now, if you would spread this amount of barley on the half acre without the straw, it certainly would manure it well. Then add the straw, which could not have been less than twelve to fifteen tons, and when all was worked into the soil do you think the turnip crop, the barley crop, and the crop of seed would have "shown no perceptible superiority over the rest of the field"?

Now, let us see what lesson we are taught by the analysis of a very rich alluvial soil.

Prof. Johnson says the Zuyder Zee soil contains enough of potash for 144 maximum and 648 average crops of barley, and enough of phosphoric acid for sixty-five maximum and 292 average crops, and enough of nitrogen in ammonia for seven maximum and thirty-one average bar-

ley crops. Here we see that without some addition from the air the ammonia would be exhausted by very large crops in seven years. Then, according to the teaching of the burnt stacks of barley, to obtain paying crops we should put on some kind of manure containing nitrogen or plough in green crops. Yet, according to common practice, many farmers would go to the expense of sowing on more phosphates as soon as the crops began to fail. This is a lesson which should not be forgotten. Then we will always know what to do when the crops begin to diminish. Not a shadow of doubt will rest upon it. We must at once restore to the soil the organic elements by ploughing in green manures. Of course the first choice will be clover; if that will not grow with the aid of plaster, then we may resort to oats or rye or buckwheat.

The reader may entertain the suspicion that I set too high a value upon the restorative powers of clover. To prove that it is almost impossible to do this, I ask a careful reading of the follow-

ing extract of a letter from the Hon. George Geddes of New York to Joseph Harris.

He says: "All that I shall try to prove to you is, that the fact that clover and plaster are by far the cheapest manures that can be had for our lands has been demonstrated by many farmers beyond a doubt—so much cheaper than barnyard manure that the mere loading and spreading of the latter cost more than the plaster and clover."

This clear declaration has more weight with me than the testimony of ten thousand unknown farmers, because George Geddes has experimented with clover intelligently, and relied upon it on his own farm for the last sixty or seventy years.

I will close this with the encouraging words of Dr. Voelcker, the able and reliable chemist who has devoted so much of his time and talents to the examination of this subject.

He says: "Indeed, no kind of manure can be compared in point of efficacy for wheat to the manuring which the land gets in a really good crop of clover."

We have said that if clover will not grow by itself you had better sow some other kind of seed. It is very probable that oats will grow ten or fifteen inches high if sown and rolled in with the clover-seed. Then you should watch it closely, and as soon as it comes in blossom mow it down with a machine, and let it lie to protect and shade and nourish the young clover.

Among old writers on agriculture I find that oats are strongly recommended to be sown in spring and summer, to be fed off by cattle to improve the land. If the animals receive nothing but the green oats for nourishment, of course their manure would add nothing to the soil that the pasture could not return if ploughed in or cut down and left upon the field. But if the cattle were fed with oil-cake or Indian meal, or something else, twice a day, it would make a material difference in the value of the manure left while grazing on the green oats.

Buckwheat might be used in the same way either as a green dressing or as feed for cattle.

But in the latter case you must only let the animals remain on the green buckwheat a short time once or twice a day. They are so fond of it, and it is so rich and so easily eaten, being soft and succulent, they would soon injure themselves if permitted to remain on the pasture all the time.

The same precaution is necessary when feeding hay made of buckwheat to either horses or cattle. It should be very sparingly given or might be safely mixed with other food.

Recent investigations of experimental chemists have discovered a remarkable similarity between Indian corn and clover in their assimilation of plaster. Although the former has always been classed with the cereals, this resemblance in their peculiar nutritive habits has awakened the question whether corn is not allied even to the legumes. Certain it is that Indian corn is so much benefited in its early stages of growth by a free use of plaster that scientific farmers have no hesitation in numbering it among the renovating crops of the farm.

Then, can we not do something with it to restore the old fields to a profitable state of production? If our favorite clover will not grow to do any good, we can sow one or two bushels of plaster per acre on the thin, half-green, sedgy grass which lives upon the shallow mould which Nature has made prolific through long years of rest. Then plough it in with care only three or four inches deep, and drop ten to fifteen grains of corn to the foot in every third furrow. By this plan you manure the seed with the decaying grass and all the little soil there is, mixed with the plaster. As soon as the corn is up, and also when it is eight or ten inches high, it should have another free dusting of plaster while the morning dew is glistening upon the leaves.

One or two good workings with the fluke will most likely be all it will require.

If the season should be wet and warm, it will soon be high and dense enough to smother all weeds, and to keep the ground between the drills

so moist and shaded it will really seem in a state of improvement.

As soon as the corn comes to maturity, and before it begins to fade and change its color, you must roll it down with a heavy roller across the drills.

If this does not break it down and make it lie flat on the ground, you had better go over it with the roller a second time, it makes the work look so much more business-like and complete; or cut it down with a machine.

The benefit which will accrue to the soil from this green dressing will be twofold. The ground being closely covered all the fall and winter, a very marked improvement will be perceptible in the darkness and mellow texture of the surface. The plant-food furnished by the gradual decay of the mulch, though beneficial, will not equal one quarter the improvement derived from the dense covering of the green manure.

The expense is so trifling compared to the permanent gain, you will certainly be willing to

repeat the operation. Do not kill the young giant in his cradle by making him try to carry a crop of some kind for the barn. I advise you when spring returns to plough in the mouldering fodder and drill in more corn, with plenty of plaster, and treat it in every particular as you did the year before.

And when the second year is over, what then?

If you have no other field to put in corn, and your circumstances are so cramped by the stern necessities of life, you will have to put in this lot; and if you work it well and use plaster as before directed, you may raise thirty or forty bushels of corn per acre.

But if you can spare the field from labor for a crop, and will continue the progressive improvement with sown corn for four or five years, precisely as you did the first and second years, you will never regret it. You will rejoice to see that the field is ready to take its place in a proper rotation with the best lots on the farm.

## CHAPTER XXI.

### HOW TO IMPROVE LARGE FARMS WITH GREEN MANURES.

IT is a very common practice among agricultural writers to advise all persons having large farms which are in a very poor condition to sell one-half or two-thirds of their land, and apply all the money they receive in manuring and improving the balance of their property.

In some cases this may be the most prudent course to follow, but, as a general rule, I am opposed to this advice for two very good reasons:

First, you can get but very little per acre for your poor fields; and, secondly, if you improve your property with judgment you can enhance its value so rapidly that in seven or

eight years it will be worth double or treble its former valuation.

To begin your improvement, take the old field about half a mile from the house, and which is now covered with thin yellow grass and a mellow soil about one or two inches deep, produced by many years of exposure to the weather.

It has never been ploughed since you knew it. And, I beg you, do not plough it now at the beginning of your efforts to make it better. Let me show you what a coating of fine mellow earth is worth upon the surface.

In Egypt the annual overflow of the Nile deposits on the land a thin stratum of very fine soil which amounts only to four or five inches in a century. This yearly settling, which is only the twentieth of an inch in thickness, of almost impalpable dust, keeps the farms for ever rich and productive. The Egyptians do not plough this precious coat under, but sow the seed on the moist ground as the waters subside, and

then, if possible, they drive sheep and hogs or goats over it to press the seed into the soil.

We should all learn a useful lesson from their example and experience. We should not plough down the only part which the air has enriched by mingling and uniting with it for so many years, but early in the spring we should harrow as many acres of the old field as we can sow with clover-seed at one peck to the acre. After the seed is sown we should roll the ground and sow one or two bushels of plaster per acre.

The principal roots of all plants must be near the surface, that they may feel the life-giving influence of air and moisture, or the soil must be loosened by Nature or by tillage, that the atmosphere may penetrate even to the deepest fibres of vegetation. Hence the reason that plant-food acts so well upon the surface, and that all seeds germinate more quickly, more naturally, when covered by only one or two inches of soil. But these great truths must not be misunderstood. Though the soil must

be loose, the finer the seed the greater the necessity when planting or sowing of pressing with the hand or foot or roller the earth into close contact with the grain.

I remember a little incident which will illustrate this subject and fix it in the mind. An old sea-captain who lived in our neighborhood tried every year to raise for himself a little tobacco. He prepared a little patch of ground with the greatest care. The surface was as fine and rich and mellow as he could make it. Then he sowed the seed and raked it over once more very gently.

Yet, much to his surprise and vexation, only a few stalks grew each year. But one spring, after the little bed had been sown with all the usual care, some fellow, to worry the old captain, went secretly on it and tramped and tramped, and danced and tramped it, till it was, to all appearance, as hard and solid as the most frequented public road. The poor old man gave him a seaman's blessing, whoever he might be, and left

it to its fate. But on his next visit to it he was astounded to see the whole bed covered with vigorous plants of tobacco. It seemed that every seed had grown. He had a grand crop. After that he could always raise tobacco.

He tramped the ground himself after the seed was sown.

Well, to return to our old field. If the clover should grow five or six inches high by the middle of August, give it a half or a whole bushel more of plaster per acre. The second year you must treat it in the same way, and if the clover is thin on the ground sow more seed, and again roll it well. Do all this the third and fourth year if necessary. After this it will re-seed itself, provided you continue the plaster each year.

Here is a practical illustration of this plan which I know to be a fact.

A person bought a very poor farm near the southern boundary of Pennsylvania, and tried to raise grain upon it in the usual way. But nothing grew large or strong enough to produce seed.

Fortunately, he did not sacrifice the property by selling it at a very low figure, as many would have done. He sowed every acre of it with clover-seed and plastered it every year. For a living he followed the profession of an auctioneer.

About seven or eight or more years the clover grew upon his farm, undisturbed by plough or hoof of any kind. Then he concluded to try his hand again at farming. Many of his neighbors gathered to see the first ploughing after so long a rest from tillage.

An old farmer who was present assured me that the soil turned over eight or nine inches deep as black as your hat and as mellow as an ash-heap.

More than fifty years have now passed since that occurrence, and the farm has the reputation of being rich and productive to the present day.

I passed it a few years ago, and looked over it with about the same interest I would survey the fields of Marathon and Platæa, where a noble work had once been achieved by man.

One thing about it was always a source of regret to me. I never could ascertain the precise number of years the fields remained undisturbed in their growth of clover.

Green crops have a manurial power equal, if not superior, to every other mode of improvement. Their roots penetrate the earth and open millions of channels, which permit the air with all its rich constituents to act upon the subsoil and improve it, not only by compelling the decay of vegetable matter, but by entering into new compounds and thus becoming available food for plants.

A farmer once dug up a clover-root seven feet ten inches in length. This of course might be a giant among them.

But what has once happened in Nature may happen again. We accept this as an index to the general average.

We suppose that three-fourths—yes, we hope that nine-tenths—of all clover-roots are three feet in length. But if they penetrate the unploughed

ground but two feet, what a vast amount of good they will do!

How superior in their action to barnyard manure! They change the color, the texture, and the quality of the subsoil. We know what stable manure can do. The experience of ages is before us. The farmers of England have been ploughing in the residue of their crops and raising grain more than fifteen hundred years. Therefore, if the contents of the barnyard and artificial manures will make a deep, dark, rich, and productive soil, we ought to find it, as a general rule, all over Great Britain. But what are the acknowledged facts in the case?

Alderman Mechi says: "If you make a transverse cut or opening in the soil, you will find that the British agricultural pie-crust is only five to eight inches thick. The slips and railway cuttings plainly reveal this humiliating fact. Below this thin crust we see a primitive soil, bearing most unmistakable evidence of antiquity and unalterability. The dark shades of the cultivated

and manured surface have not been communicated to the pale subsoil."

In another place he shows that all their labor and expensive fertilizers have extended only a few inches below the surface.

He says: "My observation of the present cultivation of our stiff clays would give an average depth of about four or five inches: all below this may be considered as unknown and unimproved territory."

Do not suppose from these quotations that we are in favor of plunging into the subsoil with a large plough and a strong pair of horses. Nothing of the kind: that task belongs to clover.

We know that it is reckless, if not dangerous, even with fifteen or twenty tons of stable manure per acre, to plough deeper than usual under the delusive hope that we can easily make a thicker "pie-crust," and thus be able to raise larger crops.

In 1865, on Plumgrove Farm, we had a field ploughed so deep that its productive power was

impaired for several years. It was done when I was not there, and of course I could not prevent it. We are so well satisfied of this fact that we record it as a warning to others.

Mechi says: "We know that there is nothing of which a farmer is so much afraid as the subsoil six or seven inches below the surface; if he brings this at once to the surface, he will grow nothing for some time."

These plain truths should convince every one that the cheapest and most effectual way to bring up a poor farm to a high state of productiveness, and also to prevent a good farm from becoming poor, is to keep every field in clover as long as possible. Other green crops are useful, but clover outranks them all. Follow this advice year after year, and you will find the dark crust of your farm is ten or twelve inches thick from the gradual decay of the clover-roots which have worked their way into the subsoil. Then it will be wise and profitable to plough even a foot deep into the new and rich fields which lie beneath the surface.

But what shall we do for a living on our poor farm while every field is growing clover? Well, that seems to be an important question, and most cheerfully I will answer it.

But let me first prepare your mind for the advice I am going to give you. If you will ask the best and most successful farmers what proportion of their crops do they return as manure to the land, they will answer, we presume, in the words of Joseph Harris: "We put on the unsold produce of ten acres to manure one." Here you see that all the straw, corn-fodder, hay, and the residue of grain consumed on a farm of 100 acres would be returned as manure to ten acres. Is not that a capital concentration? Certainly a field with such a dressing should bring forty bushels of wheat or eighty bushels of corn per acre. Yet for some reason this seldom happens.

Now, how shall we raise anything on the poor farm which has been only three years in clover? The crop is not rank, but remarkably good for

such exhausted land. Yet it will not pay to plough up fifteen or twenty acres of it and put it in wheat. It might bring ten or fifteen bushels per acre, but that will pay little or nothing for the labor and seed. What, then, shall we do? We must do with *clover* what the farmers do with their manure. We must concentrate the whole resources of the farm, if required, to raise a large crop of wheat.

Here is the sure and certain way to do it: There is a field of twenty acres. About the first of June, when the clover is coming into blossom, measure off one-fourth of the lot—that is, five acres—in one land through the middle of the field. Now take your mowing-machine and cut the whole of the clover down, and then with your horse-rake move all the clover on to the five acres and spread it carefully. There let it rot. All the rich elements in it will be carried into the soil and retained by the moisture, which is prevented from evaporating by the mulch.

When it is time to plough to put in the wheat you will find that you are master of all the required conditions. The ground will be so moist and mellow beneath the mouldering cover you can plough even when others find their fields too dry and hard to work.

After having drilled or harrowed in the seed you should roll the ground, provided the nature and texture of the soil require it. But this is not all you ought to do to ensure a good crop.

I advise you to mow all the balance of the field on both sides of the plot, and rake it and carefully spread it on the seeded land. Patience and care in spreading this evenly are the most particular part of the operation. If left in thick bunches it will prevent the wheat from coming up. But if uniformly distributed it will shelter, protect, and manure the wheat, and the clover being ripe, or nearly so, it will re-seed the lot completely.

By this plan you avoid all danger of having your crop injured by drought in the fall. If you

plough in a heavy growth of clover, and seed with wheat after the one ploughing, and do not cover it with manure or straw or clover, the upper crust, being separated from the subsoil, may become so dry that the seed will make but a feeble growth during all the rainless autumn. This unfortunate state of things cannot happen when the soil and wheat are protected by the second crop of clover used as a mulch.

Now, what have we gained by this new method? 1st. A good heavy crop of wheat—a crop that will pay all expenses and leave a handsome profit. 2d. We leave fifteen acres still in clover, well plastered and in a constant state of improvement. 3d. We have made more clear money off the five acres, after deducting the whole cost of the crop, than we could possibly have made off the whole field after deducting the labor of ploughing, harrowing, rolling, and seeding the twenty acres; for a small return per acre will always be sunk on poor land by the cost of seed and labor.

## CHAPTER XXII.

### GREEN MANURES FOR WHEAT.

COLMAN, in his *European Agriculture*, says: "Wheat, however, is to be considered as the standard grain and the great crop of England, upon which the arable farmer mainly depends for his money-returns from his farm and for the payment of his labor and rent, and to which, therefore, his attention is constantly and principally directed."

Then why do they devote so many acres to the production of the turnip, which costs so much labor and such a heavy outlay for phosphates to obtain a large crop? And why feed all these turnips to sheep and cattle on the ground where they grew? Do they derive such a profit from the animals that, after all expenses are paid, they

are certain of making considerable money? No; all this toil and all these costly investments are merely preparatory to ensure immense crops of grain.

This remarkable feature of British agriculture is strongly described by Mechi.

He says: "Suppose we take a farm of 400 acres on the four-course or mixed husbandry system: we shall find that one-half the farm produces nothing in the way of profit, but, on the contrary, leaves a considerable charge against or upon the remaining half, which is in corn. For instance, the horses consume one-quarter of the farm, the sheep and cattle consume another quarter; and you will find, if you give your live-stock much oil-cake or corn, that the whole of the expenses of one-half the farm have to be paid by the other half, which is in corn—that is, in wheat and barley."

Here, then, is a complete revelation of British agriculture. If their farms were rich enough to produce a good crop of wheat or barley every

year, the turnip crop would be abandoned until the raising and fattening of sheep and cattle were more profitable than at the present time.

But as it is, the nitric acid and ammonia in the soil are not sufficient to produce large crops of grain, and they find it cheaper to convert the nitrogen of the air into these compounds by growing and feeding green crops to animals than by sending to South America for nitrate of soda or guano.

And here is one great lesson which we must learn from their experience.

That to give the land the full benefit of green crops they must be retained on the field, to be ploughed in or to be fed to animals.

And further, we must acknowledge by our practice the important fact that of all manures obtained from sheep and cattle "twelve parts out of thirteen in weight escape as urine, only one-thirteenth part being solid. Well may farmers love the sheepfold, and well may they deplore yard-feeding."—*Mechi.*

Now, with regard to farming in the United States, we are as much under the necessity of converting the nitrogen of the air into plant-food as the British farmers. They depend, and we must depend, upon green crops for this purpose.

But here comes a serious consideration. Our climate is not adapted to feeding animals in the field during the fall and winter.

Besides this, we have to pay three or four times as much for hired labor as they do, and we cannot always get it when we need it. Hence the necessity of adopting a cheaper system of tillage.

If we can furnish nitrogen to the soil at one or two cents per pound by ploughing in green manures, is it wise to cut these green crops and feed them to cattle when the paramount object is to get the nitrogen which is in them for a crop of wheat?

If the clover, etc. can be converted into milk and butter or cheese, and these can be disposed of at a price that will pay all labor and leave a

fair profit and the manure free of cost, that is another matter. No objection can be found to that kind of farming. But all who live on farms cannot follow the dairy business. More than one thousand million bushels of wheat are needed every year to keep the human world in action.

Then, of course, somebody must raise wheat, and whoever will do it should be well rewarded for his trouble.

Now, we sincerely believe that every bushel of grain produced in the world may be raised at a moderate profit, provided it is done in the best manner; but it must be clearly understood that the same way will not answer in every quarter of the globe.

The very cheap labor of England enables the farmer to have his wheat cleaned by hand and every weed carefully removed; and when this is not done by hand he has the horse-hoe run between the drills to extirpate all grass and weeds and to loosen up the soil.

"Lord Leicester offered a large reward to any person who would discover a single weed among his crops after their usual cleaning."—*Colman.*

We cannot have our wheat cleaned in that manner. We can get no hands for that purpose, and if we could the cost would overrun all the profit. Repeated trials in this country must certainly convince every one that *our* best way to raise wheat is to plough in green crops. And to be always able to do this we should sow, if required, plenty of bone-dust or super-phosphate of lime, besides plaster, and even, if necessary, put on a top dressing of stable manure, to ensure a big heavy crop of green manure; then the wheat and corn will yield a handsome profit. What kind of a green crop would the British farmer have to feed to stock if he did not use the best of fertilizers on his turnip-field, and work it even better than we ever do our Indian corn?

By ploughing in green crops there is no danger of making the ground too loose for wheat. All we have to do is to roll the land well with a

heavy roller after seeding if too light and mellow.

I will give one example from Colman to show that no soil can be too light for wheat if properly managed.

"Mr. Theadstow of Booth, near Liverpool, informs me that in 1844–45 on a piece of land less than a statute acre he produced sixty-four bushels of wheat of seventy pounds to the bushel.

"I will subjoin his statement in this case: 'The soil is very light, consisting of a great portion of sand and lying close to the seashore. The land the previous year had been trenched to the depth of about three feet by hand labor and well manured with horse and cow manure, and planted with potatoes.

"'When the wheat was sown the ordinary mode of cultivation was pursued. Something short of two bushels of white Dantzic wheat was sown. The seed had been produced on land of a heavier nature than that on which it was sown here. The mode of sowing was broadcast.'"

This is a very useful and interesting report. As the sowing was broadcast, of course the crop could receive no hand- or horse-hoeing in the spring. And what better proof could we have that light sandy land will produce large crops of wheat if well manured and well put in? Wheat that has been drilled in is less likely to be killed in the winter; and that is the main reason why that mode is superior to the broadcast. Here the latter method seems to have suited the climate so well that it is hardly possible that any other way could have done better.

Many able farmers are satisfied that the most important crop which they can raise on their farms is the manure crop. Give them plenty of this material and they can raise large crops of everything else. This being an established fact, every effort, every spare dollar, and the most careful study should be directed to secure this all-important object. And it should be a matter of calculating investigation to every one whether, in his particular case, it would be better to cut

his green crops, make them into hay, and feed that hay to stock, and thus lose by handling, wasting, and exposure a considerable portion of the residue, particularly the liquid portion, or at once, with very little expense, turn the crops in as green manure.

He should be entirely convinced of the fact that clover gains nothing by being cut and fed to animals, but always loses a portion of its fertilizing power by passing through the barnyard.

The quickest way to convert the green crop into money is to cut it down when in blossom, and let the rains leach out the albuminoids and the soluble minerals.

While the ground is thus shaded, and while decomposition is going on in the first crop, a second will be springing up, and add an additional dressing by September.

Clover has this merit in a pre-eminent degree—that is, the ability to produce two or three good crops for manure in one summer. What objections can be offered to this plan? The plough-

man will tell you that he cannot turn in the clover so well after it has been cut. We know that, but the advantage is so great that it is worth all the trouble and care which is required to plough it in when both crops are thus mixed together. Besides, two or three careful mowings every year will eradicate any weeds that may be in the way. There is another great advantage: the crops which have been cut get mixed with the soil, and some of it is brought to the surface with the harrow. Hence there can be no danger of forming an open space between the upper and subsoil, which sometimes happens to such a degree as to be very injurious when a heavy growth of uncut clover is neatly turned in.

After wheat has been sown on a loose and loamy soil you can drive over it as much as you please, to spread manure or straw or clover on it or to roll the ground, and the more compact you make the surface after turning in a big green crop the better.

Mechi says: "For want of this autumnal rolling many thousand acres of light-land wheats have this severe winter been killed by the frost, which destroyed the roots, especially on the north side of the stetches. A farmer who lost fifty acres told me to-day that where he rolled in autumn he saved his wheat, having previously observed that where cart-wheels had passed over the land the plant was vigorous."

In September, 1875, after the wheat was sown, we had twenty-seven wagon-loads of manure hauled across one corner of the lot. This made that portion more solid and firm than fifty rollings could have accomplished, yet not one particle of injury was done to the wheat.

This reminds me of an incident which happened during our Revolutionary War. In the north of Delaware, near the head-waters of Mill Creek and about three miles north-west of Plumgrove Farm, a field of wheat which had been sown in August was noticed on the 9th of September, 1777, to be several inches high

and remarkable for its rankness and beauty. On the afternoon of that day General Howe, with an army of eighteen thousand men, and all their baggage and cavalry and cannon, encamped for the night upon that field of growing wheat. When they moved away the next morning scarcely an untrampled blade of the cereal could be seen. Most of the ground was packed solid, or was beaten into dry dust and had the appearance of a public road. Yet when spring returned it came forth with such vigor and produced such a magnificent crop that the good people of the neighborhood declared that Providence had taken special care of it because it had been trodden down by most unrighteous feet.

We cannot leave this important subject without saying a few words more upon the different modes of raising wheat with green manures.

If the field of clover is so rank and thick that it will produce, without any assistance, a large crop of grain, you have only to cut it down when in blossom two or three times during the

summer and fall, and put the whole field in wheat in the usual way.

But now comes a selfish question. How much wheat per acre will satisfy you? Will thirty-five or forty bushels pay you such a handsome profit that you will never try to raise a larger crop?

Is it not an established fact that the higher the amount of produce per acre the greater the profit? Generally speaking, we know this to be a grand truth.

Then we want to know, as a matter of pecuniary interest, how much wheat has ever been raised on an acre.

In the *American Agriculturist*, 1870, is a positive statement that in the Napa Valley in California "110 bushels of wheat had been raised there on one acre of land."

Another gentleman said that he had harvested from three acres of wheat 308 bushels.

Colman says: "It is well attested that a crop grown in Norfolk county, England, produced

eleven quarters two bushels three pecks per acre—that is to say, ninety bushels three pecks per acre."

Now, let us ascertain, if possible, the actual cost of producing one acre of wheat. The general average, I believe, is twenty dollars.

Then to raise twenty bushels per acre will cost one dollar per bushel, forty bushels but fifty cents, and ninety bushels but twenty-two cents, and 110 bushels but eighteen cents per bushel.

Of course these estimates cannot be mathematically correct. But do they not approximate sufficiently to establish the principle that the greater the amount of produce per acre the less we pay per bushel in labor and money for it?

To make farming a profitable business there must be a superabundance of plant-food in the soil. Although the plants cannot take up the one-hundredth part of it in one crop, still it must be there in profusion, that they may find enough in an available condition for all their wants. In this respect we must imitate the patient hunter,

who puts, without complaining, over a hundred shot in a single load, though he is well aware that only three or four can be effective to hit the bird. And should he be guided and controlled by that single fact, and only charge his gun with half a dozen shot, how often would he fail, and only kill by accident!

Yet, with what self-confident authority Liebig lays down the proposition in his first great work upon agriculture that "the manuring of an acre of land with forty pounds of bone-dust is sufficient to supply three crops of wheat, clover, potatoes, turnips, etc. with phosphates"!

Certainly that is a parallel case to loading the gun with four grains of shot to shoot partridges.

Regarding our statements as sound and practical, how shall we use green manures to meet them? Shall we let the field of clover grow undisturbed for three or four, or even five years, and cut it down two or three times in summer and autumn to mulch and enrich the ground, and thus ensure an immense crop of wheat when sown?

Or shall we double the green dressing over by mowing all the field as soon as the blossoms appear, and rake all the clover on to one-half, to be ploughed in for wheat at the proper time? And then, when the seed is sown and the land well rolled, we may cut the remainder, when the seed is ripe enough to grow, and spread it on the seeded half, and thus give it a second coat of manure, and protect it from the winter and effectually re-seed the field.

I like this plan much better than the other. But if the clover is not rank and heavy enough by doubling it once to ensure fifty or sixty bushels of wheat per acre, I would put fifteen acres upon five, or even twenty acres upon five, as described in the last chapter, and thus leave fifteen acres in clover to grow and improve the ground, while I raised an immense crop on one-quarter of the field.

To conclude, I request the practical farmer to consider well before he rejects this method what a great saving of labor there must be between

ploughing five acres of a moist, mellow soil, rendered by mulching as friable as an ash-heap, and the turning over of twenty acres of dry, hard, cloddy ground.

In one of my fields a broad land had been covered with old hay for several months, and while under preparation for wheat I saw the horses, when the plough entered the mulched ground, look round in surprise, as if they were sure they must be loose from the plough, so light was the draft compared with the labor of turning the furrows in the rest of the field.

I appeal to every ploughman if he has not seen this more than once. Many indeed are the benefits derived from mulching. And of all mulches the land ever produced, the cheapest and the best, red clover in blossom, stands at the head of the list.

I presume that every progressive farmer is aware of it.

I ask attention to the testimony of one who speaks from long and careful observation.

James Gaskins, a farmer of thirty years' experience, published a little work in 1838 to promulgate his views on protecting and covering the soil.

He says: "It is an incontrovertible fact that the growth of grain is twice as rapid when the soil has previously been covered as when it has been exposed to frost, which causes evaporation to take place, and your land becomes clammy and dead, until the land receives the nitre again by the dews and rains in the spring."

The reader will take notice that this was published by him two years before Liebig brought out his great work, *Chemistry applied to Agriculture and Physiology*, in which he pointed out his grand discovery, the existence of ammonia in the air; and notwithstanding Gaskins calls it nitre, he means the very same thing which Liebig discovered. Hence he is entitled to great credit for the observation that rains and dews bring down to the soil a *something* that will make it rich, and that we should retain it by covering the ground.

If you will please to turn back and re-read the second chapter of this book, you will see that Boussingault and Prof. Johnson both acknowledge the fact that ammonia is daily lost when the soil is exposed in winter and summer.

Besides this, "Brustlein ascertained further that ammonia which has been absorbed by a soil from aqueous solution escapes easily when the earth is exposed to the air, especially when it is repeatedly moistened and allowed to dry." —*Johnson.*

Now, during the rains and hot suns of summer where are the lands that are not "moistened and allowed to dry"? Nowhere, except those that are well covered by something that will save the rich compound from escaping.

Hence the undoubted profit, if not the imperative necessity, of mulching all ground devoted to tillage.

As a matter of curiosity to many and of utility to others, I will give you Gaskins's method of putting in wheat.

He says: "You should seed your wheat in the months of September and October on the top of your clover on the hard ground. Plough your clover and wheat in about four inches together, and as soon as you turn them under seed the same ground down in buckwheat. Then apply a large fallow harrow and pulverize the ground. Use the harrow in the same direction that you ploughed it; then seed the ground in timothy or orchard-grass, and the clover will seed itself from the crop you have turned in. Clear out your furrow so as to drain the land, and then take as heavy a roller as you can obtain and roll the land crossways.

"You may see from this mode of seeding wheat that it is all manured in the hill. I have turned under the clover and the soil together, which manures the wheat. The buckwheat will come up in six or eight days and cover the land from the sun. The clover and timothy will do likewise, and by the time the frost takes the buckwheat it will be from eighteen inches to two feet

high. The frost will kill the buckwheat, but the straw will remain, which will keep the land warm, and the wheat will remain beautifully green all winter with the clover and timothy."

This plan may do very well if the buckwheat will always grow eighteen inches or two feet high before the frost kills it. In my trials with it the fall happened to be too dry to make the buckwheat rank and high enough to do much good; yet there is so little expense attending the operation that I advise others to try it.

I regard it as a singular fact that "in the State of New York buckwheat is frequently sown in August along with winter wheat, affording a ripe crop in the fall without injury to the wheat, which grows along with and succeeds it."—*Farmer's Encyclopedia.*

The land must be very good and in high condition to stand this, and I presume the practice has been abandoned. I only record it to show that the two crops will grow well together. And where no grain is allowed to ripen and the

buckwheat is used as a mulch, certainly it can do no injury to the wheat, and must be beneficial just in proportion to the height and denseness of the sheltering crop.

Gaskins's mode of putting in wheat may answer, and where you have no drill it may save the crop from being killed in the winter to plough in the seed.

In the *American Farm Book* Allen says: "In Northern Europe it has been found a preventive against winter killing on strong clays to sow the wheat in the bottom of each furrow six inches deep, and cover it with the succeeding one. The wheat thus planted comes up as soon as on the fields sown broadcast and harrowed, grows more vigorously, withstands the winters, and produces larger crops."

The statement that the wheat will come up as soon as that which has been harrowed in is at variance with some very careful experiments. But this is not the question under consideration. Will it prevent winter killing? We believe it

will in a great measure, because drilled wheat, being deeper than the broadcast, is seldom injured by freezing in very severe winters, when the latter is almost ruined.

But here we must remember that wheat has to run the gauntlet of two modes of winter killing. Besides freezing out, it has the chilling, drying winds to bear, and too often nothing but shelter or mulching will save it from the last calamity.

## CHAPTER XXIII.

### GREEN MANURES FOR INDIAN CORN.

TWO hundred and fourteen bushels of shelled corn per acre is the largest crop that I ever saw published. It grew in Dearborn county, Indiana, in 1859, and took the first premium.

Now, it is an interesting question, How much did this corn cost per bushel in labor and seed? We find that agricultural writers in general agree that it costs twenty dollars in labor to raise an acre of Indian corn. Now, when we consider that the labor of ploughing, harrowing, rolling, marking out, planting, covering, and fluking an acre must be about the same whether the land is rich or poor, we feel justified in making a comparison between the yield of rich and poor ground.

And here we find that the crop of 214 bushels, because it was all raised upon one acre, cost a trifle over nine cents per bushel!

How many farmers raise but twenty bushels per acre! I know one, John Sleepy, who never raises more than this, notwithstanding he has been farming for thirty years on his own farm. He tries very hard to fill a certain crib every year, because he knows by actual measurement that it will hold 200 bushels of corn. Last year he filled it off a ten-acre lot. And yet he growls and growls, and complains and says that nothing can be made by farming. He says he wishes he had died when he was cutting teeth. Now, where is all the trouble? Let us look at it.

His ground, though naturally a good quality of soil, is very hard to work: it has no vegetable matter in it. He has to harrow and plough, and roll and harrow, and still it is a field of clods. And what is worse than all is, what he cannot work to any satisfaction, the roots of his corn cannot

work, cannot penetrate, and they have to crawl over a large space to get nourishment. Well, then, we presume it cost him twenty dollars an acre to raise corn.

And because he had but 200 bushels on the ten acres he actually paid in hard labor one dollar per bushel for his corn!

And this reveals the whole secret of his discontent. But the strangest part is yet to be told. He declares that he will make money next year by raising corn if he has to put in twenty or thirty acres. But how much will he make? He may sell 200 bushels at sixty or seventy-five cents per bushel that cost him one dollar per bushel to put in the crib!

He will not believe it costs him one-quarter as much as this to raise his crop.

And he gives a most remarkable and irrefutable reason for his belief.

He says that he does nearly all the work himself, and that he might as well be doing that as doing nothing.

What can we do to make him more happy in his noble profession? How shall we convince him that he should feed the land on clover and green corn and rye and oats to repletion?

Can we make him believe that *humus*, vegetable matter in a state of decay in the soil, is a powerful team—is more than four horses to a big plough? It makes the earth mellow, it loosens up its texture; the air and roots can penetrate it. It changes the color; it converts the nitrogen of the air into nitric acid and ammonia. It absorbs and retains moisture better than anything else. It holds the constituents of plant-food in its millions of capillary vessels. It makes the soil so friable that it is never too dry or too hard to plough, and seldom if ever too wet to till. Ashes, lime, plaster, phosphates, and salt cannot do without it so well as they can act with it.

In every stage of cultivation, in sandy loam or in stiff clay, it holds the organic foods of plant-life in a more available condition. Such is its value in tillage; it has no equal, no peer, in its

power to attract moisture. To prove these strong declarations in its favor to be the whole truth, I cannot do better than to give you the following table, so carefully prepared by Schubler, an able chemist, and reported by Professor Johnson:

| *Amount of Moisture absorbed by—* | |
|---|---|
| Quartz sand, coarse | 0 |
| Gypsum | 1 |
| Lime sand | 3 |
| Plough land | 23 |
| Clay soil (60 per cent. clay) | 28 |
| Slaty marl | 33 |
| Loam | 35 |
| Fine carbonate of lime | 35 |
| Heavy clay soil (80 per cent. clay) | 41 |
| Pure clay | 49 |
| Garden mould (7 per cent. humus) | 52 |
| Carbonate of magnesia (fine powder) | 82 |
| Humus | 120 |

You often hear farmers say that one reason why plaster does so much good is that it attracts moisture from the air.

Look at its feeble action in the table! Why, humus is one hundred and twenty times more powerful in absorbing moisture!

Ask a New Jersey farmer how he can raise anything on his white sand. He will tell you, "Give me plenty of stable manure or a heavy crop of clover or green rye or buckwheat to turn in, and I can raise anything I want, even a good crop of wheat or corn."

Certainly he can; even on that dry sand the humus will hold moisture in the hottest day in summer.

It was the unkindest cut of all in Liebig to speak so disrespectfully of humus in the soil. And, because he found it was not directly the food of plants, it was a grand mistake to declare that it is not necessary in any sense of the word.

Too often his teaching has led the credulous student of agriculture from the plain path of common sense which his father had followed to a comfortable home on earth.

I once knew a gentleman farmer who became so greatly enlightened by the plausible and profound reasoning of Liebig that he was induced

to haul out all his manure into large piles and burn it into ashes. He had these ashes carefully dusted about every hill of corn, and looked for grand results. But so little was gained by it he never repeated the experiment.

Indian corn more than any other crop clearly proves the wisdom and profit of concentrating green clover or stable manure and labor upon a little land. The careful and experienced farmer will often "use the unsold produce of ten acres to manure one." And yet we never hear any objection to this almost extravagant use of manure. But should we recommend the same thing to be done with green clover, you would probably hold up your hands in amazement at the advice. That is, the concentration of ten acres of green clover upon one acre! Most fortunately, you will not have to do that to raise an immense crop of corn.

If you will take a field that is thickly set with clover, and the crop so heavy that it will cut fifteen tons of green manure just as it is

coming into blossom, you need only concentrate three acres upon one to raise 160 bushels of corn per acre if the season is very favorable.

But it must be done in a certain way to be successful. I will give you the plan in detail, and then it will look more reasonable to the practical farmer.

In a fifteen-acre field of clover measure off five acres in the middle of the lot, running clear across the field, leaving five acres on each side of it.

When the clover is just beginning to blossom cut down the whole crop and rake it on to the five acres. This first dressing will amount to 225 tons of green manure. Then sow a bushel of plaster per acre on the balance of the field, and by the 1st of August it will be in bloom again. This time we have but ten acres to cut. No doubt but this will give us 100 tons, and must be mown and spread on top of the first crop. Then once more you should sow plaster to ensure a third growth of clover,

and by the middle or last of September we may cut five tons per acre; that will give fifty tons more to be spread on the other two crops. In all there will be 375 tons on the five acres, and every ton equal if not superior to a ton of stable manure.

Now, our best and most successful farmers when manuring for corn put on fifteen tons of barnyard manure per acre. Do you suppose that that will be equal to our seventy-five tons of green clover per acre?

This green dressing of seventy-five tons contains 900 pounds of nitrogen, 187 pounds of phosphoric acid, and 675 pounds of potash. The fifteen tons of barnyard manure contain only 150 pounds of nitrogen, 75 pounds of phosphoric acid, and 187 pounds of potash. Yet you expect to have eighty bushels of corn per acre, and in good seasons actually realize that amount. Then have we not a very good reason to expect at least double what you raise—that is, 160 bushels on each acre?

Our green clover is put on exactly at the right time—in the summer and fall—and, what is of equal importance, is in the proper condition to be converted into available plant-food. It holds the ground beneath it for seven or eight months in a moist and mouldering state and in a condition of constant improvement. Hence we depend not only upon the lavish amount of actual nourishment which we put on, but also upon the admirable preparation of the soil to produce a grand result. And when spring returns we are master of the situation. We can plough the very day that we should plant the corn. Dry weather cannot interrupt our farming operations.

Yet all our neighbors who have a naked, clayey soil may be moping about and wishing and praying for rain that they may plough to plant corn.

When ground is heavily mulched with clover and the soil is a rich loam, and of course so mellow that ploughing is unnecessary, we can

raise corn without turning in the manure. If we are satisfied upon a careful examination that the clover is dense and deep enough to prevent all weeds from growing, we may put in the corn in the following manner: Open a space in the mulch the size of your hand with a hoe, and scrape a hole less than two inches deep; then let an assistant drop in three or four grains of corn; then cover it one inch, and tread on the hill as you leave it. Plant in this way in straight lines, three by three or four feet, all over the field till it is finished. After this you will have nothing to do to it till the crop is ready to cut up.

I feel justified in recommending this method, having seen a report of a satisfactory experiment where leaves were used to mulch a crop of corn.

James Camak of Athens, Georgia, says in the *Farmers' Register:* "Last spring I planted a small piece of poor ground, first breaking it up well. The rows were made three feet apart, and the stalks left about a foot apart in the drill. The ground had been very foul last year with

crab-grass, whose seed matured. The corn was not well up this spring before the grass began to appear. When the corn had about four or five blades the young grass completely covered the ground and the corn was turning yellow. I spread a small quantity of stable manure around the corn, and covered the whole ground with leaves from the forest, taking care to do this when the ground was wet, and the leaves also, that they might not be blown away, and to leave the tops uncovered. In *ten days* there was not a particle of *living* grass to be found, and the corn had put on that deep bluish-green which always betokens a healthful condition of the plant.

"From the day the corn was planted until after the fodder was peeled and the tops cut nothing more was done with it, and the result is a product at the rate of *forty-two* bushels to the acre, about one-third of the stalks having two ears on each of them.

"I noted in the course of the summer the following facts:

"1st. The corn treated thus was always ahead of some planted alongside of it and treated in the usual way.

"2d. It ripened at least ten days sooner than other corn planted at the same time.

"3d. During the hottest and driest days the blades never twisted up, as did other corn in the neighborhood.

"4th. In the driest weather, on removing the leaves, the ground was found to be moist to the surface, and loose as deep as it had been at first breaking up.

"5th. The heaviest rains had scarcely any effect in washing away the soil or making it hard."

We cannot, of course, use leaves to raise corn, but we can obtain that which is far better—an abundance of green clover.

And when we remember that the chemist, after a careful analysis, has decided that dead leaves have so very little plant-food in them that they are not worth gathering, except as absorbents to be used as bedding for animals, we may be satisfied that

the corn received no nourishment from the leaves, and all the benefit arose from the protection bestowed upon it as a mulch. Then how vastly superior would a heavy dressing of clover be to the fallen leaves, which even hungry cattle will not eat, they are so worthless!

But another question comes up for settlement. Would that "poor ground," as he calls it, have produced forty-two bushels of corn per acre had he worked it in the usual manner? It certainly was in a most discouraging condition when all green with crab-grass and the corn turning yellow.

The crop would certainly have been a failure had he trusted to the common, careless, slovenly tillage so often seen in such cases. Of course, laborious attention with hand and hoe and fluke day after day would have saved it, but this would cost more than the crop was worth.

I cannot leave this interesting experiment without a further examination.

Will corn do as well without any working, if

the grass and weeds are kept down, as it will by frequent tillage with the fluke?

If we can prove this to be an established fact, then the very best way to raise corn is to use a heavy mulch of something that will effectually prevent the growth of weeds and grass and at the same time manure the ground.

I will here relate an authentic case where a crop was raised without the use of plough or fluke after the corn was planted:

"George W. Williams, of Bourbon county, Kentucky, has this year grown on one acre and one-eighth of land *one hundred and seventy-eight bushels*, or at the rate of *one hundred and fifty-eight bushels* to the acre! The corn was an early yellow corn, and was planted in rows two feet apart and one foot apart in the rows.

"The corn was dropped in a furrow, covered with hoes, the surface levelled and rolled after planting. The surface between the rows was scraped over with sharp hoes to cut the weeds, which was all the labor the crop received. The

soil was good, ploughed deep in the spring, and before planting a thin coat of fresh stable manure was spread over the surface, cross-ploughed, and harrowed.

"Mr. Williams attributes much of his success to not disturbing the roots of the corn during cultivation."—*Cultivator*, 1841.

Now, to return to our field of five acres in clover in a state of decay. How shall we decide the matter? Which way will produce the most corn at the least cost of time and labor? Shall we plough in the heavy dressing and work the crop as usual, or shall we put it in with the hoe and leave the mulch undisturbed?

The only certain way to decide this question is by careful and repeated trials of both methods, year after year, by a number of farmers and on different kinds of soil. If the crops should be equal, we should declare at once in favor of the mulching process. The soil would lose nothing by evaporation. One rain in May would ensure the crop against all drought.

The labor would be reduced to one-third or one-quarter. The ground would remain in a state of improvement during the fall and winter. And if the mulch was not thick enough to bring another crop of corn, it could be ploughed in for barley or oats or a second corn crop. By adopting this plan the whole field will be in clover, either growing or decaying, and in both cases improving the land.

I presume, after all that has been said in favor of the new method of raising corn without tillage, or of the other method of concentration of all the manurial power upon a little land, very few will be willing to adopt either plan. They will still cling to the old practice of putting the whole field in corn, whether the land is rich or poor. Very well, let them do it; necessity will teach them a better way.

Why not let the field rest in clover three or four years, and then plough in by this means a heavy dressing of manure?

This plan will be equal, of course, to concen-

trating the growth of one year on to one-third or one-fourth of the field.

Either method will ensure a large crop and pay well for the tillage.

Remember, when a field is improved with green clover or other green manures the benefit will be seen for several years; this proves that the greatest expense in raising corn is the labor.

Let me prove this by an extract from Joseph Harris. In his last and best work, *Talks on Manures*, he gives the cost per acre of raising corn, as follows:

| | |
|---|---|
| Preparing the land for the crop | $5.00 |
| Planting and seed | 1.50 |

Cultivating three times, twice in a row—

| | |
|---|---|
| Both ways | 5.00 |
| Hoeing twice | 3.00 |
| Cutting up the corn | 1.50 |
| Husking and drawing in the corn | 4.00 |
| | $20.00 |

Thirteen dollars per acre of this labor may be saved by the new method. But let that pass

now; we wish to say something about the harassing and wearing labor of ploughing.

Let us turn to England, and there we can see what an immense waste of horse-power there is in the present mode of farming.

Mechi says: "In one place a pair of horses abreast will plough one acre per day; in another, four, five, and six horses *in a line* will only plough three-quarters of an acre.

"In Essex we plough once for wheat; in some other counties three or four times (in some places nine ploughings for turnips; in another only two). Here we allow seven shillings per acre for ploughing, while elsewhere thirteen shillings is a common price."

Until farmers adopt an entirely different mode of tillage the horses required to do all the work will consume one-fourth of all they raise on the farm.

There is no amendment to the old method that will do, but a radical change in the whole system of agriculture.

There should be for every crop, as far as possible, a concentration of plant-food to such a degree as to do away with one-half or two-thirds, or even three-fourths, of all the ploughing. Then the business will be always profitable, always certain.

It is the too frequent breaking up of poor land that keeps the farmer poor. And it is the sole dependence upon a scanty supply of poor strawey manure that keeps the land for ever in a poor condition.

## CHAPTER XXIV.

### GREEN MANURES FOR POTATOES.

THE reader will please remember that one heavy crop of potatoes exhausts the land as much as three large crops of wheat. Hence he must expect his farm to suffer if compelled to produce potatoes every year. To provide for this great expenditure of plant-food you must either make or buy an abundance of stable manure or plough in green crops.

If you cannot obtain good rich manure for one dollar and fifty cents per ton within two or three miles of your farm, you had better conclude to depend on clover ploughed in or used as a mulch. Another fact must not be forgotten. Potatoes will flourish better and be more mealy, more palatable, and more salable raised on sandy

loam than on clayey ground. Hence it will be to your interest to select the most mellow and friable soil on the farm for this crop.

Begin the year before to prepare the lot for potatoes. Take a field that is well set with clover and sow on it two or three bushels of plaster per acre in April. And if you can afford it sow bone-dust or super-phosphate of lime on the young clover.

If the soil is rich and you have a reasonable expectation that by the next year the whole field will bring three or four hundred bushels of potatoes per acre, then you can prepare the land in the following way: As soon as the clover comes in blossom mow it down. This will check every weed that might be concealed among it. The second crop of clover will spring up and grow rapidly, and when in full bloom must be cut down like the first. Now, if August and September should be wet and warm a third crop will grow so rank that you had better mow it down when in full blossom.

If you neglect this advice you may be troubled with weeds among the potatoes, and you will regret that you had not cut their heads off in their early growth.

Do not let any person persuade you to plough up this field in the fall. And when spring returns, and about a week or more before you begin to plough in the seed-potatoes, sow on top of the half-rotted clover two or three bushels of plaster, five or six bushels of salt, and three or four hundred pounds of super-phosphate of lime per acre. If you have plenty of seed, plant whole potatoes not less in size than a hen's egg. If you have not seed enough, cut the large tubers into two or three or four pieces, and drop them in every third furrow.

Do you think all this is too much expense and trouble? Have you forgotten that there is not a crop which you can raise which will pay as well as potatoes for all the labor and fertilizers bestowed upon it?

If you cannot do all that we recommend, I beg

you to put on the plaster. And when the plants are a few inches above the ground begin and plaster their tops every two weeks till they are done growing. If the Colorado bugs should appear, then mix one pound of Paris green with every bushel of plaster that you dust on the plants till the bugs are destroyed.

The above plan may be regarded as the usual way of putting in potatoes with clover, instead of using stable manure. Some farmers prefer to let the clover grow six or ten inches high before ploughing in the seed.

If you wish to adopt this mode you had better plough the field before planting, and then run out the furrows to receive the seed. I have known the tender germs to be very much injured by turning a crop of green clover in the spring directly on them. The potato-sprouts appeared to be killed by the rich juice of the clover-stalks.

On our farm at home I have seen, when a boy, 424 bushels of potatoes per acre produced

by ploughing in clover and dropping the seed in every third furrow. But these were raised on a lot that was so much the pet of the family that every crop which grew upon it was carefully measured. When in wheat it yielded forty-nine bushels per acre, and the crop of corn eighty-eight bushels to the acre. And when in clover well do I remember my father measuring stalk after stalk that ran five feet six inches in height. Now, my good reader, if your farm and mine would always produce such crops as these on every field, we might regard the question as settled as to what plan we should follow to ensure success.

Nothing else would be required but to plough in clover over the whole field, and be well rewarded for all our labor.

But what shall we do when we know that the farm is only in a poor condition?

We wish to raise per acre as large a crop as was ever produced. It is the cheapest, the best, the most profitable, and indeed the only sure

way to make money by farming. But how shall we do it? By the concentration of plant-food. There is no other way.

Let us now prepare to raise an immense crop of potatoes.

There is a field of twenty acres well set with clover. With a good machine mow it all down when in blossom. Now rake it all on to five acres, making one land through the middle of the field. About the first of August the remaining fifteen acres will again be in bloom, and must be cut and moved with the rake on to the first crop. If a third crop should grow large enough to add considerable to the mulch, then mow it down when ready and spread it on the five acres.

You see the whole object of this labor is to concentrate all the green manure of a large field on to one-fourth of the ground. Probably the best way to do this would be to rake the first crop into large and close windrows on the middle of the land, and the second crop into

windrows alongside of the first, and move the third up in the same way. This would require no spreading of one cutting on top of the other.

This plan leaves three-fourths of the field in clover, and yet it is very likely we can raise as many potatoes on the five acres thus prepared as on the twenty acres under tillage in the ordinary way.

Great credit must be given to the admirable preparation of the soil under the mulch, remaining undisturbed in a moist, mouldering and enriching condition from September to April.

And what a difference in the cost and labor! As it requires about ten bushels of potatoes to plant an acre, we will save 150 bushels of seed by confining our operations to the five acres, and also the ploughing, harrowing, planting, fluking, and hoeing of fifteen acres of drier, harder, poorer soil. Is not this something? Is not labor the hole in the bag through which almost daily dribbles out one-half the farmer's profits? The balance of the field, being left in

clover, is in a state of gradual improvement. And how much better its condition than ground left bare and exposed all winter after a crop has been taken from it!

Has not experience taught the intelligent farmer to concentrate his stable manure to such a degree that he finds it most profitable to "use the unsold produce of ten acres to manure one"? Such is the acknowledgment of Joseph Harris, and doubtless of many others. As this is a grand truth respecting the residue of our crops, it must be the case with green manures.

Then every hour of labor will receive its full reward. But is it so when the manure and labor are spread over a large field? No, unless the field is very rich or the amount of plant-food almost unlimited.

When stable or green manure is concentrated till it forms a close and dense shelter to the ground, do we not place the soil in the very condition that the nitre-beds are in, where thousands of pounds of saltpetre are made by artificial

means? And does not this fact shed an abundant light on, if not a full and satisfactory explanation of, the remarkable benefit derived from covering the land, as related by Johnson and Anderson in the second chapter of this book?

And mark the result of this wise concentration. Year after year you will be astonished at the great crops produced on land once carefully and deeply mulched by green manures or by any other means.

I have seen five tons per acre of clover and timothy hay taken from ground which had been heavily mulched for potatoes six years before.

To raise profitable crops of any kind, and particularly of potatoes, the greatest want of the farmer is manure.

If you have plenty of straw to spare, I would advise you to use it with clover to mulch potatoes in the following manner: Cover the patch as above directed with the three crops of clover cut from the whole field. Let it remain all

winter to mellow and protect the ground. In the spring, when it is time to plant, you must rake off all the mulch and then harrow or fluke the surface, if it is not already loose and mellow enough to receive the seed, and then sow two or three bushels of plaster per acre. Then drop the seed, about one piece to every square foot. Then cover, not with dirt, but with the half-rotten clover. Now, if the covering is not ten or twelve inches thick, so as to prevent all grass and weeds from growing, you must put on straw enough to make the mulch about one foot deep.

I consider this a better and cheaper way than to use stable manure and straw. Here, you see, all the labor required is done at once—no weeding, no working, and nothing to do to the potatoes till they are ready to be taken up in the fall. To take them up, all you have to do is to turn the mulch over with a fork, and there are the potatoes all clean and ready to pick up without any digging.

I cannot leave this subject without one more

word of advice. Never use cornstalks to mulch potatoes, they are so troublesome to remove when taking up the crop.

I once had a lot of sown corn—about thirty-five or forty tons to the acre—cut down with a mowing-machine, and then doubled over and left till spring for a mulch for potatoes.

It was entirely too heavy to handle; we never tried it again.

There is a much better way to use green corn to raise potatoes. Sow the corn about twenty grains to the foot, in furrows three and a half feet apart. Plaster it, and work it two or three times, and when in full maturity run a deep furrow between the rows of corn, and then cut the crop with a machine. Now, when the hands on the farm have one or more idle hours set them to work filling the furrows with the mown corn. And when this operation is completed let them during the fall and winter haul out old hay, straw, yard-scrapings, waste ashes, hen and stable manure, and when the hogs are killed the hair and blood,

and indeed anything and everything that contains plant-food, and spread it along the furrows on top of the cornstalks. Many an hour when nothing else can be done may be devoted to this profitable work.

When it is time to plant the seed potatoes in the spring all is ready to receive them. You have only to press the seed down among the manure and sow all white with plaster, and then turn a furrow from each side on to every row. The middles may be fluked or ploughed, according to your judgment and experience.

In 1865 I raised a grand and heavy crop of Jackson Whites in this way. I bought the seed in Philadelphia (twelve barrels) on purpose for this lot.

The number of bushels per acre was not ascertained, because I had no idea then of ever publishing the result.

This little field has not yet forgotten the good treatment it received at that time. It is a grand truth that land which has been made rich by

mulching or by any other means has a remarkable power of remaining good for many years.

Let me relate an interesting example of this fact from Mechi.

He says: "Walking before harvest with a friend in his wheat-field, I was struck with the marked superiority of one corner, and asked for an explanation.

"'Oh,' he said, 'this portion was once a cottage-garden.'

"'How long ago?'

"'Why,' said he, 'I have known the field fifty years, and it was ten years before that time.'"

With such a lesson as this before us, we should not be afraid of losing our golden treasures by piling on manure, particularly for corn or potatoes. Here we have undeniable proof that land when well improved will hold its own for sixty years, and still show a "marked superiority." And is it not very probable that that corner got but little plant-food when the field was manured every four or five years for a crop of grain?

Would not the farmer be likely to say, "Ah, you are rich enough; you got your dressing when a garden"?

I once had a singular experience on Plumgrove Farm of the effects of mulching.

I wished to bring a field of ten acres into clover as soon as possible. I had oats and clover-seed sown together in the spring, but was determined to have the oats cut when in blossom, to give light and air and perfect freedom to the clover. I concluded to raise late potatoes by using the green oats as a mulch. Not living on the farm, I was under the necessity of depending upon others to do all things right and at the proper time.

The oats grew finely, and when the grain was in the milky stage two broad lands were ploughed and planted with potatoes, and then the oats were cut and spread nearly a foot thick on the fresh ground.

On my next visit I was astonished to see how careless, how thoughtless, the foreman had

been to let the oats get so far ahead before he cut them. It turned out just as I expected. The green stalks had strength and vitality enough in them to mature and ripen all the seed.

Then followed the most remarkable circumstance in the whole experiment.

It appeared that every grain of oats began to grow, and I am certain there were millions of seed that sent down their long roots to the ground, notwithstanding they rested near the top of the mulch and nearly a foot above the soil! The potatoes of course were smothered out after a feeble growth. In September I directed the lands to be ploughed up. A few days after I received a letter from the foreman, requesting me to send out an engine of ten or twenty horse-power if I wanted those lands ploughed.

I went out, and there was the plough sticking in the mulch, and not one yard could a pair of good horses move it.

The oats, new and old, were woven together, consolidated, compact, and so tightly bound to

the soil that two years passed before we could do anything with it.

It is now nine years since that happened, and we have had the field in wheat and corn and in potatoes, and those two lands are so rich that the wheat lodges, although we are careful to salt the ground, and the corn proves by its big ears and thick stalks that the soil is twice or three times as good as any other part of the field.

It shows the great necessity of doing everything exactly at the right time. Had the foreman cut the oats just as it was coming into blossom, we doubtless would have had a splendid crop of potatoes, and still left the lands in a good condition. I record this failure as a warning to others.

Do we not repeat this experiment every year by cutting grass or hay when the weeds among it are ripe enough to re-seed the field when we spread the manure made from the weedy hay?

I am a firm believer in mulching with green clover, particularly for the purpose of raising immense crops of potatoes. I know that one

thousand bushels per acre can be raised in that way easier than by any other method. I will relate a case which I know to be a fact: An acquaintance of mine, a gentleman esteemed for his integrity and reliability, was sitting one evening in a shoemaker's shop in New Jersey listening to the conversation of two farmers. One said that he believed that one thousand bushels of potatoes could be raised upon an acre. The other offered to pay all the expense and give him a handsome premium if he would accomplish the task.

The offer was at once accepted, provided there were no limitations enjoined as to time and means.

As soon as the acre was carefully measured off many loads of rich manure were spread upon the surface and ploughed in. In about two weeks the seeds of weeds and grass began to sprout up very thick; then the ground was again covered with manure, and again ploughed as before. This process was continued for two years; that

is, repeated manuring and repeated ploughing till the soil was as rich almost as a barnyard in midwinter and as mellow as a feather-bed.

Then the potatoes were planted by ploughing in the seed in every furrow. Nothing more was required. When the crop was taken up it measured eleven hundred bushels of good potatoes from that one acre!

My informant could not tell me how many loads of manure were put on; he seemed only to feel a deep interest in the result, and was careful to be present at the final measurement and decision.

I do not think that such a crop could always be obtained in that way.

The season must have been remarkably favorable in the amount of rain and heat and sunshine. Had the weather been very dry there might have been a partial failure. In all such trials the ground should be heavily mulched on top with clover or straw. Then there could be no such word as fail.

Do you regard this experiment as too extravagant ever to be repeated? Is there any great loss of manure?

What the crop could not assimilate remained in comparative safety. It was nearly all there, ready to produce great and grand harvests in future years.

The loss of plant-food by evaporation or by leaching would not be so great on that one acre as it would on six or eight acres had he spread the manure over that much ground. Besides this, he could spread clover or straw over this one acre without much labor or expense, and thus secure it in a great measure from future waste. No good reason can be given why he should not continue to raise potatoes on this highly-manured acre.

Boussingault says: "Potatoes may come again and again upon the same soil; they are incessantly cultivated at Santa Fé and Quito, and nowhere are they of better quality."—*Rural Economy.*

Again he says, in another place: "That there is no absolute necessity for alternation of crops where dung and labor can be readily procured is undeniable."

The reader will please remember that Henderson considers garden vegetables an exception to this rule. Experience has taught him that *vegetables* do better by alternation every few years, and in some cases every year.

The concentration of plant-food in general farm-tillage, which we have so earnestly commended, and, I feel, almost to a tiresome repetition of the subject, reminds me of a little instructive advice communicated to a young beginner.

Not many miles from his home lived an old man remarkable for the wisdom and knowledge which he had treasured up as a very successful agriculturist and a very money-making farmer. The youth asked him if he would please to reveal to him the choicest and most valuable secrets and gems of knowledge respecting their profession, as he was about to retire from it.

"Yes, I will cheerfully do it," said the old man with a kind expression. "Go home and make five acres of your farm as rich as a garden, and then come to me and I will tell you what to do next."

"Well, but suppose I cannot do that?"

"Then," replied the old man, "make one acre as rich as a garden."

Now, we never heard what else he intended to reveal to him, but we can easily conjecture that he would say, when informed that he had complied with his advice,

"Go and make another acre as rich as the first, and thus continue till the whole farm is as rich as a garden."

How many persons get discouraged because they fail to enrich a large field all at once and all the same year!

In conclusion, let me counsel you to follow the advice of the venerable farmer and you will never regret it. And to do this with profit and pleasure place your trust in green manures.

And if not rank enough to bring a heavy crop over the whole field, then double it once or twice, or even three times, and "great will be your reward."

There is one fact connected with the art of raising good potatoes which must not be forgotten. If the rot should make its appearance you should plant in alternation with rows of Indian corn. Put your potatoes in furrows about seven or eight feet apart, and drill in the corn for a crop at the proper time in rows between them. I know this to be an effectual remedy.

The poison which produces the rot is carried over the country in the fogs of the air, and when the moisture comes in contact with the corn it is condensed into drops of water, and thus the potatoes are protected from the poison-germs.

It is a pathological truth that the miasm of marshes and stagnant waters is suspended and carried by aërial moisture, and hence the reason that trees and groves of sunflowers protect the dwellings of man from its deadly influence.

## CHAPTER XXV.

### GREEN MANURES FOR THE MARKET-GARDEN.

THOSE who engage in raising vegetables for the market very soon discover that they cannot make the business profitable unless they manure very heavily every year. They must put on from seventy-five to one hundred tons per acre every spring of good stable manure, or something else that contains about the same amount of plant-food. Now, it will be too expensive to haul manure several miles for this purpose, because every hundred tons contains about seventy-five tons of water. Therefore, you must depend on bone-meal or super-phosphate of lime, or on guano, or on green crops for your market-garden. This being the case, you will soon discover that green clover and rye

are the cheapest and most reliable substitutes for stable manure or any foreign fertilizer.

Regarding this as a truth, it settles the question as to the amount of land required for a profitable business.

Ten acres are enough for all those who live near a city and can depend on it for all the manure they need, while all who live at a distance should have thirty or fifty, or even one hundred acres, according to the amount of business they wish to do.

Before we say anything about the preparation of the soil by the use of green crops, let me relate to you an example of a very profitable concentration of manure and labor on a little market-garden.

A man in New Jersey, within sight of the city of New York, in the spring of 1864 on one acre "planted 12,000 early Wakefield cabbages, which by the first week in July were sold in New York market, at eight dollars per hundred, for $960. Between the rows of cabbages

were planted at the same time 18,000 Silesia lettuce-plants, which, at one dollar and fifty cents per 100, brought $270. Both crops were cleared off by July 15, the ground being thoroughly ploughed, harrowed, and planted with 40,000 celery-plants, which sold before Christmas of the same year at three dollars per 100, or $1200—making the total receipts $2430. His expenses were: Manure, $150; keep of horse, $300; hired labor, $400; incidental outlay, $100," besides the interest on his investment.

Now, was it a misfortune that this man actually owned but one acre of land? What would have been his procedure had he purchased six acres and had only money enough left to buy $150 worth of manure? Is it not very probable he would have spread this amount over the whole six acres? The temptation to do so would have been very strong.

Nothing but an intimate knowledge of the business could have prevented it.

And what would have been the result on six acres? Not more than one or two hundred dollars per acre would have returned to him, and but little would have been left after paying all expenses. We know that this would happen. We have seen it again and again with truckers who were not masters of the great secret of concentration.

The market-gardener must learn wisdom from the failures as well as from the remarkable successes of others.

Let us now commence our operations without stable manure on a rich field of twenty acres well set with clover.

By a judicious use of plaster we may be certain by the time the crop is in blossom to have fifteen tons per acre.

With a good machine we must cut this without delay, and rake it on the five acres selected and measured off for the truck-patch. The remaining fifteen acres will have a second crop of not less than ten tons per acre, and will be in bloom

about the 1st of August, and must be mown and raked on top of the first cutting.

Then you had better give the field another coat of plaster, and you will have at least five tons per acre by the middle or last of September.

Cut this third crop before the blossoms begin to fade, and rake it on to the other crops. These three dressings of clover will make altogether 525 tons of green manure concentrated on the five acres. Now, what will it cost to enrich the garden in this way?

We have the published declaration of practical farmers that they can mow clover and make it into hay and put it in the barn for one dollar and a half per acre.

If this can be done, then it will cost no more to cut the clover, and rake it and spread it on the plot in the centre of the field. Cutting the twenty acres once will be thirty dollars, the fifteen acres mown twice will be forty-five dollars, and one year's interest on the field, worth $100 per acre, will be $120, or altogether $195.

Here we have the market-garden of five acres, manured with 525 tons of green clover at a cost of $195, and all ready for seeding and planting in the spring. Now let us compare this rich deposit of plant-food with stable manure purchased in the city.

Peter Henderson, author of *Gardening for Profit*, in a letter to Joseph Harris says: "In a general way it might be safe to advise that whenever a *ton* of either cow, horse, hog or other stable manure can be laid on the ground for three dollars, it is cheaper than commercial fertilizers of any kind at their usual market rates. This three dollars per ton, I think, would be about the average cost in New York, Boston, or Philadelphia.

"We never haul it on the ground until we are ready to plough it in."

This is exactly the information we need for a fair and honest comparison between the two systems. We have the cost of the manure and all the labor of hauling and spreading given in one

figure. Now, we only want to know how much is required.

You will find that question settled in Henderson's work. He says not less than seventy-five to one hundred tons per acre will answer for a market-garden, and this amount must be applied every year.

Taking the lowest quantity, the seventy-five tons will cost $225, and of course the manure for the whole five acres the sum of $1125.

Now, subtract the cost of our 525 tons of clover from this, and we have a balance of $930 in favor of the green manure. In other words, it will cost nearly six times as much for the stable-cleanings as for the green crop. Another matter of deep interest is involved in this comparison—the intrinsic value of the two in their capacity to furnish available plant-food.

Three hundred and seventy-five tons of stable manure contain 3750 pounds of nitrogen, 1875 pounds of phosphoric acid, and 4687½ pounds of potash. Now, the 525 tons of green clover

contain 6300 pounds of nitrogen, 1312½ pounds of phosphoric acid, and 4725 pounds of potash.

In the most costly element you see that clover has nearly twice the amount of it found in the manure.

And we have only to examine the analysis of cabbage to see what kind of plant-food is required in a greater proportion than all the others, to know how these rival manures will hold out.

Fifty tons of cabbage per acre are considered a large crop for a market-garden, and that amount contains 240 pounds of nitrogen, 140 pounds of phosphoric acid, and 630 pounds of potash. Again you see, on a careful comparison, that clover is superior in its ability to produce a large crop of cabbage, and of course all other garden vegetables.

There is but one more question to be settled in this examination. Is the nitrogen more available in stable manure than in the green clover? No; it certainly is not. I base this declaration on the careful experiments of Lawes and Gilbert.

They found that forty-one pounds of nitrogen in nitrate of soda would produce as large a crop of barley as 200 pounds of nitrogen in stable manure. The reason was too plain to be misunderstood. In the nitrate all was available. In the manure but a moderate percentage of the nitrogen had been converted into nitric acid or ammonia. Hence the reason the crop could not be any larger in the latter than in the former case. How different the condition of green clover! Being cut in a soft and soluble state, and being exposed to the leaching rains of the fall and winter, the albuminoids were carried into the soil, and the nitrogen in them gradually changed into nitric acid and ammonia.

After the continuation of this improving process for a period of six months, what a mellow, dark, rich soil you will find in the spring under such a mulch! If you do not remember every word which is quoted in the second chapter of this book in favor of covering the ground, do read it over again very carefully and see what

a treasure you have in clover as a shelter and fertilizing agent, and how incomparably cheaper to improve with it than by any other means within your reach.

Whether it would be better to plough the mulch under in the spring before planting and seeding, or only disturb the friable and crumbling mould enough to receive the seed and young plants from the hot-beds, must be a matter of experience or knowledge gleaned from such works as Henderson's *Gardening for Profit.*

Besides clover for the market-garden you will find green rye of great value for all kinds of vegetables which can be sown or transplanted as late as the 10th or 15th of May. See the tenth chapter of this work for very strong testimony upon this subject.

You may plough in a heavy crop of clover in August or September and sow three bushels of rye per acre, and have fifteen tons per acre of good green manure to turn in by the middle of May.

## CHAPTER XXVI.

### GREEN MANURES FOR THE ORCHARD.

FRUIT trees of all kinds should be planted in a rich field well set with clover. In June, or whenever the crop is in blossom, you should cut the clover and rake it up and mulch every tree. This covering should be about one foot deep, and should extend not less than six feet from the body of the tree in a circle all around it. This mulch will last three or four years. But you must not forget every fall to open a space around each tree about twelve inches wide, to keep the field-mice from cutting the bark. And if the rabbits are plenty on your farm you must protect the bodies of all young trees by wrapping something loosely around them, ex-

tending from fifteen to eighteen inches from the ground.

Old bark from other trees, such as the oak and chestnut, will answer the purpose. In fact, anything will do that will protect the tree.

Where stones are plenty they may be so carefully piled around the trunk as to form a protection for years against every bark-destroying animal.

I had a fine young orchard nearly killed by rabbits eating the bark off near the ground and nearly girdling every tree. This was done before I was aware of the danger. I could scarcely believe that so much injury had been accomplished by a few rabbits till I gave permission to two hunters to shoot them; but when they killed thirty-five in one day I saw at once that Plumgrove Farm was still entitled to its early reputation as being a place very attractive to gunners, and that all my fruit trees were in danger.

The first crop of clover, you recollect, is all

devoted to mulching the orchard. Every year after this you must cut down the green clover twice or three times and leave it spread on the ground to protect and improve the soil, and you had better sow one bushel of plaster per acre every spring.

As soon as the trees begin to bear, then I advise you to sow all over the orchard three or four bushels of salt per acre every year. This will have a remarkable effect upon the fruit and assist to prolong the life and energy of every tree.

The apple, pear, peach, quince, plum, apricot, cherry, grape, strawberry, gooseberry, currant, raspberry, blackberry, and indeed all things that grow out of the ground, are greatly benefited by a thick mulch, particularly of clover. Besides this, some trees require a careful examination about their roots to destroy all worms that infest them. The peach above all others needs this inspection.

If the clover does not re-seed the ground, and

thus keep the orchard well set with it, you should sow half a peck or more per acre wherever it appears to need it. Do not suppose the seed will not grow.

William West of Upper Darby on his fine grazing farm "found it necessary to sow clover thinly on the green grass sod every three or four years to correct a slight tendency which green grass has to bind the soil." If clover-seed will grow on such a sod, there is almost a positive certainty that it will grow beneath a mulch on a field of clover. If it will not, there is either a want of nourishment or the surface of the ground is too loose for the seed. Super-phosphate of lime will correct the first, a heavy roller properly used will remedy the second.

## CHAPTER XXVII.

### THE ANIMALS AND BIRDS OF THE FARM.

TO be a farmer of the highest respectability you should have a clear understanding of the position you occupy in relation to all things under your control.

Animals, and particularly those subject to your will, "are endowed by their Creator with certain inalienable rights." Among these are proper nourishment, the *kindest* treatment, and ample protection. Hence we must respect these rights, and must regard them as natural laws which must be obeyed, or we will fail in a great measure to receive from the dependent creatures the full value of their services.

The horse and the cow, with very little intel-

lectual endowment, have the feelings and propensities strongly developed, and will love those who will make them companions and will treat them with sincere affection. And they can and do greatly suffer in health and energy and spirit when beaten with clubs and harshly abused by words. Therefore you must enjoin upon all persons in your employment to speak very kindly to and handle very gently all the creatures on the farm.

No animal, not even man, can have a healthy digestion and a buoyant and energetic and lively spirit, and a full power of execution, which lives in constant fear of those around it.

The presence of the owner or a hired man or a servant should excite a feeling of confidence in animals, and a disposition to play and to get near to him, that they may manifest in their mute way their love and dependence on him.

This deportment carried out in all the relations of servitude will make everything and

everybody more healthy, more happy, and more able to discharge the responsible duties of life.

If you speak to a servant in a harsh, cutting tone of voice, with a savage expression of the eye, till you excite his destructiveness, he will go directly to the stable, and the first horse he meets he will kick in the side and tell him to get out of his way or he will smash his skull in.

This course, you see, will not do. The whole tactics of farm-life must be changed.

First, you must establish a perfect self-government over your own mind. Never permit yourself to utter an unkind word to a servant, or it will, most likely, be rained and hailed down with double force upon the poor animals about you. Besides, there is nothing gained by it; there is not even a worldly policy in it.

The strongest and most effective, most powerful, word in any language is PLEASE. By a careful and judicious use of this expression you can get more hard labor, more earnest and faith-

ful service from hired help, than the constant use of the sternest epithets can accomplish. The reason is, that little complimentary word recognizes them as equals before God, and does not disturb their self-respect.

There is another class of life which must not be forgotten.

The birds *must be* protected. The worms and bugs and other insects are preying upon our crops, and cannot be exterminated by any means in our power without the assistance of all kinds of birds. Yet you will destroy them because they eat a little of your grain.

What! are you so lost to every sense of justice that you will deny all compensation for benefits conferred? That feeling would withhold every bushel of grain and every handful of hay from the horse and the cow. They labor faithfully, yes, they do, and must receive a heavy reward—one-fourth of all you raise on the farm.

The destruction of a few moths and butterflies will prevent thousands of eggs from being laid,

and consequently prevent thousands of worms from destroying your crops. A little bird upon the wing may do this work in an hour, and when satiated with animal food will you deny it a thimbleful of grain? If you will, you become the peer of the midnight thief, who will never make a return for value received.

Six hundred species of caterpillars are already known in America. Most of these are the descendants of beautiful moths and butterflies, and many of them live by destroying the useful works of man. What shall we do with them? The army-worm at this very moment is eating our wheat and corn and grass.

Can we make no defence against this loathsome monster? Yes; a lady has just come in from the country and reports that two days before the roads and fields were alive with the worms, and now there is not one to be seen. Thousands of blackbirds and sparrows settled down on them like a cloud and devoured them.

What is this? The *blackbirds* eat them! Yes;

and should we not remember with a blush of shame how the gunners were encouraged to shoot these poor birds in the spring when seen building their nests on high trees near the corn-fields?

And what young rascals we were in childhood, to hunt their nests and gather their eggs merely for playthings!

Our parents should have thrashed us for every egg we destroyed.

And what excuse had we? They sometimes pull up the young corn. They do; but the entomologist tells us that the natural food of the blackbirds is "larva, caterpillars, moths, and beetles, of which they devour such numbers that, but for this providential economy, the whole crop of grain in many places would probably be destroyed by the time it began to germinate."

Birds are so indispensable. If pure selfishness will not save them, they should be protected by strong and relentless laws. And more than this: boxes of various kinds should be put up for

them, not only near the house and barn, but on trees in the woods and fields about the farm. So many hollow trees have been cut down, so many dense thickets cleared up, and so many large woods removed from the face of the earth, the birds cannot find places to build and live among us. Hence the necessity we are under to put up tenant-houses for them.

They will pay an enormous rent for the little dwellings by the destruction of worms, moths, butterflies, and other insects.

## CHAPTER XXVIII.

### ON DIVIDING THE FARM INTO FIELDS.

IT would be doing great injustice to the admirable system of farming with green manures to make no comparison as a matter of economy between it and the common mode of tillage.

When you plough in green crops you enrich the land without the necessity of making manure by grazing and feeding animals. Hence you save the great expense of erecting new fences every few years and the annual repair of old ones. What few horses and cows you are obliged to keep may run on lands that are never ploughed, or be kept in small enclosures by a judicious system of soiling. Few persons are aware of the cost of keeping a large farm well fenced into seven or eight fields until they have tried it for a number

of years. To give you an idea of the immense outlay required for this kind of farming, I will quote two reliable authorities.

In the *Year Book of Agriculture* Wells says: "The amount of capital employed in the construction and repair of fences in the United States would be deemed fabulous were not the estimates founded on statistical facts which admit of no dispute."

Burknap, a well-known agricultural writer, says: "Strange as it may seem, the greatest investment in this country, the most costly productions of human industry, are the common fences which divide the fields from the highways and separate them from each other.

"No man dreams that, when compared with the outlay for these unpretending monuments of art, our cities and our towns, with all their wealth, are left behind.

"You will scarcely believe me when I say that the fences of this country cost more than twenty times the amount of specie that is in it."

Here is a revelation so startling, and yet so true, that it should set every thinking man to a close, careful, and calculating investigation before erecting another panel of inside fence.

And when he sees all these structures which divide his farm into fields going down to dust by a decay which no human agency can prevent, he will rejoice to learn that he can save nine-tenths of all this expense by adopting and combining together the green manure and the soiling system.

I remember seeing a statement that the Hon. Josiah Quincy on his large farm tore out seven miles of inside fences when they were getting too old to be of any value, and instead of erecting new ones adopted the more economical method of soiling all his cattle. By this plan he found that he could keep as many animals on twenty as he formerly could keep on sixty acres in pasture.

We are glad to find that the experience of many others coincides with his views.

Colman in his *European Agriculture* says:

"That a great saving of food is effected by soiling there can be no doubt; no one rates it at less than two to one; many say that three animals, some assert with confidence that four animals, can be well kept upon the produce of land, if soiled, where not more than one could be kept if depastured."

Now, it is a common remark that if you make your land so rich that one acre will bring as much grain or grass as two acres would but a few years before, you really double the size of your farm. This may seem like a paradoxical expression, yet if you double the productive capacity of your land it is certainly much better than to purchase a poor farm alongside of it. The man who owns one hundred acres of good tillable land which he has always devoted to grazing may well say that he is now running a three-hundred-acre farm if by soiling he is fattening as many cattle on his one hundred as others are doing on their three hundred acres. And this is fact, not fiction.

I think I hear the reader say, "Will you please to tell us something about the expense of cutting grass and other things and feeding the animals?"

Yes; and time will turn your granite rocks of objection into solid ingots of shining gold. In other words, all the objections to the soiling system shall disappear beneath the profits and wisdom of the enterprise.

In advocating the new system of soiling to save the expense of fencing, and to leave many broad acres flourishing in rich crops for green manures, we ask a complete modification of the old-fashioned way of stall-feeding. You know well that more than half the manure of animals is in a liquid condition, and cannot be saved in the stable or in the yard without great expense and trouble.

What, then, shall we do? We must combine the folding with the soiling method. We must put up a temporary fence, enclosing a half or one or two acres, and feed all the horses and cattle in

this pen, and thus save all the liquid and solid excrements where they can be used without the labor of removing them.

We need not make any estimate of the amount of green corn or clover which will grow on this lot the next year. It will be so *rank* you will never get tired looking at it.

But how shall we shelter the animals from the hot suns of July and August?

That will be much easier than you suppose. A few crotches firmly planted in the ground and covered with corn-fodder or straw will make comfortable umbrellas for them, beneath which the air will move in a gentle breeze.

This plan will be far more healthy than shutting the cattle up in the stable.

I always tell my patients to live and sleep as much as possible on the healthiest side of the house, and that is the outside. The same advice is applicable to all creatures.

By folding and soiling together you see we accomplish a great desideratum, the concentration

of plant-food, which will always ensure success and victory.

When I bought Plumgrove Farm I found it divided into eight enclosures. But, strange to say, not a field had a name by which you could write or speak of it. I at once gave every lot a characteristic name. I give them here, to show you how easy it will be to know and remember them:

*Littlefield* is the smallest enclosure; *Brookfield* has a little stream of water running through it; *Clearfield* has no obstructions in it; *Woodsfield* has a woods in it; *Gullyfield* unfortunately has two gullies in it; *Springfield* has a cool spring of water in it; *Rockfield* has many rocks in it; and *Meadowfield* is a permanent meadow, which has a large run of bright water flowing through it from west to east, which divides the farm into two nearly equal portions. With this arrangement it is very convenient to charge every field with all we put on it, and to give credit for all we take off it.

My system of farming does not require the inside fences to be kept in repair, but we let the old landmarks remain. There is an advantage in having the farm laid out in fields, even when there is no necessity of erecting fences on the dividing-lines. The crops themselves are generally sufficient to show the boundary of each lot. Besides this, every field should be carefully measured and the number of acres noted down, so that you can tell without guessing what quantity of seed you may have to buy or how many bushels of plaster or other fertilizers will be required for any particular lot.

As this chapter has been devoted mainly to pointing out the difference between soiling and grazing, I cannot conclude without calling your attention to the present appearance of the country. For many miles around the city of Wilmington the pasture-fields are brown and bare and apparently destitute of verdure. The grass is nearly dead. The hungry animals wander

over the fields, and in many places can find nothing but weeds to eat. It is more than two months since we had a deep wetting rain. Only an occasional light shower fell in May and June and up to the present moment, this 15th day of July, 1880.

What better opportunity could occur to compare the merits of the two systems of feeding cattle! The sown corn is now green, fresh, and vigorous; the drought has not withered it. The quantity may be lessened, yet so little has it suffered from the dry weather it is still in a growing condition. What a contrast between it and the dead grass of the fields!

This warning should be lifelong to every farmer, and never again should he let the spring pass away without putting in one or more acres of sown corn, that he may be independent of all drought.



THE END.

## COMMENTS

OF

## JOHN C. HARKNESS, A. M.,

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THE poem "Elflora of the Susquehanna," by C. HARLAN, M. D., is so delightfully entertaining that whoever begins its perusal will not lay it aside without completion, save from sheer necessity. I have read it a number of times, and find it just the thing to entertain an honored guest.

It has great strength and stirring energy of diction, refined sentiment, clearness and fidelity of description. Its combination of these high and exceedingly rare merits gives the poem "Elflora" immortality. Mental power glows in every page. The plot is so skilfully wrought that you all the time want to know what is going to happen next.

Such a work is a monument to its author's genius, infinitely more enduring than marble column or granite structure.

The following extract, from the Third Canto of "Elflora," will show how sincere and truthful are these criticisms:

'Twas nearly day as downward through the wood
They bent their course, though every object stood
In all that shadowed loveliness of night
Which rests on earth when planets all are bright;
When clouds are only scattered far and few,
Making the clear a purer, deeper blue.
Such was that balmy morn; the setting moon,
Half down the west, was near her mountain-tomb;
The winds were still, the birds not yet in song,
And all was silent as they moved along
Through forests gilded by the level ray,
Which slept on leaves and cliffs that walled their way.
While slow they walked by crags and giant trees,
There came a sound, so like the whispering breeze
That none but Clifton, haply listening, caught
The low-breathed murmur, and its meaning sought
By hurried glance around and through the shade,
Where Night and Silence seemed in slumber laid.
And there a form he saw approaching near
With cautious step, perchance controlled by fear.
The moon a glory round her features threw
As she in breathless quiet nearer drew,
And stood so still, so pale, that Death seemed there;
Nor corse nor statue ever shone more fair.