PRACTICAL TREATISE

ON THE

CULTURE OF SILK,

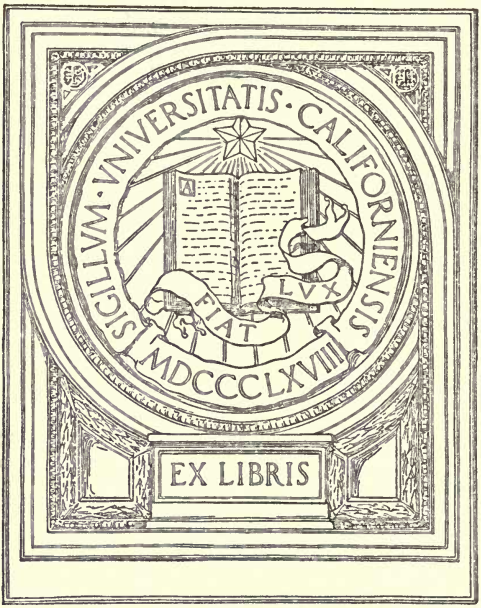
ADAPTED TO THE SOIL AND CLIMATE OF THE UNITED STATES.

BY F. G. COMSTOCK,
SECRETARY OF THE HARTFORD COUNTY SILK SOCIETY AND EDITOR OF THE SILK CULTURIST.

HARTFORD:
WM. G. COMSTOCK.

THE PRINCIPAL BOOKSELLERS IN THE UNITED STATES.

M DCCC XXXVI.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FOR SALE BY THE PRINCIPAL BOOKSELLERS IN THE UNITED STATES.

M DCCC XXXVI.

TO THE

FARMERS

AND

PRACTICAL SILK GROWERS

IN THE

UNITED STATES,

THIS VOLUME

IS

RESPECTFULLY INSCRIBED

BY THE AUTHOR.

PREFACE.

The culture and manufacture of silk is becoming a subject of much interest in this country, and it requires no spirit of prophecy to foresee that it will ultimately become one of its staple productions. These branches of national industry and economy have long engaged the attention of older countries, whose soils and climates admit of the cultivation of the Mulberry and the rearing of the Silk Worm—and even in countries whose atmospheres are too humid for the delicate constitution of the Worm, the manufacture of silk has been prosecuted as a fruitful source of national and individual wealth. As the subject is exciting much attention and interest in this country, a very brief history of its discovery may be both useful and interesting.

The Silk Worm was originally a native of China, and the adjacent parts of Asia, where it makes its cocoons upon the tree on which it feeds. It was there also fed and domesticated long before it was known elsewhere. It was first carried into Persia. In the year 552, two monks, at the instance of the Emperor Justinian, succeeded in carrying a number of the eggs, concealed in hollow canes, to the isle of Cos. In the same century, Justinian caused the Silk Worm to be introduced into Constantinople. They were thence carried to Greece, where, and in the Greek Empire, they were confined for six hundred years. In the twelfth century, they were introduced into the island of Sicily by the King, whence they spread into Arabia, Spain, Italy, France, and other European countries. From Italy the manufacture of silk was introduced into Derby, in England, in 1718, by a Mr. John

Lombe, who travelled in that country for the purpose of acquiring the necessary information. But according to statements, which are supposed to be authentic, he fell a victim to the jealousies of the Italians, having been poisoned by them. They were first known in America, about 1620, in the reign of James I., who sent out eggs and Mulberry seed to Virginia, and a book of instructions for their culture, written by himself.

The nature and origin of silk, were secrets in most countries long after the article was known. That the Romans were ignorant of its origin, is manifest from the accounts which different writers give of it. It was supposed by some to be the product of a tree, growing on its trunk and branches as hair grows upon the bodies of animals. Others supposed it proceeded from a shell-fish—a kind of muscle which throws out threads for the purpose of attaching itself to rocks. Others supposed it to be the entrails of a particular kind of spider, after being fed on paste, and the leaves of the green willow until it burst with fat. Others imputed it to an insect which built nests of clay and collected wax. These different ways of accounting for it, show that they were in utter ignorance of the Worm, by whose labor it is produced.

According to the ancients, silk was first brought from Serica or Sereinda, (China) in small quantities. The Chinese ascribe the origin of the manufacture to the invention of the Empress Si-ling-shi, wife of the Emperor Hoang-ti, about 2700 years before Christ. Manufactured silk was little known in Europe, at the time of the reign of the Emperor Augustus, who was contemporary with Christ; and it is mentioned as a wanton extravagance, in the prodigal Heliogabulus, that he had a garment made wholly of silk. The Emperor Aurelian, 270 years after this, refused his Empress a silk robe merely

because he could not incur the expense. It was then worth more than its weight in gold. Even James I.. before his accession to the English throne in 1603, was compelled to borrow a pair of silk stockings, of the Earl of Mar, when he appeared before the English Ambassador. This circumstance is supposed to have drawn his attention to the culture of silk and to have been the cause of his introducing the Worm into the colony of Virginia, where, as also in Georgia, he granted lands on condition of planting one hundred White Mulberry trees on every ten acres of cleared land.

The culture of silk received early attention in South Carolina. It was introduced into New England about the year 1760. by a Mr. Aspinwall, who is said to have had large nurseries of the Mulberry, at New Haven and at Long Island. This gentleman caused some of his trees to be transplanted in Mansfield, Connecticut, and furnished some of the inhabitants of that town with the eggs of the Silk Worm. He was aided in his patriotic endeavors to introduce the culture of silk in Connecticut, by Rev. Dr. Styles, President of Yale College. These efforts produced considerable effect; but the progress of the work was arrested by the war of the revolution.

In the year 1771, the culture of silk was commenced in Pennsylvania and New Jersey, and was engaged in with considerable spirit. It was, however, soon interrupted by the war. After the treaty of peace, the business partially revived; but was not considered worthy of much attention, until within a few years past.

During the present year, the business has attracted the attention of gentlemen of all professions, and in all parts of the country. In the spring of 1834, application was made to the Legislature of Connecticut for a Charter of a Silk Manu-

facturing Company. An Act of Incorporation was obtained, a Company formed, and a Building erected; but it was soon ascertained that the amount of domestic silk, annually growed, was inadequate to supply it with the raw material; while at the same time, there were in New England, several Silk Factories already in operation. This suggested the necessity of an association for the diffusion of practical knowledge, and resulted in the formation of the Hartford County Silk Society.

But the mere formation of a Society, did not remedy the evil—the Society could collect information, but they had no medium through which to communicate it to the public. The next step was the commencement of a periodical, devoted to the subject, under the appropriate name of "The Silk Culturist and Farmers Manual." Though the circulation of this publication is extensive and constantly increasing; yet the Society are in the almost daily reception of letters of inquiry, on the different topics, connected with the business.—To answer these letters separately and in detail, would require more time, than the Society can devote to the object of their association, and hence the want of a "Practical Treatise, adapted to the soil and climate of the United States."

To supply this want, at a price within the ability of all, is the object contemplated by the author of the following work; and should it contribute to that result, or in any manner conduce to the happiness and prosperity of the community, the author will be amply rewarded for his labor.

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PART II.—

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PART I.

THE MULBERRY TREE.

The first step in the process of the silk manufacture is to make provision for an abundant supply of food for the worm, by whose industry the raw material is produced. The only natural food for the silk worm is the foliage of several species of the Mulberry; and as the most valuable of them are not indigenous in our forests, we must depend upon the hand of cultivation, to acquire what nature has withholden from us in the distribution of her gifts. Though nature has, doubtless for good reasons, omitted to give us these species of the Mulberry tree, growing spontaneously on our farms and in our forests, yet she has favored us with a soil and climate admirably adapted to their propagation. The first object, therefore, with the culturist should be to prepare and sow a nursery of plants, from which he can subsequently have a full supply for standard trees, hedges, &c., as his taste and judgment may direct.

As there are several species of the Mulberry, each having its varieties, and as some soils are more congenial to it than others, the culturist should select the best varieties of the tree, and the soil best adapted to its growth and the quality of its foliage.

VARIETIES OF THE MULBERRY.

These varieties may be divided into two general classes, comprising such as are, and such as are not valuable on account of their foliage as food for the silk worm. The former class includes the White Italian—the Shining Leaved—the Tartarean—the Dondolo and the Chinese—the latter has three known varieties, the Morus Multicaulis—the Morus Cucallatta—and the Perrottet Mulberry. The latter class includes the Black, Red and Japan Paper Mulberry, which are considered not worth cultivating for the purpose of foliage.

Of all the species of the Mulberry there is no doubt that the Chinese is to be preferred, if it can be made to endure our climate, and of all its varieties the Multicaulis should be chosen on account of the quantity and quality of its foliage, and the facility with which it is gathered. We regret, however, to discover a disposition in many places, to neglect the cultivation of the White Mulberry. There is no doubt the foliage of the Chinese Mulberry is altogether superior to that of the White, and that the tree is to be preferred on all accounts. That this will ultimately be the case, by acclimation, we hope and believe; but we cannot say that we are without our fears. The extensive destruction of the Chinese Mulberry the last winter, we do not consider as deciding the question against its ability to withstand our ordinary winters. The last winter was uncommonly severe, and many of the most hardy indigenous trees and shrubs were destroyed root and branch. But notwithstanding the extreme cold, some of this variety of the Mulberry survived it, even in locations peculiarly unfavorable. We hope,

therefore, it will finally succeed; but it is a dictate of common sense not to exchange certainties for uncertainties. We know from the experience of half a century, that the White Mulberry is adapted to our climate, and that from its foliage, silk of an excellent quality and liberal product may be made, and it is certainly the dictate both of wisdom and economy, to hold it in reserve should the Chinese fail.

Our plan, as practical culturists, is to multiply the White Mulberry as fast as possible, and at the same time endeavor to acclimate the Chinese. Should it succeed, and render the White Mulberry unnecessary for foliage, it will still be valuable for timber and fuel. But, on the contrary, should we be disappointed in our hopes and expectations with respect to the Chinese, we shall still be enabled to prosecute the culture of silk with success and profit. It is to be hoped the most sanguine believer in the Chinese variety will not neglect to cultivate the White, until the question is settled beyond the possibility of a doubt. It appears to us that the success of the whole enterprize would be jeoparded by any other course of procedure; and, as we ardently desire its success, would earnestly entreat our fellow culturists to guard against such a result.

The Shining Leaved—the Tartarean and the Dondolo are also excellent varieties for silk, and well worth the attention of the culturist.

SOIL FOR THE MULBERRY.

The inquiry is frequently made respecting the nature of the soil best adapted to the growth of the Mulberry, and the climate most favorable to the health, industry and product of the silk worm. An

answer to the first topic of inquiry is all that need be said on the subject, for it is a well established fact that in all climates where the food may be cultivated, the animal, created by nature to live upon it, will be in its full vigor. With respect to the soil best adapted to the production of the food, it may be laid down as a general rule, that all soils adapted to the culture of Indian corn are adapted to the culture of the Mulberry. In the south of France, Piedmont and Italy, where the culture of silk has arrived to great perfection, Indian corn grows luxuriantly, and is the principal article of bread stuff among all classes of the community.

It is also a fact that the White Mulberry will grow well on light loamy and sandy land, and that its foliage is superior in quality to that which is produced on deeper and moister soils. This fact is important to farmers, as it will enable them to derive a profit from lands which have not been considered worth cultivating. We have seen Mulberry trees to the height of thirty and forty feet, growing on steep and sandy declivities, covered with an exuberance of foliage, where ten bushels of corn upon an acre would be considered a large crop. Low and wet lands are uncongenial to the Mulberry. In all other soils and locations they may be successfully cultivated.

METHODS OF PROPAGATION.

The Mulberry admits of six different methods of propagation. 1st Seed. 2d Grafting. 3d Budding or Inoculating. 4th Layers. 5th Cuttings. 6th Suckers. The seed is contained in the fruit and is procured by bruising and washing the berries. As fast as the fruit ripens it should be gathered, otherwise it

will fall from the tree and be lost, or be devoured by birds. When a portion of the fruit is ripe, spread blankets under the trees and shake them gently—by this means the ripe berries are disengaged from the boughs, and, falling upon the blankets, are easily gathered, while those that are unripe remain undisturbed. This process ought to be repeated every morning. The seed should not be suffered to remain in the berry more than three or four days at longest, as fermentation may take place which will injure, if not destroy it.

CLEANSING THE SEED.

To separate the seed, put the fruit into a tub, or other convenient vessel, and with the hands, or a pounder, mash them till they are incorporated into a common mass. Then pour water upon it and stir it briskly till a separation takes place between the seed and the pulp. After the separation has taken place, the water should be poured off, taking with it the false seeds which will rise to the surface. The washings should be repeated until the seed is clean. Rubbing it through a sieve, with meshes of sufficient size to admit the passage of the seed will facilitate the operation.

After the seed has become clean, the water is drained off and the seed spread thinly on cloths and dried in the shade. When perfectly dry it should be put into a vessel air tight, and kept in a dry place, secluded from frost or dampness, till it is wanted for sowing.

PURCHASING SEED.

In procuring seed for sowing care ought to be taken to obtain that which is genuine, and in order to guard against imposition, seed of domestic growth should always be selected in preference to foreign, when it can be obtained.

It is said, and probably with truth, that a quantity of imported turnip seed has been distributed in some parts of the country for Chinese Mulberry seed, and the same imposition, it is feared, will be attempted to be played off in the importation and sale of White Mulberry seed. The silk growing and manufacturing districts of foreign countries, are unquestionably looking upon our enterprize with an envious and jealous eye, and we must be prepared to surmount every obstacle their cupidity may throw in our way, whether indirectly, by scattering among us spurious seed, or such as will not vegetate, or directly, by sending among us foreign emissaries, as they did when the cotton manufacture was in its infancy.

To guard against these impositions it is recommended to cultivators to be careful about the quality and kind of their seed; and in all cases to procure domestic seed when it can be had.

SOWING THE SEED.

The seed may be sown from the first of May to the first of September. If sown in August, the plants will be up two or three inches before the autumnal frosts, and must be protected by covering them with horse manure, straw, or refuse hay, or the roots will be liable to be destroyed by the frosts of the ensuing

winter. The object of covering is not to protect the shoots but the roots, and care must be taken not to cover them too deep, as it may afford a shelter for rats, mice, &c. in which case they would be sure to kill them.

The seed may be sown in seed beds, or nurseries, as best suits the convenience of the cultivator. When land is no object, it will be best to sow them in the nursery, as it will save the labor of once transplanting.

For spring sowing, the land should be partially prepared the previous autumn. Every cultivator knows the fertilizing effects of frost and snow, and consequently ought to avail himself of them in preparing his ground for a nursery.

In order for this, ground, intended for spring sowing, should be dug or ploughed late in the preceding autumn and left rough through the winter. If the land require it, a suitable quantity of manure should be applied. In the spring, as early as the season will admit, the ground should be ploughed again and harrowed, or raked—care being taken that the earth be well pulverized. When the season is sufficiently advanced, ordinarily about the first of May, the ground should be laid off into drills, at sufficient distances from each other to admit of passing between them for the purpose of weeding and hoeing, and the seed sown in the manner of sowing carrots.

The seed should be covered about half an inch deep and the earth well trod, or rolled down to bring it in contact with the seed. Before sowing, the seed ought to be steeped in water about blood warm, or in milk and water, for twenty-four or thirty-six hours, as it will promote its vegetation.

After the plants are up, they must be kept free of weeds, and the earth well stirred with the hoe. If the season is dry, they should be frequently watered; but in all cases before the rising of the sun, or after its setting in the evening, as watering them during sunshine will injure, rather than benefit, their health and growth.

It is no uncommon thing for the plants to be destroyed by the frosts of the first winter; but this is considered a matter of little consequence compared with injury to the roots. If the roots are preserved in a healthy state, they will throw up vigorous shoots the second spring, which will generally withstand the cold of the second winter. Some cultivators of trees cut off the shoots of the first year's growth about two inches from the ground, and we are inclined to think it the better course. We have two nurseries, one of which was cut off in this manner, and the other left standing. The trees cut down are larger, and, in every respect, better than those left standing. The plants of spring sowing ought to be covered in season to prevent the frost reaching the roots, and it would be well to do it before the frosts are severe. The Corresponding Secretary of the Concord Silk Society, suggests hemlock boughs as a suitable material for covering, and we are inclined to the opinion that they will answer every purpose. Taking all things into consideration, we would recommend spring sowing, especially for large nurseries.

TRANSPLANTING TREES.

As the trees grow in the nursery, and become crowded, they must be thinned out. This should be done by transplanting them to situations where it is intended they shall permanently remain. To transplant trees, dig the holes for them six feet square, dress the ground two feet round the plants, shorten the tap root and press the earth on the roots as the hills are filled up.

The distances, at which the trees are to be set, depend upon the kind intended to be growed. For an orchard of full grown standard trees, Mr. Cobb recommends the usual distance between apple trees. On the subject of dwarfs, Mr. Goodrich, President of the Hartford County Silk Society, and a gentleman of science and experience, to whom the community are largely indebted for the present encouraging prospect of the silk enterprize, says:—

"I advise you to set the rows of mulberry trees, at the distance of *eight feet;* this will allow sufficient space to plough between the rows with a yoke of oxen, or to pass between them with a one horse wagon, when the trees are considerably grown.

"I would transplant the trees when they are *one* or *two* years old, (I should perfer those which are *one* year old,) and set them in the rows originally, at the distance of two feet. They will grow for two or three years within two feet of each other, as well as at a greater distance. You will then have more than 2700 mulberry trees on an acre. If your trees are one year old, or seedlings, you may, if you please, place them at the distance of one foot from another in the rows.

"It is important that the young plants should be *hoed* and *cultivated* for a few years, with as much care as is usually bestowed on carrots or onions; and in order to do this, with as little expense as possible, potatoes, beans, or ruta baga, may be planted between the rows, and when the potatoes are hoed, all the weeds around the mulberry trees must be carefully destroyed.

"When the trees are three or four years old, and have begun to spread, and fill the ground, I would *thin* them out by digging up and transplanting *every other tree.* Experience will enable you to decide at what time this is proper to be done.

"I ought to have added above, that potatoes should be between the rows, *well* manured, so that the whole ground may be rich like a garden.

"I observed the last year, that the young mulberry trees, grew as well where potatoes were planted between the rows, as where they were omitted, and the trees cultivated in the same manner without potatoes.

"I would begin to *prune* the young trees the *first* year, and continue it every year, observing to cut off all *sprouts* which grow near the ground; no leaves ought to be suffered to grow nearer than two or three feet to the ground. The earlier you begin to prune, the easier it will be to form good trees, and the more rapidly they will grow.

"The second year, I would begin to make silk of the *twigs* which are trimmed off. If the trees have been properly cultivated from the beginning, I think you may make silk enough the second year, to pay all the expense of making the silk, and of cultivating the trees that year. The principal object, however, ought to be, not to make silk the second year, but to cultivate the trees in the most judicious manner.

"I would therefore advise, that for the two or three first years, the trees should be trimmed, and the leaves gathered, only by persons who know how to trim the trees properly.

"When the trees are four or five years old, at which time, they will be six or eight feet high, I propose to gather leaves for the worms, by cutting off twigs, or small branches, which may be done by a person standing on the ground, still observing to trim the trees in such a manner as will best promote their growth. At Mansfield, in this State, the leaves have usually been stripped with the hand from the branches, and the person who gathers them, is obliged to climb trees, which are thirty or forty feet high. I propose to save this labor in a great measure, by trimming and heading down the trees from year to year, so that they shall not grow more than six or eight feet high, and in such a manner that the leaves may always be gathered by a person standing on the ground. In this manner, mulberry leaves are gathered in Persia and in the vicinity of Constantinople.

"The leaves, or rather branches, are to be conveyed to the silk house or cocoonery, in one horse wagons, and you will now see the propriety of leaving the rows sufficiently far apart for wagons to pass between them. I propose, also, to gather the leaves, or branches, in large baskets, of a proper shape, made for the purpose, and adapted to the wagons. I suppose that one man with a wagon, will carry these baskets of leaves to the cocoonery as fast as a number can fill them.

"I found the last year, that leaves which grew near the ground, were covered with sand or dirt, thrown upon them during showers of rain; and it was necessary to clean them thoroughly, before they were

given to the worms. The labor of doing this was about equal to that of gathering the leaves. This suggested the propriety of trimming up the young plant from the beginning, so that no leaves should grow near the ground.

"I omitted to mention, that the potatoes which may be grown the first year, between rows of mulberry seedlings, will, as I think, pay for setting out and cultivating the plants that year. When the mulberry trees have grown to a considerable size, and the roots have filled the ground, it may perhaps be advisable to discontinue planting potatoes between the rows, as the roots of the trees would be impaired by ploughing the land."

GRAFTING.

There are various methods of grafting which are as applicable to the Mulberry as any other tree. The thing essential in the various methods of grafting is to adapt the bark of the scion to the bark of the stock, and it is considered advisable to place the scion on the northerly side of the stock, as it is less liable to wither and die by the influence of the sun.

In Italy they are so prejudiced in favor of grafting Mulberry trees, that they graft those intended for hedges. This prejudice grows out of a mistaken opinion that grafted trees yield a greater amount of foliage than those from the seed. The facility with which trees are obtained from the seed will always render it the best way for obtaining them in this country, except in cases where it is desirable to propagate particular species, or varieties.

BUDDING.

Budding or inoculating is a much more simple operation than grafting and generally to be preferred, especially in cases where the trees are small. As there is nothing in the operation of budding or inoculating the Mulberry different from that of any common fruit trees, we refer the reader to the numerous horticultural works, in which the subject is fully discussed and ample directions given for its skilful performance.

LAYERS.

The propagation of trees by layers is one of the easiest methods to multiply them of which we have any knowledge. This operation is performed by laying down the branches of the tree, fastening them to the ground with a pin, having a hook upon it and covering them, to the depth of several inches, with earth.—In performing this operation care must be taken to leave the end of the branch above the surface of the earth,—scarifying that part of the branch which is covered, has also a tendency to cause it to throw out roots more rapidly and vigorously.

The following spring the branch is separated from the parent stock, and transplanted. The number of trees which in this manner may be obtained from a single stock is astonishing.

CUTTINGS.

Another method of propagating the Mulberry is by means of Cuttings. To produce trees by cuttings, the perpendicular shoots, and especially such as terminate branches, should be selected. These are to

be cut into pieces from six to fifteen inches in length, having on them, towards their ends, two buds—one for the root, and the other for the branch. These are to be stuck, early in the spring, into the ground about two thirds their length and have the earth well closed around them.

A shady location is preferable, when it can be obtained, and in dry weather they should be kept well watered. The cuttings should be of the last years shoots. Cuttings from horizontal branches will grow equally well, but incline to grow in a more spreading form and do not make as handsome and thrifty trees. The second year they may be transplanted if well rooted.

SUCKERS.

Trees may also be obtained from suckers. These are to be separated from the tree early in the spring, care being taken to leave some roots upon them, and planted either in the nursery or orchard. In dry weather they should be watered.

Though the White Mulberry admits of these various methods of propagation; yet ordinarily the better method will be to propagate them from the seed. Seed of a good quality can ordinarily be obtained at a moderate price, and from a single pound, one hundred thousand plants may reasonably be expected.

PRUNING.

The subsequent treatment of the trees ought to have particular reference to the quality and quantity of the foliage, the duration of the tree and the convenience of gathering the leaves.

These objects are attained by cultivation, pruning and picking. Though trees from eight to ten years old will do well in grass land, yet if the ground is manured and cultivated they will produce a greater abundance of foliage. The health and form of trees also depend much on pruning. Trees left to take care of themselves produce small leaves, and they often assume a form which renders it extremely difficult and unpleasant to gather them.

Great care in pruning is necessary the first year they are picked. After gathering the leaves, all damaged and decayed branches ought to be removed as well as such as are either too tardy or too vigorous in their growth. Regard should also be had to the form of the tree in pruning. It should not be permitted to grow too high, to throw out its lateral branches too far, or to have them hang in a drooping position.

To prevent these consequences the tree should be headed down by shortening its top shoots, as should also the lateral branches. Those that droop should be entirely cut away unless they can be made to take an upright, or at least a horizontal, direction by shortening. Such branches as have been displaced by picking the leaves, should be replaced in order that they take their proper direction. In other respects they may be pruned in the manner of common fruit trees.

PICKING LEAVES.

It is the prevailing opinion in the silk growing districts of Connecticut, that trees only two years old may be stripped of their leaves without injury, provided the leaves nearest the ends of the main stem and lateral branches are left. There is no doubt that the

leaves of trees are their lungs, and contribute, by obsorption of moisture and the principle of vegetation from the atmosphere, to their growth; but the health of a Mulberry tree is probably promoted as much by depriving it of its leaves, in a reasonable manner and at the proper season, as that of a sheep by being shorn of its wool.

It is recommended by some culturists to let the trees rest one year after the first picking, in order to recover from the loss of its leaves.

Various methods of picking leaves and transporting them to the cocoonery have been practised; but as experience will soon discover the best method to the practical culturist, it is supposed to be unnecessary to give any directions in relation to it. It may, however, be proper to state that the leaves ought to be stripped upwards, as downwards would injure the buds.

HEDGES.

A very good way of cultivating the Mulberry is in hedges, and it is probable it will ultimately be found to be the best method. It is cultivated in this manner in the form of fence or field hedges. On the borders of fields, Mulberry hedges are cultivated for the double purpose of fence and foliage, and the interior of fields is often covered with hedges, at suitable distances from each other to admit the passage of a hand or horse cart for the purpose of transporting the leaves to the cocoonery. The method of propagating hedges in both cases, is much the same, and is done either by transplanting plants from the nursery or sowing the seed when it is intended to make a hedge.

To make a hedge by transplanting from the nurse-

ry, take plants one or two years old and set them at the distance of eighteen inches apart, or, if it is intended to make a thick set hedge, at the distance of one foot. Cut off the tops at four or six inches from the ground, leaving two buds opposite each other, and removing all the rest. This causes the stock to have two vigorous branches the first year. The next spring, cut one of these two branches on the same side, at about twelve inches from the ground, in such manner that each plant may have a long and a short one. Cut horizontally on the same side also one after another, all the branches, and fasten them with cords or withes, so that they may form a line parallel with the earth, and leave the entire branches untouched. At the commencement of the third year, the plants will have branches to form a hedge.

The height, form, &c. of a hedge may be regulated accordnig to the taste of the cultivator by cutting off the branches, when covered with leaves, and feeding the silk worm upon them. Some cultivators are permitting standard trees to grow up out of their hedges at the distance of ten or twelve feet from each other. This is doubtless an improvement, as by cutting away the hedge an orchard of standard trees would be left should it ever be found desirable so to do. Rails might also be inserted into the standards and a good fence easily made.

To make a hedge from the seed it is only necessary to sow the seed and then treat the plants in the same manner as if transplanted from the nursery.

SOWING BROAD CAST.

Mulberry seed may be sowed every spring, broad cast, in well prepared ground. The next year, when

the plants are covered with foliage, they may be mowed down, in the same manner that farmers mow small bushes in their pastures, and given to the worms for food. These mowings may be repeated until the stock becomes so exhausted as to be unable to send out shoots, when the land must be seeded again.—This crop can be daily made, except after very dry weather, in different portions of the ground, and each plant will bear to be topped three times at least.

This method has several important advantages.—The leaves are gathered with trifling labor and expense—the same area of ground will produce more foliage—it enables the culturist to commence the making of silk in the course of one year—tenants from year to year, as well as owners of the soil, can secure a yearly crop of silk and the quantity can be increased or diminished according to the demand.

This method of sowing is practised extensively in China and found to answer a good purpose. It has also been successfully tried in New England; but culturists generally prefer standard trees or hedges.

CHINESE MULBERRY.

Of all species and varieties of the Mulberry the Multicaulis is beyond controversy the best for the culture of silk and consequently the culturist ought to cultivate it extensively on his plantation. Fears have hitherto been entertained that it could not endure the severity of our climate; but its superior excellence has induced many nursery men to experiment upon its cultivation, and their results have afforded strong evidence that, with suitable location and proper treatment, it may be depended upon, to furnish an annual supply of food for the silk worm. These experi-

ments have been made in different parts of the country and by different persons Among them are Mr. Whitmash and Dr. Stebbins, at Northampton,—Mr. Davenport at Colerain,—Mr. Kenrick at Newton and Mr. Bestor at Suffield.

The details and results of the experiments of these gentlemen might be interesting, but they are unnecessary as they all unite in one theory as indispensable to a successful cultivation of this valuable variety of the Mulberry. This theory is to force their growth in the fore part of the season and check it in the latter part; for the purpose of giving the plants time to harden and mature, before the commencement of the succeeding winter.

The Multicaulis is a plant of rapid growth and consequently its shoots are succulent and tender and liable to be destroyed by frost, if exposed to it, before they have time to harden and assume a woody state. The nature and habit of the plant then, naturally suggests the method of cultivation adapted to it, and this being corroborated by the results of numerous experiments, establishes the theory aforesaid beyond the shadow of a doubt. The theory then, being established, that the growth of the plant must be forced in the fore part of the season, and checked the latter part, all that is further necessary is to give directions for reducing this theory to practice, and the Multicaulis may be as easily and safely cultivated as any other plant.

To accomplish this, a soil must be chosen in which the plant can be kept under the perfect control of the cultivator—where it will grow luxuriantly till about the first of August and then cease growing. In selecting soil for the Morus Multicaulis, the cultivator will

be governed by the same rules as for the White Mulberry—dry sandy or loamy soil; except in regard to its fertility. To keep a plant under the complete control of the cultivator, and grow or not grow at his bidding, it must be set in soil where it will not grow at all without the aid of manure and cultivation.

Select then a soil too barren to make the plant grow at all, or, at any rate, very slowly, and by the application of manure and frequent hoeing, force its growth as fast as possible till the first or middle of August. At the time you wish to stop its growth, cease hoeing it, and, if the fertilizing properties of the manure are exhausted, it will stop as a matter of course, and commence hardening; and by the time of severe frosts, will be in a state of maturity to withstand them. A little experience will enable the cultivator to select the most suitable kind of manure and proportion it to the object he has in view.

The Multicaulis is of easy propagation either by engrafting or budding on White Mmulberry stocks, or by cuttings and layers. Some nurserymen suppose it will endure the winter better on White stocks than on its own roots; but this must be determined by further experiments.

Persons unacquainted with the cultivation of the Multicaulis are not aware of the extent to which they may be multiplied in a single season. In order to show the number that may be produced from a single tree, we would refer the reader to the result of an experiment by Mr. Bestor, of Suffield, the present year. He laid down the branches of two plants and thereby produced *two hundred and two,* in addition to the original plants. This is, however, a very extraordinary increase; but they may be rapidly multiplied with a very little trouble.

Cuttings take root as readily as the willow, poplar, or currant, and layers as surely as any other tree, or shrub, that can be propagated in the same manner.—From the "many stalks" which the roots shoot up, and from which it derives its name, it will be seen that it affords more material for cuttings and layers, than most other tress. In all cases all the stalks, having buds on them, may be cut up into cuttings in the spring, by which means they will be greatly multiplied. These may be laid down during the summer, and doubled or trippled, so that by the following spring the cultivator himself would be astonished at their increase.

With respect to propagating the Multicaulis from the seed, the question remains unsettled. Dr. Stebbins of Northampton, has plants from the seed which he believes to be the genuine Multicaulis, but it must be left to time to decide whether the same variety can, in all cases be depended on from the seed.

We have but little doubt of the ultimate acclimation of the Chinese Mulberry in this country, and consider it of but little consequence whether they can or cannot be propagated from the seed; but should it finally be compelled to yield to the severity of our climate, we should still consider it the most valuable variety of the Mulberry for cultivatiou in this country. It is the opinion of the most skilful and experienced cultivators and culturists, that should the shoots of the Chinese Mulberry be destroyed by the frosts of every winter, so that nothing could be gathered from the plants but the foliage on the annual shoots, they would be far preferable to the White Mulberry, as more silk could be made from them, than from trees of the White eight and ten years old.

A larger number of them may also be planted on an acre of land. They may be planted at about double the distance of hills of Indian corn, and be manured and cultivated in much the same manner.—Cultivated in this way, they make a most beautiful appearance and yield a large crop of the very best kind of foliage. We would, however, again recommend to the culturist, to continue the cultivation of the White Mulberry. It is a valuable tree for fuel and timber, and should it finally turn out, from any unforeseen cause, that the Chinese Mulberry cannot be cultivated in this country, he will still be furnished with a supply of food for the silk worm, by whose labor he can produce a profitable crop of silk.

An experiment is being made at Manchester, a neighboring town, to produce two hundred pounds of silk from an acre of land. Mr. Cheeney, the experimenter, is confident of success, and from the outlines of his plan, we think it not impossible. A family of worms, of sufficient numbers to make two hundred pounds of silk, will require, not to exceed 20,000 pounds of foliage during the season of feeding; and Mr. C. has already ascertained that a Chinese plant, the second year, will yield a pound and a half of leaves.

Taking this, then, as the average product of the plants, the 20,000 pounds of food will be gathered from 13,325 plants. This being the fact, the only difficulty in the case, if there be any, is to set that number of plants upon an acre at such distances as will admit of sufficient air and light to cause a rapid growth, and bring forward a perfect foliage. The soil may undoubtedly be so highly charged with the food of plants as to give them the requisite nutriment

during their growth; but we are not without fears, with respect to the admission of air and light in sufficient quantities to bring them to maturity.

The experiment, however, is an interesting and important one, and will be thoroughly tried by Mr. C. and the result given to the public. Should he fail of success, it ought not to operate as a discouragement to the cultivators of the Chinese Mulberry. Two hundred pounds of silk from an acre is an enormous crop—it is altogether more than has been expected by the most enthusiastic culturist, and should one half —one third, or even one fourth of that quantity be realized, it must be put down as one of the most profitable of crops.

TRANSPLANTING.

Trees intended for transplanting may be taken up in autumn and preserved through the winter with very little trouble. On this subject Mr. Bestor, an experienced and successful cultivator of the Chinese Mulberry, says:—

"Small Mulberry trees, intended to be removed the ensuing autumn, should be taken up soon after the fall of the leaf, and the roots carefully covered with sandy loam, or a hole may be dug in a sandy upland where it will not hold water, and a layer of trees and dirt alternately put in, and when near the top fill it with dirt, and raise a mound over it sufficient to shed the rains, and let them remain until it is time to set them out in the spring.

"Trees may also be preserved good by putting them into a box, well packed in dirt, as above mentioned, and placed in the cellar. In all cases, care should be taken that the dirt comes in immediate con-

tact with the roots; for if they are crowded together without, they will be liable to heat and mould, and the future death of the tree will be the consequence.

"Care also should be taken that the mice do not harbor amongst the roots, as they are excessively fond of them, and will ruin the trees; therefore no straw ought to be used.

PART II.

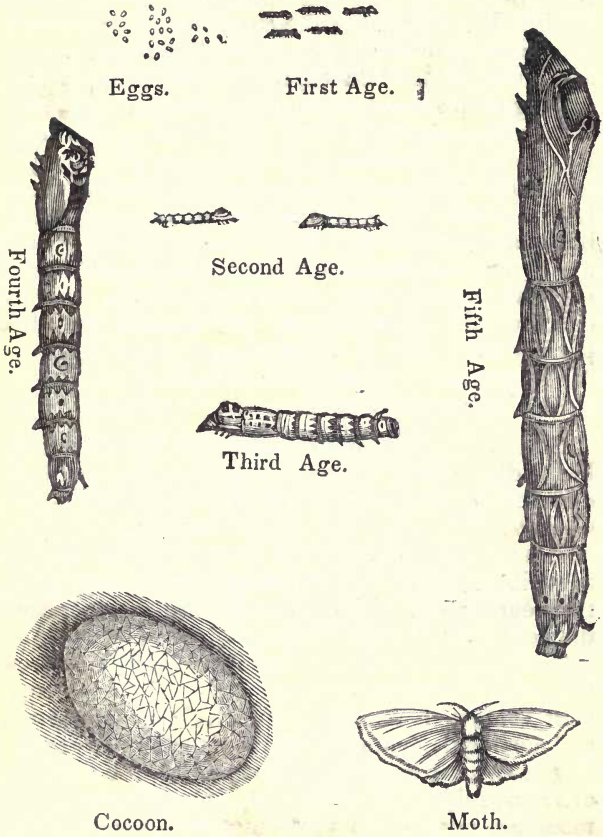
THE SILK WORM.

In order to a skilful and successful rearing of the Silk Worm, it is necessary that the culturist should have a thorough knowledge of its nature, habits and the diseases to which it is liable.

The Silk Worm (*bombyx mori*) is a species of the caterpillar, which after undergoing several metamorphoses becomes a moth like others of the genus. The color of the Worm for the first eight or ten days after hatching, is an obscure black. It casts its skin at stated periods, until it has attained its largest size, when it becomes yellow. It is about three inches long when full grown, covered with scattering hairs, and has a small fleshy tubercle on the upper end of the last ring. After constructing its cocoon, which is usually about the size of a pigeon's egg, and similar in shape, it is transformed to a chrysalis, and subsequently to a moth. After remaining in the cocoon about twenty days, it forces its way out and dies immediately after depositing its eggs, to the number of five hundred or more, which are attached together by a gummy substance. The several ages of the Worm amount to thirty-two days, but have been known to extend to sixty.

The Silk Worm undergoes four changes during its brief existence. These are called moultings, and follow each other at irregular periods depending on climate, or temperature, and the quality and quantity of the food on which it is fed. The periods of moulting are also hastened or retarded by the high or low temperature in which they have been kept during the winter. When they have been kept in a regulated degree of temperature, the first moulting takes place on the fourth or fifth day after hatching; the second on the eighth; the third on the thirteenth or fourteenth; and the fourth on the twenty-second or twenty-third. The time intervening between the several moultings is called the several ages of the Worm. The fifth age continues ten days, making thirty two days, at the end of which it ordinarily attains its full growth. The time however, has been protracted to sixty days. After it has attained its greatest size, which is about three inches in length, the silk gum is elaborated in the reservoirs, the Worm ceases to eat and soon diminishes in size and weight.

The vessels in which the silk is elaborated, consist of two parallel tubes of the same size, so very delicate, near their termination, as to appear to unite in one; but by immersing and hardening the insect in spirits of wine, Reaumur found that they continued separate to their ends and that he could take them out entire. By the aid of a microscope he found that the fibre of silk, minute as it is, has more breadth than thickness, and that in the middle of each fibre there was a kind of furrow, giving it the appearance of two flattened cylinders glued together.



GROWTH AND CHANGES OF THE SILK WORM.

The foregoing engravings represent the Silk Worm in its various changes and sizes from the egg to the moth. With the aid of the engravings the metamorphoses and growth of this apparently insignificant insect, may be easily traced, from its dormant state in the egg to the construction of its cocoon; and from thence to the moth, which again deposites its eggs for another generation. They are first of a pale yellow color, but soon change to a light slate and finally to a dull brown. By the color of the eggs it may be determined whether they are impregnated. Such as are not, continue of the original color, and consequently are worthless. Those that finally assume a dull brownish slate color, are genuine and should be preserved.

DISEASES OF THE SILK WORM.

Silk Worms, like other animals and insects, are liable to disease and subject to death. There are six diseases to which they are liable—*The Passis—The Grasserie—The Lusette—The Yellows—The Muscardine* and *The Tripes.* The first of these diseases is attributed to the Worms being too much heated in their early state. The symptoms are shortness and thinness of body and a want of vigor, or appetite. The remedy is to separate the diseased Worms from the healthy ones, by putting them into another room well ventilated, and of a little higher temperature, and feeding them moderately with tender leaves.

The Grasserie.—The period at which the Worms are most subject to this disease, is before the second moulting, and in the third and fourth ages. It is induced by feeding on food too nourishing for their digestive organs. The symptoms are want of diges-

tion—swollen bodies of an opaque form and green color—tender skins, which break at the least touch and covered with a viscious oily humor. As this disease is occasioned by feeding, its preventive and remedy is to be found in a contrary mode of treatment.

The Lusette.—This disease sometimes attacks the Silk Worm in its fifth age. It is supposed to be occasioned by being stinted in its food, as the stomach on dissection is found filled with a glairy transparent fluid, without any remains of food. The symptoms are a shining appearance of body and an enlargement of the head. This disease is easily prevented by taking care that they have a full supply of food; and the only remedy for it is separation from the other Worms, and a greater supply of food. Care must be taken that the food be not given in too large quantities, as a disease, directly the reverse, may be the consequence, which will be equally fatal.

The Yellows.—This disease is imputed to exposure to sudden and great heat. When it attacks the Worm it is generally toward the end of the fifth age, when it is filled with the silky fluid and is about to commence spinning. The symptoms are yellowness and swelling of the body—an enlargement of the rings and an appearance of having the feet drawn up. They also cease to eat and wander about, leaving stains of a yellow fluid on whatever it touches, which exudes from the body. The Worms soon become soft and burst, throwing out an acrid humor, which is sure to kill every one which comes in contact with it. This is considered the most fatal disease to which the Worm is liable, and, on account of its contagion, it the most to be dreaded.

When it makes its appearance in the cocoonery, it

must be attended to immediately, or the destruction of the whole family may be the consequence. The only remedy for the diseased Worms is to remove them to a separate apartment and give them additional heat. A change of air and an increase of heat, sometimes effects a cure; but far the greater part that are attacked die. Early attention to the diseased Worms will, however, generally prevent the spreading of the disease, which is the great object to be accomplished. For this purpose, all dead and diseased Worms should be speedily removed and the dead bodies carefully buried, to avoid their being eaten by poultry. In 1792, a family of Silk Worms in Bucks county Pennsylvania, were attacked with this disease and many of them died. The remainder were cured by eating oak leaves which accidentally come in their way.

The Muscardine.—This disease sometimes attacks the Worm in the fifth age. It is engendered by a long continuance of hot, dry, close, or calm state of the atmosphere. Its symptoms are black spots on different parts of the Worm, which afterwards turns yellow, then red, or cinnamon color, diffusing over the whole body. The Worm finally becomes hard and covered with a white mould and dies. The only remedy is to purify the room.

The Tripes.—This disease is engendered by the confined exhalations of the Worms and their litter. When the Worms are laboring under this disease, they become flaccid and soft, and when dead, for a time, retain the semblance of life and health; but soon turn black and become putrid. This is the only disease to which the Silk Worm is very liable in this country; and this, it is said, may be prevented by the use of chloride of lime in the cocoonery. It has

also been known to arrest the disease after it had become epidemic and threatened the destruction of the whole family. It is a cheap article, a dollar's worth being sufficient for a large establishment. The manner of using it is simple. Put an ounce or two on plates, with a little water, and set them in different parts of the cocoonery, replenishing every four or five days. It may also be put in a jug, or demijohn, and a gallon of water added for every pound. Sprinkle the floor with a little of this solution three or four times a day, when there is an offensive smell in the room.

In very hot weather, when it would be unsafe to cool the room by sprinkling cold water on the floor, (in consequence of the vapor evolved,) it will be of the greatest importance to have this solution, as it may be safely used. Should they, however, after all these precautions, become diseased, the only remedy is to purify the air of the cocoonery, or convey them to another apartment.

We have been thus particular in the description of the diseases of the Silk Worm, not because they are peculiarly liable to disease, but that the culturist should have a knowledge of them, should they appear, which is not much to be feared if the proper precautions and preventives are duly regarded.

THE COCOONERY.

For the accommodation of the Worms during the season of feeding and making their cocoons, a labratory, or, as it is of late, more commonly called, a cocoonery, must be provided. Every thing, however, that is indispensable, is to have a building inclosed in such manner as to exclude the rain and chilling winds.

If a building has not been erected expressly for the purpose, which, however, may be done at a small expense, barns, stables and other out houses, or unoccupied rooms in a dwelling house, may be easily fitted up for temporary use. They must be furnished with shelves, or tables, on which the Worms are to be placed and fed.

Cocooneries have been furnished in various ways; but the following is perhaps attended with as little expense, as any that have been adopted. It is recommended by Mr. Cobb of Dedham, who thus describes it: "I have used three tiers of rough pine boards, fixed upon upright posts, about four feet in width, one above the other, with a space between of two and a half feet, affording room sufficient to pass all around the frame, so that I could reach any part of it. In making the shelves it is well to have the lowest one six inches broader than the one above it, and to make the same difference in the shelves above, so as to break the fall of such Worms as happen to tumble down." Mr C. also describes another method of constructing shelves, which he saw in the nursery of Mr. Smith of Baltimore, which he thinks a very good one. He says, "it is about two and a half feet wide, by five or six long, made of thin boards, with a piece two inches wide nailed flat on the upper edge along the sides and ends, with legs about a foot long in the corners. The legs do not pass through the table, but leave a part of the hole on the upper side for the feet of another table to set in. Thus contrived, five or six of these tables are set one above another, and are taken down, cleansed and again set up with facility. One of these shelves will accommodate 500 Worms." He also recommends putting old newspapers on the shelves,

which may be taken off whenever it is necessary to clean the Worms, and then be replaced.

HATCHING.

Having a stock of Mulberry trees and a cocoonery conveniently fitted up, the culturist has arrived at the point where he is prepared to commence operations in the delightful task of rearing the Silk Worm. The first step in the process is to hatch the eggs; and here we would caution the culturist against being deluded and discouraged by the particularity and apparent difficulty of the Italian process. It was our avowed intention in the commencement of this little manual to give the practical culturist "a practical treatise on the culture of silk, adapted to the climate and soil of the United States," without reference to the soils and climates of other countries less adapted to the same object. Hence we have studiously avoided noticing the peculiar manner in which the tree is cultivated in the silk growing districts of Europe and Asia for the purpose of freeing the subject of every difficulty with which it might seem to be embarrassed. In giving directions for rearing the Silk Worm and making Silk, we shall endeavor to regard the same object.

ITALIAN PROCESS.

We will, however, give the Italian process of hatching the eggs, not on account of its necessity in this country; but to show the American culturist, the advantages he possesses over the Italian, for a profitable production of silk. These directions are copied

from Mr. Rhind's instructions in the art of managing Silk Worms in Italy.

"The temperature of the chamber near the place where the eggs are put, should be 63½ degrees; this is obtained by increasing the fire, should the temperature be less, and by opening the ventilator, and even the door, should it be greater. This temperature should be observed two consecutive days. On the third day, the temperature is raised to 66; on the fourth to 68; on the fifth to 70; on the sixth to 72; on the seventh to 75; on the eighth to 77; on the ninth to 79; and on the tenth, eleventh, and twelfth, to 81 degress."

Whatever artificial heat may be necessary for hatching and rearing Silk Worms in Italy, or other countries, our climate is so congenial to their growth and health, that nothing of the kind is wanted. Indeed a resort to it would be injurious rather than beneficial. All that is necessary here, is to expose the eggs to the ordinary heat of a common sitting room, and in due time they will hatch, and require a little of your time and attention in procuring them food and cleansing their cocoonery, and they will make you an abundant crop of silk.

TIME OF HATCHING.

The proper time for hatching the eggs is always determined by the advance of the season. In New England and kindred climates, the season is ordinarily sufficiently advanced by the latter part of May. The only sure criterion, however, is the leaves of the Mulberry—and hence the maxim among culturists, that "it is time to hatch the eggs when the leaves of the Mulberry are about the size of your thumb nail."

When the leaves have attained this size, the papers, on which the eggs are laid, are to be brought from the cellar where they have been deposited for safe keeping through the winter, and exposed to the action of the atmosphere of the sitting room. In a day or two the Worms will begin to appear, and must be immediately fed with the young and tender foliage of the Mulberry. This is done by laying the leaves upon them, to which they will cling and commence eating. Care should be taken to classify the Worms according to the time of hatching, keeping those which hatch about the same time in distinct classes; this will produce more uniformity in their future operations. While they are upon the leaves at the first feeding, they should be removed to the shelves intended for their future use. This is easily done by taking the leaf by the stem and carrying them to the cocoonery.

SPACE REQUIRED.

The health of the Worms and the product of their labor depend materially upon their having sufficient room allotted them during their several ages. As they increase in size, it is manifest more room must be given them, or they will become crowded, diseased, and either die, or perform their labor like a sickly and feeble man, or animal.

It is somewhat difficult to prescribe the space necessary with mathematical accuracy; but as a general rule, the Worms should never be permitted to come in contact with each other during any period of their lives. Mr. Cobb, who has much practical and scientific knowledge on the subject, says:—"It is calculated the Worms proceeding from one ounce of

eggs, which in number are estimated at 35 or 40,000, should have space on the shelves,

	sq. feet.	*inches.*
In the 1st age of - - - - -	7	4
In the 2d age of - - - -	14	8
In the 3d age of - - - - -	34	10
In the 4th age of - - - -	82	6
In the 5th age of - - - -	183	4"

A little experience and observation, however, will be the best guide for the culturist with regard to the space, and many other matters which cannot be fully given in a general treatise.

FEEDING.

The Worms being placed upon the shelves, they must now be fed three times a day, and care must be taken that the foliage be in good order. The leaves should never be picked when they are wet with rain or the morning dew, unless it be in cases of absolute necessity; and then they must be thoroughly dried before they are given to the Worms. As the leaves must not be wet, so neither must they be wilted, for in either case they will make the Worms feeble and diseased. To prevent this, care must be taken, on the approach of wet weather, to lay in a supply until the re-appearance of the sun. In order that the leaves may be kept without wilting, they should be closed in a glazed vessel, or carried into a cellar or other cool place. M. D'Homergue recommends putting them under cover, on a brick pavement, or graveled floor, and removing them three or four times a day lest they contract moisture. In this manner, he says, they may be kept three or four days.

In feeding Worms care should be taken not to give them too many leaves at a time, and to lay them thin upon them. If laid too thick, many of the Worms will be carried off with the litter and destroyed. During the first age of the Worm, the tenderest leaves should be selected for them, and those on young trees are better than those on older ones. Some cultivators sow the seed every year for the purpose of having tender leaves for the young Worms, and all would find it materially for their advantage.

Leaves from young plants are preferable to those from older ones, during the second age. As the Silk Worm is tenacious of cleanliness, care must be taken to remove all the litter which they make. This may easily be done by scattering fresh leaves on the corner of the shelf to which the Worms will readily attach themselves. When they have thus attached themselves, take up the leaves to which they cling, leaving the litter underneath, and place them in a clean place. After removing the litter, they may be re-placed in the same manner. Some lay the Worms on sheets of paper. In that case, it is easy to take out the paper, lay it on a table, or shelf, and carry the Worms to another sheet placed on the shelf after cleaning it.

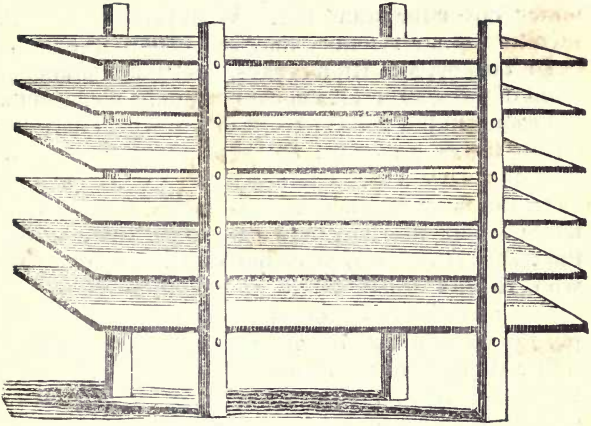
Full grown leaves, from the largest trees may be given during the third age, and the litter should be removed every day. All dead and diseased Worms should be immediately removed or they will endanger the health of the others. When the Worms are sick and are about changing their skins, they hold up their heads, are stupid and appear to be asleep. This ought to be particularly noticed for at such times they should be fed sparingly. The diseases of Silk Worms,

as has already been remarked, are in general the consequence of want of sufficent air and space—being suffered to get wet—being fed on damp or wilted leaves and not being kept clean. The preventives of disease, are to prevent the causes which produce it. Give them room and air—keep them dry—feed them on fresh leaves and keep them clean. If the cocoonery is fitted up with glass windows, they should be partially darkened during the silk season, as the Worms do not work as well in a full blaze of light.

As rats, mice, spiders, ants and fowls will destroy the Worms, care must be taken to prevent their having access to them. In some cocooneries, a space of several inches is left between the shelves and the walls, and the legs, or posts, by which they are supported, are tarred to prevent the attack of these enemies.

The destruction of the Worms by ants, has been prevented by placing lemon juice about the shelves and cracks where they make their appearance. In some cocooneries, streaks of thick molasses are made around the lower part of the post to prevent their ascending. In others, the legs of tables are placed in plates or bowls of water for the same purpose.

The smoking of tobacco must also be forbidden in the cocoonery, as it will endanger the health and may destroy the lives of the Worms. In the fifth age, the Worms must be fed during the night, or a double portion of leaves given them at the last feeding.



FEEDING SHELVES.

The foregoing engraving represents the feeding shelves and the manner in which they are arranged, and supported. We think having the shelves of a width, an improvement on Mr. Cobbs plan, as they will accommodate more Worms, and their falling may easily be prevented by having a cleet on the sides.—This may be done by nailing a thin piece of board upon each edge and letting it rise an inch above the surface. The width of the shelves should be such as to render the feeding convenient by laying in leaves on both sides. If they are to be attended by children they should be of less width than if by adults. As economy in room is an object, it is believed a foot space between the shelves will answer every purpose. The length of the shelves will, of course, be according to the size of the room, and after the Worms have

finished their work, they may be taken down and kept under cover for future use. With proper care, the furniture of a cocoonery may be made to last an age.

In Turkey, Mr. Rhind says, "At the commencement of the season almost every family clear out all the rooms in the house except one in which they live, during the crop season; the Worms being produced, they purchase a quantity of leaves and strew them over the floor of each room, leaving a small space next the wall, that they may walk round and distribute the leaves; they then place the Worms on the leaves, who readily attack them, and then daily throw on such a quantity as experience teaches them will supply the want of the Worms, and this they repeat until the Worms are ready to rise and wind the cocoon, without ever removing the offal or stems, and frequently the pile of collected matter will reach the height of three or four feet."

This slovenly mode of feeding has never, to our knowledge, been attempted in this country, and there appear to be substantial reasons, other than the health and comfort of the Worms, why it should not be adopted. But the promotion of their health and comfort, is of itself, a sufficient reason for rejecting this method, especially when the health and enjoyment of the feeders are taken in connexion with it, and are duly regarded. The exhalations arising from the litter &c. must be very offensive and deleterious to health.

WEIGHT OF FOOD.

Various estimates have been made of the weight of food consumed by the Silk Worm, and the product of silk received in return. Among them is that of

Count Dandolo, who calculates that 200,000 Worms will consume 7,000 lbs. of leaves and that 21 lbs. of leaves will make 1 lb. of cocoons.

Count de Hazzi calculates that the same number of Worms will require 10,000 lbs. of leaves in the following proportions. In the first age, 50 lbs.; 2nd, 150 lbs.; 3d, 460 lbs.; 4th, 1390 lbs.; 5th, 7950.

M. Bonafous, says that 200,000 Worms were sustained by 7217 lbs. leaves. The quantity, however, given them between their regular meals was not taken into the account, and the leaves were chopped during the first stages, which enables the Worm to consume them with less waste.

Estimates have also been made of the daily consumption of food by the Worms, proceeding from five ounces of eggs, (from 175 to 200,000 in number) each day of their different ages. Though we have not much faith in feeding Worms by arbitrary mathematical rules; yet as they may be of some practical use to the culturist, in ascertaining the amount of food necessary to be provided for his family of Worms, we give them, in brief extracts, from the manual published by authority of Congress in 1828. In doing this, we shall give the amount prescribed, on each consecutive day of their life, without regard to the day of their respective ages.

1*st day.*—The first day after coming forth, and the distribution of the Silk Worms, they should be given in four meals, about three pounds three quarters of single soft leaves, chopped very small, dividing the time, so as to allow six hours between each meal; giving the smallest quantity for the first feeding, and gradually increasing the quantity at each meal.

2*d day.*—On this day, about six pounds will be

needed, chopped very small. This will suffice for the four regular meals, the first of which should be the least, increasing them as they proceed, as was done in the meals of the first day.

3d day—This day, twelve pounds soft leaves, chopped very small, will be required for the four meals. The Worms will now feed with avidity.

4th day.—This day, six pounds twelve ounces of chopped leaves should be given. For the quantity should be diminished, as the appetite increases. The first meal should be of about two pounds four ounces and the other meals should decrease in proportion as the quantity of leaves given before, appears not to have been thoroughly eaten.

5th day.—This day, one pound and a half of young leaves, chopped small, will be about sufficient. They should be scattered very lightly several times in the day, on the sheets of paper, where there appears still to be Worms feeding. Should the Worms have left off feeding, it would be unnecessary to distribute any further quantity. Towards the end of this day, the Worms are torpid; a few begin to revive.

6th day.—For this day, will be needed nine pounds of tender shoots, and nine pounds of Mulberry leaves, well picked, and chopped small.

7th day.—This day, will be required about thirty pounds of chopped leaves. This quantity, divided into four portions, should be given at intervals of six hours, the two first meals less plentiful than the two remaining.

8th day.—This day, thirty three pounds of chopped leaves, well picked, will be necessary, and this time the two first meals should be the largest.

9th day.—This day, only nine pounds of picked

leaves, chopped small, will be required. The Worms sink into torpor, and the next day, they will have cast their skins.

10*th day.*—This day, fifteen pounds of the small shoots, will be necessary, and equally as much of the picked leaves, chopped rather less than hitherto.

11*th day.*—This day, ninety pounds of leaves, chopped, will be needed. The two first meals, the least copious, because towards the close of the day, the Worms grow voraciously hungry.

12*th day.*—This day, there should be given ninety seven pounds of picked leaves, chopped, divided into four meals—the three first meals the most plentiful. Towards evening the hunger of the Worm decreases; consequently the last, should be the least meal.

13*th day.*—This day, about fifty two pounds and a half of chopped leaves, will be sufficient. The decrease of food is in consequence of the diminution of appetite. They should have four meals, the largest first; and the last the least meal. Those only that seem to require it, should be fed.

14*th day.*—This day, twenty seven pounds of picked leaves, chopped. will be about the quantity; if not enough, more may be added; if too much, less given.

15*th day.*—On this day, the Worms begin to rouse, and thus accomplish the third age. The general view of this age presents the following result. In six days the Worm goes through its third age. In this age, those Worms proceeding from five ounces of eggs, have consumed nearly three hundred pounds of leaves and young shoots.

16*th day.*—On this day, thirty seven and a half pounds of the young shoots will be needed, and sixty

pounds of picked leaves, coarsely chopped with a large blade.

17*th day.*—For this day, will be wanted one hundred and sixty five pounds of sorted leaves; a little cut. The two first meals ought to be the lightest; the last most copious.

18*th day.*—For this day, will be needed two hundred and twenty five pounds of sorted leaves, a little cut. The two first meals ought to be the most plentiful; the last meal to be about seventy five pounds.

19*th day.*—This day, the distribution of the cut leaves should be two hundred and fifty five pounds; the three first meals of about seventy five pounds each—the fourth of forty five pounds only.

20*th day.*—No more than one hundred and twenty eight pounds of picked leaves, will be needed this day; because the Worm's hunger diminishes much. The first meal should be the most considerable.

21*st day.*—Thirty five pounds of picked leaves, are enough for this day. It is easy to find out when and in what quantities, the Worms need feed.

22*d day.*—The Worms rouse in this day and accomplish their fourth age. In about seven days, the Worms have accomplished their fourth moulting and cast their skins. They have consumed in that period two hundred and seven pounds of leaves, for each ounce of eggs.

23*d day.*—Since the preceeding day, almost all the Worms must have accomplished their fourth moulting, or casting of skin, and be already roused.—The Worms proceeding from one ounce of eggs, in the fifth age, consume about 1,098 pounds of sorted, picked leaves, which makes the quantity of leaves required for the five ounces, to be 5,490 pounds weight.

24*th day.*—For this day, will be wanted two hundred and seventy pounds of leaves, sorted, divided into four feeds; the first which should be the least, of about fifty two pounds, and the last, which is the most plentiful, of ninety seven pounds.

25*th day.*—This day, the Worms will require about four hundred and twenty pounds of sorted leaves. The first feed should be of seventy seven pounds; the last feed should be the largest, and of about one hundred and twenty pounds.

26*th day.*—This day, the Worms will want five hundred and forty pounds weight of sorted leaves. The first feed should be of one hundred and twenty pounds and the last of one hundred and fifty.

27*th day.*—The Worms will this day, want eight hundred and ten pounds of picked leaves. The first feed of one hundred and fifty pounds, and the last meal of two hundred and ten pounds.

28*th day.*—This day, the Worms should have nine hundred and seventy five pounds of picked leaves, divided into five feeds; the last of which should be most plentiful.

29*th day.*—The Worms will require this day, nine hundred pounds of well sorted leaves. The first meal should be the largest, and those following should diminish. Should there be any intermediate meals wanted, they must be given as before.

30*th day.*—The Worms this day, must have six hundred and sixty pounds of well sorted leaves. The proportion of leaves must diminish as the appetite of the Worms decreases much. The food must, as usual, be divided into four messes. The largest meal given first, and gradually diminishing. The first meal should be two hundred and ten pounds.

31*st day.*—The Worms this day, need four hundred and ninety five pounds of leaves, which must be distributed as it may be wanted.

32*d day.*—This last day, they attain perfection, which may be ascertained by the following indications.

1st. When, on putting some leaves on the wickers, the insects get upon the leaves without eating them, and rear their heads as if in search of something else.

2nd. When, on looking at them horizontally, the light shines through them, and they appear of a whitish yellow transparent color.

3rd. When numbers of the Worms, which were fastened to the inside of the edges of the wickers, and straightened, now get upon the edges, and move slowly along, instinct urging them to seek change of place.

4th. When numbers of Worms leave the centre of the wickers and try to reach the edges, and crawl up upon them.

5th. When their rings draw in, and their greenish color changes to a deep golden hue.

6th. When their skins become wrinkled about the neck, and their bodies have more softness to the touch than heretofore, and feel like soft dough.

7th. When, in taking a Worm in the hand and looking through it, the whole body has assumed the transparency of a ripe yellow plum, When these signs appear in any of the Worms, every thing should be prepared for their rising, that those Worms which are ready to rise may not lose their strength and silk in seeking for the support they require.

This day, the two hundred and forty pounds of sorted leaves, which are still in reserve, should be given by degrees, and according to their wants. The little

appetite of the silk Worm, and their wish to rise upon the leaves, prove that, even were they given more food at one time, it would only add to the little which would become dirty, because this is the period at which they evacuate most. From this, it is better rather to stint them in each distribution. The hours of feeding cannot be fixed in this last day; it cannot even be known, whether there may not be required a small quantity of leaves for the following day.

In giving the foregoing estimates of the daily amount of food consumed, and directions for feeding, we must be understood as giving the estimates and directions of foreign culturists, and not our own.—They may be of some use to the American culturist in several points of light; but we cannot recommend a literal observance of them in this country. It will be noticed, that, on most of the days of feeding, the leaves are to be sorted and chopped. Chopping, in this country, is unnecessary, and sorting is never done, except in the early ages of the Worms, when they require tender leaves, The voluminous directions for feeding and rearing Worms, may all be summed up in the following—feed well, keep them clean anddry, and see that the cocoonery is well ventilated.

MAKING COCOONS.

The Worms having arrived to maturity, all that remains for them to do, is to make their cocoons; and to enable them to do this, they must be furnished with suitable accommodations for that purpose. Various plans have been contrived, but the method most commonly adopted, is to make them little arches, or cabins, of brushwood or broom corn. Several days before the time of rising, branches, with spreading

tops, of chesnut, hickory, oak, or birch, are to be procured and brought to the cocoonery. As soon as the Worms give indications of rising, these are set between the shelves, with their twigs upwards. They should be cut at proper lengths to press against the top of the bottom shelf and the bottom of the one next above it, in order that they may keep their places while the Worms are upon them. To prevent the Worms from falling off they should also stand considerably out of perpendicular. Broom corn is also used in the same manner. The arches or cabins being thus prepared the Worms readily climb them and make their cocoons.

At the end of twenty-four hours, after the commencement of rising, the principal part of the Worms will be found to have mounted. Should any remain, as they probably will, without any signs of a disposition to rise, they should be removed to another room of a little higher temperature, and furnished with brush or broom corn as aforesaid. This removal will generally cause some of them to rise immediately; others will eat and then rise, and so on till all will have risen. The Worms are three or four days in making their cocoons, and at the end of eight days, generally, all will have risen and completed their work.

GATHERING COCOONS.

In taking the cocoons from the brush care must be taken that they be not injured by either compressing them in the hand or mutilating them in detaching them from the bushes. In gathering them, begin on the lower shelf, and take them down gently, and pass them to those who are to gather the cocoons. Place

a basket between two of the gatherers, to receive the cocoons. Another person may receive the stripped bushes, which may be laid by for another year's use.

PRESERVING EGGS.

The cocoons selected for seed should be firm and of the largest size. After having stripped the floss from them, they should be strung together and hung up in a warm airy room or chamber, partially darkened. In about two weeks from winding, the moths will emerge from the cocoons. The male is known by its smaller size and continual fluttering of its wings. After having been paired and remained together during the day, they should be separated by the wings and the females placed upon sheets of paper where they will deposit their eggs. It is computed that one hundred females will produce an ounce of eggs and an ounce of eggs will produce forty thousand Silk Worms. The papers on which the eggs are deposited, should be rolled up and put in tight boxes and placed in a cool dry cellar where they will not freeze. If it is required to keep them late in the season for a second crop, it may be necessary to have recource to the ice house.

STIFLING THE WORM.

The next step in the process, is to stifle the Worm in such cocoons as are intended for sale, or reeling.—If this is omitted, the Worm will, in a week or two, eat out of the cocoon, which will destroy it. The Worms may be stifled in various ways, but the most convenient method is to expose them to the rays of the sun. Three or four hot days exposure in this

manner, for a few hours in the middle of the day, will generally destroy the life of the Worm.

Another method is to place them in an oven, moderately heated, or in the steam of boiling water. On this subject Mr. Cobb says:—"I have used the first method with success. The oven being moderately heated, the cocoons were spread out in oblong baskets, eight inches deep, in box covers, pans, &c. and permitted to remain in the oven half an hour." Mr. Smith, of Baltimore, speaking on this subject, says:—"I put the cocoons into a tight tin vessel with a cover, closely fitted, and put this vessel into another a little larger, containing such quantity of water as will nearly fill it. Fire is then applied and the water kept boiling half an hour or more, according to the size of the vessel, and until the cocoons in the inner vessel shall have become as hot as the boiling water. The cocoons are then spread out in a dry room, that the moisture may evaporate."

Another method of destroying the chrysalis, is by the use of alchohol. On this subject Mr. Williams, of Elm Hill, Roxbury, says:—"The first cocoons I raised were killed by putting them in a close tin kettle, after turning in a gill of high wines, throwing a net over to keep them from the alchohol, covering them close, and placing the kettle in the warm sun. The evaporation kills the chrysalis without staining the cocoons. The two last seasons, I have found New England Rum would answer the same end. By this process, the embryo seems not to exude any thing to stain its shroud, as it does by steaming and baking."

There are other methods of stifling the Worm; but as the foregoing are considered the most easy, convenient and effectual, we pass them unnoticed.

CURING COCOONS.

The next thing in order, is the preservation of the cocoons; for unless they are well cured and preserved, they will be reeled with difficulty and furnish but a small quantity of a very inferior quality of silk.—We have seen several lots of cocoons, the present season, that did not yield silk enough to pay the expense of reeling, on account of the manner in which they had been cured and preserved.

To preserve them, however, care, rather than skill, is necessary. After the Worm is destroyed, they ought to be spread in thin layers, on shelves, distributed into as many stories as the room, in which they are cured, will admit, say two or three feet apart, one above another, and turned every day. If they are spread too thick and left unstirred, they will be liable to mould, and be destroyed by moths. Cocoons put up damp and in large quantities, will contract additional moisture, and throw out an offensive odour, and in that condition are not worth reeling. Persons who intend to have good cocoons, and obtain a good price for them, should be particularly careful that they be preserved in good order.

TRANSPORTING COCOONS.

If the culturist disposes of the product of his Worms in the cocoon. as he ought always to do until he acquires the skill of reeling it well, he ought to take especial care that they be not damaged while on their way to the factory. As silk may be all but ruined in reeling, so cocoons may be much injured in transporting them to market. To avoid this, care should be

taken in handling and packing them, that they be not dented or flattened, as this will seriously damage them. They may be packed in tight boxes or barrels, and should be pressed together sufficient to prevent their shaking and chafing each other by the motion of the carriage in which they are conveyed; but not so hard as to alter their form by compression.

The cocoons and the boxes or barrels, designed for them, should be perfectly dry, otherwise they may contract mould, which would be injurious. Put up in this manner, they may be transported without injury, any distance either by land or water. If the journey be long, and made in an open carriage, the boxes, &c. should be covered with a tarpaulin or oil cloth, that they may not be exposed to rains or dews. The same is advisable where they are to be transported by water.

SUBSTITUTED FEED.

Though the foliage of the Mulberry, is the only natural aliment of Silk Worms, and the only substance on which they can advantageously make silk; yet there are various other plants, on the foliage of which they will feed and live. The more common, are the lettuce, rose, bramble, dandelion, hop, hemp and fig. It is also said, they will feed upon the leaves of the currant. The Worms may, therefore, be fed with these leaves, when the leaves of the Mulberry cannot be had, for the purpose of keeping them alive until they can be procured. It is supposed there is a resinous matter in the leaves of the Mulberry, which undergoing a change in the stomach of the Worm, enables it to make silk.

The transactions of the Society for the encourage-

ment of Arts, &c. contain many experiments on substituted feed, which throw some light on the subject, one or two of them may be both useful and interesting. We copy them from Lardner's Cabinet Cyclopœdia:—

"A letter from Miss Rhodes relates, that in the summer of 1785, she subsisted several thousand Worms entirely on lettuce leaves during three weeks, and that for the remaining short term of their lives she afforded them their natural food. At the end of a month from their first hatching, they began to spin, and eleven ounces of silk were procured from four thousand cocoons. After repeated trials, this lady had become convinced that Silk Worms could not safely be fed on lettuce leaves for a longer period than three weeks; as on persisting further in their use, the greater part of the Worms died without forming their cocoons. Some indeed, possessed sufficient vigor to spin and to produce perfect and well-formed balls, even when lettuce leaves had constituted their only food. Reasoning from this fact, Miss Rhodes was brought to suspect that the premature mortality of her brood was not altogether occasioned by the unwholesome nature of the aliment on which they had fed, but might be owing to some extraneous circumstance; and further observation led her to the conclusion that it was the coldness of the lettuce leaves, rather than any inherent property, which made them detrimental. This lady having thence suggested that if the Worms were kept in a higher temperature, they might be successfully supported through their lives on lettuce leaves, General Mordaunt caused a considerable number to be hatched and reared in hot houses. These were fed entirely on lettuce leaves; they

throve, and went through all their mutations as satisfatory as if fed with their natural nourishment; scarcely any among them died, and the number and quality of the cocoons that were gathered, proved the entire success of the experiment. If a solitary trial be sufficient to establish a fact, this must certainly be satisfactory to those who consider it desirable to naturalize Silk Worms in this country, where, owing to the inequality of seasons, the appearance of Mulberry leaves must always be uncertain in regard to time. Lettuce leaves have an advantage over other vegetables which have been offered as substitutes for the Mulberry, that they may be gathered in wet weather without themselves being wetted, as a lettuce, once cabbaged, resists the entrance of all moisture within; and the heart being always perfectly dry, insures nourishment to the Worm, free from that moisture which is always found to affect it injuriously.

"Mrs. Williams, an earlier correspondent of the Society whose "Transactions" have been quoted, gives a very minute and copious account of the various trials which she made, of vegetable substances as substitutes for Mulberry leaves. Having hatched her brood in severely cold weather, when even lettuces were not easily procurable, she offered to her Worms the tender parts of blackberry leaves and relates that the Worms ate them greedily. She next presented to them young leaves of the elm, and reports that equal success attended this trial; encouraged by these facts, she then succeeded in causing the insects to feed on the leaves and flowers of the sweet cowslip and primrose. But meanwhile the Mulberry had put forth its leaves, and having procured some of these for her brood, it was thenceforth vain to offer them

any other kinds of food; all were rejected; and another proof was afforded that the Mulberry tree, which no other insect will attack, is alone adapted to the natural desires of the Silk Worm. Mrs. Williams records one peculiarity which discovered itself throughout her investigation; by no means could the Worms be brought to touch any flower of roseate hue. Pinks, roses, sweet-williams, polyanthuses, were each in turn offered by this persevering lady, and were all rejected without hesitation. It is proper to remark, that these experiments of Mrs. Williams are not confirmed by those of any other person, but, on the contrary, that Miss Rhodes was unsuccessful in every endeavor to repeat them, and succeeded only in reconciling her Silk Worms to the use of lettuce and spinach.

"Attempts to discover a substitute for the Mulberry are not entirely abandoned even at the present time. It is recorded in the Bulletin Universal, for 1829, that Mademoiselle Coge of Epinal has used with success the leaves of the scorzonera (viper-grass) for the nourishment of Silk Worms. The silk produced by Worms fed on this leaf, is represented to be in no respect inferior to that from Worms kept on the natural food.

"Notwithstanding, however, this last announcement, and the partial success so frequently recorded as attending the substitution of the lettuce, all practical cultivators of silk continue to be convinced that it would be unprofitable to feed their Worms on any save their natural nourishment; and the most intelligent writers on the subject approve the practice of destroying, as useless, any Worms, which through ill management may be hatched before the Mulberry

tree has put forth leaves sufficient for their support. Recent attempts which have been made to rear Silk Worms in England, do not offer much encouragement to the pursuit, except as matter of amusement. Some pairs of silk stockings, of good quality, are to be seen in the gallery of "The National Repository," woven from silk of home production. The Worms which spun this, were reared by Mrs. Allen, of Wandsworth, the result of whose careful observations on this subject has been obtained.

"The difficulty of procuring a sufficient and continuous supply of proper food was the reason why this lady was obliged to relinquish a pursuit in which she had taken much pleasure for four successive years.

"Mrs. Allen's testimony strongly corroborates the necessity of extreme cleanliness in preserving the health of the Worms. The most scrupulous attention seems to have been paid by her to this particular, as well as to the dryness of the leaves, and the temperature of the apartment wherein the insects were reared and set to spin; and yet a very great mortality was always experienced among them, scarcely more than one in five of the Worms that were hatched, coming to maturity and forming their cocoons. Of these it required 1000 to furnish an ounce more.—The cocoons were gathered in eight days from their commencement, and in eight days more were wound off. No necessity hence arose for destroying the vitality of the insects to prevent their piercing the balls. The chrysalis being placed in bran, in due time became moths and produced eggs, each female furnishing between three and four hundred."

From the foregoing experiments, it will be seen that nothing has, as yet, been discovered, which can

be relied on as a substitute for the foliage of the Mulberry tree.

There may be other substances in the vegetable kingdom, which will enable them to perform the work assigned them by their Creator, but it would be gratifying a mere idle curiosity to attempt to discover them. The Mulberry is as easily cultivated as any other tree, shrub, or plant. And why should the culturist be speculating about a substitute, when he can without difficulty furnish in abundance, the food most congenial to their tastes and best adapted to their labor. It is like enquiring whether there is not some other vegetable that may be substituted for wheat and corn as bread stuff. As long as these grains are growed with little labor and in rich abundance, why should not man be contented with them? When a fine sirloin of beef is set before an epicure, he never stops to think whether something else eatable, but less palatable, would not satisfy hunger.

SUCCESSIVE CROPS.

The project of rearing successive families of Worms is engaging the attention of some culturists, and there is little doubt of its practicability in this climate.—The Mulberry renews its foliage in quick succession, and may be deprived of it two or three times during the season, without essentially injuring its constitution. In Tuscany they make two crops of silk annually; and the same may be done in this country. The two crops are obtained by the aid of a peculiar variety of the Silk Worm, commonly called the "Two crop Worm" or "White Worm." This Worm, hatched at the usual season of hatching, will make its cocoon, eat out and deposit its eggs; which may be again

hatched, the same season, and another cocoon produced.

There is no doubt of there being an advantage in making two crops in a year; and it is believed to be a good method to have several families of Worms, of different ages, at work at the same time, on account of the different states and stages of the foliage. But it must be left to further experiments to decide whether, after taking all things into consideration, a succession of crops is worthy the attention of the culturist.

To make a succession of crops, all that is necessary is to hatch the eggs in succession, with regular or irregular intervals, and feed in the ordinary manner. When this course is adopted, care must be taken that the eggs do not hatch until it is intended they should. To prevent this they must be kept in a cold cellar; and, if the weather be very warm, it may be necessary to deposit them in an ice house.

DETERIORATION OF SILK WORMS.

A superstitious notion formerly prevailed to a considerable extent, that the eggs of the Silk Worm must be changed every two or three years, to prevent the deterioration of the Worm. This notion, like many others of the same class, is at war with reason and science. The supposition that good cocoons after a few years, are no longer fit to produce good seed is ridiculously absurd. The time has gone by, when the idle and foolish theories of Buffon, Robertson, De Pauw and others, respecting the tendency of nature "to belittle" and degenerate every thing in the new world, are received as truths. Facts also have settled the question, that the Silk Worm will not degen-

erate, except as a consequence of neglect, or the long propagation of those of a diminutive size.

Though new varieties of the Silk Worm may not be obtainable, by selecting the largest and best cocoons for seed; yet it is believed the same variety may be improved in size and vigor and that, in this respect, it will be an object of importance with the culturist to make a careful and judicious selection.

Having carried the culturist through the various processes of making silk, from sowing the seed of the Mulberry, to the making of cocoons; it is believed, if the directions given, are carefully followed, he will meet with no insurmountable obstacle in the prosecution of this most profitable branch of rural economy. There are no more difficulties to be encountered in the cultivation of the Mulberry, than in the ordinary crops of corn or potatoes; and a farmer's wife and daughters may rear a family of Silk Worms with about the same ease and more certainty of success, then they do the young of their favorite geese and turkeys.

In giving directions, however, for the successful prosecution of silk growing, they must, from the nature of the subject, be general. It would be impossible to anticipate every thing that may take place in the various processes conducted by the most skilful and judicious culturist. Cases unprovided for and questions unanswered may, and doubtless will, present themselves in the course of operations—but like all other cases and questions on practical subjects, they must be refered to the decisions of sound judgment and discretion; and these, with the aid of a little experience, will almost invaribly be found correct.

The next process is to reel the silk from the cocoon in a suitable manner for the manufacturer, for in

its present state it is worthless; but this forms the third part of our subject, as originally proposed and in which full directions will be given. This is an important part of the business; but its apparent difficulties ought not to deter the culturist from acquiring it, as much of his profit is dependent upon it.

PART III.

REELING SILK.

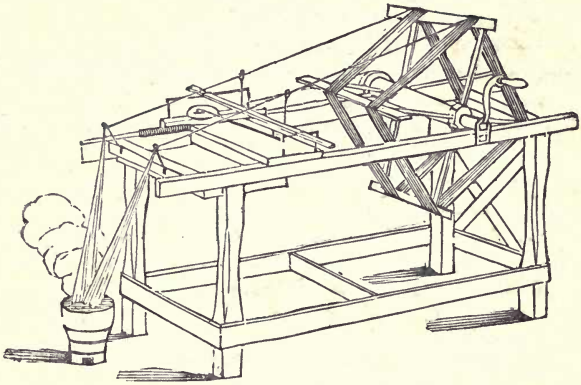
Every culturist ought to acquire the art of reeling silk, as it will afford him an additional profit on his labor, and at the same time diminish the expense and hazard of transporting his silk to market. The quality of silk depends materially upon the manner in which it is reeled, and its value is often increased or reduced, fifty per cent, by the skillfulness with which this operation is performed. This being the fact, the culturist will see the necessity of acquainting himself and family, as early as may be, with this delicate part of the silk process. Instruction from an experienced reeler, and directions from manufacturers, will doubtless be of much service to him; but after all, "practice" in reeling silk, as in every thing else, "makes perfect." We have known persons, with very little instruction, soon become skilful reelers, and among others, a lady in Litchfield County, whose name deserves to be mentioned, both in justice to herself, and as an encouragement to our fair countrywomen, to engage in this appropriate and profitable employment.

The lady to whom reference is had, is Mrs. Church, the wife of Samuel Church, Esq. of Bethlem. We have seen several specimens of the reeling of this lady

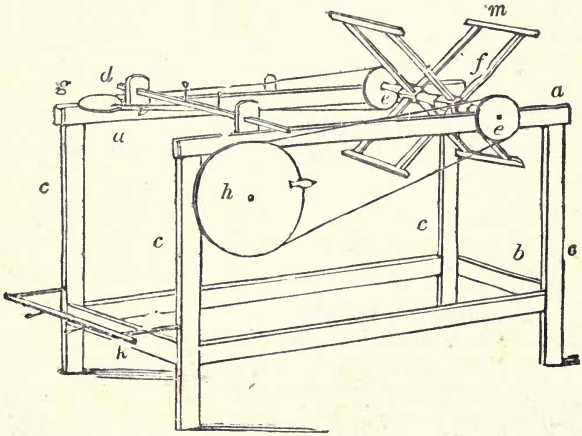
the present season, which we do not hesitate to pronounce equal to any foreign silk, we have ever seen. And what is most surprising, they are the results of some of her first attempts at reeling. We have too high an opinion of the intelligence and skill of American ladies, to believe they can be out done in reeling silk, by those of France or Italy, and we can but hope they will turn their attention to it, as a suitable object of female labor.

In order to acquire the art of reeling, the culturist must first furnish himself with an appropriate and well constructed silk reel. Several silk reels have been invented, and many of them perform their work admirably well. Among them we notice those of Mr. Cobb, of Dedham, Mr. Smith, of Baltimore, and Mr. Gay, of Lisbon. The Piedmontese reel, has also been extensively used, and for a time, was considered the best in use. It has however, of late years given place to those of the above mentioned gentlemen, which in some respects, are considered superior to it. The silk reel requires no complicated machinery, and is constructed at comparatively a trifling expense.

Mr. Dale has also made an improvement on Mr. Cobb's plan, by which half the labor is saved.



COBB'S REEL.



DALE'S REEL.

The first engraving, on the preceding page, represents the reel invented by Mr. Cobb. It has been thoroughly tested by experiment, and found by long use to answer the most sanguine expectations of the inventer.

The second engraving, represents a reel on the plan of Mr. Cobb, but geered in such manner that it may be conveniently turned by the person who attends the cocoon basin. This improvement, together with a considerable reduction in price, will render it a very desirable reel for use in small establishments and private families. It has been introduced into the Factory of the Connecticut Silk Manufacturing Company, and found to answer a good purpose. The expense of making a reel of this kind, need not exceed four or five dollars and can be done by a joiner or any other person acquainted with the use of tools.—As it may aid the workman in making them, we subjoin its dimensions.

Length of frame *a a* 3 feet 6 inches—width *b* 2 feet—height *c c c c* 3 feet—length of traverse bar *d* 2 feet 5 inches, with a lateral motion of 5 inches—diameter of band wheels *e e* 5 inches—length of reel arms, from centre of shaft *f* 13½ inches—diameter of horizontal band wheel which carries the traverse bar *g* 5½ inches—diameter of band wheel *h* 11 inches—length of sweep, from outer edge of band wheel to traverse bar *i* 13 inches—bar *k* which supports the lower rampins projects 8 inches from the frame—width of reel *m* 13 inches.

There are several other reels in use, but these will be found as simple as any that have been, or can be constructed. All have, or must have, the lateral motion, or they will not reel well.

SORTING COCOONS.

Before commencing the operation of reeling, the reeler should sort the cocoons and place them in separate parcels, according to their quality. The qualities of cocoons admit of five varieties and are known by the names of double cocoons—the *chiques* or skins—the fine—the demi-fine and the satin cocoons. The double cocoons are those in which two or three worms have worked and enclosed themselves together. They are larger than the single ones; the *chiques* or skin cocoons are softer and resist much less to pressure—the fine cocoons are those of which the surface presents a very fine and very close grain—the demi-fine are of a more loose and larger grain—the satin cocoons are those of a still inferior quality.—Though cocoons are not ordinarily so particularly sorted; yet when it is intended to reel silk of an extra nice fibre, it is desirable they should be.

Before reeling, they should also be cleaned from the floss and loose threads with which they are enveloped. This is done by having them picked off by children.

REELING.

The reeler, having prepared the cocoons as above directed, is now in readiness to commence reeling.—And here it is proper to state, that reeling may be done at any season, but best in dry weather, and that the softest water should also be chosen for soaking the cocoons.

The cocoons are to be put into a basin, or some other vessel of water, placed over a moderate fire in

a small furnace, raised to near a boiling heat. The precise degree of temperature cannot be determined until the reeling is begun, as different compositions of silk, require different degrees of heat in reeling. If on trial the water is found too hot or too cold, it may be varied by increasing the fire or adding cold water. If the water is too hot they furze out in unwinding. A little experience on this point, will enable the reeler to keep the water at the proper temperature.

The reeler having placed her basin of water on the furnace and provided herself with a small whisk of broom corn, or sharp twigs, she throws in a handful of cocoons and presses them under the water for two or three minutes, in order to soften the gum of the silk, and thereby loosen the ends of the filaments.—She then stirs the cocoons with the end of the whisk as lightly as possible, until one or more of the fibres adhere to it. She then lays aside the whisk and draws the fibre towards her until it comes off clean from the floss and the fine silk begins to appear.—She then breaks off the thread, and collecting the floss first taken off puts it aside. She then applies the whisk again, to get hold of the fine fibres. This operation is repeated until a sufficient number are collected to form a thread of the intended size. She then unites the fibres, and passing the thread through the guides, attaches it to one of the arms of the reel.—Another thread is in like manner to be prepared and passed through the other guides, and attached to the reel when two skeins are intended to be wound.

Both threads being fastened to the reel, it is turned with a regular but slow motion, until the threads are found to run freely, when it may be more rapidly turned. If it happens, as it often will, that some of

the ends which compose the thread are false, new ones must be added, to supply their deficiency, or the thread will be uneven and of little value, if not entirely worthless. This will also show the utility of putting in a few more cocoons than is intended to continue, as they will soon be reduced to the competent number. Crossing the threads is also recommended, though they are sometimes reeled uncrossed. If the cocoons are drawn up to the guides on the thread the motion of the reel must be slackened and they must be stroked down with the thumb and finger. During the reeling, the reeler must constantly add new fibres to each thread, as fast as she can find the ends. In order for this, the basin must be occasionally replenished with cocoons and care taken that they be wholly immersed in the water that they may be equally soaked. As fast as the cocoons are wound off, and such as wind only in part, they must be taken out of the water, otherwise they will injure the color, and lustre of the silk. The water must also be changed as soon as it becomes discolored.

A person unacquainted with reeling would naturally suppose that rapid revolutions of the reel, would overstrain and be liable to break the thread; but experience has proved the reverse to be true. It has been found that the thread never breaks in consequence of the rapidity with which the reel revolves, and that the silk reels better with a quick than a slow motion. The breaking of the fibres is owing to the imperfection of the cocoons, or to an improper regulation of the heat of the water, in which they are immersed. If the water is too hot, it will occasion burrs, which stop at the holes through which the thread passes and cause it to break. If it is too cold

the silk will not come off readily and consequently the thread will be broken.

In order to keep the water at the right temperature, without causing delay, the reeler should have cold water within reach, that may be quickly dashed in, should the water become too hot. In like manner, the reeler should be provided with chips, or shavings, that the fire may be suddenly quickened, should the water become too cold.

We might go on and fill pages with directions for reeling silk; but they would tend to perplex, rather than enlighten, the reeler on the subject. Silk reeling is an art, rather than a science; and must be acquired by experience and observation, and not by theorizing on it as an abstract subject. This being the fact, we consider a few plain practical directions, better calculated to perfect the reeler in the art, than instructions minutely drawn out in detail. The mystery of reeling silk seems to resolve itself into one simple operation—keeping the thread even as it passes from the cocoon to the reel; and this will easily be done when the attention of the reeler is particularly drawn to it.

RAW SILK.

Silk direct from the reel, is called raw silk, on account of its being in an unmanufactured state. It is ordinarily divided into three qualities, according to its fineness, and numbered one, two and three—the finest being number one. The fineness of silk is graduated by the fibres, taken from a given number of cocoons. This the reeler regulates according to the number of silk it is intended to reel.

DISBANDING SILK FROM THE REEL.

We have already spoken of the importance of good reeling; but in order to ensure a good article, care must be taken in disbanding the silk from the reel.—The single fibres of which the thread is composed, are liable to different degrees of stretching as they are wound from the cocoons. This, however, depends much upon the assorting of the cocoons—if they are well assorted, the degree of extension will be less than if poorly or carelessly assorted. Care in assorting, however, will not wholly overcome the difficulty, because some are necessarily longer in the water than others, and therefore yield their silk more readily. The weak latter ends of some cocoons, also wind off with the strong first part of others. The consequence of this is, the fibres are unequally stretched, and (if taken from the reel too suddenly,) those that are most stretched will contract the most and make a thread less compact and firm.

To remedy this, let the skein remain on the reel six or eight hours, or until it is dry and the different fibres brought to a more uniform degree of extension. This also gives the fibres an opportunity to unite more firmly. After the skein is completely dry and ready to be taken from the reel, squeeze it together all round, to loosen it upon the bars; and then with a thread, made of refuse silk, tie it in the places where it bore on the bars of the reel. It may then be slid off the reel, and ties should be made opposite to those first made. It should then be doubled, and tied near each extremity, and laid by for use or sale. When the skein is finished, a mark should be tied to the end

of the thread, otherwise it may mix with the threads of the skein and render it difficult to find it.

WASTE AND REFUSE SILK.

Though the culture of silk is among the most profitable branches of rural industry; yet prudence and economy must be observed, or the nett profits of a cocoonery will be materially diminished. The reeler should therefore take care that nothing, even of small value, is lost. In giving directions for the saving and manufacture of waste and refuse silk, we avail ourselves of the knowledge and experience of Mr. D' Homergue. He says:—"In winding off the silk from the cocoons, whether perfect or imperfect, the finest and best threads are not those which are first spun out; on the contrary, the first threads which come off the cocoon are coarse, uneven, and unfit for use in the silk manufactories, either of the stuffs, twist or sewing silk. This loose, furzy substance, which is about one-tenth part of the whole silk on the cocoon, is called in French *fleuret*, and in English *floss*, from the Latin *flos*, flower; a name which reminds us of *lucus a non lucendo*. As soon as the threads of silk in the process of reeling come out fine and regular, this floss is separated from them and put aside for use, as will be presently mentioned. To it are added all the threads which, either from some defect in the cocoons, or from the awkwardness of the women employed in the different operations of reeling, winding and doubling, either break off so as not to be easily united to the other threads, or come out uneven, or otherwise unfit for use; these are called the *waste silk*, and added to the *floss*, assume with it the same name. This mass, boiled in soap and water, after-

wards carded and spun on the spinning wheel, takes the name in French of *bourre de soie* or *filoselle.*—Boyer, in his dictionary, translates the word *filoselle* into English by *ferret silk* or *flurt silk.* This last name is evidently a corruption, or an English pronunciation of the French word *fleuret, floss silk.*

"This floss, ferret or flurt silk, by whatever name it may be called, is employed in making silk stockings, mittens, gloves, suspenders, night caps, and, in general, all kinds of silk hosiery. I have heard that the women of Connecticut knit silk stockings and mittens out of the silk which they extract from the cocoons. I shall speak of these also in their proper place.

"Thus nothing is lost or wasted of the precious material produced by the silk worm. I mean by those who understand the art of employing it. Otherwise, all experiments by those who are unskilled in the business cannot but be attended with considerable loss.

"There are then, six different kinds of silk, extracted from the cocoons by processes of various kinds, or which vary more or less from each other in the manner of using them, and all of which require not only skill and dexterity, but knowledge, acquired by long practice. I shall recapitulate them in their order, according to their different degrees of fineness.

1. Silk of the first quality, or singles.
2. Silk of the second quality, or organzine.
3. Silk of the third quality, or tram silk.
4. Sewing silk of the first and second quality.
5. Cordonnet, or twist of ditto.
6. Filoselle, or floss silk.

CLEANSING SILK.

Though cleansing silk, comes more appropriately within the province of the manufacturer, than the culturist, yet as the manufacture of sewing silk and twist may be profitably connected with the growing, we subjoin the method by which it is cleansed and prepared for dyeing.

Silk, as left by the worm, contains certain impurities which must be separated from it. especially, when it is intended for particular kinds of fabrics. Yellow silk contains gum, coloring matter, wax and an oil similar to the essential oils of many vegetables.—White silk also contains gum, wax and an oil slightly tinged with coloring matter, resembling the liquid in the chrysalis of the worm. By chemical experiments it has been ascertained that the amount of gum is from 23 to 24 per cent. It is dry, friable, and when pulverized, of a yellowish red color—soluble in water. The coloring matter is resinous; but exists in a very small proportion—supposed to be from $\frac{1}{55}$ to $\frac{1}{60}$ per cent. The wax is hard, but brittle and slightly colored. Its proportion is about one half per cent.—These substances affect the whiteness and flexibility of silk, and the process by which they are extracted is called "cleansing silk." It is also varied according to the nature and kind of the article for which it is designed.

These processes are called "ungumming," "sulphuring" and "aluming." Silk also intended to remain white, is boiled and gummed, while that intended for dyeing is boiled, but left ungummed, on the supposition that the gum has some affinity for the coloring matter with which it is to be incorporated.

UNGUMMING SILK.

The silk, intended for white, is made up into hanks, by running a thread around each hank, containing a number of skeins tied together. The hanks are then untied and several of them bound together in a bundle of convenient size. This is done that the silk may be handled without becoming entangled. The silk is then prepared for ungumming which is done by putting it in strong soap suds. For every hundred pounds of silk take thirty pounds of soap and dissolve it in water. Cutting it into small slices will facilitate its solution. Some dyers consider fifteen pounds of soap sufficient, and think more injures the lustre of the silk.

After the soap is dissolved, the kettle is filled up with fresh water, and placed over a moderate fire until it rises to the highest possible degree short of boiling heat—for should it boil it would injure the silk by making it flossy. When the bath, or suds, is ready, the hanks of silk are immersed in it, or such parts of them as the capacity of the kettle will admit, and suffered to remain until it is freed from the gum, which is determined by the whiteness and flexibility of the silk. This operation is repeated until all parts of the hank have been immersed. After the hanks have been ungummed, the soap and water is wrung out of them, and they are next to undergo a process which is called bagging.

BAGGING SILK.

To bag silk, bags of strong coarse linen are prepared. They are about fifteen inches wide, and four or five feet long, and closed at the ends with one side

left open. These bags are filled with hanks of silk, laid in lengthwise and sewed up with strong thread. These bags are put into a bath, or suds, prepared in the same manner, and with the same proportions as the former, and boiled for fifteen or twenty minutes. When the suds begin to boil over it must be checked by throwing in a little cold water. While it is boiling it must be stirred often to bring up to the surface such bags as are at the bottom of the kettle, or it will be liable to be burned. It will also produce more uniformity in boiling. This operation, it will be remembered, is to be performed when the silk is to be left white.

Silk intended for dyeing is boiled in the same manner, with this difference—the silk is continued boiling three or four hours, and the kettle occasionally filled up with water. For common colors twenty, instead of thirty pounds of soap are used in making the suds; but if intended to be dyed blue, iron grey, or other colors, thirty pounds is used.

After the silk is supposed to be thoroughly boiled, the bags are carefully taken out of the kettle, opened, and the silk examined. If any part remains unboiled, it must be put in and boiled again. This is ascertained by the yellow and a certain kind of slime on such parts as have not been boiled.

A more simple method of ungumming silk, has long been practised in Connecticut, and it will doubtless answer every purpose, provided measures are taken to prevent its becoming entangled. This method is to merely boil the silk in water saturated with a small quantity of soft soap; or the ley of common wood ashes.

SULPHURING SILK.

When it is desirable to give silk a peculiar firmness it is fumigated with brimstone. This process is called sulphuring, and is thus performed:—A high studded room or garret, without a fire place, but with doors and windows which may be thrown open at pleasure for ventilation, is chosen for the operation. The skeins of silk are hung on poles suspended from above by cords, at the height of seven or eight feet from the floor. For every hundred pounds of silk a pound and a half, or two pounds of roll brimstone is procured, placed in a chaffing dish, and set on fire. The doors and windows are then closed, as are also all crevices through which the fumes of the brimstone might escape. In this situation it is left for twelve or fifteen hours, generally through one night, when the doors and windows are opened. When the room is sufficiently ventilated to admit of going into it, the silk is taken down. The process is sometimes repeated on silk designed for some uses, particularly azure whites.

ALUMING SILK.

When silk is to be dyed, it sometimes undergoes a process which is called "aluming" which is thus performed. A solution of alum water is first prepared by dissolving forty or fifty pounds of alum, in forty or fifty buckets full of soft water, or in about the proportion of a pound to a bucket full of water. The alum is dissolved in hot water, and then poured into the tub, or other vessel, containing the cold water. In doing this, care must be taken to stir it briskly, so

that it may mix; otherwise the coldness of the water might produce a chrystalization or congelation, as it is termed by dyers.

The skeins of silk, after being washed and freed of the soap by beetling, are strung together by a cord, care being taken that the hanks be not too much rolled up, or folded one upon another, and steeped in the alum water, for eight or ten hours. They are then washed and wrung with the hands, over the tub that the alum water may not be lost. They are then rinsed in clean water and beetled again when necessary.

In aluming silk, especial care must be taken, that the skeins are not put into the alum water until it is cold, as a warm solution would destroy the lustre of the silk. When large quantities are alumed, it will be necessary to replenish the water with alum occasionally, or the solution will become too weak, to sufficiently saturate the silk.

In performing this process, particular care should be taken, that the alum used, be of the first quality.—It is often combined with iron, which renders it worthless for the dyer. It is, however, easily detected by dissolving a small piece of it in distilled or rain water, and adding a few drops of a solution of prussiate of potash. If it be a combination of alum and iron, a blue precipitate will immediately take place.

MANUFACTURE OF SILK.

We have now arrived at that stage in the business, where the operations of the culturist cease, and those of the manufacturer begin—indeed, such was the fact when the silk was disbanded from the reel, the subsequent processes of ungumming &c. being the first

steps in the process of manufacture. The culture and manufacture of silk in all countries, has been kept distinct and prosecuted by men of different situations and pursuits—the former being growers of the raw material, and the latter manufacturers of the almost infinite variety of fabrics, of which silk forms the whole or a component part.

The imaginary impossibility of manufacturing silk in this country, especially the finer and more delicate fabrics, has hitherto prevented skilful and enterprising agriculturists from engaging in its cultivation on a large and profitable scale. It has been supposed that American ingenuity was inadequate to the production of those fanciful and beautiful textures, which are considered so essential to the elegance and perfection of female dress, and that we must forever be dependent on the skill and ingenuity of India and Europe for their fabrication. Though the inventive genius of American Manufacturers, and particularly the Yankees, has long been proverbial, yet they have hitherto, by common consent, accorded to their foreign brethren a decided superiority in the manufacture of silk. It has also been supposed that European and India fabrics were constructed by aid of expensive and complex machinery without which they could not be manufactured. It is true European ingenuity has invented labor saving machines, by which her manufacturers are enabled to compete with the native skill of China: but after all, the patient and persevering Indian succeeds in the manufacture of fabrics, which, for delicacy of texture, cannot be rivalled by the European, aided by the labors of the most scientific machinist.

Silk looms in Europe, are of the most simple con-

struction, but when contrasted with the contrivances in India would seem to give them a decided advantage. In India the weaver weaves his web in the open air. He first selects a station for his operations, generally under a tree, that its foliage may protect him from the scorching rays of the sun. He then extends the threads which compose the warp of his intended fabric lengthwise, between two bamboo rollers, which are fastened to the ground by means of wooden pins. He then digs a hole in the earth large and deep enough to contain his legs in a sitting posture. He next attaches to a limb of the tree the cords by which his harness is to be operated, and to the lower shafts of the harness cords with loops of sufficient size to admit the insertion of his great toes. With his web thus arranged, he is prepared to commence weaving. This he does by putting his toe into the loop of the cord attached to that part of the harness which he wishes to tread down, and then with a shuttle introduces the woof and beats up by striking the threads of the woof with the shuttle instead of a batten. The shuttle is in the form of a netting needle, and longer than the breadth of the web. With this rude apparatus he manufactures a fabric of which an Italian silk weaver would be proud.

If the silk manufacture in China is so simple and so easily performed, without the aid of complicated machinery, can it not be successfully and profitably prosecuted in a country abounding in machinists, with ingenuity to invent and skill to execute the most perfect machinery in the world?

PART IV.

MANUFACTURE OF SEWING SILK AND TWIST.

The vast consumption of sewing silk and twist, in this country, will ever make it a profitable branch of silk manufacture, not only in silk factories, but in the families of silk growers. For many years after the culture of silk was introduced in Mansfield, the whole crop growed on the farm, was manufactured, by the wife and daughters of the grower, into sewing silk and twist, and sold at high advances, while the labor bestowed upon it, was comparatively of small consequence. The Mansfield silk and twist, was long manufactured without the aid of machinery, other than the common reel and spinning wheel, and though it was not carried to that degree of perfection to which it has since arrived; yet very good articles were made, which were readily sold at a fair price.

The stock, which has heretofore been manufactured into sewing silk and twist, in Connecticut, is directly the reverse of that used for the same purpose in Italy and other foreign countries. Here, the best quality has invariably been selected; there, it is manufactured into fabrics, while that of an inferior quality is worked up into thread and twist, or cordonnet, as it is there called. It ought, however, to be stated

that foreign sewing silk is of two kinds—one for sewing silk stuffs, and the other for woolens, cottons, &c. and that the foregoing remark applies to the second kind, the first being made of the first quality of the raw material.

Though the Connecticut sewing silks, of domestic manufacture, have afforded the grower a fair compensation for the labor bestowed upon them; yet, they have never been able to compete with foreign manufacturers of the article—so far from this the fact has been, that foreign silk well reeled, has commanded a higher price in its raw, than the Connecticut, in its manufactured state. This shows the importance of good reeling and wherein the superiority of foreign silk consists. The silk from which the foreign article is made, is reeled upon the Piedmontese reel, whose lateral motion prevents the fibres of silk from becoming united by the gummy substance which they contain, and which would otherwise be unavoidable. We have now, not only the Piedmontese reel, but several others, which are considered by all equal, and by many preferable, so that the only difficulty in the way of making sewing silk and twist equal to foreign, seems to be entirely removed.

Sewing silk and twist is manufactured in three different methods—in silk factories, where various kinds of machinery are used—in families by the aid of Brooks' Patent Silk Spinning Machine, and by reeling on a common reel and spinning on a common wheel. In factories the silk is first reeled on the Piedmontese or some other approved reel, and then wound upon bobbins by means of a piece of machinery, called a winding frame. The machine is so constructed that the silk passes from swifts over glass

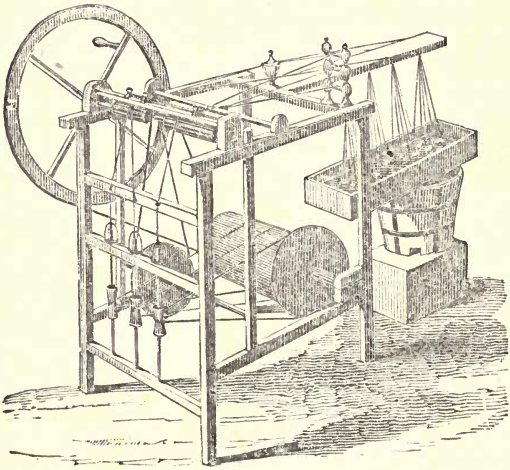
rods, and is distributed on the bobbin by a traverse motion. It is next cleared of knobs and husks by another machine, so constructed that the silk passes through holes in two plates of iron, over a glass rod and on to another bobbin. The silk is next spun single on a spinning frame, so constructed that the spindles turn 1800 times in a minute, and may be so regulated as to make any given number of twists in an inch.

The next process in order is tramming, or, in more familiar language, doubling the silk. This is done on a machine so constructed that the silk may be doubled any number of times required to make a coarse or fine thread. After tramming, it is throwsted, or, as it is commonly called, twisted. This also is done on a machine constructed in such manner that any given number of twists may be made in an inch. The twist is then set by steaming. This is done by submitting the silk, while on the reels as it comes from the throwsting machine, to the action of steam. The steam is generated in a tin vessel over a cylindrical stove, and passed into a receiver by a leaden pipe. It is then ungummed by boiling in soap and water. Having carried it through these several processes the silk is ready for dyeing.

After dyeing, the silk goes through another process called "soft silk winding," the object of which is merely to get the silk from the skeins to the bobbins. It is then prepared for the weaver, and, if of the proper size and twist, makes good sewing silk.

The foregoing is the manner in which Mr. Cobb, of Dedham, manufactures silk with the machinery which he has in his factory. Some of his machinery is from English patterns, and some of American in-

vention. Within a few years past, silk machinery has been much improved in this country, and the community are much indebted to Messrs. Gay and Moseley, two ingenious machinists, of Lisbon, Connecticut, for the degree of perfection to which it has arrived.



BROOKS' SPINNING MACHINE.

Mr. Amos Brooks, of Scituate, Mass., has invented a very useful machine for taking the silk from the cocoon and manufacturing it into sewing silk, at one operation. The foregoing engraving representing the machine in operation, and the following description of it, we copy from the Complete Farmer, a valuable agricultural work, published at Boston.

"Brooks' Silk Spinning and Reeling Machine, which was invented by himself, is found to be a very simple and easy operating machine, and yet one of the most perfect that has been invented for the purpose of reeling and twisting silk from the cocoons, and manufacturing it into sewing silk. By the different arrangements of this machine, it will operate upon a single or double thread, as may be required, and prepare it for twisting or weaving. Experience has fully proved, that by uniting the filaments of silk as they are drawn from the cocoons, wet in their natural glutinous substance, before they dry, the thread is more firm, smooth and strong. The simplicity of the machine, and the very easy way in which it is used, bring it within the comprehension and capacity of any person to use it. Mr. Brooks has received a premium for his invention from several societies, and of late a premium and medal from Scott's legacy, in Philadelphia."

The inventor, in a letter to the editor of the New York Farmer, in speaking of the machine, says:—"I do not reel it all before it is twisted into warp or filling, or doubled and twisted into sewing silk, or for other uses, of any size or twist that may be wanted—perfectly even, firm, smooth and strong, as any that can be produced from any part of the world."

The above described machine will be found worthy the attention of farmers who engage in the culture of silk, and who intend to manufacture it into sewing silk and twist. They can be made with any number of spindles ordered, and at an expense within the means of culturists on the smallest scale. The cost of an ordinary machine is from $20 to $30. Mr. Brooks has taken out a patent for his invention.

Sewing silk is also manufactured in Connecticut, in private families without the aid of machinery. It was formerly reeled on the common reel; but this has of late given place to some of the improved reels heretofore described, and a much better article is made. Mr. Cobb thus describes the process of making silk in families after it is reeled from the cocoon: "It is immersed for a few moments in boiling water, taken out, put on swifts and spun or twisted on a common woolen wheel, beginning at the large end of the piece, that is the end which was reeled first; and when it becomes small, which is the case when one half or two thirds is run off, the small end of another piece is added to it, and thus they are twisted together. It is then spooled directly off the spindle, a sufficient number of spools is put into a small spool frame to make a thread of proper size, which is twisted again while it is moist. It is reeled again, and cleansed by boiling in strong suds for three hours, then dried and colored. Undergoing this process it shrinks about one half in weight; after this, for sewing silk, it is doubled, twisted and reeled on a reel two yards long, and is divided into skeins of twenty threads each, as the statute of the State requires. If it be calculated for twist, it is made three threaded, twisted and done up into sticks with a small hand machine, and is then ready for market."

The Silk Manual, prepared by order of Congress, and published in 1828, contains the following communication, to the Secretary of the Treasury, from Daniel Bulkley, Esq., of Hampton, Connecticut, in which the manner of manufacturing sewing silk and twist, at that time, is described. Since that time, some improvements have been made; but the process in families is substantially the same.

"The raw silk is first spooled on bobbins, the number of which is in proportion to the size of the intended thread from the first spinning; and to facilitate the operation, they are put into warm water. The silk is again spooled, taking two or three bobbins, according to the size of the intended thread. After being spun, it is reeled into skeins, each forty yards in length, or half a knot of the country reel, as required by the law of the State. About twenty-five of these skeins are put together, like a skein of cotton or woolen yarn. They are then boiled, adding a small quantity of soft soap, or ley of wood ashes, to cleanse them from the gum. They are then ready for dyeing.

"Silk twist is spun in the same manner, except that it is always of three cords. The winding of twist is done on a machine imported from England.

"We have a small establishment for spinning by water, with a machine similar to a throstle frame of a cotton mill. The silk is first spooled by hand, on bobbins which are placed on the top of the frame; the thread of raw silk passing from it under a line, through a trough of water, then through rollers to the spindle. A single frame may contain from thirty to fifty spindles, and can be attended by one person. The doubling and twisting may be done on the same frame, at the same time, by giving the bands to a part of the spindles a contrary direction. As many threads are put to a spindle as are required to make a thread of two or three cords. Silk, spun in this way, is far superior to that done by hand. The machine will spin from two to three pounds in a day. A pound of silk, after being spun and cleansed, will weigh about ten ounces, and form one hundred and seventy skeins; the threads of sufficient size to sew woolens. If spun

fine, it will make more. It increases little or nothing in weight when dyed. Silk is sold by the skein; one hundred of which will measure one third more than half a pound of Italian or English silk of the same sized threads. One woman can make from twelve to fifteen pounds of raw silk, in a season of six weeks."

DYEING SILK.

It will not be expected that a treatise on the culture of silk will contain full directions and recipes for dyeing the almost endless variety of colors of which silk is susceptible of taking. A few, however, for making the more common colors of silk and twist are subjoined. They are taken from the manual prepared by order of Congress, in which full directions for making most fancy colors, may be found, should the culturist have occasion to make them.

BLACK.

"The silk being cleansed, is to be bleached by being sulphured, or rather to be steeped in water charged with sulphurous acid, then washed, and passed through water in which a small quantity of soap has been dissolved; then take three-fourths of the weight of silk, of gall-nuts, make a strong decoction of them, and boil the silk therein for a short time: let it remain in the vat for thirty-six hours, then wash and wring it. The silk is so saturated with tannin, that 100 lbs. of silk, thus galled, will weigh 125 lbs. Put in the bath copperas and gum, according to the quantity to be dyed, heat it, dip the silk therein, and, when deeply black, put it in a trough of cold water, in which it is to be turned on a cylinder; then pass it through

cold soap suds. As the price of Aleppo galls is high, white galls are often used, in the proportion of eight or ten parts of nuts to two parts of Aleppo galls.—Dyers have a cauldron on purpose for black, and when the dyeing composition is exhausted, they renew it by what they call a brevet, (refresher.) When the deposite is considerable, it is taken out, and iron filings added to the liquid. The dyeing of the silk is finished by heating the cauldron containing the dye, and stirring it, from time to time, to prevent the sediment from heating too much.

"The liquor must not boil; add more or less gum and iron solution; and, when the gum is dissolved, and the liquid nearly boils, it is left for one hour, the silk, divided into three portions, is then immersed; each portion in succession. The silk is lightly wrung three times, and aired each time. The great point of this operation is to press out the liquor with which the silk is impregnated; and, when it is drained, to fill it again therewith; and, above all, to expose it to the air, which deepens the color. After each portion of silk has been wrung three times, the vat is to be heated and more gum and copperas added as at first.—The reheating of the vat is called giving a fire. Two fires are commonly given for a light black, and three for a deep dye; and sometimes the silk is left in the vat, after the last fire, for twelve hours. Commonly, thirty kilogrammes [a kilogramme is 2 lbs. 3 oz. 5 drachms, avoirdupois,] of silk are dyed in one operation.

"This is technically called a heat. If half that quantity is dyed, only one fire is required for a light black. The dyeing being finished, the silk is rinsed on the rods according to art.

"When the silk is dyed, it must be softened, by immersing it for a quarter of an hour in a solution of soap in water, in the proportion of from two, to three pounds of soap, to one hundred of silk. The quantity of water is not mentioned. It is afterwards wrung and dried."

BEST BLUE.

"Take filings of copper, free from alloy of other metals, and put them into a glass vessel, and then pour upon them muriatic acid, sufficient to cover them twice as deep as the space they occupy. Let them stand for the space of twenty-four hours, or as long as necessary, for the muriatic acid to attain a blue or deep green color. Then pour off the clear part of the colored muriatic acid into another glass vessel, and add fresh muriatic acid to the copper filings, and continue this process until the whole of the copper filings have been dissolved, when nothing but the earthy and impure parts will remain.

"Mix all these several blue or deep green colored solutions of copper, and add thereto as much spirits of ammonia, as will saturate the mixture. The silk is then to be moistened with warm water, care being taken that all parts be completely and equally soaked in the water, and wrung out. It is then to be steeped in the blue tincture, prepared as above directed, and occasionally stirred, until it takes a handsome ultramarine color. It must then be wrung, rinsed in a running stream and dried in the shade. This makes a beautiful blue, but cannot be called a fast color, as exposure to the sun will give it a greenish tint.

DARK BLUE.

"Powder very finely, and sift one and a half ounces of indigo, and put three-quarters of a pound of oil of vitriol in a stone jar; add the pulverized indigo to it, stir the whole well with an earthern pipe stem, or some similar earthern article, and continue the stirring until the oil of vitriol ceases to ferment; the mixture having become quiet, set it by for the space of twenty-four hours; at the expiration of this time, a little water must be added, and the whole matter stirred again, by which it will receive, as it were, new life and vigor; after which, it must be set away undisturbed, until it is to be applied to the dyeing of the silk. After this, prepare a kettle with eight buckets of water, put into it one and a quarter pounds of alum, and dissolve it completely therein. This being done, pour the solution into a pail, steep the silk in the solution, and work it well therein for an hour; after which, take it out, wring it, and lay it by, in its wet state, for further use.

"This being done, put eight buckets of water in a kettle, pour the solution of indigo into it, and mix it well by stirring; work the silk well in this blue liquor for the space of half an hour, then take it out, rinse it in running water, wring it, and lay it by, in its wet state, for further use. By this process, the silk will receive a handsome light blue color.

"To deepen this blue, or to change it to a dark blue, proceed in the following manner: Take a kettle with sixteen buckets of water, and bring it to a boiling state; then put into it four pounds of logwood, and boil it well for about three-quarters of an hour; then take out one half of the liquor, and run it through

a sieve into a tub; let the other half, or eight buckets of the same, remain in the kettle for further use; put into the liquor in the tub, a quarter of a pound of alum, which has previously been dissolved in some vessel; stir the whole well, steep the light blue silk in it, and work it well in the liquor a quarter of an hour; then take it out, wring it, and keep it, in its wet state, for further use, and throw out the liquor as useless.

"Lastly: pour into another vat the remaining eight buckets of the logwood liquor left in the kettle, after having first run it through a seive; steep the silk in the liquor, and work it well therein for the space of half an hour; then take it out, rinse it in running water, wring and dry it. By the above process, you will obtain a dark blue, in every respect equal to any of the blues which have been colored by means of the keep.

"The above blue is likewise applicable to the dyeing of any other goods; and not alone in this respect, is it of advantage, but it likewise saves you the trouble and expense of preparing a keep for dyeing a small quantity of silk to a dark blue; and if the risk of missing a keep, and the consequent loss thereof be taken into consideration, the above receipt is of considerable advantage to the dyer as well as to the manufacturer; particularly as the smallest quantity may be colored, equal to the coloring of a keep, by reducing the ingredients in proportion to the quantity of the silk, which is to be dyed."

PRODUCT OF THE SILK WORM.

Various estimates have been made of the silk produced by a given number of worms; but it depends essentially upon the amount and quality of the food

consumed, and the care and cleanliness with which they are attended. That is, they will make more and better silk if they have been well fed and carefully attended, than if they have been stinted in their food and suffered to remain in their filth.

In the early settlements of Georgia, cocoons were made of an uncommon weight. There were instances when two hundred weighed a pound avoirdupois; and Mrs Davenport made some, under the direction of Mr. Cobb, two hundred and six of which made a pound. M. Bonafous averages them at two hundred and fifty six to the pound, and a Mr. Basti of Pennsylvania, made a quantity which required three hundred and six to the pound. Mr. D'Homergue fed worms from Carolina, and also from France, the former made cocoons which required three hundred and thirty seven to the pound, and the latter three hundred and eighty seven.

Count de Hazzi calculates that from seven to ten pounds of cocoons will make a pound of reeled silk. In France, twelve pounds have been required, while two thirds of that weight have given a pound of silk in this country. Mr. Cobb reeled from 8000 cocoons three pounds, including floss.

A large yield has been obtained from a lot produced the past season, by Mr. Lyman Atwater, of New Haven, and reeled at the factory of the Connecticut Silk Manufacturing Company, in Hartford. From the books of the company, it appears that from thirty-four and a quarter pounds of cocoons, nine pounds and three ounces of which were damaged, six and three-fourths pounds of silk were reeled. By this statement, it will be seen that five pounds of cocoons yielded about a pound of reeled silk. This, however, is a

very extraordinary yield, and must be considered altogether more than an average product. Part of the silk was reeled on Mr. Cobb's, and part on Mr. Dale's reel, by Miss Ann M. Benton, of Windsor, a very careful and skilful reeler.

Cocoons are, ordinarily, sold by the bushel; and a bushel is estimated to contain from 2500 to 3000, according to their size. But as it is difficult to ascertain their accurate measure, it is generally commuted for weight, eight pounds being considered a bushel.

PROFIT OF THE SILK WORM.

With respect to the profit which may be derived from the culture of silk, much might be said and many estimates made, demonstrating the fact of its being a prolific source of wealth; but it has always been the studious endeavor of the writer, both in his private correspondence, and his editorial articles, in "The Silk Culturist," to stop short of the truth. He is aware that the silk enterprize is an exciting subject —that farmers, who have not been accustomed to realize large incomes from their lands and labor, may be worked up into enthusiasm, in view of sudden wealth—and that by far the greater part of mankind, are prone to indulge in "air castle building," always to their detriment, and often to their ruin.

To guard against these evils, which he is determined shall not be brought upon the community through his instrumentality, he has always taken the lowest estimates of product and profit, as the basis of his calculations, considering these amply sufficient to induce rational and cautious men, to try the experiment.

He is aware of the various estimates which have been made by practical culturists, and is fully satis-

fied that most of them are erroneous in their results. By this, he does not mean that the gentlemen who have made them, have intended to mislead the public; but that they have misjudged with respect to a fair average crop. Some of these estimates are manifestly extravagantly high; while others are, equally as manifest, below the truth. Were the medium, between the two extremes taken, it is believed it would be as near an approximation to the truth, as the present imperfect state of the business will admit. Taking this, then, as correct data, the conclusion would be, that from $125 to $150 nett profit may be expected from an acre of full grown trees, or covered with full grown hedges.

LABOR REQUIRED.

It is difficult to make accurate estimates of the labor required in feeding and attending a family of silk worms of a given number; as there are several circumstances which tend to increase or diminish it materially—such as the distance the foliage is from the cocoonery—the size of the trees and the quantity of their leaves—the variety of the tree, whether of the Chinese or Italian, &c. &c.

The following estimate, however, has been made by a correspondent of the New York Farmer, which may be regarded by the culturist as accurate as any thing he can find on the subject, short of actual experiment. "The labor required to attend 1,000,000 worms would be, the first week, two persons; for the second, four; for the third, eight; for the remaining two, fifteen or twenty." This will make an aggregate amount of 324 days, necessary for a family of that number. The same writer estimates the product

of this number, at 500 pounds, which, at present prices, cannot be estimated at less than $3 a pound, after deducting the expense of reeling.

If these statements are to be relied on, it will be easy to calculate the nett profit which may be expected from 1,000,000 worms. The gross profit being $1500, the expense of the labor is to be deducted. Calling this a dollar a day, which is the highest it can be called, it will amount to $324, which being deducted as aforesaid would leave a nett profit of $1176. But when the fact is taken into consideration that most of the labor can be performed by boys, girls and aged women, its expense will be materially diminished, and the profit proportionably increased.

CONCLUSION.

In conclusion, we must say, that the culture and manufacture of silk in this country, is *yet* in its infancy, and improved methods of cultivating the Mulberry, rearing the Worms, &c. are constantly developing themselves through the result of experiments, which are monthly published in "THE SILK CULTURIST," a paper devoted to the subject. To such culturists, therefore, as are desirous of keeping themselves advised with regard to the progress of the silk enterprise, and possessed of all the information, in relation to it, as it discloses itself, it is recommended to become subscribers to that work, which is published at Hartford, Connecticut, by the Executive Committee of the Hartford County Silk Society, at a mere nominal price.

THE SILK CULTURIST,

AND FARMER'S MANUAL,

PUBLISHED MONTHLY BY THE EXECUTIVE COMMITTEE OF THE HARTFORD COUNTY SILK SOCIETY.

THE object of the publication is to disseminate a thorough knowledge of the cultivation of the Mulberry Tree in all its varieties; rearing Silk Worms; the production of Cocoons and Reeling Silk by the most approved method. The publication will contain a complete manual or directory from sowing the Seed to Reeling the Silk, together with such facts and experiments, as will enable Farmers to raise Silk, and prepare it for market, without further knowledge or assistance. It will also contain interesting matter on agricultural subjects in general.

THE CULTURIST was commenced in April, 1835, and there are now published five thousand copies monthly, with a rapidly increasing circulation. Arrangements have been made to furnish the first volume to those who make early application for the second. Each volume will contain ninety-six quarto pages. The terms are 50 cents a year, to be forwarded to F. G. COMSTOCK, Secretary, postage paid.

This publication has received the unsolicited notice of almost every respectable public print throughout the United States. From some of them the following are extracted.

It affords abundant evidence of the ability and judgment of the Committee for the performance of their duties; and while it will excite public attention to the advantages to be derived from the general introduction of the culture of Silk into our country, it will also afford the information necessary to enable such as are disposed to enter into it, to proceed understandingly.—*Genesee Farmer, Rochester, N. Y.*

We would suggest to gentlemen who can afford it, and who are zealous for the real improvement of our country, to procure instead of "Extra Globes" and "Extra Telegraphs," $5 worth of copies of this work, and distribute them among such of their acquaintances as will not otherwise be likely to

see, or even hear of the work—such as women, children, old persons, and others who have to maintain themselves by their industry, and are not capable of heavy or hard work.—*Farmer and Gardener, Baltimore.*

It is very handsomely printed on fine paper, and its great object, the promotion of the growth and manufacture of American Silk, is worthy of the attention of every man who would enrich either his country or himself.—*Providence Journal.*

Judging from the high source from which it eminates—the selection of subjects and their arrangement, (to say nothing of the first rate mechanical execution of the number before us,) we think it merits a rapid rise in the scale of popular favor.—*Methuen Falls (Mass.) Gazette.*

It gives a deal of valuable information on this subject at the cheap rate of 50 cents per annum.—*Franklin (Mass.) Mercury.*

We believe it is destined to promote the culture of Silk in this portion of the Union, where it is said the climate is peculiarly suited to that business.—*Patriot and Democrat, Hartford.*

We most heartily welcome to our table a new publication bearing the above title, emanating from the Hartford County (Ct.) Silk Society.—*Burlington (Vt.) Free Press.*

It contains a variety of information on the culture of Silk, and promises to be a valuable auxiliary to those who intend to turn their attention to this article.—*Herald, St. Augustine, Florida.*

We know of no work so well adapted to diffuse information and counsel on the subject, as the "Silk Culturist."—*New York Journal of Commerce.*

We have been perfectly astonished with the interest which this important subject has already excited throughout the United States, and with the amount of valuable information respecting the Worms and Mulberry, and the useful and curious historical details collected by the conductors of that excellent publication.—*New York Evening Star.*

To those engaged in the cultivation of the Mulberry, the instructions contained in this periodical must be highly valuable.—*Philadelphia Com. Herald.*

We conceive no work has yet appeared in the United States which affords as much general information upon the subject.—*Lancaster Journal.*