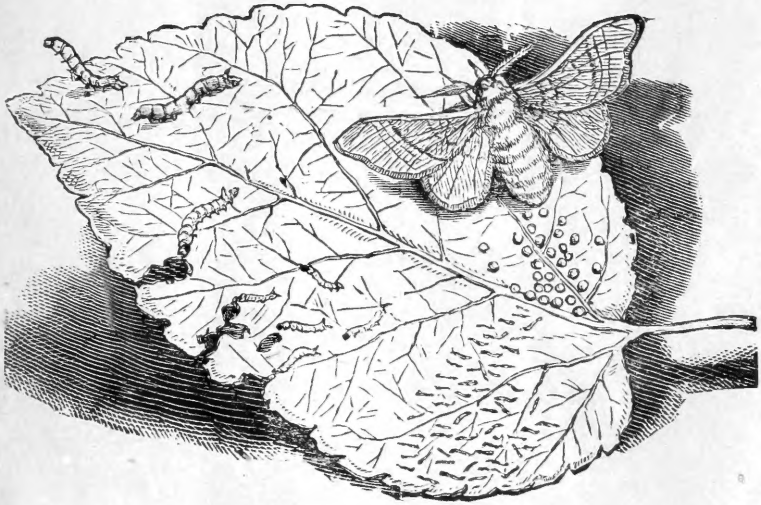
SILK FARMING.



—BY—

ELLEN CALL LONG.

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"Wherein there is no Man but may make his Paradise."

INTRODUCTORY.

THE use of silk in garments is known to have been adopted three centuries before the Christian era; how much earlier in the history of the world is uncertain. It seems coeval with civilization, and yet to-day in many parts of the world it is almost as new as of recent discovery. In reference to America, it is found that sericulture was introduced into Mexico with the Spanish conquest, and that Cortez, in his plan of government, appointed officials to take charge of the industry, and ordered the planting of mulberry trees, which fact is established by a case of litigation, arising subsequently, from an investigation of what had been done by the first board of auditors.

Among other items, one-quarter of an ounce of silkworm eggs is charged to have been sent by the crown of Spain for the introduction of silk culture into the newly achieved territory; whereupon it is proved that said quarter of an ounce was given to one party, who, though eminently successful, only returned two ounces of eggs to the government, yet sold a very large quantity for his own benefit, at prices ranging as high as sixty dollars per ounce: proving that at the start the culture was crippled by speculation on this Continent.

That one Oliver de Serres, in 1600, attracted the attention of Henry IV. to the value of Silk Culture to France, and the first favor asked and granted was that all *useless* trees be banished from the Royal gardens, and that the Mulberry be made to supply the

vacancies, and afterwards silkworm eggs and experts in raising them were imported from Italy for the purpose of instructing the people. Prime Minister SULLY grumbled, and to his remark that France was not made *for finery and trappings.* The good King HENRY replied: "*I would rather meet the King of Spain in three battles than fight the regulations of gentlemen of the gown.* Each *peasant ought to have daily a chicken in his pot, and it is only by plentiful resources that they can.*" Thus, HENRY introducing it, several sovereigns, down to Louis XV. devoted themselves to the encouragement of silk culture, spending millions in the project. Even now the government cherishes it, as much as three thousand francs having been offered in more recent years to those who should raise the greatest number of Mulberry trees, and heavy rewards to whom discovering a cure for the dreaded flacherie. And they have in France what we must have in this country, organized societies for instruction and demonstration of the work.

Then James of England and Scotland required of his subjects to plant the mulberry, with a view of raising silkworms; but it was nearly a century after Cortez had made the effort in Mexico that the same monarch ordered the planting of trees in the *American* Colonies, and he there essayed to enforce the silk industry by fine and premium. Missionaries, finding the production a wonder of nature, seized the mystery as a means of conversion, hoping thus to fill the Indian's mind with pious awe, but the shame of work with them outweighed every other consideration.

The *Huguenots* brought the culture to South Carolina, and even there manufactured silk. LAW (of South Sea Bubble fame) brought it to Mississippi, and in 1734–35 OGLETHORPE planted it in Georgia, and it is historical that he presented to QUEEN CAROLINE of England eight pounds of raw silk, from which CHARLES II. wore robe and hose at his coronation; and still later (in 1755) the PRINCESS DOWAGER and LORD CHESTERFIELD boasted of wearing American silk. QUEEN CHARLOTTE previously, on the King's birthday, appeared arrayed in the same. Premiums were bestowed and penalties enforced to fix the industry in the Colonies, for the Treasury of *England* complained that no foreign commodity more exhausted her Exchequer than the importation of raw silk to feed

her forty thousand silk manufactories. But neither royal favor, hope of reward or fear of punishment availed, for England paralyzed one hand by the arbitary use of the other, in sanctioning a charter to a joint stock company of London, privileged to take African negroes to the Colonies, which caused all other enterprise to be abandoned for that of cultivating tobacco.

There was a struggle, however, here and there, still to sustain silk culture, for in 1744 a filature had been established in Savannah, and silk from this quarter was quoted at two shillings above that imported from any other country, and this convenience of reducing the cocoon to silk thread encouraged its raising; but most unfortunately the filature was burned, consuming a large stock of raw material. Then followed the Revolution that made breadstuffs the first consideration; yet many women of the land continued to raise silk for their own use, mixing with it wool for home-spun garments but with peace came cotton, then the gin, whereupon followed the monarchy of slavery.

This is very much the history of silk culture in the United States, with spasmodic renewals here and there, but the want of a home market for the cocoons has been the great want at all periods; for though the manufacturers of silk goods have for a long time imported the raw material, and now as much in value as fifteen million dollars per annum, yet they claim that they cannot only buy the raw material cheaper abroad, but in two advanced stages of preparation for the loom beyond raw silk reeled in this country; in short, it is not raw silk at all that comes in free of duty, and this one advantage to the manufacturers is really what discourages silk culture in the United States; but this is only a matter of time to correct. Cheaper labor in Europe, say the manufacturers, will make it impossible to raise silk in this country on equal terms, but silk and its advocates do not propose to interfere with the labor of the country—*it is to the non-producers that it appeals or provides for.* Those that from sex or circumstances are removed from business centres are herewith recommended to a means of adding to other resources an increase of revenue just in proportion to the extent of outlay—not potential, but always equal to any investment of money or time, more certainly than any other agricultural pursuit

for the amount of time and money devoted. It is a field for that army of household martyrs who toil in the tread-mill of domestic wants; to them this industry opens a way for diversified interest, with return for labor bestowed. But let not these enter into it with wild expectations of sudden and embarrassing wealth, for disappointment will follow.

"The reports received from the different associations organized for the purpose of encouraging silk culture all tend to prove that the interest is spreading and operations extending, but the industry can only said to be in a *chrysalis* state, after spinning many threads of visionary and exaggerated notions of wealth; yet, notwithstanding, we do not doubt that time—with the aid of judicious management—will place it on a firm basis. The great obstacle to success so far is overweening confidence, accompanied with ignorance and the want of experience. In Europe, raising silk or cocoons is a hereditary education; children learn it from practical observation, and so generation succeeds generation in the knowledge of the work, but here, there are none to lead except in favored districts, consequently the results are discouraging and disappointing. To raise cocoons successfully demands very little physical strength, nor does it demand talent or skill of a high order, but it does demand intelligence, patience, perseverance and system, from which there shall not be the slighest relaxation. Every State should have an industrial school connected with its agriculturial department, by which this work can be properly set forth, through teachers, and until this is done there will be more or less ignorance at work, resulting, first in disgust and disappointment and finally in the abandonment of the work altogether. The industry was not established in Italy or France until Count Dandolo, and men like him, taught the skill to the people, and in China it was an emperor, assisted by his royal mate, that led in the work. So it must be in every new field. The people must be taught the difference between a good and an imperfect cocoon, and how to obtain the one and avoid the other, and this can only be done through instruction. Many have ventured into the work during the current year—1884—that will not do so again, because of the wide gap between their

expectations and the real returns—a gap wide enough upon reasonable grounds, but made the more distressing from a want of knowledge of the work undertaken; but whether "good or bad" cocoons be obtained as a result of personal efforts incidentally bestowed upon their production by experimentalists, they send them to market, demanding "my money" with as much confidence as if it were *gold* they had dug, seemingly never doubting the value of what is sent, but always deploring disappointment from lack of quantity forwarded; whereas, we regretingly learn that not one pound in ten received by the Home Association is worth the charges paid thereon by them in receiving the same. This result, however, is not to be attributed to any deficiency in the desired climatical conditions of our country, but entirely due to a want of knowledge on the part of incidental experimentalists as to the best way to raise good silk-covered cocoons, and until parties will take the trouble to learn the requisites of conducting the business systematically, there will continue to be disgust and disappointment in return for their improperly applied labors."—*Article written by Author for Silk Culturists.*

There are serious obstacles to be overcome, which perseverance can alone subdue, and thus place the industry on a footing with that of the old country. If ignorance on the subject among our people was not baffling, it would be amusing.

Some think the crop continuous, and seriously ask on what shall "we feed the worms in winter,"—one correspondent asks for a *pair of cocoons* to start the work; another orders trees and silkworm eggs at the same time; and some, fired by hope of sudden wealth, are ready to sell sewing machine and renounce the wash-tub for the new investment. So that really there is as much trouble in suppressing unnecessary enthusiasm as to excite a healthy interest in the enterprise. Of course, there must be blunders at the start, and there will be failures; but these average 90 per cent. in all enterprises, and possibly will not prove greater in silk-raising than other industries—but in no instance would I advise parties to undertake it on a large scale without experience and knowledge of the work in all its mysterious changes, which, though easily acquired, are manifold and important. In the capacity to favor silk, raising it, is as genial

as the air we breathe—flourishing in RUSSIA and SWEDEN, where the silk equals in brilliancy, softness and strength that growing in temperate and tropical climates, for in the latter there is no special advantage to the culture, except that of a longer season, which make it possible to multiply crops.

The fact that good silk can be raised in the United States has been long established, but the possibility of profit from the culture is the question to be answered, and the demonstration of which the country is waiting. Expense and profit will depend upon the utilization of labor, and the convenience of orchard and cocoonery with economic modes throughout the "Education," directed by competent knowledge. Experiments have been mostly among those who are from necessity impatient of results; thus we have not had so far a fair test of its money value to this country.

Silk culture is a fine art, which will require apprenticeship with time to perfect, but it is not difficult to master, and need not be attended with special expense, as silkworms and the mulberry tree (or osage orange) are the needful capital, and if persued in the United States intelligently, it may arise at conditions yet unknown in the World. Almost any farm can spare a few acres of poor land for the mulberry, and every family has its non-producing labor; consequently, the cost of experiment is almost practically nothing. A gradual development or adoption of the industry is advised; plant trees and experiment in the treatment of a few worms through the various stages, thus gaining practical experience in their nature, always studying the best species to improve their productive qualities.

INSTRUCTION.

FOOD.

FOOD is the first matter of consideration in sericulture, which must be *good, plenty* and *convenient*, and which is furnished wherever the varieties of the Morus, or the Osage Orange are found. By priority of use, I will treat of

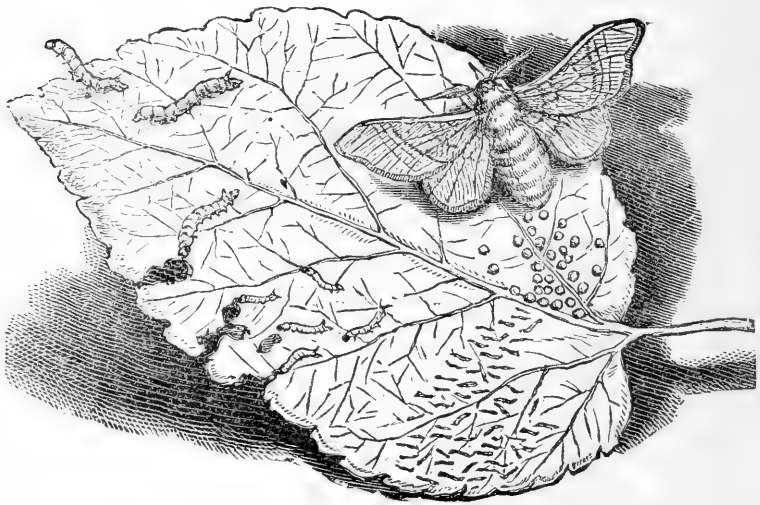
THE MULBERRY TREE,

which belongs to that family of plants which have stamens and pistils on separate growth, that is male and female flowers are found on different trees; therefore, to obtain reliable seed for planting, this rule of nature must be considered. There are many varieties, all beautiful from the leafy luxuriance, and fruit productiveness, and useful for the many purposes to which the wood is adapted. Fast growers—they are great absorbants of water and impurities of soil; and are thus, in the respect of resisting frost, better as health plants than the Eucalyptus. The paper and some other roughed leaf mulberry are indigenous to American soil, but these are not silk-making, and where the silk-morus are found growing in a wild state, they are the remains of old settlements, or the seed have been carried by birds. The mulberry is very hardy, is little affected by climate after the second or third year, and will flourish wherever the temperature rises to 65° (and so stands for

three months), and where it never falls below 10°. In short, wherever the vine and apple grow, the *Morus* can be trusted, and after being thoroughly rooted, the severest frost, will only affect the extremity of branches. It is more a matter of soil (which must be dry). There are many varieties of mulberry, and all are silk-making, equally good as far as brilliancy and strength are concerned, but culturists assert advantages in feeding, one over the other. The *Morus* in all its varieties seems to be indigenous to the Chinese Empire, and parts adjacent, especially the *Alba* and its varieties.

The Disciples of Confucius claim that the *Morus* is the foundation of the solidity and prosperity of that country, for there it is the means of livelihood to millions of individuals.

From the Morus Alba and Niger (white or black), spring all the varieties. Nothing better as food or silk-making can be found than the ordinary white mulberry, the leaves of which are of the



illustrated size, dark rich green, full of saccharine and resinous substance, but the smallness of the leaf doubles the work in gathering, and it is of slower growth, and not so easily propagated as any of

its seedlings except as standards, and would not perhaps thrive so well. The Moretti and Multicaulis are seedlings of the Alba, and the Japonica, and Rosea differ so little from the Multicaulis as not to make it necessary to consider them separately.

The Morus Multicaulis from its adaptiveness to the poorest soil, its rapid growth, easy propagation and large size of its leaves, renders it most valuable as silk food; the leaves grow six or seven inches either way. It is therefore, evident, how much labor is saved in gathering food, which, though succulent with less resin or saccharine when young, will attain the the requisite durability by age. It is also valuable for its easy re-production of leaves in the same season, especially in those latitudes where two or more crops can be raised. The Multicaulis was first found by Americans in the Philipine Islands, but subsequent knowledge of China, established the fact that it had been long known and valued by the Chinese as silk food.

The *Morus Nigra* makes a strong silk, and is preferred for the cold climates as food for worms. It is also very prolific in fruit bearing. Persia, Russia, and Spain use this variety, and as the world knows, makes good silk.

One writer on this subject says: "If I could not have but *one* mulberry, I should take the *Morus Multicaulis*," and a book published in London, in 1689, says: "One worm fed on the *Black Mulberry is worth more than two on the Morus Alba.*"

These various opinions should establish the fact that no *dictum* relative to varieties of the mulberry as food for the silkworm is to be received—*quantity* is the main question.

Myself, I believe that the black-fruited mulberry is equally good, and its prolific fruit, so useful on a farm, gives it many advantages.

In Europe, those who have the land, and perhaps never propose to raise a worm, plant mulberries for hedging, and in orchards; and the authorities plant them along the road-side; and these are *let* for the season to worm-raisers, to furnish the *leaf market*—thus dividing the interest and responsibility of the industry, giving a great advantage to those who have no land to raise silk, and a revenue to those that only plant the tree. One acre of the mul-

berry, treated as described, will furnish food for eighty thousand worms, and at the *minimum* price and estimate of cocoons, these should yield $80 net; and every year these two acres should feed more and yield more, until perfect maturity, when they will be worth $125 to $150 per acre. It will be a happy day for the United States, when individuals and the public authorities can boast of thousands of acres of this valuable tree. Every college and school grounds, public squares, church yards, etc., might be thus utilized to the good of the people.

In addition to the Morus Multicaulis, (to which I give preference), I recommend planting the Alba or Nigra, for feeding in the last stage of the worm. It is not necessary, but I am inclined to think these have more resin, (which is important to silk-making) than the Multicaulis. The Mulberry, and I suppose, most plants are composed of five different substances, fibrous and color matter, water, saccharine and resinous substance. The cultivation of the Mulberry must be in reference to the *in* or *decrease* of these qualities. It will hold a great quantity of water, which if encouraged, would make it too succulent for the health of the worm; therefore to avoid this, dry, well drained, sunny slopes must be selected for the planting, and a sweet inoxious soil be selected, a fertile, sandy loam or well drained clayey-land.

To recapitulate, in the first ages of the worm, the food must furnish saccharine, to nourish and make them grow; subsequently, the worm fills its silk vessels, which extends the length of the worm on each side, from which it spins through a small orifice below the mouth, and the *resin* accumulated and which makes the silk; the strength and weight of which depends upon the quality and quantity thus secreted.

To produce this food, select suitable land, plough thoroughly, and place the plants 12 feet each way, so as to admit a cart or hand-barrow for picking leaves; beside, the space can be at different seasons of the year cultivated in melons or vegetables. Healthy, vigorous shrubs are to be made of the plants instead of trees—which to do—they must be cut back the beginning of every season, forcing them to shoot from the root, making many branches and leaves.

To plant cuttings, the ground must be prepared very neatly, by spading and raking, leaving it mellow and free from all stones

or sticks, selecting ground shaded and protected from cold wind and hot sun. In planting the Alba and Nigra, which are of hard wood, place them in the ground somewhat *inclined*, covering the cutting entirely, excepting *two buds*; press the soil close. This done after a rain, they will not require water unless a continuous drought prevails. In the Southern States this propagation can be done in the fall or spring, but in cold latitudes the spring will be the period best suited for cuttings. The Morus Multicaulis, being a more succulent plant, of soft wood, it can, after preparing the soil as heretofore advised, be planted horizontally, putting a cutting, any length or size, entirely in the ground, which will sprout from every bud. When roots are well formed (next season) these must be subdivided and transplanted as advised.

Grafts, where acres are required, would be too expensive, and I think are entirely unnecessary. I am satisfied that neither the quantity or quality of silk would be changed by feeding worms on grafted mulberries—we are in pursuit of leaves, not fruit. I believe an orchard, carefully nursed, can be obtained almost as soon from seed as from cuttings, and is much the least expensive manner of doing so, as one ounce of seed will give five thousand plants. First, procure *reliable* seed. Prepare bed as for onions, soak the seed for forty-eight hours, plant in drills, press or water so as to make the soil lie close. Water when necessary; hand weed. If too thick, draw out plants as soon as they have strength for transplanting. Finally (next season), cut back within four or six inches of root, and transplant to orchard ground.

Picking leaves to feed requires very considerable judgment. I would not advise the use of the orchard for feeding worms before the third summer from seed or cuttings. If well cultivated, they will have required sufficient strength or *resin* at this time to make silk. In gathering leaves, pass the hand upward, taking *all* the leaves from the same branch, except the terminal, which must be left as the *lung* of the plant. If stroked downward, the buds will be destroyed, and if one or more leaves are left, they will draw the sap and prevent a new growth. In the early stages of the worm, when *very few* leaves will suffice, of course very young leaves can be selected from branch to branch. Hand bags, with a hoop at

the top, are convenient for receiving leaves, which must not be exposed to the sun, rain or dust. Of course, mulberries can be cultivated in hedges if preferred.

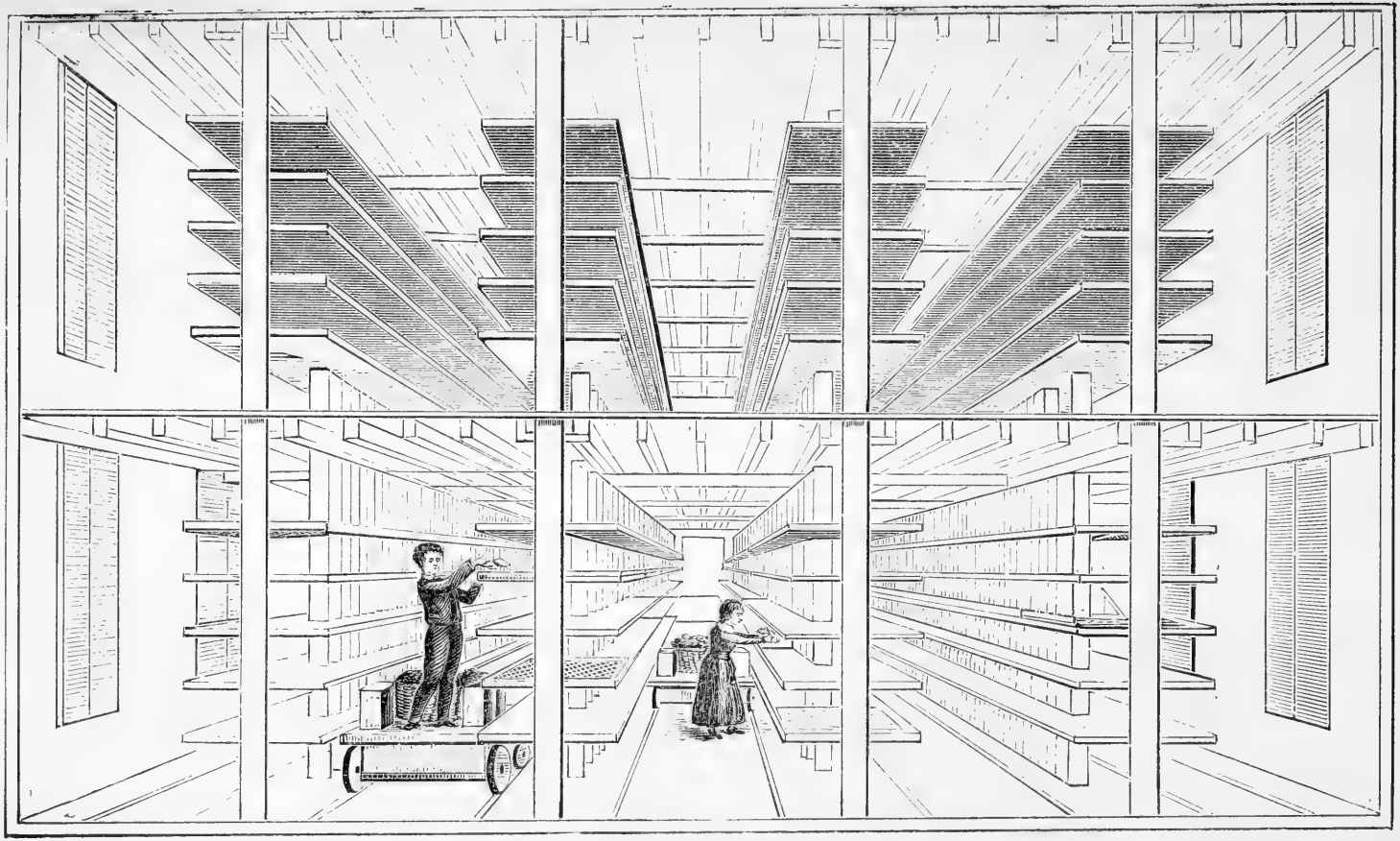
In reference to the Osage Orange as food for the worm, I can testify that they thrive and make good silk upon it, and a Mr. Itschner, a silk manufacturer of Philadelphia, says "he could discover no difference in the silk raised on the mulberry and that raised on the osage orange." Prof. Riley, of the Agricultural Department, Washington City, D. C., raised a family of worms for eleven consecutive years on the osage and testifies that he saw no decline in the breed, and he thinks that the osage is preferable, because it possesses more of the silk-making resin than the mulberry.

With such testimony we are left to follow our own choice, and we hail it as a fortunate support to sericulture that there are so many miles of this doubly valuable plant traversing the country; yet, to me the thorns would always be a serious objection, but American invention will circumvent this difficulty and furnish some protection in gathering leaves—still query? if supplied in branches, will not the thorns wound more or less the worms?

The silkworm is very dainty, and has a choice from what it shall make the winding sheet of golden thread, which is the one purpose of its short life, into which no adulteration is admitted, for it will die before submitting to imposture. Lettuce, cabbage or dandelion leaves will be tolerated to accommodate the season for awhile, but when the silk making age (the fifth) arrives, the worm requires silk making food.

COCOONERY.

IN this, expense can be avoided; at the same time a suitable shelter is a necessity to the worm, and as eggs that fill an ordinary wine-glass, will develop into forty thousand worms and more, growing three inches in length, it becomes those entering upon the work to consider "what will he do with it."



Circumstances must control or direct individuals in the matter of cocoonery, into which greatly enters the matter of climate. For experimental purposes a vacant room in a dwelling house will answer, or a table even in one already occupied; but those who intend to make sericulture a business, a money making interest, undoubtedly should make an independent provision for sheltering the worm. In parts of the South an outside shelter *might* answer, provided the rains and dews could not reach the larvæ, but the birds, ants, lizards and poultry would render such exposure impossible.

If, therefore, a cocoonery must be built, let other purposes enter into its construction, as it will be needed only for a few weeks of the year for worm-raising. I would advise a loft to break the force of the sun, and a ground floor to shelter or dry leaves if the weather should be unfavorable. This ventilation above and below will give to the centre-room great advantages in temperature. Windows should be in on all sides, admitting air from the top and if possible, openings should be left (arranged to close however) below windows, so as to effect free circulation of air at times. Window frames can be filled with bagging instead of sash and glass, but there must be shutters to close in case of storm and rain. It is most prudent to provide means of heating by fire-place or stove, as the weather is variable in the South during the spring, and always a great difference in the temperature of day and night. For the advantage of those who desire to have a separate cocoonery, I have attached a plate of what is considered a model. It should be 100 feet long and 30 feet wide, two stories high, and contain four rows of shelves on each floor, by passage-room between for the convenience of changing hurdles, etc. It is estimated that two millions of worms can be raised in a building of this construction, but the loft and basement must be considered for reasons given.

I would recommend feeding frames, laced and counter-laced with cotton-cord of different sized mesh for different aged worms; a large nail should be driven half through each corner of frame to prevent it resting heavily on the worm. Place the leaves on top of the netting or cords, and the worms will crawl through or above, leaving the tray below, so that it can be easily cleaned of all débris, Perforated paper is recommended, but it is too heating, I think, and

mosquito netting is of doubtful use, though I think it may be admirable as lining to the bottom of a tray, instead of paper, as it will admit greater circulation of air.

Hygiene is of the utmost importance in preparing a cocoonery for the *Education*, or raising of the worm, and to avoid contagion; *Pasteur* gives the following directions in the preparation of a cocoonery, which I suppose are in point where a building has been in continuous use for a long time:

1st. Paint or wash the walls or surface of the floors with a solution of chloride of lime.

2d. Place together all boxes, frames, utensils, before used, and having closed hermetically all openings into the cocoonery, burn a few ounces of sulphur, in order to destroy by fumigation all animalcula suspended in the air, or hidden in the crevices of walls.

3d. Wipe the floors with strong solution of spirits of turpentine or coal oil.

4th. To lower the temperature, sprinkle the floors with cold water frequently, and never sweep during the *Education*, but wipe the floor with a wet cloth.

Construct so as to exclude mice, rats, birds, lizards, ants and poultry.

Temperature is of very great importance in sericulture; first, to the egg and to the worm throughout its existence, thermometers must adorn the walls of a cocoonery, which must be constantly studied, for during the feeding period, they should not fall below 75° or 80°, which must be corrected by closing windows and gentle fires. So carefully is temperature considered in the Chinese cocooneries, that a man devoid of clothing is sent occasionally into the wards to test the atmosphere. This is a very difficult matter upon which to advise, for there is, I believe, greater danger from too great heat than cold; consequently, I will recommend the good sense of following nature as far as possible. Consider the worm as on the tree. Naturally, he seeks shade under the leaf: this indicates that he would avoid the heat of the sun. To reach this instinct, arrange a cocoonery so as to command light and air, but do not admit the power of the sun. The air should be fresh, never stagnant, but draughts must be studiously avoided, for chills are death to the

worm; there must be warmth without heating. Damp or moist atmosphere must on no account be allowed. When the weather is equable and genial windows can be opened, but a necessity to ventilation are holes above and below in the walls of a room, made with movable slides, and the number proportioned to size of room. The perspiration from worms is very great, consequently the surrounding air is soon affected by it, and hence disease.

The best period of raising worms will be from the first of April to first of June. This is usually a dry season with us, making it practicable to use barns and even sheds for the raising of worms, provided the latter can be protected from vermin of all kind, birds and poultry. Indeed, in carrying millions of worms through the "*Education*," I am satisfied these open buildings will be favorable if the influence of rain and winds can be avoided. Of course, a building conducted upon strict principles of ventilation to serve at all times and different conditions of the atmosphere must be a great advantage to the prosperity of the worm, and will in time bring return in the abundance of cocoons of good quality. Thus a trifling expense would render useless garrets, barns and warehouses as desirable places for rearing silkworms.

EGGS.

HAVING had the opportunity of studying varieties in cocoons, and of observing results, I have arrived at the conclusion that there is nothing of so much importance in silk raising as to procure a breed that is productive of silk, as some are greater spinners than others, and though these natural capacities are greatly augmented by *plentiful* feeding and careful tending in good races, yet there are varieties the natural force of which cannot be changed by any amount of food. It is most discouraging to see the work of a season expended on the worthless *many-crop* worms; and as Southern people are especially deluded by the promising names of *Bivoltines* and *Trivoltines*. I would warn them that it is labor lost to raise them, for they produce a thin cocoon, eat as much and occupy as much time to complete their work as the Annual; besides,

the small quantity of silk returned is coarse and rough. One big crop of Annuals will pay better in results, and if a second crop is desired it will pay better to import eggs from a colder climate, or to keep part of the stock back, by subjecting them to a low temperature in an ice-house or refrigerator; but do not place them on ice, or the vitality will be destroyed. Varieties in worms have been so multiplied by crossings, that it is difficult to ascertain what are independent or original breeds, but inquiry and close study of the subject enables me to give the following list, which I think covers the subject sufficiently to guide in a choice towards raising a crop; and from these, by careful selection and subsequent attention in keeping kinds distinct, the United States may arrive at great success in raising a healthy variety, that will not only make us independent of importing eggs, but give a reputation that will enable us to export for foreign use. As the best cocoon that I have found, I name the

Milanaise Yellow, which is of medium size, a rich cream color, very fine; said to yield 120 pounds of cocoons to one ounce of eggs.

The *Yellow-var* is larger, same color, and will yield from eighty (80) to one hundred pounds (100) of cocoons to one ounce of eggs.

The *Corsica White* is a large firm white cocoon, not satin looking (which is a defect), which will yield from one hundred to one hundred and twenty pounds of cocoons to one ounce of eggs.

The *Japanese Green* is a small, firm, green cocoon, very fine, yielding forty pounds of cocoons to one ounce of eggs.

There is no way of distinguishing the race by the egg.

I have had an opportunity of examining a variety of cocoons exhibited at the last Paris Exposition (1873) from the Levantine Coast, Turkey, Syria, Asia Minor, Greece, Egypt and English India. With few exceptions they appear to be of the many-crop worms, large, thin and coarse; and as these are purported to have been collected from the Marseilles market, I concluded that if they were veritable specimens of what the Eastern world had furnished for the silk supply, it had much to gain from the adoption of the

industry in the United Sates, the brisk breezes and space of which can and must in time bring silk to a higher standard than it has reached heretofore in any country. For, in addition to natural advantages, a different people will handle it—one that by intelligence, enterprise and perseverance overcome all obstacles to establish perfection. In Europe and Asia, the people have raised silk work in a groove, generation after generation, thus perfecting what they do, but never advancing. Americans will appropriate what is best from them, then go forward developing modes of their own, even to the subjection of nature to their indomitable will.

If eggs are imported from abroad, they should be obtained in the months of October, November and December, and on their arrival should at once be placed at very low temperature, and so kept until the spring food is ready. The transportation is in itself calculated to advance incubation, for I believe, *if left undisturbed* in any climate, they will not hatch until nature provides leaves plentiful to support them; but under all abnormal conditions they should be kept at a temperature not higher than 55°. Relative to eggs, we have very much to learn. It may arrive that we shall find that while one section is best adapted to cocoon raising, another is better for eggs. So let none be obstinate in belief until experiment establishes what is best.

More than one crop in a season may succeed, but will fail nine times out of ten. There is one certain chance of success, and that is to begin the crop as early as respective climate will admit, and then push the crop forward by feeding, so that the worm will not be eating more than *thirty* days. Every day after that is loss in silk and increase of expense.

It has become a general opinion that it will pay best to raise eggs. So it would if you can be assured of purchasers, but the simple question how long the demand would last answers the question of expediency. It is possible that the United States may become a great egg-raising district, but to give her eggs record she must first raise silk in plentiful crops of *firm* cocoons.

As old as silk raising is to the world there seems to be nothing positively known as to the causes of *blight* to the silkworm, so that we start with equal ignorance to make the industry profitable;

but we must accept the ignorance before we can attain knowledge. *So let no one undertake to raise eggs for market* until the reputation for healthiness and superiority of the worm is established; let the test continue through two or three generations of worms, observing and recording *Education*, until the record for health and vigor of the worm and yield of cocoons can be officially declared. This care in practice by individuals in neighborhoods will bring its reward in a few years, whereas if eggs are raised and by every experimentalist, doubt will always attend the reputation of home breeds. Silk culture in its various phases is big with interest and profit, but to develop it we must rise to the magnitude. France for thirty years has been so deficient in raising eggs for her own use as to be obliged to import them from Japan and China, expending in this trade annually over a million dollars, and these eggs to reach France pass over our country. We are nearer to France, so if we can establish the reputation of producing healthy eggs of *reliable* varieties, we can find a convenient market for all we raise. This blight or disease of the silkworm, which effects the moth and consequently the egg, has caused such immense loss of revenue to France that PASTEUR, the great scientist, has been for years employed by the Government to discover the cause. He attributes it to careless breeding; and thus the evil was partially corrected by cross breeding, using Japanese male and French female moths, and those of the valleys have crossed with those of the highlands, but as the trouble continues, it would seem as if the cause of failure is not yet established.

I am inclined to think that this blight to the silkworm in France is owing to causes easily avoided in this spacious territory. There was a time when the French peasant raised a few thousand cocoons, and reeled them into silk in a very primitive way, which brought them satisfactory prices, and as they reeled the cocoon green they saved the chrysalis, which developed into the moth and produced the eggs, which was another source of dependence; after awhile capitalists established filatures, and by rejecting the silk reeled by peasants, obliged them to sell the cocoons at a low rate. To remedy this loss the peasant endeavored to raise greater quantities of cocoons, greater than they had space in their homes to accommodate; hence

crowding and overcrowding, and hence disease and death; and all "Pasteur" has affected is to declare a remedy in more room, good air and cleanliness, which at the same time declares the cause of the evil.

When the eggs are supposed to be perfectly dry the cloth or paper upon which they are deposited should be placed in tin boxes with a sheet of tissue paper between each card. The box should then be placed in a cellar or suspended in an ice-house, and not be disturbed until the next spring. The surrounding temperature must be noted in the autumn and spring, which should not rise above 45°. If eggs are to be transported to another country it should be done in December or early in January. If the distance only occupies two or three days in passage I would advise eggs not being shipped until the food of the locality to which they are destined is ready, because the agitation of the eggs even during the winter seems to provoke premature "*d'ecloision.*" The Japanese give their cartoons of eggs a cold bath in the autumn—also in the spring, the object being to remove the natural gum, which is supposed to retard equal incubation, and for the same reason they subject them to a gentle vapor bath by the evaporation of heated water near at hand. Dryness is opposed to incubation. Japanese eggs require a longer time to develop.

HATCHING.

AS it is very desirable to get through the *Education* before the hot weather, it is well to commence as soon as the mulberry leaves are large enough and plentiful to allow no interruption or falling off in feeding. In the South there are seasons in which the crop might be opened in February, but great discretion must be exercised in this matter, as the temperature of night and day vary so greatly. But those so situated as to use artificial heat to keep up the same temperature in the cocoonery need not hesitate to venture thus early upon the *Education*, but the last of March or first of April will give time to accomplish the work before the heated term of June. Two or more crops can be raised most certainly, but experience must establish whether this can be done

without detriment to trees and breeds. Supposing now that the mulberry leaf is sufficiently developed for feeding, the eggs are brought to a higher temperature, and still to a higher, as incubation requires *progressive* heat, and the change must not be sudden, but must occupy a day or more. The eggs will hatch at 60°, but it may be necessary to subject them to 75° or 80°, but in any case it will take seven or eight days to produce the change. Do not hasten incubation by forcing heat—avoid any check by chilling—but if artificial heat is applied let it be slow and progressive—raising the temperature half a degree each day. It is of the greatest importance (to convenience thereafter) to hatch all eggs at the same time, or as nearly so as possible, that they may moult and spin all at the same time ; and in order to effect this, establish an equilibrium of temperature night and day (say 75°), and keep the eggs out of a draft. From the deep lavender or sage-green tint the eggs will grow gradually lighter in color until the little mite breaks the shell. The room for hatching should be small, as the temperature can be better regulated. Do not admit outside air for the first few days ; the same temperature in which the eggs were hatched must be maintained—for if the larvæ get chilled they hide themselves in the leaves, eat no more, and die. The first age passed, a little air can be admitted, with great caution. They will hatch from six to ten o'clock in the morning, when incubation seems to cease until the following morning. Those that first come forth are few comparatively, and as early hatching indicates vigor, it is recommended to keep these separate throughout the *Education* and feed them up for *egg producers.* When hatching commences, place a few *very* tender leaves over the eggs (to which the *larvæ* will attach themselves immediately, and which should be transferred to another tray and to a lower temperature, so as to retard appetite), and feed lightly until a second and third lot of larvæ are secured in the same way ; this done, feed up as if *all were the same age.* By this means they will be brought through all the *moults* and *ages* at the same time, and to do this is of incalculable advantage. Those hatched after the third day can be classed in the same way, or better still, a lot of eggs can be kept at the low temperature, until the first are a few days in advance. If two crops are desirable, obtain from a more

backward climate the second supply of eggs (annuals), but under no circumstances would I advise reliance on the Bi, Tri and Polly-voltine families, for I am convinced it is loss of time and labor. It is best to *winter* eggs where you propose to raise them, for it hastens incubation to move them, which must not occur until the food is ready for them.

It is estimated that there are 40,000 eggs in one ounce, and consequently if well hatched will return 40,000 worms. What quantity of cocoons shall be the return, depends, I think, greatly upon the variety of eggs, and then upon feeding and rearing.

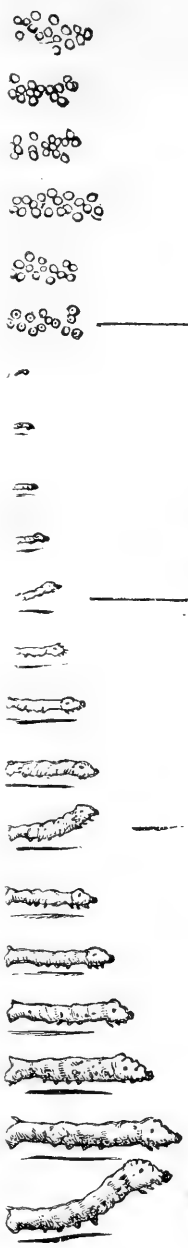
As arbitrary rules are so likely to prevent many from an undertaking in which they think they must follow directions to the letter I would advise only the practice of *common sense* in the pursuit of natural laws and influences. The fowl brings her eggs gradually to a temperature that develops life, and we know that any unnatural depression of this heat would destroy the vitality of the egg. The French peasants, with this idea, carry the silkworm eggs about the body, even placing them in the bed at night so that there can be no loss of heat until incubation is complete, when they proceed to raise the larvæ in their kitchens, or sleeping rooms, on top of a bed, top of a toilet or table. Notwithstanding, when possible, a small well-plastered low-ceiling room is best for hatching, because, in such, an equilibrium of heat can be best sustained, and to do this a small stove is best. This room should be well-warmed for a day or two previously to bringing the eggs into it; the heat shall then be gradually increased, starting at 60° and increasing daily (not all in a day) until it reaches 80° and even 90° by the seventh day. If you have more than one ounce of eggs, divide them, keeping each ounce on a tier of shelves distinct from any other, and then sub-divide ounces, spreading your eggs so each worm as it comes forth may have freedom of movement. If your eggs have not been separated from the cloth or paper in which they were laid, make the same calculations for space. *Dry air* is not favorable to hatching, so it is well to keep one or more buckets of water in the room to furnish the necessary moisture from evaporation. One mode of removing the larvæ from the nest is to stretch lightly over the eggs very coarse mosquito net-

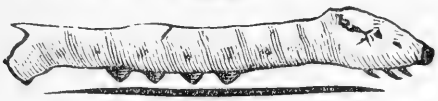
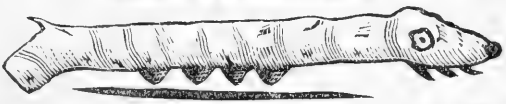
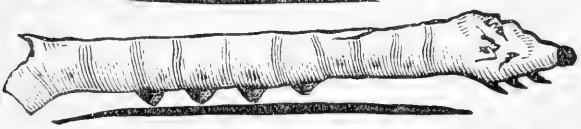
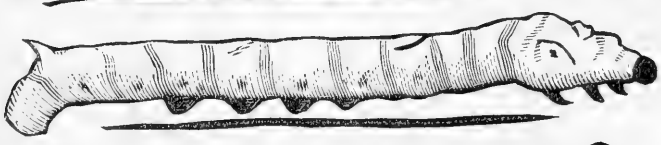
ting, on which you will lay the most tender mulberry leaves; the larvæ will make its way through the holes of the netting and attach themselves at once to the leaves, on which they can be transported to trays, though placing the tender leaves on the eggs will accomplish the same. If your eggs hatch *uniformly*, you can retain the worms for awhile in the same room by gradually lowering the temperature, as they must not be exposed to too great a change at once; 75° is the established necessary temperature for the worms, and this must be secured by the admission of pure air without draft or wind.

Count Dandolo (an Italian authority) says "that the worms hatched from one ounce, and calculated to be 40,000, should at the start occupy *nine-and-a-half square feet*, the worms being first laid in squares of ten inches, which will give a margin to cover by the first moulting," but adds, "where it is possible to occupy more room do so, for with greater space the worms eat, digest and rest better."

They should not be removed from the litter until immediately after the first moult, taking them up (as they revive) on twigs and removing to portable hurdles, but they must not be fed until the whole lot shall revive. This matter of keeping the worms in the *same stage* of development is of the utmost consideration throughout the *Education*. Without this system it is impossible to feed any number to advantage, and this rule must be practised throughout every moult or change. These periods of torpor last about twenty-four hours, and it is much better that those that revive first should be kept back, by giving them very little or no food until the more sluggish rise than to permit one portion to advance beyond another. These changes known as moults are periods of sickness with the worms, during which they do not eat, but labor in waiting to rid themselves of a skin, from which they come forth fresh, vigorous, and with increased growth and appetites; and you learn from these changes how important it is to keep the worms in a parallel condition from the start. If kept even they will moult and rise at the same time which is a great advantage in feeding, clearing the litter, and one that is felt throughout the *Education*. There are four of these periodical changes which end with the fifth age of the worm, which then passes into the chrysalis stage with the sixth age.

No. of Day of Crop.	AGE.	DEVELOPMENT.
1		HATCHING.
2		
3		
4		
5		
6		
7	1st Day	FIRST AGE.
8	2d "	
9	3d "	
10	4th "	
11	5th "	
12	1st Day	SECOND AGE.
13	2d "	
14	3d "	
15	4th "	
16	1st Day	THIRD AGE.
17	2d "	
18	3d "	
19	4th "	
20	5th "	
21	6th "	



No. of Days of Crop.	AGE.	DEVELOPMENT.
		FOURTH AGE.
22	1st Day	
23	2d "	
24	3d "	
25	4th "	
26	5th "	
		FIFTH AGE.
27	1st Day	
28	2d "	
29	3d "	
30	4th "	
31	5th "	
32	6th "	
33	7th "	
34	8th "	

COUNT DANDOLO'S TABLE

OF THE

REARING OF SILKWORMS FROM ONE OUNCE OF EGGS.

AGES.		SPACE.		TEMPERATURE.	LEAVES.		TOTAL AMOUNT OF LEAVES.
		Ft.	In.		Lb.	Oz.	Lb.
FIRST AGE.	1st Day.				0	14	
	2d "				1	6	
	3d "	9	6	75°	3	0	7
	4th "				1	6	
	5th "				0	6	
SECOND AGE.	1st Day.				4	8	
	2d "				6	12	
	3d "	19		73° to 75°	7	8	21
	4th "				2	4	
THIRD AGE.	1st Day.				6	12	
	2d "				21	8	
	3d "				22	8	
	4th "	46		71° to 73°	12	5	69
	5th "				6	8	
	6th "				6	8	
FOURTH AGE.	1st Day.				23	4	
	2d "				39	0	
	3d "				52	8	
	4th "	109		68° to 71°	59	4	210
	5th "				29	4	
	6th "				26	12	
	7th "				26	12	
FIFTH AGE.	1st Day.				42	0	
	2d "				66	10	
	3d "				93	0	
	4th "				130	0	
	5th "				185	8	
	6th "	239		68° to 69°	223	0	1,281
	7th "				214	0	
	8th "				150	0	
	9th "				120	14	
	10th "				56	4	

The pupa or chrysalis accomplishes a transformation in twelve or fifteen days and re-appears to the light as a moth. It requires from thirty to thirty-five days to develop these changes (not including that of the pupa), but the time can be lessened by increased temperature and increased food, and this can be done without danger to quality or quantity of silk. After each moult continue to spread, giving space, but be careful to keep lots numbered; though you may have a dozen separate trays of the same age, they should *all* be *No. 1*, or *No. 2*, as it may be.

The fifth age is the most critical, and as the worms come out of the last moult (the 4th), it is considered best not to wait for the most tardy, but remove and feed generously, as they revive from their sleep, still dividing and giving space. Count Dandolo's chart, by which he regulated space, temperature and food for each age, in regard to space must be considered, as a minimum, the least that can be allowed to safety and to health.

This chart, with one presenting the size of the worm corresponding with the different ages, can be utilized to great advantage by the student, though more space and more food can always be allowed. Indeed, discretion will often suggest intermediate meals to help the sluggish forward, and a nice judgment must be exercised as to the air of the cocoonery, for though the temperature is dictated, there must be ventilation and a frequent agitation of the atmosphere, which can be procured by openings in the floor or near it (in the lower part of a door) and transoms over windows; indeed, it must be determined by those in attendance when it is sometimes necessary to have all doors and windows open, always remembering to avoid winds or chilling drafts.

FEEDING.

THE young worms having attached themselves to tender leaves which were laid over the eggs, remove them to the feeding-frame, where they are spread, preserving as nearly as possible the same temperature in which they are hatched which must be gradually lowered, at the same time accustoming them to ventila-

tion, when, finally (in good weather) the windows and doors can be left opened, provided the sun is not admitted, and the chills of morning and evening must be prevented. Draughts must be avoided and all sudden changes of temperature, and in chilly or rainy weather fire may be necessary. For the first feeding, chop the leaves very fine and feed frequently, but little at a time. They would seem rather to suck at this period than to eat, consequently the food must be administered fresh and often. As the *larvæ* grow spread by breaking the bed very gently before sprinkling the fresh food, filling the spaces with the fresh supply, and persevere in this mode, not changing or throwing away the bed until the first day of the 3d age, but always space as the larvæ seem to require. Continue to chop the leaves (though less fine) through the 4th age, at which time they can be trusted to eat whole leaves, which must gradually increase in firmness with the age of the worm. The worms must never wait for food, nor must they be burdened with leaves; watch the trays and give leaves when needed. To remove the dried leaves and to clean the beds of the very young larvæ the best plan is to place coarse mosquito netting over them, and then sprinkle on top of the netting finely chopped leaves, to which they will readily crawl, leaving the old bed free to be removed; later, when the larvæ are too large for mosquito netting corded frames are useful. I object to the use of perforated paper on account of keeping the worms too much heated. All through the Education spacing the worms must be considered for lying too close for twenty-four hours will make them sick; as they perspire freely leaves must not lie too thick, for the accumulation will create damp and mould, which does not come from outside influences, nor must the leaves be rough or tough, and it is best not to give more food than they can consume in a short period, for it is best to *feed all the time*, instead of stated hours, passing the hurdles, placing on each only what may be consumed until the round is made. A good start is of the utmost importance, and it will be found that individual intelligence must provide for the comfort and growth of these little mites; having adopted them, we must think and act for them; spread the fresh food so that all can have an equal chance; having allowed a margin in placing them on the tray keep spreading so that none shall get hidden or

buried under dried or withered food. The peasants of Europe tend them as babies, and sit *up with them at night* as with the sick. Never feed with wet, dusty, withered or diseased leaves; see that no insect infests the leaves; anticipate rains and gather leaves, which can be kept two or three days in a cool cellar; and a good plan is to gather leaves in the afternoon for the early morning meals, and gather in the forenoon for the evening consumption. Nothing must prevent regularity and abundance, not only at the early stage, but all through the season of *Education*—feeding as late as possible at night and at earliest day must be the rule. To imitate nature and give the worm the advantage of ventilation it is a good plan to feed occasionally with branches or twigs (called the Cavallo system), which from not lying so close permit a circulation of air beneath, and to lay these crosswise increases the advantage, and then over these feed with leaves.

The utmost *cleanliness* is necessary throughout; débris excrement and dead worms must not only be removed from trays, but must not be allowed to accumulate in the cocoonery. The larvæ must not be disturbed to remove litter during first stage. By spreading they will keep healthy, but all litter must be removed after each moult, and, as they grow more helpful oftener, and at last every day.

There is nothing easier than to raise silkworms, but to raise them so that they will make firm full-cocoons is no holiday matter; it remains with the feeder whether a cocoon shall reel off four or five hundred yards or twelve or thirteen hundred. To accomplish the latter it is necessary to have eggs of healthy parentage. Plenty of good food for larvæ, plenty of space, pure air of uniform temperature, thorough cleanliness and constant watchfulness can alone secure these advantages. Strict adherence to these rules, and the daily study and pursuit of the system directed, should bring the "Educateur" success and reward. Fine camels' hair brushes of different sizes, will aid very much in removing small and large worms.

It is of the utmost importance to see that neither *ants, mice, roaches, birds or poultry* can have access to the larvæ, for they will destroy in a short time all prospects of a crop. To avoid ants set the

legs of your stands or tables in cups of water tinctured with spirits of turpentine, and wipe off the tables and even floor with a little carbolic acid mixed with the water; this will conduce to health also.

No sweeping can be allowed; wipe floors over with wet cloth, and all noise, even thunder, must be shut out if possible, and no noxious vapors, such as tobacco, be admitted, nor smoke of any kind.

The most critical period of silkworms is after the fourth moult, during the fifth age, and the success of the culture depends upon its safe passage. This is the time that destructive diseases attack them and the fruits of mismanagement heretofore develop. They must be most carefully watched, so that any showing symptoms of disease may be at once removed, and plenty of pure, dry air must be admitted. The value and quantity of silk depends upon the quality of food at this time, and it must be the very best that can be procured—not the soft and tender leaves of suckers or leaves of young trees, but the *firmest*, darkest green leaves from oldest trees free from dew, or dampness; and especially should no change in the variety of food be made at this time, and they should have more frequent feeding—in short, never allowed to be without food. Count Dandolo says "that at this period they should occupy 239 square feet of hurdles and be supplied with 1089 pounds of *sorted picked leaves*," and this he calls a minimum. The hurdles should be cleaned every day during this period.

Especially look to the temperature, which, if too high, will exhaust the vigor of the worms and cause them to produce small and thin cocoons. If the weather is stormy and the air damp and chilling, close the windows, and it may be necessary to make a little fire, but if the weather is clear and dry, open the windows and let in light and air; even wipe the floors with wet cloths if the heat seems oppressive, or at least sprinkle the floor.

As the worms advance to maturity they will assume a yellow color, and are upwards of three inches in length, having attained their utmost growth, the extremity begins to grow shining and yellowish, and finally they seem to grow less, eat less and begin to wander as if in search of a need. At this time the night temperature must be carefully watched, and it may be advisable towards day to have a little fire in the cocoonery, for if the worms are chilled

at this critical period they will never revive to spin to any advantage.

To any worms that seem a little backward at this time, give intermediate food as much as they will eat, always well *matured leaves.*

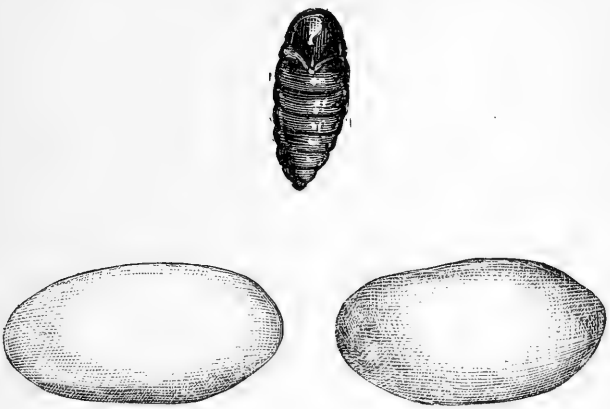
Quantity of leaves consumed must bear *relation to the nutriment* they contain or the quality of the leaf; worms may grow and yet lack of resin may cause failure in silk. Five properties exist in the mulberry and osage orange; the coloring matter, fibre and water are useless as food; the saccharine substance feeds and makes bodily growth; the *resin* is attracted by the organization of the worms to fill certain reservoirs from which it is subsequently spun forth as silk; so in the preponderance of the saccharine and resin elements in leaves fed to silkworms depends success. The Chinese believe that the maturity of the worm is accelerated by abundance of food, and that the silk is better and increased by rapid growth, and that their appetites are stimulated by high and dry temperature. Atmospheric changes must be considered, for one false step in this, as relaxation in other matters, may be fatal.

SPINNING.

SUPPOSING that the worms have been kept at the same space of growth and age, they are now equally ready to mount, or *to go up*, which means they have run their course and are now ready to spin. For weeks previously preparations should begin for this period by many devices; such as gathering bundles of twigs or straw, tied boquet fashion and pulled loose at one end, and made to stand like a shock of grain, big end downwards; and twigs may stand upright around the trays; newspaper cut into broad fringes and laid over the table; cornucopias of paper; or twigs may be piled six inches on the table, and worms of one *mind* be strewn over these, to which shall be given a light meal of fresh leaves, over which shall be placed a thin cloth or mosquito netting (old table cloth or sheet, and tucked in); they will take their last supper and then crawl below into the interstices of the twigs to make cocoons. When there are several hundred thousand cocoons it will require great and swift attention to keep them from spinning together, which latter destroys cocoons for reeling purposes. Much floss and silk are lost oftentimes by raisers not being prepared for the spinning of worms, which, in wandering to and fro in search of some object to which to cling, waste their silk, and sometimes end by weaving a mat or net, and do more, as if from vexation they abandon the project. They should be most carefully watched at this period, not being left to their own desires for a moment. After the majority have gone up

remove the lazy ones to another bed—give them light and frequent repasts, until they also "go up." After the worms go into the cocoons they need plenty of air, though it may be rainy and windy. Do not let them spin in the dried leaves and debris as it gives much trouble and injures the market of the floss.

HARVESTING.



THE difficulty of determining when the worm ceases to spin and is transformed causes various opinions as to the best time for gathering the cocoons, which must not be delayed too long, or the fly will pierce the cocoon and thereby spoil it for reeling. The sixth day *after they begin to spin* is that generally fixed upon for harvesting the cocoons, which up to this time *must be left undisturbed.*

If the object is to raise eggs for home use or otherwise, the largest and best-shaped cocoons must be selected for that purpose, choosing an equal number of each sex, the female being determined by greater roundness, and the male by a slighter depression in the

middle like that seen in a peanut, though it is said that the indications are not always reliable; *sixteen ounces of* cocoons will make one ounce of eggs.

It is estimated that a female fly will lay from 400 to 600 eggs, so that it will be safe to allow 125 flies to an ounce of eggs. Having made your selection of cocoons for egg raising, they can be placed aside in a dark closet, for it will be twelve or fifteen days before the fly appears.

On the sixth day, therefore, it is generally determined that the chrysalis shall be stifled, and various modes for this are proposed. Where the lot is small this is easily accomplished by putting them in an oven after the family baking is done for the day, but this requires nice judgment, or they may be scorched and the thread so dried as to loose its lustre. Of course, it depends upon the amount of heat applied, but thirty or even twenty minutes should suffice. Another method is to place them in a basket, and to suspend that over a boiler, with a blanket thrown over to keep in the heat; an hour in this way will stifle them; they should be carefully sunned for several days afterwards.

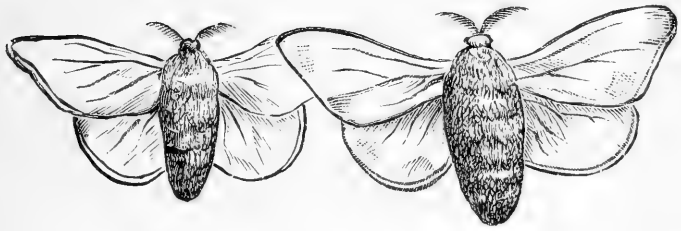
Again, they are recommended to be put in a tin vessel, and that set within boiling water, which shall be kept boiling until the heat reaches equally all the cocoons; throw a blanket over the top, but do not close hermetically, else the vessel might burst. Then some are suffocated with camphor and alcohol in air-tight vessels.

A sun of several days in succession might suffice, but it would be dangerous to trust entirely to this, though in every instance they should be sunned for some time. If there are steam mills convenient, the difficulty of stifling quantities will be very much facilitated by having the bags of cocoons subjected to their steam, confining the heat as entirely as possible, so as to steam the whole alike. Now, that they are thoroughly stifled, take off all floss and sort the cocoons, placing all of the firmest and of one color together—the satins which are smooth and glossy like satin, together; the thinnest, the doubles and most inferior apart, as these points affect their marketable value very greatly. They should be carefully packed (not crammed) in bags or barrels for transportation. Floss

and pierced cocoons being of inferior value can be packed in coarse bags, and as express charges tax severely heavy transfers, it would be best to pack in bags altogether.

Cocoons lose by desiccation about two-thirds of their weight. When fresh from 250 to 300 cocoons will make a pound, three months after it will require seven or eight hundred to give the same weight.

MOTHS.



MALE. FEMALE.

AFTER carefully selecting the largest, firmest, most precocious and best shaped cocoons for breeding purposes, it is recommended to take off all loose floss, which is apt to impede the movements of the fly on coming out; and a good plan is to string them together and gum them to a box, so that the cocoon in being

fixed will aid egress of the moth by resistance. Place all cocoons thus, but separate the sex so that they may not mate too soon on coming forth, it being necessary that the female should first discharge a viscid liquid from her body, which takes place about an hour after coming out of the cocoon.

After this they may be paired, male and female. The room in which the moths were produced should have been made dark, and it should be kept so during the time of mating. The moths generally come out in the morning, and they should be mated so as to remain coupled for five or six hours, after which time they must be separated, which is done by taking them by the wings and body and pressing the male very gently away from the female. The females should be placed on blotting paper for a short time, to give them an opportunity to throw off a liquid that would otherwise soil the cards or cloth on which they are to lay their eggs. This must all be watched and directed in a room admitting as little light as possible. Cloth is recommended for receiving the eggs, as it is easier to remove them from its surface, which is done by some sericulturists; but whether cloth or paper it should be weighed and so marked, so that after the eggs are laid upon, it is easy to discover their weight by re-weighing. It should be a thick and not too smooth paper or the eggs will not adhere. The paper or cloth should be hung against the wall, or made to incline a little, as the fly seems to lay better than if on a plane. Do not have your cards or sheets too large, a foot square is the best size, and on this place the females, beginning at the top and going down regularly, allowing space for each to lay from 400 to 600 eggs, which are at first a pale yellow in color, and after various changes they become a bluish grey; those that do not finally adopt this color, but remain yellow, are considered imperfect.

The *graine* that is laid within twelve hours is all that should be preserved. To raise *graine* is a *Special Education*, which by careful study of selection, raises the quality of the worm and lessens the period of feeding as much as ten or fifteen days when brought to the highest standard. If the females lay their eggs quick and regularly, not heaped, and if they do not loose much of weight after drying, they can be accepted as reliable.

Preserving the eggs is of great importance. Some sericulturists order them laid on woolen cloth, and later (in January or February) they scrape them gently off, give them a bath in cool water, dry on blotting paper, otherwise, *thoroughly*, and pack them in boxes, like seed. I do not like this mode, for I am inclined to think the latent heat is sooner developed in this way, and the eggs are in danger of hatching before the food of the tree is ready for them. The simplest mode is to let them be thoroughly dry after being laid on cloth or paper, and then pack these into a tin box made to fit the cards, and place the box in a *dark, cool, dry place*, where it will not be disturbed until hatching time, at a temperature not below 32° or above 50° or 55°. All possibility of ants, mice, roaches or lizards reaching the eggs must be considered.

It is recommended and put in practice by some to send eggs laid in the South to season in the North, but I do not think it necessary if they are all kept undisturbed in a dry, dark, cool cellar. If the leaves are backward, and there is fear of eggs hatching prematurely, endeavor to place them in an ice house, or refrigerator, but not *on the ice*. They can (if they persist in being hatched) be fed on lettuce, dandelion, and even cabbage leaves, and will grow, but these things will not make silk, though they may be useful to keep the worm alive until the mulberry or osage orange is sufficiently developed to feed them.

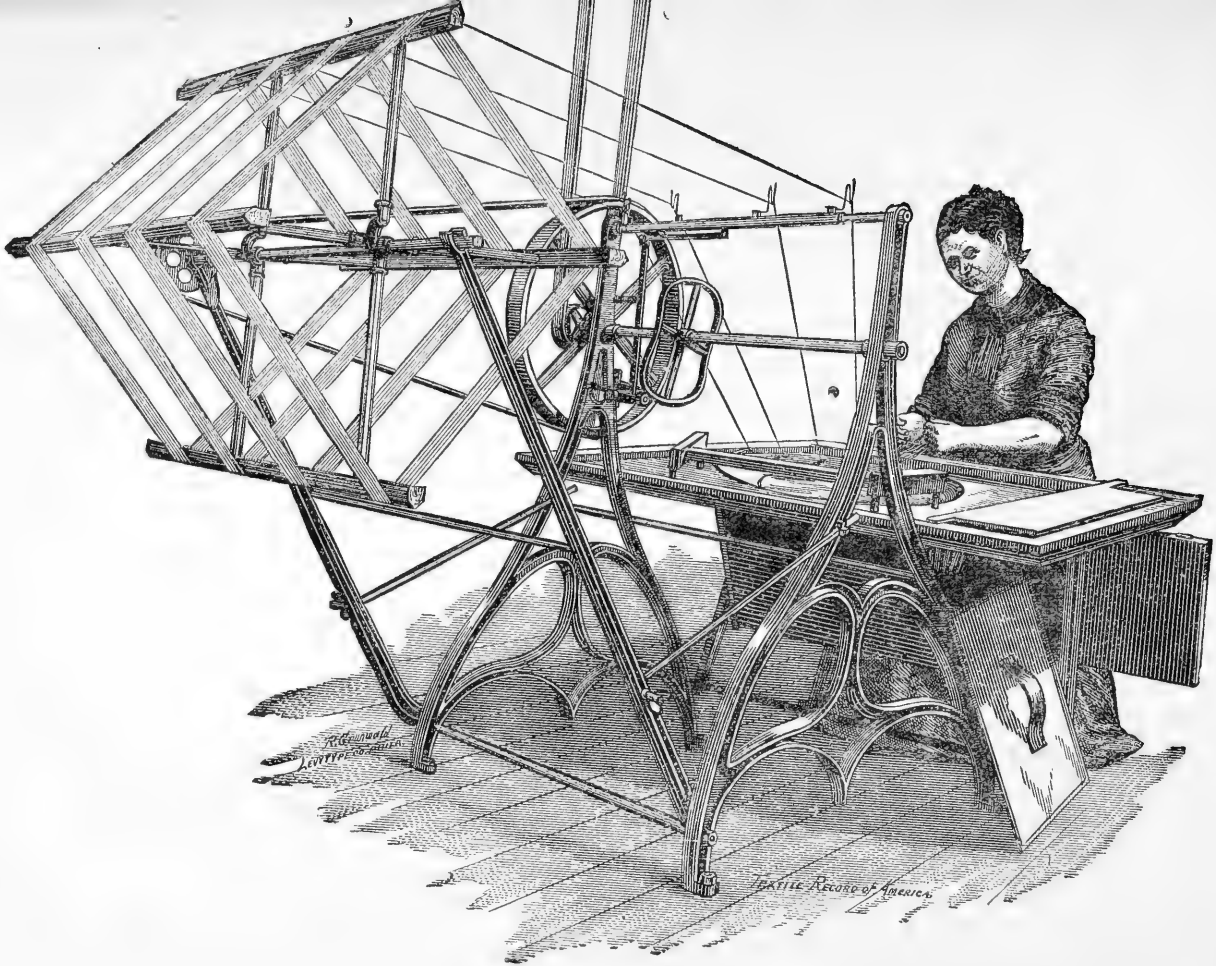
In producing moths from cocoons, the temperature must not be too high, not above 73°, or the transition would be too rapid and result in an enfeebled moth. In the transformation from worm to moth, there is no disposition to wander; the fly will spend its short span of life in within limits. Count Dandolo calculated that an ounce of eggs could be raised from 180 cocoons, the sexes being equal. Eggs from the same climate in which they are raised will hatch sooner than if they are imported from a colder climate. Broods from imported varieties of eggs will improve in quality and quantity in the second and third generation, and there need be no decline, if well matured.

REELING.

THE process of reeling, though apparently simple, requires skill, patience, watchfulness and experience to make a marketable thread; but good eye sight, nimbleness of fingers and studious attention, will in time overcome all difficulties. The object to be obtained is an even, smooth thread, made by uniting the filaments of six or more cocoons into one, and this is rendered difficult by the variable length of silk on the cocoons, this varying from 800 yards to 1000 yards. Even worms of the same breed will not spin the same amount, and cocoons differ in fineness, and even the same cocoon will differ in the inner and outer thread, and there are defective cocoons. These differences require great watchfulness to detect and tact to remedy. When they are apparent, the reeler must instantly join on a fresh filament, so quickly that no break or change shall be discovered in the reeling thread by microscopic examination. Cocoons must not be reeled too close to the chrysalis as the silk becomes inferior, which portion is macerated, carded and spun into sewing silks and for material of fringes and braids. Double cocoons and the outside floss are also subjected to maceration and used for inferior purposes. And in reeling there is a certain lapping of the threads necessary, which a little manipulation and the reel itself make easy.

In the plate, glass eyes are to be fed each with five or seven cocoons, the threads of two eyes are twisted together, then, separating again, they pass through hooks above, and so on again over the wheel holding the hank as it increases. Two hanks can be reeled at once if the reeler is expert. This form of reeling is still very primitive, but new methods will arise, and upon this depends the future of silk raising. An automatic patent is being developed to be worked by electricity with which one woman can attend six reels or pans.

The difficulty of reeling has been solved in Europe in the establishment of filatures by corporations, but the low price paid by these for cocoons would be discouraging to American labor, although it is the experience with all agricultural products, that the producer is the least paid for his work. These public filatures are of great advantage in the encouragement of silk raising, but domestic reeling by farmers' wives and daughters is practicable, and the


Textile Record of America.

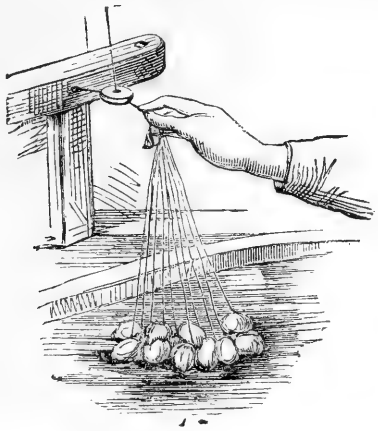
pursuit by them will so certainly secure to the raiser of cocoons, the *profit on silk* that I would not have them throw away this opportunity of controlling the fruits of labor. The power of steam

and electricity may enable corporations to run numbers of reels more cheaply to themselves, but neither steam or electricity effects the quality of silk reeled, nor supplies the place of a skillful *hand and experienced head.* American ingenuity will further

facilitate the means for domestic reeling, but the principle of making a continuously *even, smooth* thread, must be secured through all inventions, and the accomplishment of the work can only be done,

by skill and practice, both of which the average American woman is capable, though Americans may not follow established plans, for they have already in the matter of reels made greater progress than they have done in centuries throughout Europe and Asia.

The art of reeling must be acquired *by instruction*, and practice will give all that is requisite, but if the student is sufficiently self-confident to undertake it without an instructor, he must put a number of cocoons into the basin wherein the water is kept near boiling, and with a whisk-broom the floss threads are whipped loose and gathered into the hand of the reeler, until single threads wind from the cocoons, which are passed through the glass eyes in numbers of five or seven; the natural gluten makes them adhere and they pass over



the wheel as one thread, and the skill of reeling consists in keeping the thread supplied, that no break or deficiency shall be discovered even with a microscope. If the water is too hot, the silk fibre will come off in bunches and get tangled in the water, if not hot enough it will not unwind at all. Old cocoons require more soaking than the fresh or green; consequently, the sooner they are reeled after stifling the better. Of all the processes of manufacture through which silk must pass in being transformed from the raw material in the cocoons to furnish goods, that of reeling is the most important; on

the perfection of this depends subsequent results; a filature is the foundation of a manufactory. Therefore it is most important that the work of reeling should be conducted by experts. From time to time during the hours of work, tests are made as to the regularity, elasticity, strength and cleanliness of the silk, and a record is kept of these tests. Sorting must precede reeling; stained cocoons must be reeled immediately, as the stain is an acid that destroys the thread. In one crop there will be four or five different lots or qualities. Count Dandolo says, "2,800 worms will make twelve pounds of fresh cocoons, these reeled and woven will make sixteen yards of Gros de Naples, or fourteen yards of best description of silk."

On the acquisition of the art of reeling dèpends the value of silk to any country, and if this becomes *national*, it is not easy to calculate its value, but all is lost if cocoons cannot be *well* reeled, for otherwise no *profit* to the country can be derived from sericulture.

Diseases of the Silkworm.

THESE arise from mismanagement rather than constitutional causes, though the worm possesses great heredity in all characteristics, and they are often so afflicted as to destroy crops and blast the prosperity of entire provinces. Scientists have been employed to find causes and to recommend cures, but to little purpose, so that we are inclined to think that a close study and practice of common sense rules in the care of the worm throughout its growth is the only means of providing against disease. The worm must be allowed to live in its confinement, so nearly as possible, in a way corresponding to its natural life on the tree. The worm breathes through small holes placed down each side; if these are obstructed by overcrowding or smearing by ejecting liquids, their pores are closed, hence disease; consequently, worms should not be so crowded as to touch each other. Diseases proceed from improper food, such as leaves from trees that grow in low wet places, or *over rich soil*, and these are often fatal. Unsuitable temperature, either too low or too high, and want of pure air and cleanliness are serious causes of

diseases. Mulberry trees may be unhealthy, and they may be covered with poisonous fungi or insects, the effects of which may not be seen at once; but diseases are liable to attack the worm in the latter stages of life, so late as when the worm has begun to spin, and sometimes not discovered until the moth comes out diseased, which is a cause of injury to the eggs, and through them disease may be perpetuated. Prevention and cure for these many troubles are the same—good food, pure air and plenty of room. Never let the air become stagnant; watch closely for any effluvia; never permit withered leaves or excrement to remain in the laboratory; when the atmosphere is chilly and damp outside, build fires within (damp is worse than mephitic air), but avoid sudden and violent heats. When worms are found sick, either throw them away or remove to other hurdles for experiment. Don't let cold winds blow upon the worms, but give them light and air all the time.

Grasserie attacks the worms before the second moulting, and comes from too rich food; it is recognized by the worms swelling and ejecting a greenish fluid. Remedy, is to clean the hurdles and change the food.

Flacherie or Blight is the dreaded disease of France; it attacks the worm in the fifth age: science has failed to find cause or cure. The quality of food, ventilation and atmospheric changes have their influence.

The Yellows is caused by sudden and too great heat; the worms swell, turn yellow, throw off an acrid humor that poisons all that *comes in contact with it.* Remedy, cleanliness, and cool the atmosphere by sprinkling the floors and admitting pure, dry air.

Tripes arises from confined exhalations from the worms themselves, Remedy, clean the hurdles, wipe over with solution of chloride of lime, give dry, healthy food.

Pebrine (which means pepper) causes the worms to look as if sprinkled with pepper; worms found afflicted with this disease should be buried as they are said to be poisonous.

Then there is the *Muscadine* and other troubles, but for all we can only advise watchfulness, cleanliness, pure air and plenty of good food.

Count Dandolo says in reference to the jaundice or yellows, that he found sifting very fine quicklime over the worms efficacious, but as this is too severe a remedy for experiment, it would be more prudent to remove diseased worms and use chloride of lime or carbolic acid in wiping over the trays, wall and floor as a disinfectant.

Darkness is unhealthy (until the spinning period), as it generates carbonic acid gas, which is unfit for respiration.

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