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AN ACCOUNT OF THE HABITS, CHANGES,  
AND DISEASES

OF THE

**BOMBYX MORI:**  
**Or Common Silkworm.**

✓ Compiled by the  
BOYS' SILK CULTURE ASSOCIATION,  
of the UNITED STATES.

PRICE 23 CENTS.

WALKER & COMPANY, PHILA.





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OR

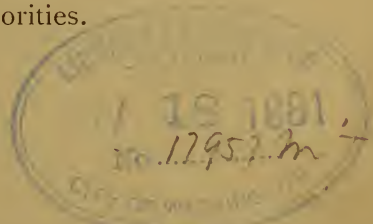
COMMON SILKWORM.

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COMPILED BY THE

BOYS' SILK CULTURE ASSOCIATION of the United  
States, from Personal Experience and the Works  
of Various Standard Authorities.

PRICE 25 CENTS.



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## INTRODUCTION.

The silkworm is a native of China. The silk industry was first introduced into Europe about the middle of the sixth century (552 A. D.), by two Persian monks, who brought a few silkworm's eggs from China in a hollow cane, in order to avoid detection. The worms proceeding from these eggs were carefully reared by the monks until they spun cocoons. They were the ancestors of those countless numbers of silkworms now in existence in Europe and Western Asia.

The silkworm is the caterpillar of the silkworm moth, which belongs to the family *Bombycidæ*, genus *Bombyx*, of that branch of lepidopterous insects known as moths. Like all other insects, it undergoes two complete transformations during its lifetime.

The full-grown worm is two and a half or three inches long. If now examined, it will be ascertained to have sixteen legs arranged in pairs: the first three pairs are attached to the first three rings of the body, and are called "true legs," being the only ones that are retained in the moth state; the next three rings of the body are without legs; the other five pairs of

legs are called "holders," and exist only in the caterpillar, being used in climbing.

On each side of every ring of the body may be observed a small hole, surrounded by a black ring: these are the spiracles or breathing holes, the organs of respiration in insects.

The silk is produced from two reservoirs extending the whole length of the body and uniting in the spinneret at the mouth. When about to spin, these reservoirs become very much enlarged. The silk exists in the body of the worm as a yellow gum. If it be taken from a cocoon and examined under a microscope, it will be found to be composed of two fibres, being derived alike from the two reservoirs. These fibres are made to cohere by a gummy substance secreted by a number of glands situated on each side of the body near the mouth.

The silkworm has fourteen eyes, seven on each side of the head, near the mouth, which has a vertical instead of a horizontal opening. The worm, after having wrapped itself up in the cocoon, is called a *pupa*, or "chrysalis"; and on emerging from the cocoon, it is called an *imago*.

The silk is wound from the cocoon by a process called reeling. It is then sent to the throwster, who unites several threads of reeled silk and twists them; afterward to the dyer, when it is ready for weaving.

## SECTION I.

### THE CATERPILLAR PERIOD.

As soon in the spring as the mulberry leaves have attained sufficient size to be given to the young silkworms, which in this climate is about the middle of May, the eggs may be brought out from the place where they have been kept during the winter, and placed in the cocoonery. Keep them out of the sun; the natural temperature will be sufficient to hatch them. The direct rays of the sun, or its reflection, are found to be injurious to the eggs, the worms, and the moths.

About the ninth day after the eggs have been placed in the rearing apartment, or cocoonery, they will become lighter in color, and the worms may be seen curled up inside. When about to hatch—(they usually hatch on the tenth day after they are brought into the cocoonery)—they should have pieces of *white* mosquito netting placed over them, and on top of this a few white mulberry leaves, chopped into small pieces. The worms, as soon as hatched, will crawl up through the meshes of the mosquito netting on to the leaves, and at once begin to eat. They will hatch in the morning from daybreak until eight or nine o'clock.

When first hatched, it is of a black color, which is due to a number of hairs with which the

young worm is covered. This black color, however, gradually disappears, and is replaced by that of a dingy white.

Young worms continue to increase in size until they cast their skin, or "moult," a period varying, according to the temperature in which they are reared, from four to eight days. When moulting, they erect their heads and cease to eat. They moult either four or five times during their caterpillar life, which lasts, in this latitude, from four to five weeks.

The period from hatching until the first moulting is called the first *age*; from the first until the second moulting, the second age, etc.

In order to insure success in rearing silkworms, the following must be particularly attended to, viz :

I. Only worms that are hatched on the same day should be kept together. By keeping worms hatched on different days apart, you will save a great amount of labor, as the worms will, by this arrangement, all moult at the same time.

II. No regular number of times for feeding the worms can be assigned ; they should be fed as often as the leaves become dry or are consumed.

III. Feed the worms on the leaves of the *Morus alba*, or white mulberry, if procurable ; if not, those of the black or red mulberry, or of the *Maclura aurantiaca*, or osage orange, may be



substituted. Those of the white mulberry are preferable, for—

*First*—The tree bears leaves earlier in the spring;

*Second*—A greater amount of leaves are furnished in a shorter period of time;

*Third*—The silk produced from these leaves is of that sort most desired by the manufacturers.

IV. Should any worms hatch before the above-named leaves are procurable, substitutes must be given, such as lettuce, or even tender cabbage leaves; but they will not thrive on this kind of diet during their last ages.

V. Young worms must have the leaves chopped up for them during the first three ages. This saves a great waste of leaves and is also a great advantage to the young worms; because the smaller the leaves are cut the greater is the number of fresh-cut edges that exist, and the greater the number of worms that can be fed on this amount of leaves.

VI. Do not allow the leaves on the trays to ferment, as the odor from fermented leaves will tend to generate diseases.

VII. The litter must be allowed to remain on the trays while the worms on them are moulting; for the worm, during its sickness, does not like to be disturbed.

VIII. Tobacco in every form should be kept away from the cocoonery, and much caution must be taken to keep it free from rats, mice, birds, and insects.

IX. Most of the diseases to which silkworms are liable are caused by foul air, dampness, or defective management. Charcoal or chloride of lime should always be kept in the cocoonery, and must occasionally be renewed.

X. The amount of leaves consumed by the produce of  $\frac{1}{4}$  oz. eggs (about 10,000) is as follows :

During the first age . . . . .	1 $\frac{1}{2}$ lbs.
“ “ second age . . . . .	4 $\frac{1}{2}$ “
“ “ third “ . . . . .	15 “
“ “ fourth “ . . . . .	45 “
“ “ fifth “ . . . . .	274 $\frac{1}{2}$ “

XI. The temperature during the caterpillar period must not be allowed to fall below 70° Fahr., but should be kept above that point by artificial means; should the air become too hot, its temperature may be lowered somewhat by sprinkling the floor with water, but the worms ought never to be deprived of the great benefits arising from keeping the air continually in circulation throughout the rearing apartment. The temperature should be maintained as even as possible, as any sudden change is disastrous to the health of the worms.

XII. One hundred worms just hatched weigh about

	Grs.
	I
After their first moulting, . . . .	15
“ “ second “ . . . .	94
“ “ third “ . . . .	400
“ “ fourth “ . . . .	1628

On attaining their greatest size and weight, 9500.

XIII. Of the *cocoonery* and *feeding*.

A room with windows on all sides except the east is preferable. Perfect ventilation is of the utmost importance: for this purpose numerous ventilators must be made.

The worms not being of a wandering disposition, are placed on frames or “trays,” the most convenient size being two by two and a quarter feet. A tray of this size will hold from four to five hundred worms.

On the bottom of the trays, twine or cane may be stretched across, forming a network on which the worms are placed.

In feeding young worms (*i. e.* worms not yet too large to crawl through the meshes of mosquito netting), place a piece of mosquito netting of a convenient size to cover all the worms, over them; on top of this put a number of pieces of mulberry leaves: the healthy worms will soon crawl up on to the fresh

leaves, and the stale leaves underneath may be removed.

In feeding older worms, place the leaves on top of the worms, and remove the litter as often as possible. (It may be appropriate to remark here, that the warmer the atmosphere in which the worms are reared during the first age, the sooner will they spin cocoons; the only economy in having worms to spin soon is in the *time* saved, as they consume the same quantity of leaves during the caterpillar period, no matter what the temperature was in which they were reared.)

Silkworms naturally are quite hardy. If they are attended to as described above, they will not be subject to any disease; but they are frequently reared in damp places or in impure air, which will produce the diseases which are described in the next section.

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## SECTION II.

### THE DISEASES OF SILKWORMS.

As already remarked, the diseases of silkworms are generally the result of bad treatment. Their causes and remedies are as follows:

I. Diseases in consequence of defective eggs, or in preserving them. The worms will become diseased—

*First*—When the room where the moths are laying eggs is damp, the evaporation will be very slow and the eggs will not become dry enough.

*Second*—When the place where the eggs are kept during the winter is damp.

No diseases will occur if the eggs are kept dry.

II. Diseases in consequence of the temperature not being regulated properly will occur—

*First*—When the eggs that are about to hatch are suddenly exposed to any great change of temperature, either warmer or colder.

*Second*—When the worms that are just hatched are brought suddenly into a much higher temperature; for the greater the degree of heat the greater will be the evaporation, and this will affect the delicate organs of the newly hatched worm very severely.

The first organs affected by the diseases proceeding from the causes above enumerated are the reservoirs containing the silk; and should they become very greatly affected, the worm will usually die before reaching the time for spinning its cocoon.

These diseases can never happen—

*First*—If the worms are kept in an even temperature; and

*Second*—If, in removing the worms, they have not been exposed to draughts of damp air.

III. Diseases, not generated in the eggs, arising from defective management, are caused—

*First*—By placing the worms too thick on the trays, thereby hindering them from feeding comfortably.

*Second*—By not keeping the air dry and in constant circulation. (This impedes the breathing, and causes the leaves on the trays to ferment. If this is continued, it will make the worms unhealthy, and probably cause their death.)

*Third*—By giving the mulberry leaves to the worms when not sufficiently dried; for water is fatal to silkworms.

*These can be prevented—*

*First*—If the worms are evenly distributed on the trays, and are not too much crowded.

*Second*—By renewing the air, and keeping the cocoonery dry.

*Third*—By drying the leaves thoroughly before giving them to the worms.

It may also be appropriate in this connection to state—

*First*—That keeping the cocoonery *light* is of great benefit to the worms.

*Second*—That keeping some purifier, such as charcoal or chloride of lime, in the room, will prevent a great many of the diseases of silkworms.

We have given some of the causes producing sickness in silkworms, and the means by which they may be prevented; we will next give a description of the most common diseases arising from the aforementioned causes.

## I. THE YELLOWS.

The yellows is probably the most common disease to which silkworms are liable. It is accompanied by the following symptoms:

*First*—The head of the worm swells;

*Second*—The skin is drawn tight over the rings of the body, making it look as if varnished;

*Third*—A yellow liquid is discharged, which may be observed on the leaves.

When any worm becomes affected with this disease, it will avoid other worms, seeming to know that if a healthy worm should touch this yellow liquid it would become infected with the disease.

As soon as any evidences of the yellows appear in any of the worms, the unhealthy should immediately be removed, as the disease is very contagious.

*Remedy*.—Sometimes, if the worm is not too far gone, removing it into purer air may restore it to health; hence, the obvious cause of this disease is the impurity of the air.

Persons living in the country, and raising silkworms, must be careful not to throw any diseased

worms where the poultry could find them to eat them, as they would be likely to be poisoned by them.

## II. THE TRIPE SICKNESS.

In this disease, the worm, although dead, still appears to be alive. In order to ascertain whether it is dead or not, it must be touched, when it feels somewhat like tripe: hence the name.

## III. THE SCARLET.

This disorder dries the rings of the body up, and stupefies and cramps the worms.

As its name indicates, it turns the worm red at first, which, however, in later stages of the disease changes to white.

These are the principal diseases of silkworms occurring during the caterpillar period. They all result from bad treatment, and will never occur in a well-regulated cocoonery. The care of rearing during this period should be particularly attended to, for *worms* that are ill-managed will neither spin perfect cocoons nor will they emerge as healthy moths, and consequently will not lay healthy eggs. Imperfect cocoons can not be sold at market rates of good cocoons, but go with that class known to the manufacturers as waste silk, the price paid for which is very low.



### SECTION III.

## PERIOD WHEN THE WORMS ARE PREPARING TO SPIN THEIR SILKEN COCOONS.

Silkworms prepare to spin their cocoons in about thirty days after hatching. It is very important to know when the worms are about to spin, in order that preparations may be made accordingly.

When any worms appear as follows, they are likely to spin in less than twenty-four hours after being examined:

*First*—When fresh mulberry leaves are placed on the trays and the worms do not eat them, but merely crawl upon them, and when they erect their heads.

*Second*—When, on holding the worm up toward the sun, it appears to be somewhat transparent and of a straw color.

*Third*—When large numbers of the worms leave the centre of the trays and crawl up along the framework which supports them.

*Fourth*—When their bodies become much thinner up near the head and about the neck, causing the skin to become wrinkled; and feel softer than they do ordinarily.

*Fifth*—When the rings of their bodies are drawn tight around them, and the whole body changes to a light yellow color.

When these signs appear in any of the worms, preparations for spinning must be made immediately, in order that those worms that are ready to spin shall not lose their strength and silk in hunting for the support requisite for the perfect formation of their cocoons.

All the worms hatched on the same day will not spin on the first or second day after the first have spun, but the majority will. Those that will not should be removed and placed in a warmer atmosphere, in order to accelerate their movements.

In order that the silk may be gathered with ease, various receptacles for the cocoon are used by different silkworm rearers; however, for those raising but a small number of cocoons, paper cones or funnels are about the cheapest and best; for the cones are more like the leaf of the mulberry tree, in which the silkworms naturally like to spin. The cone also economizes the silk used in the formation of the "floss silk," or that used to support the cocoon, hence leaving more silk with which to form the cocoon itself.

Bunches of twigs, arbors, etc., are also used extensively; but the advantages of cones over these are obvious.

## SECTION IV.

### CHRYsalis PERIOD.

The silkworm requires four or five days to complete the formation of its cocoon; most cultivators, however, allow seven or eight days to elapse before gathering them.

When the cocoons are gathered, and the floss silk removed, they are divided into nine qualities:

*First*—GOOD COCOONS. They seldom attain to any great size, but they are compact and spotless.

*Second*—COCALONS. These are larger than good cocoons, but contain about the same amount of silk, being less compact.

*Third*—POINTED COCOONS. Cocoons of this kind are very difficult to reel, and often can not be reeled at all. They have one end rising in a point, and the silk, when it reaches the pointed end, will very likely break.

*Fourth*.—DOUBLE COCOONS or DUPIONS. The fibres are interlaced. They are formed by two or more worms spinning in the same cone at the same time. They can very seldom be reeled.

*Fifth*—SUFFLONS. These are very imperfect, so much so as to be transparent. They are usually not reeled, as they contain very little silk.

*Sixth*—PERFORATED OR PIERCED COCOONS can not be reeled in water, but sometimes they can be reeled around the finger without the use of water. They have an opening in one end, through which the moth has emerged.

*Seventh*—GOOD CHOQUETTES. The worms in these have died; if shaken, they do not rattle. The silk which they contain is as fine as that of good cocoons, but it is not so good for manufacturing purposes.

*Eighth*—BAD CHOQUETTES. These are spotted and rotten cocoons, produced by unhealthy worms. They are of a dark color and are not worth reeling.

*Ninth*—CALCINED COCOONS. They are of more value than any other quality of cocoon, but are very scarce. The worm inside, after having completed its cocoon, becomes petrified, or converted into a white powder.

Pointed and pierced cocoons, dupions, sufflons, bad choquettes, the waste in reeling, and the floss silk, are taken together, and form an article known as *waste* silk, which is spun into yarn.

The chrysalis remains in the cocoon from fifteen to twenty days.

For the purpose of breeding, an even number of male and female cocoons must be selected. The male cocoons may generally be distinguished by

being considerably compressed in the middle, smaller than the female, or by having one extremity much more pointed than the other.

It is a great advantage to those who do not reel the cocoons to sell them as soon as gathered, as they weigh more then than at any other time.

The first object of attention, after the cocoons have been gathered, is to choke or "stifle" the chrysalides, which is generally done in one of the following manners :

#### I. By the solar rays.

Select a clear warm day; spread the cocoons out on a cloth, and place them in the sun, being careful to keep the ants away.

Keep them exposed in this manner for four or five hours during the middle of the day, for five or six days, and the chrysalis will usually be stifled.

In order to ascertain whether life is extinct or not, strip the silk from a cocoon and stick the chrysalis with a needle; if no signs of animation are evident, the stifling has been completed.

#### II. By the heat of an oven.

Place the cocoons to be stifled in long shallow baskets, and put them in an oven whose temperature is about 200° Fahr. Let them bake for about two hours. When taken out of the baskets they

must be spread out until perfectly dry, when they are ready for the market.

### III. By the use of alcohol.

Put the cocoons in a box, as nearly air-tight as possible. First put in enough cocoons to make a layer six inches deep. Upon every *superficial* square foot of these, sprinkle half a pint of alcohol. Place layers of six inches each, one upon the other (sprinkling each layer), until the box is filled. Let them stand for twenty-four hours, and during that time sufficient heat will be created to stifle the chrysalides.

### IV. By camphor.

Line the inside surface of an ordinary barrel with paper, so as to make it nearly air-tight. Use about a pound of camphor to the barrel. Sprinkle a little in the bottom of the barrel, put in six or seven inches of cocoons, then sprinkle a little more camphor, and so continue until the barrel is filled. Close the barrel, and let it stand for two or three days.

After the stifling has been completed by any of the means described, the cocoons should be placed on cloths and dried, in order to preserve them from moulding, which is very likely to occur. When thoroughly dried, they can be packed in boxes and sent to the market.

## SECTION V.

### PERFECT PERIOD.

The moths, or perfect insects, issue from the cocoons in the morning from four to nine o'clock.

As soon as they pierce their cocoons, they are placed in a dark room on pieces of blotting paper, until they discharge a liquid of a light brown color. As soon as this is discharged, which is usually in five or ten minutes after they emerge from the cocoon, they should be placed on sheets of cardboard and mated. After ten or twelve hours have elapsed, they may be separated, and the males thrown away. Now place the female moths on large pieces of paper, card-board, or linen, for the purpose of laying their eggs. The cards on which the moths are to lay their eggs are tilted at an angle of  $45^{\circ}$ : this will cause the moths to lay their eggs closer than if the surface is horizontal.

The number of eggs laid by each female moth varies from 300 to 450.

The eggs, when laid, are of a yellow color, which, if the eggs are not defective, changes in a few days to a bluish gray.

In this climate, there is no danger of eggs laid late in the summer hatching before December; but after that time they must be kept in a temperature below  $40^{\circ}$  Fahr.

An ounce of eggs (576 grains), is found to contain 40,000 (39,168), and can be produced from 120 female moths.

The greatest precautions must be taken to preserve the eggs during the winter in a perfectly dry place ; and they should be looked at occasionally, to see that no mould gets on them.

These are the principal points that must be attended to previous to the process of reeling. Reeling is usually carried on as a business distinct from that of rearing the worms, or else it would have been described here.

Every fact recorded in this book must be attended to strictly, or else success will be very uncertain. Only the most important facts are mentioned ; but anything further respecting the rearing of silkworms or the sale of cocoons, will be given gratuitously by addressing

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