

SILK-CULTURE IN CALIFORNIA.

THE material benefits accruing from the long, dry seasons, and mild and equable climate of California, are peculiarly manifested in the culture of silk. The worm that spins this delicate fibre is exceedingly sensitive to meteorological changes, whether these be in the electrical conditions, the quiet, or the temperature of the atmosphere. It is liable to be fatally injured, at all stages of its existence, by any considerable excess of heat, cold, or long-continued moisture, as well as by heavy thunderstorms, or other violent electrical disturbances. It also suffers readily from an insufficiency of sunlight, or a lack of ventilation. It has happened, on many occasions, both in European and Asiatic countries, that almost the entire stock of silk-worms has been killed by a long, cold rain; heavy and repeated peals of thunder having been attended with like effects. Protracted dampness covers the worm with a downy mold, inducing disease, and often causing death. Owing to the injuries received, or the maladies engendered, by these meteorological changes and conditions, more than one-half the worms hatched in these countries die before they reach maturity. Nor are the injuries arising from these causes confined to the worm itself; the eggs sometimes suffering to an equal or even greater extent.

In Europe, it is calculated that not one egg in four will produce a cocoon, the fatality of late years having risen to an average of fifty per cent. among the peasants, or small growers, and seventy-five per cent. among the larger proprietors. This disease has now been prevalent in the silk-growing districts of Europe for fourteen years, its ravages

having increased steadily throughout all that time. The entire region within a thousand miles of the Mediterranean, is afflicted with this scourge. Although the ablest chemists and entomologists have investigated the subject with the utmost care, they have been unable to detect the cause, or to furnish any preventive; and were it not that fresh supplies of eggs could be procured from places abroad, these countries would be obliged to give up the culture of silk altogether. The annual loss from this cause in France alone is estimated at \$20,000,000, the production of cocoons having been reduced from 25,000,000 to 4,000,000 kilograms; while in Italy and Turkey the results have been almost equally disastrous.

Until within the past few years, these countries obtained their supply of healthy eggs chiefly from Japan, sending there annually a considerable number of persons to make these purchases. The prices paid for eggs at Yokohama—the principal mart in Japan—have varied from \$1.50 to \$6 per ounce, averaging about \$2.50 per ounce. The sum expended there for eggs, on account of Italy and France, amounted, in 1867, to \$2,000,000, and in 1868 to double that sum. These eggs, which were formerly sent to Europe *viâ* the Isthmus of Suez, have, since the establishment of the San Francisco and China line of steamers, come this way, going forward first by the Panama route, and latterly by railroad.

For several years past, the California breeders have been sharing this traffic with those of Japan, the proportion falling to the former being rapidly on the increase. That they will be able to mo-

nopolize this trade in a very short time seems probable, inasmuch as the California eggs have shown themselves more healthy, and every way superior to those of Japan; while our greater proximity to the points of ultimate distribution will enable us to supply all demands from that quarter quicker, and at less cost, than could be done by the Japanese grower. It appears that of the eggs sent to Europe, none raised in this State failed to arrive at their destination in a sound and healthy condition, whereas a large proportion of those forwarded from Japan were damaged to an extent that rendered them worthless; this result having been mainly due to the greater length of the sea-voyage, and in part, also, perhaps, to defects inherent to the eggs. In view of this experience, most foreign orders will, no doubt, hereafter be filled in California, thereby curtailing the product of raw silk, and retarding, for the time being, its manufacture in this State. The latter business, however, has begun under favorable auspices, and with every prospect of proving remunerative to its enterprising founders. It is reasonable to suppose that the California grower will dispose of his eggs so long as he finds this more profitable than rearing the worms; and as there is little likelihood that the disease now so prevalent in Europe will suffer early abatement, it seems probable that the raising of eggs will for a long time constitute the principal branch of this husbandry in California.

So deeply interested have the principal silk-growing countries of Europe become in the question of obtaining a full and cheap supply of eggs, that France, Italy, and Austria lately sent out a joint Commission to Japan, for the purpose of ascertaining the reason for the constantly increasing cost of eggs in that country, and whether it was due to a system of extortion being practiced, or to an actual scarcity arising from the ravages of

disease, as alleged by that people and Government. The latter these Commissions, after a careful examination, found to be really the cause, and so reported to their Governments. They say that a little before the silk-worm there begins to form its cocoon, a small fly deposits an egg upon it, which, adhering to the animal, is carried into the cocoon with it, afterward hatching out a minute grub that eventually destroys the chrysalis. This pest has been spreading rapidly in Japan for some years past, and, in the absence of any remedy—none having yet been found—the silk-raisers of that country will themselves soon be obliged to look abroad for eggs.

Dr. Tryski, the Austrian Commissioner, says that of all the cocoons reserved for producing eggs the past year in Japan, more than forty per cent. was lost, causing the price to advance to \$4.50 and \$5 per ounce; and yet there had already been shipped thence to Europe 1,300,000 ounces, at a cost of \$5,850,000, the prospect being that the entire quantity sent away the current year would reach 2,000,000 ounces, costing there not less than \$9,000,000.

These are enormous figures, taken in connection with a business, or rather only one branch of a business, which, even as an entirety, Californians have been apt to consider as but of secondary importance. It is almost startling to think that from a calling so neglected, and a commodity so apparently insignificant, we may be able to realize in a short time a larger sum, and infinitely greater gains, than from one-half of all our other agricultural productions. And this, too, from a business that can be readily started, and with little capital—that requires but a small amount of land, no skilled labor—demanding scarcely any other care than that of women and children, and which, in any event, need not greatly interfere with other farming operations, the attention bestowed upon it being called for

mostly at times when other matters are not apt to be pressing.

Thus far the business, since it became fairly established, has proved generally profitable; and, in many cases, where largely engaged in and well attended, highly lucrative. Hitherto, California-grown eggs have sold readily at from \$8 to \$10 per ounce, with the exception of a short period in 1868, when the price fell to \$4. Since then former rates have been re-established, and it is not probable that they will again very soon recede to so low a figure. Should they do so, however, the business would still be profitable, as it was found to pay well at \$6 per ounce, at a time when the production of eggs was comparatively limited, and when a large percentage of loss resulted from sending them to market by a circuitous route through tropical climates. Many of the eggs transmitted by way of Panama—the only practicable route up to one year ago—were hatched or killed outright on the voyage, owing to the high degree of heat to which they were exposed.

Reverting to the early history of silk-culture in California, we find that we owe its introduction, in the first instance, to the late Louis Prevost, a native of France, and pioneer settler in this State. Accustomed to the business in his native land, perceiving the advantages enjoyed for its prosecution here, Mr. Prevost determined upon testing the capacities of our climate in this respect by a practical trial. To this end he purchased a tract of land well suited to the purpose, near the town of San José, a portion of which he proceeded to plant with mulberry-trees. Having prepared the necessary food, he met with many disappointments in attempting to supply himself with worms; several shipments of eggs, consigned to him during as many successive years, having come to hand in a condition that rendered them useless. Succeeding, at last, in obtaining a healthy lot,

he was soon the owner of a large number of worms, which, to his delight, proved to be voracious feeders and vigorous workers; the cocoons produced by them surpassing in size, appearance, and every desirable quality any he had ever seen in Europe. From this time, Mr. Prevost engaged in the business to the extent of his means, which, being limited, restricted his operations at first. In the fall of 1860 he had but five hundred eggs, which were gradually multiplied until, in 1865, the number reached 100,000; after which they increased much more rapidly.

Meantime, other parties, encouraged by Mr. Prevost's example and advice, had begun to experiment in this line of production; and, having met with invincible success, the quantity of trees, as well as worms, increased rapidly; the number of the former growing in the State, last year, having been estimated at 6,000,000 to 7,000,000. The number of cocoons made during that year exceeded 5,000,000; and it is the opinion of competent judges that 10,000,000 or 12,000,000 will be produced the present, and nearly twice as many the next ensuing summer, notwithstanding the large prospective shipments to Europe. It is believed that the annual increase will be at the rate of sixty or seventy per cent. for some time hereafter.

The counties in this State most extensively engaged in the business of growing the trees and rearing the worms are Los Angeles, Santa Barbara, Santa Cruz, Santa Clara, Sacramento, Yolo, El Dorado, and Nevada. It is, however, largely carried on in many other counties, there having been twenty-eight exhibitions of cocoons at the State Fair in 1868, representing nearly every portion of California. Among these parties the largest growers were I. N. Hoag, of Yolo County, who had, at that time, 1,000,000 worms; W. M. Haynie, of Sacramento, with 800,000 worms, and Louis Prevost, of San José, who was then feeding over

500,000 worms; and the operations of these parties have, since that time, been much extended. At present, there are other growers in the State not much behind these in the extent of their operations.

The mulberry-tree will not only grow, but thrives wonderfully in nearly all parts of California, requiring no more care in its culture than ordinary fruit or forest trees. Spots where the cotton-wood, poplar, or balm of Gilead spring up naturally, would be well suited for mulberry nurseries and plantations, these trees all belonging to the same family.

How readily and largely this business of growing the eggs and cocoons can be made to pay, is shown by the recently published statements of Mr. I. N. Hoag. Mr. Hoag, who resides in Yolo County, near Sacramento, has a plantation of mulberry-trees, embracing an area of three and a half acres. On the 1st of June, 1868, he commenced feeding his worms, having finished by the 25th of July, when the eggs, amounting to 486 ounces and 13½ pennyweights, were all laid. These, excepting a few kept for his own use, were at once disposed of, at the rate of \$4 per ounce; amounting, with those retained, and a small number of perforated cocoons, to \$3,920. The entire cost of this production, labor included, was but \$472, leaving a net profit of \$3,448: at the rate of \$1,000 per acre. But a little over two months elapsed, from the time he commenced feeding until the eggs were sold and receipted for. The trees, in this case, had been grown from cuttings, planted where they stood, two years before. During the preceding winter they had been cut back close to the ground—the tops being required for planting—and gave scarcely more than half as many leaves as they would if they had been pruned with a view to promoting a more exuberant foliage. In the following month of August Mr. Hoag fed, from the same trees, about

an equal number of worms of the Japanese trivoltine variety; but not caring to procure eggs of this kind, he destroyed the chrysalides in the cocoons, preserving the fibre for future use. The silk thus obtained was donated to Mr. Joseph Neumann, of San Francisco, who has since woven it into two flags: one of which is destined to float over the State House at Sacramento, and the other over the National Capitol.

Taking at random a few other examples, we find that Mr. H. G. Ballou, of Yolo County, obtained, last year, (a very unfavorable one for the business) sixty ounces of eggs and twelve pounds of cocoons, from the worms hatched from a single ounce of eggs of the French variety; his profits being at the rate of \$996 per acre of trees. T. B. Flint, of Sacramento, feeding worms hatched from less than three ounces of French eggs, produced forty-eight pounds of perforated cocoons and two hundred and eighty ounces of eggs, realizing clear profits at the rate of \$1,261 per acre. Without citing other instances, we may say that a similar success has attended the silk-growers generally throughout the State.

To commence the culture of silk in California is now comparatively an easy matter. Eight or ten years ago labor and materials were costly, while eggs and cuttings were difficult to be obtained, and every thing had to be learned by experiment. Now such labor as will serve for this business can be had at low rates; material for building and fencing is cheap, while eggs for hatching can be procured conveniently and at little cost, cuttings for planting being obtainable at mere nominal figures, and even without charge in many places. Not much land is needed, though it should be of a good quality, and is the better for having a southerly or easterly exposure. Deep plowing and thorough cultivation are necessary at first, though the trees, after attaining a few years of age, and being set

out in plantations, require but little care. The tree can be grown from the root, from the seed, or from cuttings—the latter being the most common mode of propagation in California. It grows in this State so readily and vigorously that no manuring is needed, the shoots set out in the winter yielding a considerable quantity of leaves suitable for feeding the young worms the following summer. In twelve months from planting, the trees have reached a height of ten or fifteen feet, with a corresponding growth of trunk, and are ready for regular cropping at the end of three years, being often cut back a year earlier. Neither in Japan, China, nor any European country do the trees grow so rapidly or yield so large an amount of leafage as in California, nor will they elsewhere bear such close and frequent stripping of their leaves and branches. The mulberry-tree in California generally attains as large a growth, and is as prolific of food for the worm at three years, as in France at five years. Owing to the vitality and recuperative power of the tree here, the plan of cutting off the branches with the leaves on, instead of plucking the latter and feeding them to the worms, is generally practiced after the insects are a week or ten days old. In but few countries would the trees be able to recover themselves, and at once put forth new shoots, after such extensive mutilations. By this method of gathering the food much labor is saved, while the worm, crawling upon the branches, attacks the leaf in a natural way, insuring cleanliness to itself and economy of food. In supplying the shoots after this manner, four are first laid down in the form of a square, crossing each other at the ends. As fast as the leaves are devoured, four new branches are added; a rectangular pen being thus built up, with fresh leaves, and the worms feeding upon them constantly at the top. The litter, *exuvia*, and droppings now fall below, and the

worms are easily removed. By this plan ventilation is also secured—this, as well as cleanliness, being essential in every cocoonery. In countries having a humid atmosphere, it is important that no *débris* of any kind be suffered to accumulate, as the gases generated by their decomposition, and even the bad odors caused by their presence, endanger the life of the worms. In California, however, such extreme care is not necessary, the dryness of the atmosphere counteracting decomposition to such an extent that no removal of these waste matters is called for during the latter half of the worms' existence.

Nothing is more essential to the health of these creatures than a dry climate and a tranquil existence. Even the leaves must be free from rain and dew when fed to them, while violent electrical disturbances always cause them more or less harm. In those countries subject to heavy rains, it is difficult to provide against the first of these evils; while the latter can in no wise be averted. In California, *any* rain or thunder seldom occurs during the season of the silkworms' active existence. In most parts of the State the temperature, as well as the aridity, of the atmosphere best suits the habits of these insects. Advantages arise, too, from the evenness of the climate; as sudden and extreme changes, from which it is exempt, work to the prejudice of the worm. In California the eggs hatch spontaneously, no artificial heat ever being required for this or any other purpose connected with silk husbandry. In nearly all other countries, heat, generated by various artificial means, has to be employed for drying the leaves, or raising the temperature of the cocoonery, involving a necessity for much additional labor and expense, and interfering with effective ventilation. In localities where the temperature of the open air is insufficient to hatch the eggs, Californians may insure

this process by placing them in glass-covered boxes exposed to the sun, or in a garret upon which the rays of the sun fall during the day. Light being another element necessary to the health of the silk-worm, the long-continued and uninterrupted sunshine of the California summer fully meets its requirements. That it would thrive here might be inferred from the fact, that a species of this worm is native to the country, being found in the interior of the State, breeding, and subsisting upon the wild lilac, the leaf of which seems to contain properties similar to those of the mulberry-tree.

As compared with France—the leading silk-growing country of Europe—California can produce the raw material at much less cost than can be done there, notwithstanding high-priced labor. In California, one person can feed and look after 75,000 worms; in France, this calls for the services of two persons. Here an acre of trees will feed 140,000 worms—a third more than the average in that country, whose trees also do not yield leaves as early. The most skillful Eu-

ropean growers are satisfied with a net yearly profit of \$400 per acre, while the California grower can safely count on \$1,200. His cocoons yield not only more silk, but of a better quality than most others. With the rich, virgin soil of California no stimulating manures are required, such as often tend to enfeeble the worm and deteriorate the quality of the fibre spun by it.

In regard to the reeling and weaving of this textile into fabrics, it will probably be some time before this will be extensively carried on in California. Recently, however, a company, embracing a number of skillful operators, has been formed for the purpose of manufacturing silk in San Francisco; it being their intention to use whatever raw material of domestic growth may offer, and obtain the balance of their supply, should more be needed, from China and Japan. In the establishment of this manufactory, the silk-growers of California, having the assurance of a home-market for their fibre, will be warranted in paying more attention to its production than heretofore.
