worms increase in size with astonishing rapidity, and no less remarkable is their growing voracity. Certain races moult or cast their skin three times during their larval existence, but for the most part the silkworm moults four times—about the sixth, tenth, fifteenth, and twenty-third days after hatching. As these moulting periods approach, the worms lose their appetite and cease eating, and at each period of change they are left undisturbed and free from noise. The worms from 1 oz. of graine—numbering, say, 40,000—consume in their first stage about 6 lb of picked leaf, in the second 18 lb, in the third 60 lb, fourth 180 lb, and in their final stage 1098 lb,— in all 1362 lb of mul­berry leaf ; but from that is to be deducted about 590 lb of unconsumed fragments removed in the litter, giving of leaf really consumed 772 lb. An ounce of graine so treated may yield from 80 to 120 lb of cocoons, 85 per cent. of which consists of the weight of chrysalides and 15 per cent. of pure cocoon. The growth of the worms during their larval stage is thus stated by Count Dandolo:—

|  |  |  |
| --- | --- | --- |
|  | Weight per 100. | Size in Lines. |
| Worms newly hatched | 1 gr. | 1 |
| After 1st moult | 15 ,, | 4 |
| ,, 2d ,, | 94 ,, | 6 |
| ,, 3d ,, | 400 ,, | 12 |
| ,, 4th ,, | 1628 ,, | 20 |
| Greatest weight and size | 9500 ,, | 40 |

When the caterpillars are mature and ready to undergo their transformation into the pupa condition, they cease eating for some time and then begin to ascend the brush­wood branches or echelletes provided for them, in which they set about the spinning of their cocoons. Crowding of positions must now be guarded against, to prevent the spinning of double cocoons *(doubions)* by two worms spin­ning together and so interlacing their threads that they cannot be reeled. The insects complete their cocoons in from three to four days, and in two or three days there­after the cocoons are collected, and the pupa killed to prevent its further progress and the bursting of the shell by the fully developed moth. Such cocoons as are selected for the production of graine, on the other hand, are col­lected, freed from the external floss, and preserved at a temperature of from 66° to 72° Fahr., and after a lapse of from eleven to fifteen days the moths begin to make their appearance. The coupling which immediately takes place demands careful attention ; the males are afterwards thrown away, and the impregnated females placed in a darkened apartment till they deposit their eggs.

*Biseases.—*That the silkworm is subject to many and serious diseases is only to be expected of a creature which for upwards of 4000 years has been propagated under purely artificial condi­tions, and these most frequently of a very insanitary nature, and where, not the healthy life of the insect, but the amount of silk it could be made to yield was the object of the cultivator. Among the most fatal and disastrous of these diseases with which the culti­vator had long to grapple was “muscardine,” a malady due to the development of a fungus, *Botrytis bassiana,* in the body of the cater­pillar. The disease is peculiarly contagious and infectious, owing to the development of the fungus through the skin, whence spores are freed, which, coming in contact with healthy caterpillars, fasten on them and germinate inwards, giving off corpuscles within the body of the insect. Muscardine, however, has not been epidemic for many years. But about the year 1853 anxious attention began to be given in France to the ravages of a disease among silkworms, which from its alarming progress threatened to issue in national disaster. This disease, which at a later period became known as “ pebrine,” —a name given to it by M. de Quatrefages, one of its many in­vestigators, —had first been noticed in France at Cavaillon in the valley of the Durance near Avignon. Pebrine manifests itself by dark spots in the skin of the larvæ ; the eggs do not hatch out, or hatch imperfectly; the worms are weak, stunted, and unequal in growth, languid in movement, fastidious in feeding ; many perish before coming to maturity ; if they spin a cocoon it is soft and loose, and moths when developed are feeble and inactive. When sufficient vitality remains to produce a second generation it shows

in increased intensity the feebleness of the preceding. The disease is thus hereditary, but in addition it is virulently infectious and contagious. From 1850 onwards French cultivators were com­pelled, in order to keep up their silk supply, to import graine from uninfected districts. The area of infection increased rapidly, and with that the demand for healthy graine correspondingly expanded, while the supply had to be drawn from increasingly remote and contracted regions. Partly supported by imported eggs, the production of silk in France was maintained, and in 1853 reached its maximum of 26,000,000 kilos of cocoons, valued at 117,000,000 francs. From that period, notwithstanding the importation at great cost of foreign graine, reaching in some years to 60,000 kilos, the production of silk fell off with startling rapidity: in 1856 it was not more than 7,500,000 kilos of cocoons ; in 1861 and 1862 it fell as low as 5,800,000 kilos ; and in 1865 it touched its lowest weight of about 4,000,000 kilos. In 1867 De Quatrefages estimated the loss suffered by France in the 13 years following 1853, from decreased production of silk and price paid to foreign cultivators for graine, to be not less than one milliard of francs. In the case of Italy, where the disease showed itself later but even more disastrously, affecting a much more extended industry, the loss in 10 years De Quatrefages stated at two milliards. A loss of £120,000,000 sterling within 13 years, falling on a limited area, and on one class within these two countries, constituted indeed a calamity on a national scale, calling for national effort to contend with its devastating action. The malady, moreover, spread east­ward with alarming rapidity, and, although it was found to be less disastrous and fatal in Oriental countries than in Europe, the sources of healthy graine became fewer and fewer, till only Japan was left as an uninfected source of European graine supply.

A scourge which so seriously menaced the very existence of the silkworm in the world necessarily attracted a great amount of attention. The disease was studied by the most eminent men of science ; reports and suggestions innumerable were made, and a whole pharmacopoeia of remedies proposed. So early as 1849 M. Guérin Méneville observed in the blood of diseased silkworms cer­tain vibratory corpuscles, but neither did he nor the Italian Signor Filippi, who studied them later, connect them distinctly with the disease. The corpuscles were first accurately described by Signor Cornalia, whence they are spoken of as the corpuscles of Cornalia. The French Academy charged MM. de Quatrefages, Decaisne, and Peligot with the study of the disease, and these learned men issued two elaborate reports—*Études sur les Maladies Actuelles des Vers à Soie,* 1859, and *Nouvelles Recherches sur les Maladies Actuelles des Vers à Soie,* 1860 ; but the suggestions they were able to offer had not the effect of stopping the march of the disease. In 1865 M. Pasteur undertook a Government commission for the investigation of the malady. Attention had been previously directed to the corpuscles of Cornalia, and it had been found, not only that they occurred in the blood, but that they gorged the whole tissues of the insect, and their presence in the eggs themselves could be microscopically demonstrated. Pasteur set himself to elucidate the life-history of these corpuscles, and he soon established (1) that the corpuscles are the special characteristic of the disease, and that these invariably manifest themselves, if not in earlier stages, then in the mature moths ; (2) that the corpuscles are parasites, and not only the sign but the cause of the disease ; and (3) that the disease manifests itself by heredity, by contagion with diseased worms, and by the eating of leaves on which corpuscles are spread. In this connexion he established the very important practical con­clusion that worms which contract the disease during their own life-cycle retain sufficient vitality to feed, develop, and spin their cocoon, although the next generation is invariably infected and shows the disease in its most virulent and fatal form. But this fact enabled the cultivator to know with assurance whether the worms on which he bestowed his labour would yield him a harvest of silk. He had only to examine the bodies of the moths yielding his graine : if they were free from disease then a crop was sure ; if they were infected the education would assuredly fail. Pasteur brought out the fact that the malady had existed from remote periods and in many unsuspected localities. He found corpuscles in Japanese cocoons and in many specimens which had been pre- served for lengthened periods in public collections. Thus he came to the conclusion that the malady had been inherent in many suc­cessive generations of the silkworm, and that the epidemic condition was only an exaggeration of a normal state brought about by the method of cultivation and production of graine pursued. The cure proposed by Pasteur was simply to take care that the stock whence graine was obtained should be healthy, and the offspring would then be healthy also. Small educations reared apart from the ordinary magnanerie, for the production of graine alone were re­commended. At intervals of five days after spinning their cocoons specimens were to be opened and the chrysalides examined micro­scopically for corpuscles. Should none have appeared till towards the period of transformation and escape of the moths, the eggs subsequently hatched out might be depended on to yield a fair crop of silk ; should the moths prove perfectly free from corpuscles