Silk Industry of Japan

THE

Imperial Tokyo Sericultural Institute.

THE SILK INDUSTRY OF JAPAN

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PREFACE.

THIS work is intended to introduce to the world the sericultural industry of Japan, giving a full description of the history and the present state of this industry, and also venturing upon some impersonal opinions as to the possibility of its further development in the future. It is, therefore, a humble hope and assurance of the author that the reader may get some idea of the general features of the sericultural industry in this country.

In the compilation of this book, the author owes valuable assistance to Messrs. C. Tsuji, T. Hayashi, Y. Tsuchiya, Y. Machida, C. Yokota, Experts of this Institute, and to Mr. T. Mitani, an Assistant-Expert.

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Tokyo, March 30th, 1909.

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THE SERICULTURAL INDUSTRY OF JAPAN.

CHAPTER I.

HISTORY OF THE SERICULTURAL INDUSTRY OF JAPAN.

The existence of silkworms as early as in *Jindai* (the Sacred Age) is stated on record, but whether their rearing was then practiced as an occupation is not ascertained. During the reign of the 14th Emperor, Chū-ai, 199 A.D., Koma-Ō, a descendant of a Chinese Emperor, came over to Japan and got naturalized, paying a tribute of precious things from China, among which were included some silkworm eggs. This was the first introduction of Chinese silkworm eggs into this country ever known in history. Some ninety years later, Tsudzuki-no-Kimi, son of Koma-Ō, also came over to Japan bringing with him the inhabitants of 127 districts of his country, who were, accordingly, distributed among various quarters of this Empire and ordered by the then Emperor Ō-jin to engage in silkworm rearing. This took place some 1620 years ago, and the real origin of the sericultural industry of Japan may be said to have dated from that time.

The succeeding Emperor Nin-toku showed his warm interest toward this industry by sending the Empress to visit Nurinomi, a Korean lady, who was engaged in silkworm rearing at Tsu-dzuki in the province of Yamashiro. This Imperial encouragement gave the people an affective inducement to pay further attention to this industry.

Another important event in the history of sericulture in Japan is to be met with in the reign of the 21st Emperor Yū-ryaku, who induced the Empress, by way of setting an example, to try rearing silkworms in person. The Emperor also gathered all the naturalized Chinese, who had been scattered throughout various districts, and made them undertake this industry more exclusively under the leading of Miki-no-Kimi, a descendant of Koma-Ō after six generations. An Imperial decree was also issued, encouraging the cultivation of mulberry trees in a greater extent in all places fit for such plantation. This reign is indeed marked by the unprecedented progress of sericulture in ancient Japan.

In the celebrated Constitution of Prince Shō-toku, promulgated in the reign of the 33rd Empress Suiko, about 1300 years ago, one clause is inserted to secure to the people freedom from public services during the seasons of farming and silkworm rearing. Fire warming was even practiced, as is recorded, in regulating the temperature of the rearing room in such remote days.

Some years afterwards, in the reign of the 36th Emperor Kō-toku, some 1260 years ago, a new system of collecting taxes was inaugurated, whereby taxes were made payable in silk textures, which caused a subsequent increase in the production

of silk fabrics. The 42nd Emperor, Bum-bu ordered by a special decree that every family should cultivate mulberry trees according to its class, viz., 300 trees for the first class, 200 and 100 for the second and the third respectively.

Up to this time sericulture had been restricted to the central and south-western parts of Japan, but during the reign of the 43rd Empress, Gem-myō, some of the rich families in the central part of Japan were transferred to the north-eastern part, and therefrom dates the origin of the sericulture in the north.

In the reign of the 60th Emperor, Daigo, some 1000 years ago, the districts producing silks of a superior quality were the following prefectures :—

Miye, Aichi, Shiga, Gifu, Hyōgo, Okayama, Hiroshima, Wakayama, Tokushima.

The districts producing silks of a medium quality were the following :—

Fukui, Ishikawa, Niigata, Kyōto, Tottori, Shimane, Yamaguchi, Kagawa, Ehime, Kōchi, Fukuoka, Nagasaki, Saga, Kumamoto, Ōita, Miyazaki, and the southern part of Shidzuoka.

The districts producing silks of an inferior quality were the following :—

The northern part of Shidzuoka, Yamanashi, Kanagawa, Tōkyō, Chiba, Ibaraki, Nagano, Gumma, Tochigi.

Thus it will be noted that the geological distribution of sericulture at that time was quite different from that of to-day, this industry flourishing more in the central and south-western parts than in the north-eastern districts.

The practice of silk-raising had been kept on in as lively a condition as before until twenty years later, by which time, however, farmers began to pay less attention to this industry, resulting in the gradual decrease of the production of silk; this was especially the case in the turbulent era of Gem-pei (the time of the contest of the two rival families of Minamoto and Taira).

It is an undeniable fact that the prosperity of industry of any kind depends upon, and goes together with, the political vicissitudes of a country. The peace Japan had been enjoying up to this time with little interruption had offered favorable conditions for the general development of sericulture, and the mode of paying taxes in silk fabrics, as has already been mentioned, had induced the people to give stronger efforts for the production of silk. But from the end of the 12th century to the end of the 16th century, the country was disturbed by civil discord; wars were frequent, farmers were overburdened with heavy taxes, and the youth were called off from farming for military service.

In this state of things, it was but natural that no due attention should have been devoted to such a delicate industry as sericulture. Another drawback was also brought on the practice of silk-raising by the prevalence of the use of cotton clothing, which had been gaining ground against the use of silk fabrics in the north-eastern and central parts of Japan some 400 years ago. The chief silk-producing districts at that time are given below:—

Chiba, Ibaraki, Gifu, Nagano, Gumma, Fukui, Ishikawa, Niigata, Kyōto, Tottori, Shimane, Hyōgo, Okayama, Ehime, Saga, Kumamoto, Miyazaki, Kagoshima.

This geological distribution of sericulture shows some difference as compared with that of 1000 years ago. The sericultural sphere seems to have moved somewhat in the north-eastern direction.

Towards the close of the 16th century peace began to prevail in the country by the establishment of the Tokugawa Dynasty, and industry of every description received fresh encouragement, sericulture naturally resuming its long-suppressed development. But as a result of frugality being the fundamental principle kept through in all state affairs by the successive *Shōgun*, the use of silk for clothing was permitted only to "*Samurai*" (military clan), and common people were strongly prohibited from wearing silken clothes, which gave considerable restriction to the demand for silk.

It may, however, be noticed that by the reign of the 118th Emperor, Kōkaku, about 100 years ago, the prevalence of the sericultural industry was moving still northwards. Here are given the chief silk-producing provinces at that time :—

Shiga, Gifu, Nagano, Gumma, Tochigi, Fukushima, Miyagi, Yamagata, Fukui, Ishikawa, Tōkyō, Yamanashi, Kyōto, Hyōgo.

After this time sericulture met with more or less encouragement; but at the time of that dreadful famine which occurred in 1785, devastating the whole country, the *Shōgun* issued a decree absolutely prohibiting the common people from wearing silk clothes, which influence was felt not only by silk traders, but extended to all silk-raisers.

Upon the opening of Yokohama harbor for foreign trade at the beginning of the Meiji era, the sericultural industry of Japan assumed a new aspect. Wide markets being now open,

the ever increasing demand for Japanese silk gave a fresh stimulus to the development of this industry, and the amount of exported silk has enormously increased year after year, till at present silk has assumed the foremost position of all exports from Japan, so much so that both the government and the people are giving every possible attention not only to the encouragement, but also to the further betterment of this industry.

Thus far we have treated of the general survey of the history of the sericultural industry in Japan before the Restoration. Here we are led to observe more at length the changes and growth of this industry since the beginning of the Meiji era.

It is to be well remembered that about fifty years ago, the silk-raisers of Italy and France, alarmed by the fearful ravages of pébrine, imported Japanese eggs with the view of introducing a healthy stock to replace the native races. The annual export of our egg-cards reached sometimes the enormous figure of over 1,000,000. In fact, the production of silkworm eggs was a profitable branch of industry at that time. But since M. Pasteur introduced his system of egg selection, the number of such exported egg-cards gradually decreased to 4,000 in 1886, to 800 in 1895, till at present the export is reduced literally to nothing.

Silk-reeling had so far been performed by means of the simple hand-wheels, but in 1869 Ono-gumi established a factory for 100 reelers at Tsukiji, Tōkyō, introducing filatures after the French model. This factory was removed three years later to Nihonmatsu, Fukushima prefecture, where it still remains by the name of the Sōshō-kwan. In 1870, the government also started a factory at Tomioka in Gumma prefecture, in which new

filatures were set and a Frenchman, Paul Bruner, was employed as an instructor, and the factory commenced its work in the following year. This gave rise to the successive establishment of many other factories in various localities, and at present we have throughout Japan 2,320 of those factories which employ more than 10 reelers each, the total number of the reeling basins provided therein amounting to 128,152.

Formerly, local silk-raisers used to sell off their products at Yokohama. In 1875, a certain Chōtaro Hoshino of Gumma prefecture tried the direct export of silk through Kindon & Co., No. 89, Yokohama, which attempt, however, resulted in failure. In the following year, this man in company with a Momotarō Satō of Chiba prefecture, succeeded in executing the sale of 400 *kin** of his silk at the price of ¥650† per *kin* to a certain American merchant of New Jersey. This was the first instance of the direct export that has ever been known.

The establishment of the Dōshin-kwaisha at Yokohama in 1879 opened the way for the direct export, and the Yokohama Specie Bank inaugurated the following year afforded a great facility to its practical management.

It is a matter of course that the silk of forty years ago should have been much inferior to that of to-day. A greater part of the silk at that time was reeled from yellow cocoons, and consequently assumed a yellowish tint, which, however, not being much admired by the dealers concerned, gradually gave place to the white silk, so that at present the latter enjoys a unique importance in the field of this industry. The silkworms that had been reared in Japan were in the main the univoltine

* *kin* = 0.6 Kilogramme. † ¥ = ½ Dollar.

race hatching in spring, but the rearing of the bivoltine race had also been tried for the summer crop. About fifty years ago, however, it was found by chance in Nagano prefecture that the silkworm eggs of the univoltine race preserved in a cave would retard their hatching until autumn. By this means the so-called *autumn silkworms* are now reared with satisfactory results, and the practice is quite extensive.

The stifling and drying of cocoons had usually been done by the heat of the sun, thus causing not a little harm to the quality of the silk so produced. The stifling apparatus by fire heating invented by the Tomioka factory, therefore, may be said to have been a great improvement in the method of cocoon preservation. In 1888, S. Morita succeeded in applying the canning method to the preservation of cocoons. In 1899, the Sericultural Institute at Nishigahara invented a certain cocoon drying apparatus fit for the practice in Japan, and brought its recommendation into public notice, which called forth many other successive improvements in the preservation of cocoons.

The government has frequently sent abroad specialists in order to make them investigate and observe the state of the sericultural industry in Europe and America, and foreigners have often been employed for the further betterment of the industry in Japan. In 1874, the Sericultural Experiment Place was opened by the Department of Home Affairs at Naitō-Shinjiku, Tōkyō, which, however, was abolished in 1879. As already mentioned, the fearful silkworm disease that had prevailed in France and Italy some years before, induced the government to establish the Station for the Investigation of

Silkworm Diseases in 1884, at Yamashita-chō, Kōjimachi-ku, Tōkyō. Careful examination practiced in this station proved the presence of pébrine in Japanese silkworms also. As an immediate measure, official regulations for the examination of silkworm eggs were promulgated in 1886, whereby silkworm eggs were made to undergo strict examination before practical use. Some months later, this station was moved over to Nishigahara, a suburb of Tōkyō, and there students from various silk-raising districts were trained in the methods of examining pébrine. This continued for three consecutive years, after which, the scope of this training was somewhat widened, and instruction was given there more at length in the general knowledge of sericulture.

Induced by the general development of society, another extension was introduced in the scope and system of this station, which was, thenceforward called the *Sericultural Institute*, according to the regulations issued in 1896. Three years later, another institute on the same basis was established in Kyōto, where experiments and instructions concerning silkworm rearing were exclusively conducted.

The need of reeling equipments being strongly felt by the Tōkyō Institute, the Filature Department was newly established in 1902 in addition to the Silkworm Department, and experiments and instructions regarding filature work were carried on there, so that these two Departments might combine their efforts for the perfection of the work aimed at.

Besides these two Institutes, many sericultural schools and institutes on a lower standard sprang up in a later date in various localities.

It is a most desirable as well as an essential thing in the silk trade both for the buyer and the seller to have an accurate knowledge of the quality and weight of the silk intended for such trade. In order to meet this necessity, which had long been felt and acknowlegded, the government established in 1895 two Silk Conditioning Houses, one at Yokohama and the other at Kōbe. The number of tests operated in the Kōbe Conditioning House, was, however, almost nil, while in the Conditioning House at Yokohama operations increased abundantly, so that the former was at length closed in 1897, and its business was carried over to the later. Since that time the number of operations in the Yokohama Conditioning House has been ever increasing, and at present the Silk Conditioning House has attained such importance that it is now considered to be an indispensable institution in the silk trade of Japan.

These governmental encouragements detailed thus far, combined with energetic endeavors on the part of sericulturists at large, have brought forth the prosperity and state of development that the sericultural industry of Japan is enjoying at present, as will be illustrated in the following chapter.

CHAPTER II.

THE PRESENT STATE OF SERICULTURAL INDUSTRY.

The sericultural industry of Japan has been given so much encouragement and protection from various quarters since the Restoration that it has attained remarkable progress and is now carried on almost everywhere throughout the Empire except in Saghalien.

Generally speaking, the production of silkworm eggs is undertaken on a comparatively large scale, and is more common in Nagano, Fukushima, Gumma, Aichi, Saitama, Yamanashi, Gifu, Yamagata, Shiga, and Tōkyō prefectures, while there are few, if any, who attempt silkworm rearing as an exclusive industry, this being carried on mostly as a supplementary employment of farmers. It may, therefore, be noted that silkworm rearers are found all over the country, though, of course, their number may vary according to the district.

In Japan, mulberry trees can be cultivated everywhere between the Hokkaidō and Formosa in an area extending over 23 degrees of latitude, which fact renders the rearing of silkworms possible at any place so far as economic circumstances allow. In fact, the number of those families, in which silkworm rearing is practiced, constitutes fully fifteen per cent. of all the families throughout Japan.

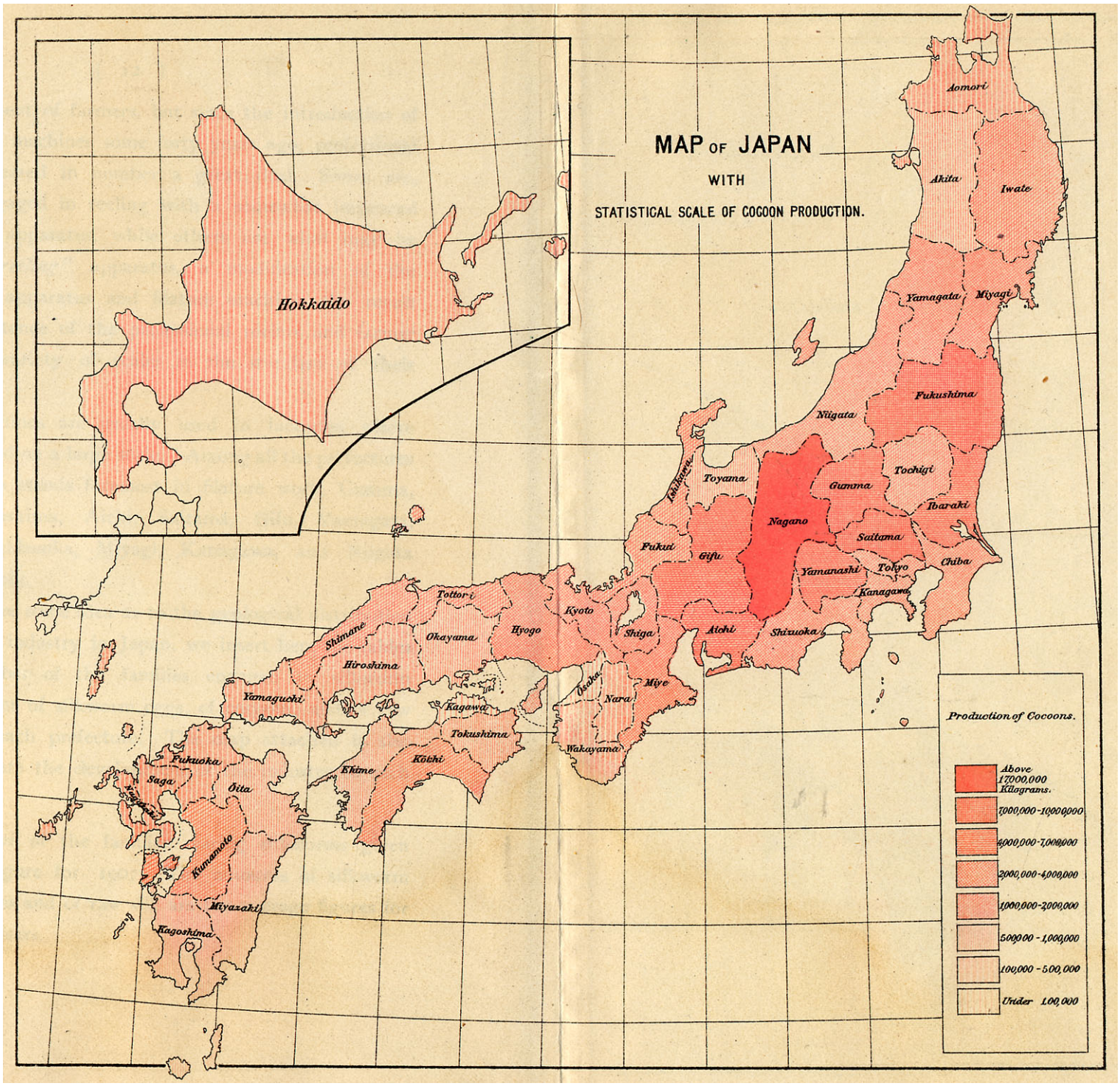
The reeling of silk from cocoons had long been performed by means of a "*sedentary reeling*" apparatus as a supple-

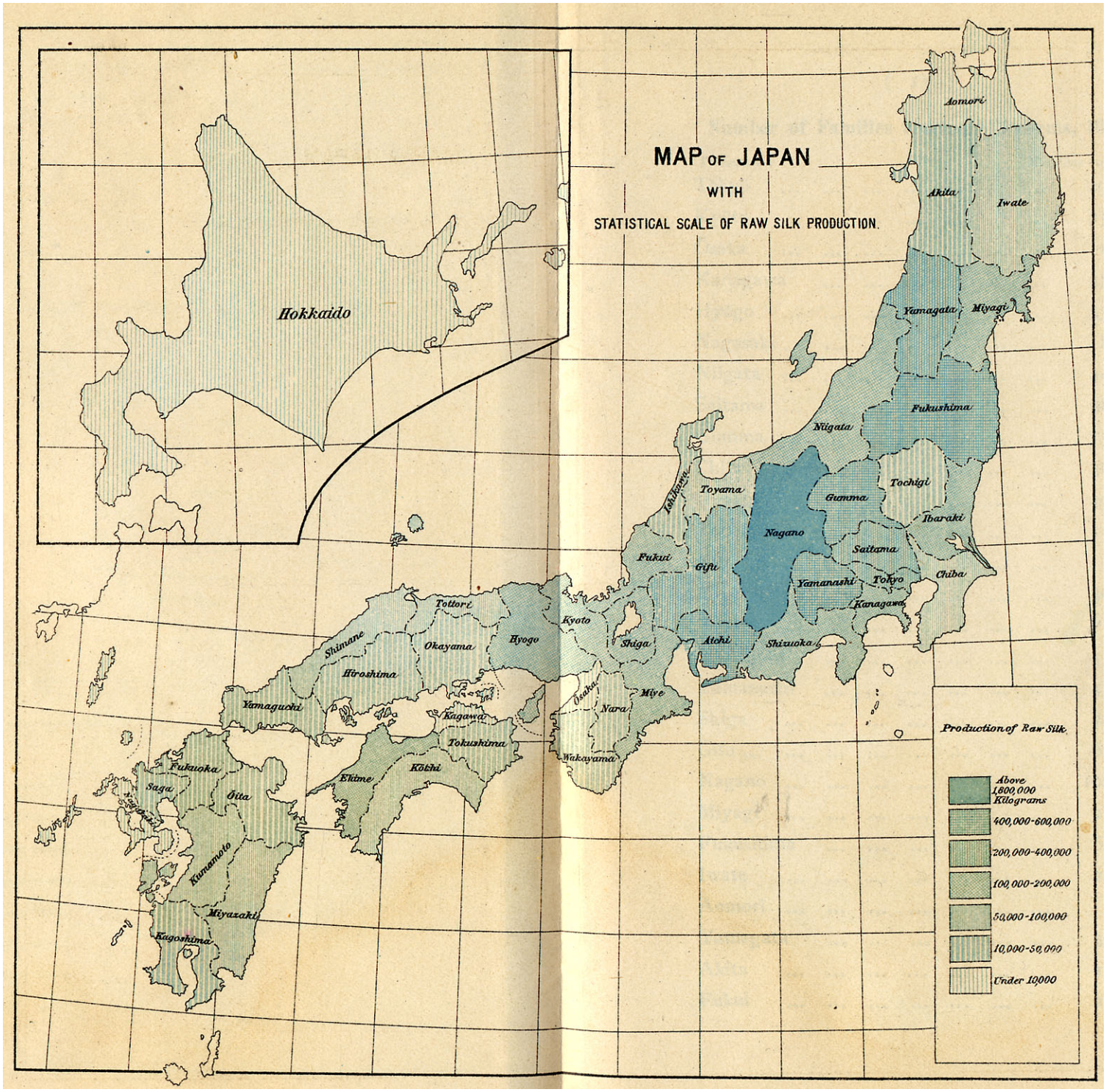
mentary employment of farmers, but since the introduction of filature or reeling machines some forty years ago, professional reelers have increased in number a great deal. Some are, however, still engaged in reeling with a somewhat improved *sedentary reeling* apparatus, while others use what may be called a "*foot reeling*" apparatus, a modification of the *sedentary reeling* apparatus and filature machine, the result being the co-existence of the professional reelers and farmer reelers, with a variety of scales in the standard of their work.

Filature machines are usually used in factories, where reeling is performed on a large scale. Among all the prefectures of Japan, Nagano stands foremost in filature work, Gumma, Yamanashi, Fukushima, Aichi, Saitama, Gifu, Yamagata, Tōkyō, Miye, Shidzuoka, Miyagi, Kanagawa, and Niigata following successively.

In order to give some idea as to the geological distribution of the sericultural industry in Japan, we insert here the tables showing the number of the families engaged in silkworm rearing, the amount of silkworm eggs, of cocoons, and of raw silk produced in each prefecture. The map attached is also intended to illustrate the development of the industry in each prefecture.

N. B. The number of the families rearing silkworms given here is the figure for 1907. The amounts of silkworm eggs, of cocoons and of raw silk are the average figures for the last five years.


MAP OF JAPAN
WITH
STATISTICAL SCALE OF COCOON PRODUCTION.
Hokkaido
Aomori
Akita
Iwate
Yamagata
Miyagi
Fukushima
Niigata
Ishikawa
Toyama
Tochigi
Gumma
Ibaraki
Nagano
Saitama
Fukui
Gifu
Yamanashi
Tokyo
Chiba
Kanagawa
Tottori
Kyoto
Shimane
Okayama
Hyogo
Shiga
Aichi
Shizuoka
Hiroshima
Osaka
Mie
Yamaguchi
Nara
Kagawa
Tokushima
Wakayama
Fukuoka
Ehime
Kochi
Saga
Oita
Kumamoto
Miyazaki
Kagoshima
Production of Cocoons.
Above 17,000,000 Kilograms.
10,000,000 - 17,000,000
7,000,000 - 10,000,000
4,000,000 - 7,000,000
2,000,000 - 4,000,000
1,000,000 - 2,000,000
500,000 - 1,000,000
100,000 - 500,000
Under 100,000


MAP OF JAPAN
WITH
STATISTICAL SCALE OF RAW SILK PRODUCTION.
Hokkaido
Aomori
Akita
Iwate
Yamagata
Miyagi
Fukushima
Niigata
Ishikawa
Toyama
Tochigi
Gumma
Ibaraki
Nagano
Saitama
Fukui
Gifu
Chiba
Yamanashi
Tokyo
Kanagawa
Aichi
Shizuoka
Shiga
Kyoto
Tottori
Shimane
Okayama
Hyogo
Hiroshima
Yamaguchi
Osaka
Nara
Mie
Wakayama
Kagawa
Tokushima
Ehime
Kōchi
Fukuoka
Saga
Ōita
Kumamoto
Miyazaki
Kagoshima
Production of Raw Silk.
Above 1,800,000 Kilograms
400,000-600,000
200,000-400,000
100,000-200,000
50,000-100,000
10,000-50,000
Under 10,000

Number of Families rearing Silkworms, 1907.

Prefectures.	Families engaged.
Tōkyō	29.103
Kyōto	25.210
Ōsaka	1.894
Kanagawa	37.384
Hyōgo	33.316
Nagasaki	8.331
Niigata	44.757
Saitama	98.078
Gumma	75.171
Chiba	36.433
Ibaragi	49.102
Tochigi	15.253
Nara	5.733
Miye	36.323
Aichi	71.888
Shidzuoka	53.286
Yamanashi	47.430
Shiga	24.989
Gifu	62.062
Nagano	108.004
Miyagi	25.733
Fukushima	63.183
Iwate	21.189
Aomori	3.454
Yamagata	41.333
Akita	14.365
Fukui	27.449

Prefectures.	Families engaged.
Ishikawa ... ...; ...	20.153
Toyama	14.037
Tottori	18.665
Shimane	25.133
Okayama	13.057
Hiroshima	6.962
Yamaguchi	18.483
Wakayama	9.670
Tokushima	24.950
Kagawa	3.485
Ehime	20.708
Kōchi	35.546
Fukuoka	12.676
Ōita	24.325
Saga	25.506
Kumamoto	33.901
Miyazaki	17.141
Kagoshima	27.597
Okinawa	484
Hokkaidō	7.797
Total	1.421.030

N. B. Silkworms are reared in three seasons in Japan, i. e. spring, summer and autumn. But generally the families rearing "*spring silkworms*" are the same as those of the "*summer*" and "*autumn rearing.*" Thus the above mentioned statistics are the number of the spring raisers only.

Production of Silkworm-eggs.

Prefectures.	Cellular Reproduction. No. of Moths.	Industrial Reproduction. Sheet.
Tōkyō	894.047	79.389
Kyōto	4.470.950	50.302
Ōsaka	27.759	1.518
Kanagawa	763.673	15.098
Hyōgo	1.237.528	26.937
Nagasaki	444.341	11.085
Niigata	912.521	59.132
Saitama	2.322.906	29.548
Gumma	2.923.613	205.789
Chiba	473.377	24.218
Ibaragi	788.811	51.815
Tochigi	416.068	72.227
Nara	5.060.608	6.459
Miye	1.695.774	64.918
Aichi	1.390.710	112.933
Shidzuoka	3.634.267	66.220
Yamanashi	2.331.992	183.787
Shiga	1.936.428	306.838
Gifu	5.551.302	186.356
Nagano	14.916.648	2.411.281
Miyagi	2.101.922	58.822
Fukushima	4.704.051	363.011
Iwate	224.373	14.033
Aomori	265.128	4.158
Yamagata	4.604.100	121.429
Akita	421.840	135 774

Prefectures.	Cellular Reproduction. No. of Moths.	Industrial Reproduction. Sheet.
Fukui	320.516	66.967
Ishikawa	178.412	11.020
Toyama	645.761	56.426
Tottori	1.318.787	33.082
Shimane	2.457.144	18.482
Okayama	176.200	10.777
Hiroshima	373.409	6.170
Yamaguchi	218.813	5.960
Wakayama	695.689	1.695
Tokushima	1.398.084	10.044
Kagawa	23.322	1.047
Ehime	1.274.118	21.344
Kōchi	1.005.722	22.281
Fukuoka	287.792	3.556
Ōita	693.563	15.223
Saga	169.117	5.310
Kumamoto	3.848.845	26.900
Miyazaki	270.336	19.786
Kagoshima	401.251	16.227
Okinawa	—	—
Hokkaidō	1.098.026	35.723
Total	88.740.558	5.349.216

N. B. The egg-grains on a card of the "*industrial reproduction,*" are the result of the deposits of 100 female moths.

Production of Cocoons.

Prefectures.	Quantity. Kg
Tōkyō	2.961.523
Kyōto	2.005.715
Ōsaka	86.377
Kanagawa	2.821.985
Hyōgo	2.011.526
Nagasaki	119.743
Niigata	2.412.819
Saitama	8.198.651
Gumma	8.337.739
Chiba	2.852.164
Ibaragi	4.107.404
Tochigi	1.483.179
Nara	358.179
Miye	2 253.599
Aichi	5.213.547
Shidzuoka	3.295.146
Yamanashi	4.267.899
Shiga	2.565.666
Gifu	5.501.020
Nagano	17.281.278
Miyagi	2.614.065
Fukushima	7.604.622
Iwate	1.465.109
Aomori	142.312
Yamagata	3.904.096
Akita	634.968
Fukui	1.233.384

Prefectures.	Quantity. Kg.
Ishikawa	1.050.135
Toyama	539.631
Tottori	1.147.194
Shimane	1.075.176
Okayama	637.592
Hiroshima	281.512
Yamaguchi	430.873
Wakayama	430.123
Tokushima	697.089
Kagawa	97.774
Ehime	954.533
Kōchi	1.114.840
Fukuoka	284.024
Ōita	739.903
Saga	318.553
Kumamoto	1.374.946
Miyazaki	645.090
Kagoshima	654.013
Okinawa	6.711
Hokkaidō	270.753
Total	109.199.260

Production of Raw Silk.

Prefectures.	Quantity. Kg.
Tōkyō	213.425
Kyōto	143.380
Ōsaka	2.944
Kanagawa	159.842

Prefecturers.	Quantity. Kg.
Hyōgo	125.848
Nagasaki	6.930
Niigata	158.848
Saitama	397.720
Gumma	590.801
Chiba	74.212
Ibaragi	126.388
Tochigi	47.872
Nara	11.707
Miye	195.238
Aichi	413.616
Shidzuoka	187.209
Yamanashi	449.687
Shiga	143.833
Gifu	353.242
Nagano	1.839.540
Miyagi	182.334
Fukushima	425.308
Iwate	77.440
Aomori	3.626
Yamagata	283.489
Akita	47.981
Fukui	104.586
Ishikawa	37.635
Toyama	69.562
Tottori	74.092
Shimane	79.319
Okayama	47.984

Prefecturers.	Quantity. Kg.
Hiroshima	26.936
Yamaguchi	23.977
Wakayama	25.320
Tokushima	22.534
Kagawa	2.100
Ehime	101.976
Kōchi	83.894
Fukuoka	19.080
Ōita	39.712
Saga	19.729
Kumamoto	95.339
Miyazaki	55.657
Kagoshima	31.297
Okinawa	161
Hokkaidō...	6.892
Total	7.631.095

Besides, in order to show the state of sericultural industry in Japan, let us give the principal statistics as follows:—

Area of Mulberry farms, 1903 to 1907.

Year.	Farm. Acre.
1903	782.302
1904	796.432
1905	833.271
1906	893.923
1907	957.943
Average..	852.774

Annual production of Silkworm-eggs and the Number of Families engaged in the Egg-card manufacture, 1903 to 1907.

Year.	Families engaged.	Cellular Reproduction. No. of Moths.	Industrial Reproduction. Sheet.
1903	17.404	44.791.423	5.163.072
1904	18.031	57.612.006	5.530.658
1905	14.189	56.672.349	5.039.934
1906	13.514	96.781.913	5.077.176
1907	15.101	187.945.101	5.935.242
Average ...	15.648	88.760.558	5.349.216

Number of Families engaged in Silkworm Rearing, 1903 to 1907.

Year.	Spring.	Summer.	Autumn.
1903	1.445.220	587.782	652.997
1904	1.474.587	587.215	712.618
1905	1.484.750	549.649	746.038
1906	1.407.766	564.619	804.554
1907	1.421.030	593.190	890.136
Average ...	1.446.671	576.491	761.269

Annual production of Cocoons, 1903 to 1907.

Year.	Spring Cocoons Kg.	Summer Cocoons Kg.	Autumn Cocoons Kg.	Total amount. Kg.
1903 ...	61.947.913	14.204.849	20.836.942	96.989.704
1904 ...	69.390.354	14.657.015	21.887.224	105.934.593
1905 ...	66.423.057	13.784.061	21.890.636	102.097.754
1906 ...	69.918.887	15.505.452	25.948.216	111.372.555
1907 ...	84.035.635	17.596.306	27.969.752	129.601.693
Average ..	70.343.169	15.149.536	23.706.554	109.199.599

Number of Raw Silk manufacturers, 1903 to 1907.

I. Total Manufacturers.

Year.	Manufacturers having under 10 basins.	Manufacturers having 10 to 49 basins.	Manufacturers having 50 to 99 basins.	Manufacturers having above 100 basins.	Total.
1903	—	—	—	—	402.475
1904	—	—	—	—	408.055
1905 ...	407.224	3.809	603	307	411.943
1906 ...	397.885	2.916	597	330	401.728
1607 ...	392.581	3.770	619	369	397.339
Average..	399.230	3.498	606	335	404.308

II. Filature Manufacturers.

Year.	Manufacturers having under 10 basins.	Manufacturers having 10 to 49 basins.	Manufacturers having 50 to 99 basins.	Manufacturers having above 100 basins.	Total.
1903	—	—	—	—	—
1904	—	—	—	—	—
1905 ...	5.173	1.677	560	297	7.707
1906 ...	4.392	1.611	564	326	6.893
1907 ...	4.839	1.615	566	364	7.384
Average..	4.802	1.634	563	329	7.328

III. Manufacturers using Sedentary Reeling Instruments.

Year.	Manufacturers having under 10 basins.	Manufacturers having 10 to 49 basins.	Manufacturers having 50 to 99 basins.	Manufacturers having above 100 basins.	Total.
1903	—	—	—	—	—
1904	—	—	—	—	—
1905 ...	354.792	1.777	22	9	356.600
1906 ...	350.227	1.116	6	2	351.351
1907 ...	351.133	1.954	24	4	353.115
Average..	352.051	1.616	17	5	353.689

IV. Doppioni Manufacturers.

Year.	Manufacturers having under 10 basins.	Manufacturers having 10 to 49 basins.	Manufacturers having 50 to 99 basins.	Manufacturers having above 100 basins.	Total.
1903	—	—	—	—	—
1904	—	—	—	—	—
1905 ...	47.259	355	12	1	47.636
1906 ...	43.266	189	27	2	43.484
1907 ...	36.609	201	30	1	36.841
Average..	42.378	248	26	1	42.653

Annual production of Raw Silk, 1903 to 1907.

Year.	Amount of production by Filature. Kg.	Amount of production by Sedentary reeling. Kg.	Total. Kg.
1903	4.361.591	2.554.871	6.916.462
1904	4.486.268	2.491.433	6.977.701
1905	4.526.655	2.369.958	6.896.614
1906	5.282.258	2.456.254	7.738.512
1907	6.169.778	2.598.300	8.768.078
Average ...	4.965.311	2.494.162	7.459.473

Annual production of Doppioni, 1903 to 1907.

Year.	Quantity. Kg.
1903	575 573
1904	509.994
1905	412.588
1906	475.228
1907	463.337
Average	487.342

Annual production of Waste Silk, 1903 to 1907.

Year.	Quantity. Kg.
1903	1.475.918
1904	1.640.398
1905	1.716.822
1906	1.948.014
1907	1.996.873
Average	1.755.605

N. B. The waste silk includes "*Noshi*" and "*Kibiso.*"

CHAPTER III.

GOVERNMENT ENTERPRISES FOR SERICULTURAL INDUSTRY.

The present development of the sericultural industry of Japan owes a great deal to the encouragement from the Imperial Households. Not to mention those given by our ancient emperors, Ō-jin, Nin-toku, Yū-ryaku, the late Empress Dowager was, as is well known, personally engaged in rearing silkworms, reeling and even weaving in the Aoyama Detached Palace. It may also be noted here that H. I. M. the Empress and H. I. H. the Crown Princess were pleased to visit the Tōkyō Sericultural Institute last year in order to see how the work of sericulture was being done there. In fact, the Crown Princess is giving a great encouragement to the industry by her personal experiments in silkworm rearing in the Royal Palace, every season. In response to the Imperial wishes the government is also giving every encouragement and assistance to this industry, which may be summarized as follows :—

I. Instruction and Investigations.

The enterprises as regards instruction and investigations vary a great deal. Here we shall give some of the chief details.

A. Sericultural Institutes.

Sericultural Institutes originated, as mentioned in the preceding chapter, in the Station for the investigation of

Silkworm Diseases established in 1884. At present there are two of them, one in Tōkyō, the other in Kyōto, both under the direct control of the Minister of Agriculture and Commerce, intended to give instruction and to conduct experiments concerning sericultural industry. The Tōkyō Sericultural Institute is situated at Nishigahara, Tōkyō, and the scope of the work is divided into the five departments, viz., (1) The Silkworm Department, (2) The Filature Department, (3) The Summer and Autumn Silkworm Department, (4) The Department of Reports, (5) The Department of General Affairs. The Silkworm and the Filature Department conduct experiments as well as give instruction, while the Summer and Autumn Silkworm Department conducts experiments exclusively, and has its branch office at Matsumoto, Nagano prefecture. The Silkworm Department provides instruction to the male students, the course of study extending over three years. The students to be admitted therein must all be the graduates of Middle Schools and their number must not exceed sixty. The Filature Department gives instruction to both male and female students, the course of study and the number of the students in the Male Department being just the same as in the Silkworm Department, whilst in the case of the female students, the instruction is divided into two courses, Regular and Special, the former admits twenty students, all of whom must be the graduates of the Higher Course of the Primary School, engaged in filature work, and the term of study extends over two years; the latter admits forty students, all of whom must be the graduates of the Lower Course of the Primary School, engaged in filature work, and the term of study extends over ten months.

THE IMPERIAL TŌKYŌ SERICULTURAL INSTITUTE. MR. IWAJIRO HONDA, THE DIRECTOR.

THE IMPERIAL KYOTO SERICULTURAL INSTITUTE.

MR. SHIGETANE ISHIWATA,
THE DIRECTOR.

The total number of the graduates from this Institute up to 1908, is as follows:—

Silkworm Department		2,002
Filature Department	male	98
	female	172
Total		2,272

As to the present state of these graduates, some are teaching either in governmental or in private schools, some are working in prefectural government offices with credit and skill, while some are personally engaged in the actual management of this industry; and most of the female graduates are employed in filatures and factories as women teachers, all affording every possible effort and playing an important part in the development of the sericultural industry throughout Japan.

Besides instruction, the Silkworm, Filature and Summer and Autumn Silkworm Departments conduct various experiments and investigations, and the results collected and printed are distributed to those interested in this industry. The Institute also sends out its officers to different localities from time to time and gives lectures in order to disseminate the general knowledge of sericulture.

Egg-cards of elaborate preparation are also distributed to silkworm rearers with the aim of propagating superior varieties of silkworms. All queries concerning sericulture propounded by the general public are readily answered by the expert officers of the Institute.

The Kyōto Sericultural Institute is situated at Kinugasa, Kyōto, and its scope of work consists of the four departments,

viz., (1) The Silkworm Department, (2) the Female Department, (3) the Department of Reports, (4) the Department of General Affairs. The Silkworm Department provides instruction as well as conducts experiments, while the Female Department gives instruction only. The instruction of the Silkworm Department which is limited to male students, is divided into two courses: Regular and Special; the former is just the same as that of the Tōkyō Sericultural Institute in its term of study and the number of students to be admitted, while in the latter the stated number of students is sixty, the term of study extending over seven months, and the applicants for admission must be the graduates of the Higher Course of the Primary School, who have been engaged in sericulture. The Female Department provides instruction in sericulture and the stated number of students to be admitted is sixty, the qualification for admission being the graduation from the Higher Course of the Primary School, the term of study extends over two years.

The number of graduates from the Silkworm Department up to 1908 was 688, while the Female Department has no graduates so far, having been established only last year.

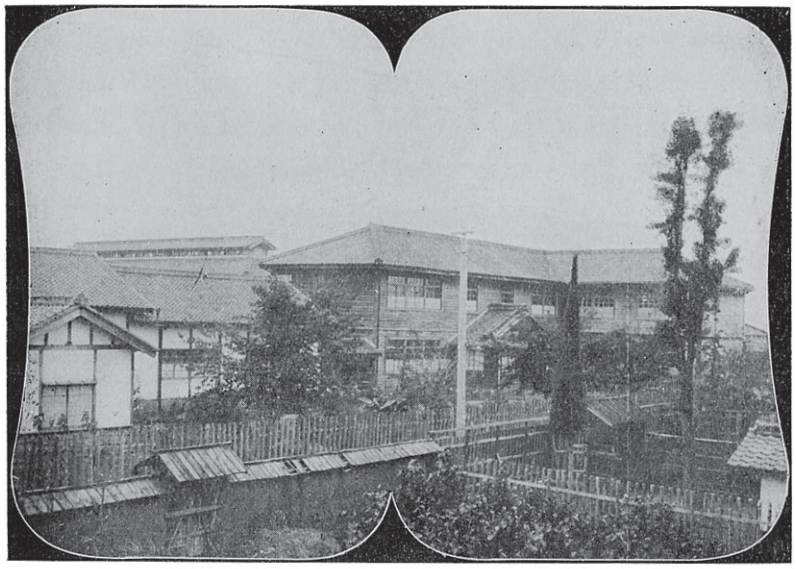
The present state of these graduates may be said almost the same as that of the Tōkyō Sericultural Institute.

B. The Higher Sericultural School.

This school is to be established at Uyeda, Nagano prefecture, under the direct control of the Minister of Education with the same curriculum and course of study as that of the Tōkyō Sericultural Institute. Its actual opening will take place within a year or two.

C. The Prefectural Schools of Sericulture.

The Sericultural Schools under the direction of prefectural governors are the following four :—

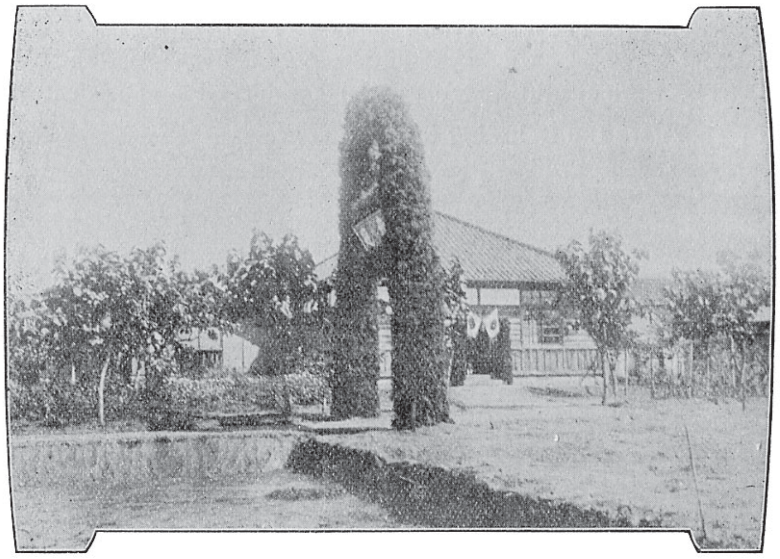


NAGANO-KEN CHIISAGATA SERICULTURAL SCHOOL.

(*a.*) The Nagano-ken Chiisagata Sericultural School.
(*b.*) The Fukushima-ken Sericultural School.
(*c.*) The Toyama-ken Sericultural School.
(*d.*) The Hyōgo-ken Sericultural School.

The former three have the same standards of instruction as the Middle School and the last the same as the Higher Course of the Pimary School.

Besides these, there are thirteen sericultural schools established by *gun* (county). As for private institutions, there



FUKUSHIMA-KEN SERICULTURAL SCHOOL.

are many of them; two of them named below are somewhat noteworthy. They are the Takayama-sha Sericultural School, at Fujioka-machi, Tano-gōri, Gumma prefecture, and the Kyōshin-sha Sericultural School, at Kodama-machi, Kodama-gōri, Saitama prefecture.

D. The Prefectural Institutes of Sericulture.

Sericultural Institutes under the control of prefectural governors are all intended to give training to the students, to conduct various experiments, and to send their officers throughout different districts in order to give guidance to those engaged in silk-raising. The standards of instruction given therein vary according to the districts, where such institutes are situated. The sites of those Institutes are shown below:—

(*a.*) The Hokkaidō Sericultural Institue, Sapporo, Hokkaidō.

(*b.*) The Niigata-ken Sericultural Institute, Nagaoka-shi, Niigata prefecture.

(*c.*) The Miye-ken Sericultural Institute, Komata-mura, Watarai-gōri, Miye prefecture.

(*d.*) The Aichi-ken Sericultural Institute, Hotei-machi, Nishi-kasugai-gōri, Aichi prefecture.

(*e.*) The Aomori-ken Sericultural Institute, Shinjō-mura, Higashitsugaru-gōri, Aomori prefecture.

(*f.*) The Shimane-ken Sericultural Institute, Hirata-machi, Hinokawa-gōri, Shimane prefecture.

(*g.*) The Okayama-ken Sericultural Institute, Ninomiya-mura, Komota-gōri, Okayama prefecture.

(*h.*) The Saga-ken Sericultural Institute, Koshiro-machi, Koshiro-gōri, Saga prefecture.

Besides these, there are five sericultural institutes established by counties. Private institutes are innumerable, the one at Ayabe-machi, Ikaruka-gōri, Kyōto prefecture, called the Jōtan Sericultural Institute, enjoys some reputation. As to such temporary institutes and training places as are open only during the rearing season, they are indeed countless.

E. Schools and Institutes providing the Sericultural Course in the Curriculum.

In the Agricultural College of the Tōkyō Imperial University instruction is given in sericulture besides other subjects, and various sericultural experiments are performed both theoretically and practically. The same is the case with the Morioka Higher Agriculture and Forestry School and most of the agricultural

schools in various prefectures and counties, in which sericulture is placed among the subjects of studies provided. Moreover, in nearly all agricultural training places, sericultural instruction and investigations assume the chief feature of their works. So, it might safely be added that the instruction and investigations concerning sericultural industry are now being undertaken in every part of Japan with energy and assiduity.

F. Experiments and Investigations.

Sericultural experiments and researches are sometimes conducted likewise in local Agricultural Experiment Stations, as in the various institutions above described, and the results of such experiments and researches are usually published in book form and distributed free of cost to the silk-raisers at large with a view to improve this industry.

II. ENCOURAGEMENTS.

These previously mentioned equipments for instruction, experiments, and investigations have no other aim than the improvement and propagation of the silk industry, but further attempts are very frequently made by the central government and the lower local offices to give direct and substantial encouragement in stimulating the rapid progress of the industry, which fact may be illustrated in the following articles.

A. Exchequer Subsidies for Industrial Schools.

At the establishment of any industrial school in the country, the government sometimes gives aid towards its fund, or affords a subsidy for its annual expenses.

B. Exchequer Subsidies for Agricultural Training Places and Experiment Stations.

This kind of subsidy is granted alike as in the preceding case.

C. Special Subsidies for Agricultural Experiment Stations and Agricultural Training Places.

Tha government may sometimes order any local Agricultural Experiment Station to undertake a certain specified experiment, for which a special subsidy is often granted. To quote some examples: annual subsidies have been given to the four Agricultural Experiment Stations in Miyagi, Gumma, Miyazaki, and Shimane prefectures, and the Sericultural Institute in Miye prefecture, for their respective specified experiments concerning mulberry cultivation. The eleven Agricultural Experiment Stations in Fukushima, Yamagata, Nagano, Gumma, Aichi, Shiga, Okayama, Fukuoka, Kagoshima, Ishikawa, and Tottori prefectures, also received subsidies respectively for experiments regarding the varieties of silkworms.

D. Encouragement for the Increase of Mulberry Plantations.

The government has been giving a certain amount of subsidy to induce the enlargement of mulberry plantations.

E. Subsidies from the Local Government Offices.

Local Government Offices likewise afford subsidies for the establishment or support of industrial schools and agricultural training places.

F. Circuit Lecturers.

The effectual improvement of silkworm rearing and filature can only be attained through the combined efforts all those who follow the proper methods of silk-raising based upon scientific investigations. So in all prefectures, counties, towns, and sericultural associations, those who are well qualified in the knowledge and practice of sericulture are employed as circuit lecturers in order to give direct guidance and encouragement to those engaged in this industry. Some circuit lecturers are employed all the time, while others are only for the silkworm season. In either case, such lecturers are supplied from among the graduates of the before-mentioned schools or institutes, so that the effect of this system is very encouraging.

G. Competitive Exhibitions.

These exhibitions aim at giving encouragement to sericulturists by collecting and exhibiting their products and giving a chance to study the manners and devices taken by others and the results actually achieved, thus giving a stimulus for the betterment of this industry. These are usually undertaken by the central government, or the local offices, but sometimes private associations may open such exhibitions under the auspices of the government, or local offices. Prizes or certificates of excellence are given to those whose exhibits have shown superiority either in quality or manufacture. The number of such exhibitions has also increased to the annual figure of fifty.

III. Precautions against Silkworm Diseases.

While the government is thus on one hand striving for the dissemination and progress of sericulture by every possible means, it is also on the other hand, taking great pains for the precaution against silkworm diseases by the compulsory force of law so that the modes for preventing such diseases may be observed in every particular. This was so done, because the acute contagion of these diseases can not, as is usually the case, be properly checked by mere individual endeavors. The first promulgation of such regulations came in the form of "the Law for the Examination of Silkworm-Eggs" issued in 1886 with the intention of preventing the most fearful silkworm disease, pébrine. The enforcement of this law was postponed for some time, and the matter was left to the discretion of each prefectual administrator. This indulgence, however, instead of bringing the desired effect, rather tended to loosen the observation of this law. Consequently, another law No. 22 was issued prescribing the Regulations for the prevention of Silkworm Diseases, thus giving uniformity to the methods and the practice to such precautions.

Here are cited some chief articles of these regulations:—

Art. 1. Silkworm diseases prescribed in this law are five in number as follows:—

Pébrine, Flacherie, Muscardine, Grasserie and '*Uji*'-*disease*.

Art. 2. All silkworm-egg producers, silkworm rearers, raw silk producers, cocoon dealers, and those engaged in stifling and drying cocoons shall come under the control of this law.

ART. 3. Those parties stated in the preceding article shall strictly follow the prescribed methods necessary for the prevention of the various silkworm diseases.

MICROSCOPICAL EXAMINATION OF THE FEMALE MOTH.

ART. 4. Silkworm-egg producers shall observe the following provisions :—

(*a.*) Silkworm egg-cards for reproductive purposes shall be prepared according to the cellular system.

(*b*) Silkworms of imperfect growth, or cocoons of inferior quality shall not be used for reproductive purposes.

(*c.*) Silkworm rearing rooms and implements shall be disinfected every year or at every rearing season.

(*d.*) All such silkworm egg-cards hatched off, silkworms in the course of rearing, cocoons, pierced cocoons, moths, and eggs, that are intended for reproductive

IMPERIAL JAPANESE SILK CONDITIONING HOUSE.

MR. AKIRA SHITO,
THE DIRECTOR.

purposes shall undergo strict examination by the office in charge.

The offices for the prevention of the silkworm diseases are 132 in all throughout Japan, the number of the offices employed therein amounting to 3,175, the annual expenses paid out for this purpose by the central government or prefectural offices reaches the vast sum of nearly ¥1,000,000.

IV. Conditioning of Raw Silk.

A greater part of the raw silk produced in Japan is exported into Europe and America, mostly into the latter, and its consumption at home is comparatively very small, the export of silk fabrics being likewise limited to a small figure.

As the filament of raw silk is very fine, it requires special tact and delicacy to get at the true quality of raw silk, and its strong humidity renders its weight subject to constant change, which is a source of serious difficulties in the dealing with raw silk. The government, therefore, judged it an indispensable measure for removing these difficulties to have some institution established for the conditioning of raw silk, and in consequence, in 1895 the law No. 32 was issued prescribing the regulations relating to the Silk Conditioning House. The construction of this institution was commenced at Yokohama, the central market of silk trade, and the inauguration took place in August of the following year (1896). The management of this house was modeled after the regulations of the Conditioning Houses in Europe and America, more particularly after those at Lyon, and the work is classified into the following four operations:—

1. Test for net weight.
2. Test for conditioned weight.
3. Test for boil-off.
4. Test for quality (winding, size, cleanliness, tenacity and elasticity).

A certificate is made out of each test in two languages, Japanese and French, the latter being intended for foreigners.

At the beginning of this establishment, the intended purpose of this house was not fully understood by the people, so the requests for conditioning were not very numerous, but the usefulness and value of this institution was gradually recognized, and the number of tests began to show rapid increase year after year, so much so that in 1901 and 1907 an extensive enlargement was made in its building, apparatus, and officials, giving a fresh impetus to its work, and at present 1,000 tests for net weight 600 tests for conditioned weight, and 500 tests for quality are daily executed in this house with ease.

The following table shows the annual number of tests performed in the Silk Conditioning House at Yokohama for the last five years.

Year.	Tests for net weight.	Tests for conditioned weight.	Tests for quality.	Tests for boil-off.	Total.
1904	33	41,998	28,544	6	70,581
1905	13	32,527	27,909	76	60,525
1906	0	45,196	35,503	59	80,758
1907	5	37,807	46,824	4	74,640
1908	10	43,036	54,666	11	97,723

BARON MASANAO MATSUDAIRA,
THE DIRECTOR.

THE SERICULTURAL ASSOCIATION OF JAPAN.

H. I. H. PRINCE FUSHIMI,
THE HONORARY PRESIDENT.

CHAPTER IV.

SERICULTURAL ASSOCIATIONS.

The existing number of those private associations intended for the progress and improvement of sericulture may be numbered by the hundred, among which the Sericultural Association of Japan stands foremost. Here we shall describe some of the chief examples of such associations.

I. The Sericultural Association of Japan.

This association was established in February, 1892, for the furtherance of sericulture by making investigations and researches in the theory, art, and practical management of the industry, and at the same time, for the mutual exchange of knowledge among the members; and after going through many changes and transformations, it has attained to the present state of prosperity. The office is at Sanchōme, Nishiki-chō, Kanda, Tōkyō. It has at its head the Honorary President and Patron H. I. H. Prince Fushimi, and Baron Masanao Matsudaira takes the present presidency, with 30 councillors appointed from among the influential men in the sericultural circle. Its Board of investigation includes many noted scholars and sericulturists throughout the country, and the members reach the enormous number of 60,000, thus forming an association of unique importance in the sericultural field of Japan. The scope of work managed in this association is summarized as follows:—

1. Making investigations and researches regarding sericulture.
2. Making, in case of necessity, petitions to the government on behalf of the sericulturists.
3. Giving answers to queries concerning sericulture propounded by the government offices in charge.
4. Giving answers to queries concerning sericulture from the general public.
5. Giving efforts for the expansion of the market for our silk.
6. Forming connections with sericultural associations abroad.
7. Investigation of the services rendered by sericulturists and their recognition.
8. Opening competitive exhibitions of sericultural products, implements and apparatus.
9. Giving lectures and instruction in sericulture.
10. The compiling and translation of books on sericulture to be distributed among the members.
11. The publication of monthly reports to be distributed among the members.
12. The publication of a series of lectures on sericulture for the benefit of those interested in the industry.
13. Giving efforts for the development of the co-operative work concerning sericulture.
14. Introduction and supply of teachers and experts in sericulture.
15. Giving encouragement to the growth of this industry by every possible means.

This association has its branches in every prefecture throughout the country, and a firm connection is constantly kept alive between the main office and the branches, so that

the object of the association may be executed effectively. Women's departments are also attached to this association in various districts so that the female members may be induced to cultivate the admirable virtues of frugality and economy as well as to improve their mutual intercourse.

II. The Takayama-sha and the Kyōshin-sha.

There are a great number of those corporations intended for the improvement and growth of the sericultural industry, but the above mentioned two are the most important.

The Takayama-sha.

This association is at Fujioka-machi, Tano-gōri, Gumma prefecture, established in 1873, and its function is to give supervision and encouragement to the members, as well as to train instructors who are to be sent out to various districts to improve the management of the industry, thus contributing a great deal whether directly, or indirectly, to the development of sericulture. The present number of the members is some 40,000, and those who are trained therein amount to some 2,400.

The Kyōshin-sha.

This association is at Kodama-machi, Kodama-gōri, Saitama prefecture. Since its establishment in 1877, it has passed through many variations. Its function is exactly the same as that of the Takayama-sha, highly conducive to the furtherance of the industry. It has some 36,000 members, and those trained therein are some 3,200.

III. Sericultural Guilds.

The government issued in 1898 a law relating to the Chief Exports Guilds with a view to induce the improvment of the chief exports from Japan. The law of this kind was later found necessary not only for exports, but also for all the chief products of Japan, and accordingly, in 1890, the scope of this law was extended so as to cover the general products by the promulgation of the revised law relating to the Chief Products Guilds. These guilds under this law are juridical persons or associations organized by those engaged in the same occupation in a certain locality with the purpose of removing defects and increasing profits in the practical management of their occupation by the joint efforts of the members. The enforcement of this law proved effectively likewise in making the silk raisers combine themselves into such guilds, with the result that their products have been much improved to the immense benefit of the members. As the promulgation of this law was a matter of quite recent occurrence, the establishment of these guilds is not yet so universal as is desired.

The present number of such institutions is as follows :—

Sericultural Guilds...	67
Silkworm-egg Guilds	35
Raw Silk Guilds	21
Silkworm Rearers' Guilds	1
Silkworm Rearers' and Silkworm-egg Producers' Guilds	2
Double Cocoon Reelers' Guilds	1
Total	129

In order to keep connection among these guilds, two or more of them unite themselves in a guild-union, which is also a juridical person or association prescribed by the law. The number of these unions is as follows :—

Sericultural Guild-union	5
Silkworm-egg Producers'¡Guild-union... ...	1
Raw Silk Producers' Guild-union	1
Total	7

IV. Sericultural Co-operative Societies.

In March, 1898, the government issued the law relating to the Co-operative Society, the object of which is to induce the industrial as well as economical expansion of the people, and the societies organized in conformity to this law are sanctioned as juridical persons or associations. The present number of the societies concerning sericulture established under this law is shown below :—

Socieities for Production, Sales, and Consumption	206
Credit Societies...	1,139
Societies with the combined function of the above two sorts of societies	1,091
Total	2,442

Thus it may be seeen that the sericultural co-operative societies occupy 57 % of the whole number (4,264) of the Industrial Co-operative Societies.

V. Miscellaneous Societies.

Besides those above mentioned societies, there are thousands of those societies, whether temporary or standing, that have to do with sericultural, scientific, or miscellaneous technological investigations.

CHAPTER V.

THE CULTIVATION OF MULBERRIES.

The total area of the mulberry farms in Japan is 957552,61 acres, according to the investigations in 1907. It is 7,44 per cent., comparing to the total cultivated lands, 12876465,735 acres and over 16,2 per cent. to the total farms and they tend to increase gradually year after year.

The percentage of the mulberry farms to the cultivated lands in each prefecture is as follows:—

Prefectures.	Percentages.	Prefectures.	Percentages.	Prefectures.	Percentage.
Gumma	31,5	Iwate	7,7	Akita	4,2
Yamanashi	30,2	Ibaragi	7,5	Shimane	4,1
Fukushima	21,6	Shidzuoka	7,4	Ishikawa	4,0
Nagano	21,4	Shiga	7,3	Miyazaki	3,5
Saitama	15,6	Hokkaidō	7,1	Wakayama	3,3
Tōkyō	15,0	Miye	6,8	Nara	3,0
Yamagata	14,6	Hyōgo	6,4	Ōita	3,0
Kanagawa	14,4	Fukui	5,4	Kumamoto	2,8
Gifu	13,9	Tokushima	5,3	Ehime	2,7
Miyagi	13,5	Chiba	5,0	Kōchi	2,0
Kyōto	10,3	Niigata	4,6	Okayama	1,9
Aichi	10,0	Tochigi	4,6	Kagoshima	1,9
Tottori	8,1	Toyama	4,4	Yamaguchi	1,4
Saga	1,2	Kagawa	0,9	Ōsaka	0,4
Hiroshima	1.1	Nagasaki	0,6	Okinawa	0,1
Fukuoka	1,0	Aomori	0,6		

I. The Varieties.

On account of the fact that wild mulberry trees are found in the Hokkaidō, the island of Hachijō and the Lu-chu group, Japan is thought to be one of the lands where the mulberry grows naturally.

The variety most widely cultivated now-a-days, is one of the white mulberry species, the Morus alba, according to the classification by De Candolle but all kinds are indigenous except the Rosō transplanted from China. Although over four hundred names of mulberries are found, there are not a few synonyms in the lists, owing to local nomenclature.

These are practically classified into three varieties, *early*, *middle* and *late*, according to the period of budding. The *early* varieties are used to feed the silkworms of the first and second age, because they bud earliest among others and their leaves harden also earliest. Those which belong to this variety and are most widely cultivated, are as follows:—

Fushi-nagari, Ichi-bei, Tago-wase, Yanagi-da, Shiro-wase, Ō-chirimen.

The middle varieties bud in the middle between the early and the late season and serve to rear the silkworms of the third and fourth age. The following are the important ones among these varieties:—

Komaki, Kumon-ryū, Hiko-jirō, Tsuru-ta, Akagi, Rosō.

The late varieties bud latest among the three and supply their leaves chiefly to the fifth age worms. The principal varieties belonging to this class are as follows:—

Nezumi-gayeshi, Jiū-monji, Yamanaka-takasuke, Hosoye, Yotsume, Obata.

II. The Modes of Propagations.

There are four modes of propagations commonly practised: Seedling, grafting, cutting, layering. Each mode has different modifications as follows:—

- Seedling
  - Summer seedling
  - Spring seedling
- Grafting
  - Branch grafting
    - Cutting grafting
    - Splice grafting
  - Root grafting
    - Cutting grafting
    - Splice grafting
- Cutting
  - Common cutting
  - The *Kima-ki* method
  - The *Sudare-buse* method
- Layering
  - The *Shumoku-dori* method
  - The *Yoko-buse* method
  - The *Karakasa-dori* method
  - Mound layering

A. Seedling.

By seeds, we may obtain a new variety which has different characteristics from the original and often tends to degenerate into the wild variety. It is not profitable to propagate the plants by means of sowing seeds, on account of the waste of time, but by this method growers may sometimes set not only plants superior to the parent-stock, but if they use the plants as

the stocks of grafts, healthy and long lived specimens may be obtained. On account of the latter advantage this method is popularly practiced in some districts.

In the practice of this method, well ripened berries are collected from the end of April to the middle of June. Then they are soon planted either by rubbing them against each other, mixed with ashes or fine sand, or by taking off their pulp and washing them in water. Sowing seeds in the same year that they are gathered is called "*summer seedling*." The seed, washed in water as described above, are well dried in the shade, placed in a box or a dry straw bale and buried in a dry sandy soil. The next spring they are taken out and sown. Thus this method is called "*spring seedling*," the seeds being preserved and sown in the next year, after their production. On account of the fact that the power of germinations is injured in seeds preserved a long time, *summer seedling* is widely practiced. A seed bed has been beforehand tilled and manured. The surface is leveled down, covered with earth, and then seeds are sown in the proportion of one or two grains per one-tenth foot square.

Then the seeds are covered with soil, and straw is scattered over them for protection from dryness. Especially when the weather is fine and dry, water is splashed over them both morning and evening to keep the proper moisture. When the seeds germinate, the straw is taken off and a fence, about two feet in height, is made round the bed and a cover is spread over it, when the sun shines or when it rains heavily, the young plants are well taken care of to keep them from injury.

At the beginning very dilute liquid manure is applied to them but the concentration should be made stronger as they grow on. When their height is two or three inches, thinned out and weeded. Afterwards they are gradually reduced in number, until the distance between every two plants is some five or six inches. Thus the plants will grow on from two to three feet in height by the close of autumn, when the leaves fall.

B. Grafting.

The well grown and vigorous shoots are selected as scions. Then with their terminals and roots are cut off and only their middle parts are used. There are three different periods of cutting, (1) shoots are cut off after the fall of the leaves and before the autumnal frost, and preserved until the next spring; (2) shoots are cut off about 10 days before grafting and preserved by stricking them in potatoes or radishes; (3) they are cut off at the time of the actual grafting. The first and second method are widely practiced but the third but rarely, owing to the fact that the scions take up the juice of the stock with difficulty, when they contain too much sap in themselves and good results can scarcely be obtained. Grafting is practiced about two or three weeks after the buds have begun to develop. The grower should take special care of the following two points in grafting, namely, (1) that the cut surfaces of scions and stocks are flattend, both the cambiums and the barks of each should be brought so closely into contact that both air and water may be completely excluded, so that it can not enter into the inserted part, (2) that the shoots, with the short internode,

which have two to three buds, and are about two to five inches in length, serve as scions. Stocks are cut off from two to five inches in length, and grafting is practiced on the smooth surface, where the texture of the bark is not disturbed. Soft straw, after being soaked in water overnight, is used to tie up the inserted part.

a. Branch Grafting.

1. Cutting Grafting.

The proper stocks, having been selected beforehand, are cut off three or four inches from the terminal part when an extended period of fine weather seems probable. One part of the bark, with the small wood, is cut off with a sharp knife and the cut surface is made smooth. A scion, having a smooth and even cut, is inserted in this part. The fit should be so complete as to contact close and firm in all parts and be bound together so properly as not to move. Then the grafted plants are transplanted to a seeds bed.

2. Splice Grafting.

This grafting is practiced commonly in case where stocks and scions are of a same size. For this purpose both are cut off and the cuts are made of the same size and the same form. Then they are placed in close contact and bound together in the same manner as the previous method.

b. Root Grafting.

"*Root grafting*" is practiced when stocks are wanted. This method can not be distinguished from "*branch grafting*" except

that roots are used in the place of the stocks. Roots are dug out and cut off five or six inches long and shoots, prepared with two or three buds, are grafted to them by "*cutting grafting*" or "*splice grafting*" according to the size of the roots.

C. Cutting.

This is a method to propagate mulberries by taking advantage of the fact that the plants are capable of producing a new individual by divisions. Cuttings are generally more easily prepared from the shoots which are in the low part, and have a short internode or are in an oblique position, than by those in the opposite cases and they are always taken off beneath a node.

a. Common Cutting.

There are two ways in this method, namely, shoots are either cut off about 10 inches long in early spring, when the buds have not yet developed, or they are preserved until the spring planting after cutting them between the late autumn when the leaves fall and the early winter. The latter method is most widely used because the cuts will by that time have been quite cured and the cuttings will strike root vigorously. For the preserving of the cutting, a pit seven or eight inches in depth, is dug out in a sandy, well-drained and shady place. The cuttings are placed in it layer by layer, covering each layer with sandy soil one or two inches deep until the pit is filled up. A mound of earth is drawn up over it and the surface is covered with straw or straw-mats to keep in the moisture. The farms for the planting of cuttings are deeply tilled and manured. Ridges, three or four feet wide, are made on which holes are

opened, sloping towards the south, with a stick, having the same size as the cuttings. They are inserted in the holes so deep that only two buds will be above the surface of the ground. Their bases are hardened; straw and dry hay is scattered over the fields to protect them from drought. When the buds grow one or two inches long, other buds are taken off, leaving only a single, most vigorous one in every cutting. The dilute manure is sprinkled near the base of the plant and the earth between the ridges, is drawn thickly to it as the bud grows. Thus we will have plants, five or six feet in height, until the close of the autumn.

b. The "Ki-maki" Method.

In the early part of July, the new shoots, over three feet high, of the "*bush planted*" mulberries (*negari-kuwa*) are turned down on the ground and buried with earth or straw, leaving their terminal parts remaining, about six inches long, upon the surface. After the leaves fall, the shoots, bleached in the earth, are taken out, and after being cut off some four or five inches in length are placed in dry soil until the spring. In the other way, the shoots are taken out in the coming spring and cut off. In both cases, the cut shoots are planted, until the budding commences in the spring. For this purpose, seed beds have been prepared beforehand and ridges, two feet in width, are made, on which small trenches, four or five inches wide, are dug out. The cuttings are laid in them in an oblique position, keeping them five or six inches from each other when they are covered with fine soil, so that their terminal parts are not exposed.

The soil over them in trodden down slightly, straw is scattered over the whole, to protect the plants from the damage caused by dryness, wind and rain. When buds grow three or four inches, dilute liquid manure is applied and afterwards they are nursed as described before.

c. The "Sudare-buse" Method.

This method is practiced on buds in the spring. On the farm, tilled and manured, trenches, about eight inches deep, are opened, so that they are from three feet and six inches to four feet from each other. The soil is heaped up on both sides. One end of the cutting, one foot and three inches to one foot and nine or ten inches in length, is put into a mound on one side of the trench, as deep as three or four inches and the other end is placed in the other mound on the opposite side. The distance between every two cuttings is about four or five inches. The exposed part of the cutting is covered with bamboo leaves, straw or green grass to protect them from dryness. Dilute night-soil is applied occasionally. When the young shoots grow to be four or five inches high, all of them, except two, are taken off, and afterwards earth is drawn up two or three inches high, when these two shoots are six or seven inches in height. Thus we will get the young plants some five or six feet high, by the close of the autumn. They are taken out in the autumn or the next spring and transplanted in other fields, after cutting them in the middle into two parts if they have two new shoots.

D. Layering.

In this method, roots are made to spring out from twigs or

branches by burying them completely or only their middle parts in the soil, or by drawing earth to the bases of new shoots, turned down to the ground, and then when they have sprouted, they are separated from the mother plants, as individuals.

a. The "Shumoku-dori" Method.

For practicing this method, all the branches of a *bush planted* mulberry are taken off in the middle of April, leaving only three or four straight and vigorous ones which have a moderate size. When the buds grow three or four inches high, trenches, three or four feet in length and four inches in depth, are opened in the place where they are laid, in which fertile soil is set. The earth surrounding the trenches is made to be three or four inches higher than the surface of the ground. Then the shoots to be laid down, are cut off three or four inches in length at the terminal parts and bent, so as to turn them stemward. Thus the downward buds are got rid of. At first the twigs are fastened down at a distance of about one inch above the ground and after one week, they are brought in contact with it, then earth is drawn up to them, by using a rich soft soil. Afterward they are top-dressed with dilute liquid manure in the latter part of June and the shoots are covered with earth to the depth of one or two inches, at the same time an incision is made at the bent part of the shoots, one or two inches long, by partly stripping off the bark. In the middle of July the plants are again manured, earth is drawn up to the depth of one or two inches and the bark is again stripped off, leaving only a small part which will be completely stripped of bark at the end of the month. In the close of the autumn, the shoots are taken

out when the weather is fine, and are cut off into something like a knocker shape, which serve as sprouts.

b. The "Yoko-buse" Method.

This method is popularly practiced in some districts of the prefecture of Shiga. According to this method, new sprouts are obtained from those of the previous year, without using the old stock as in the preceding method. For this purpose, a well-drained and fertile bed, which has been thoroughly cultivated, is used, and vigorously rooted sprouts, without cutting their terminal parts, are planted on the ridges, which are about three feet wide, sloping them about 40 degrees and keeping them some four or five feet from each other. When buds develop about one inch, the shoots are brought down to the ground and the buds are reduced so as to have, say, one in every six or seven inches of the shoots. On the buds turning straight, their bases are covered with earth. Afterward they are treated just as in the preceding method, and thus new plants are produced at the close of the autumn.

c. The "Karakasa-dori" Method.

In order to practice this method, branches are cut off before budding and earth is drawn up to the bases of the mother trees. When new shoots grow from one foot and six inches to two feet, radiate trenches, less than five inches in depth, are opened round the mother trees. At the bottom of the trenches, well decomposed compost is placed, and covered with earth in a thin layer. Then the new shoots are turned down into the trenches and buried, leaving some four or five

leaves in the terminal part on the surface of the ground, after strippring off all the leaves except these. Afterward they are occasionally manured. Thus during the dog days or thereabouts the bark of the bent part is stripped off partly and the incision is made gradually greater until the shoot becomes separated from the mother tree in the late autumn or in the coming spring as new sprouts.

d. The Mound Layering Method.

The young mulberries on budding, are planted in a triangular positions in well cultivated fields, keeping them five or six feet from each other. The next year the stocks are cut off some three or four inches high above the surface of the ground before the growth commences. In this state they are left and when the new shoots reach one foot in height, earth, mixed with compost, is drawn up to the lower part of the shoots, and covered with other soil some three or four inches deep. Afterwards those are properly manured and sometimes before or after September, the parts between the stocks are tilled. The shoots are cut off in the autumn or the next spring. Thus sprouts are taken off from the same mother tree in a similar manner every year.

III. Plantation and Management.

The preparation of farms for the planting of young mulberries should be commenced in the autumn or the winter of the preceding year. For this purpose, the whole farm is deeply spaded out and well decomposed compost (300 *kwan** to 500

* *kwan* = 3,75 kilograms.

kwan per *tan*†) is scattered on it, after mixing it with surface soil. Then the soil is turned upside down, by deep tilling and in the next spring cultivated once more. In the warm districts, the season of the planting of mulberries is in the autumn when the leaves fall, but in the very cold or snowy districts, it is practiced in spring when snow and ice disappear. The best season for planting is believed to be about the time of the vernal equinox.

For the convenience of rearing silkworms, the *early*, *middle* and *late* varieties are generally planted in some proportion.

The proportion is changed, according to the period of the silkworms' brushing in relation to the budding of the *early* varieties. It is shown in general in the following table :—

	In the districts where the hatched silkworms are early brushed, compared wth the budding of mulberries.	In the districts where the opposite is the case.
Early varieties	20 %	10-15 %
Middle varfieties	30 %	20-25 %
Late varieties	50 %	60-70 %

Young mulberries are planted, deeply or shallowly, separately or closely, accroding to various circumstances. In case, the soil is loam with a well-drained subsoil, or sand with a deep surface soil, the mulberries should be planted one or one and a half feet deep, keeping them five feet from each other, and the distance between the ridges should be some six feet. In the opposite case, when the surface soil is shallow and the subsoil is

† *tan* = 0,245 acre.

clay and of bad drainage, or when the sandy but poor, the plants should be planted seven or eight inches deep, keeping them two feet and five inches to three feet from each other and the distance between the ridges should be some five or six feet.

Before planting the young plants, their roots are dressed. For this purpose, the number of roots and their future growth are ascertained by looking at their forms. The roots injured by cut or diseases, and those which have no prospect, owing to bad growth, or are of no use, are thrown out. Also the overgrown parts of the roots which are to remain, and any withered and tufty radicles are removed. There are two ways of planting, namely, *Mizobori-uye* (planting in trenches) and *Tsubobori-uye* (planting in pits). The latter may be practiced only when the whole farm is deeply tilled, but otherwise the former is widely used. In planting, the direction and the width of ridges are at first determined according to the features of the fields. Then ropes are streched along the direction, and trenches or pits are dug up to the proper depth and width, in which compost is placed, covering it with earth some two or three inches deep. The earth trodden down slightly, the young plants are laid in and their roots are put in the proper position. Then the planter holds the shoots upright with one hand and covers the roots with dry, fine soil, gathering it up with other hand. The plant is moved slightly and then the earth is trodden down. Again the soil is drawn up some four or five inches deep, in shape like an inverted basin. In "*planting in trenches*," the earth on the foot of the plant, is leveled down with a spade, after finishing, the operation. If the shoots

have not been cut off beforehand, they should be taken off with a sharp sickle soon after planting. At first, the trenches or pits are filled, leaving some four or five inches under the surface of the ground and gradually leveled up, as the buds grow, by putting in the earth some two or three times, which serves at the same time as weeding. After transplanting, the mulberries are pruned in various ways and so trained as to facilitate their cultivation, their management, the gathering of the leaves and the forcing of the growth. Thus the methods of plantation are generally classified as four :—

The bush plantation (*Negari-jitate*).
The dwarf-plant plantation (*Chūgari-jitate*).
The high-grown-plant plantation (*Takagari-jitate*).
The full-grown plantation plant (*Kyōboku-jitate*).

The fourth consists of many ways among which the "*Akita method*" is widely used and is thought to be a good one.

The "bush plantation" (*Negari-jitate*): Many disadvantages are caused on account of that in this method, mulberries are planted close to each other and many shoots are made to come out from the stock by cutting them off on a level with the ground every year, that is to say, it is inconvenient to manure and cultivate them ; the leaves of the lower part of the stem are almost all stained ; the damages caused by frost and snow are most severe ; and the plants get easily attacked by *rachitis* and are soon decayed. But this method has the following advantages at the same time ; the plants grow

quickly and yield a crop in a short period; the leaves are soft for a long time; it is convenient for gathering them and other management and there is less fear of insects and fungi which are

THE "DWARF MULBERRY PLANTATION" (*Negari-jitate*).

easily driven off even in the case of their attack. For these reasons, this method is popularly used in level districts. According to this method, 600 to 900 mulberries are planted per *tan*. They are well manured and should not be harvested in the year when planted. In the following spring, the shoots are cut off before the buds develop, leaving one or two of them. Then they should be well manured and cultivated as in the previous year. In the third year, the leaves may be supplied to the annual silkworms and in the fourth, the plants will yield an ordinary crop.

The "dwarf-plant plantation" (*Chūgari-jitate*): This is popularly practiced in the prefectures, of Fukushima, Gumma and Tōkyō. According to this method, 400 to 700 mulberries are planted per *tan*. All the buds, except certain vigorous one, which have come forth in the next spring after plantation, are removed and manure is sufficiently applied. Before budding in the spring of the second year, the plants are cut off one to three feet above the level of the ground and two or three buds

THE "HIGH-GROWN MULBERRY PLANTATION" (*Chūgari-jitate*).

on the end are made to grow. Then the plants are carefully nursed as in the previous year. In the third year the leaves may be gathered and supplied to the spring silkworms. From the fourth year we will have an ordinary crop.

The "High-grown-plant plantation" (*Takagi-jitate*): This is one in which the mulberries are trained to some four or five

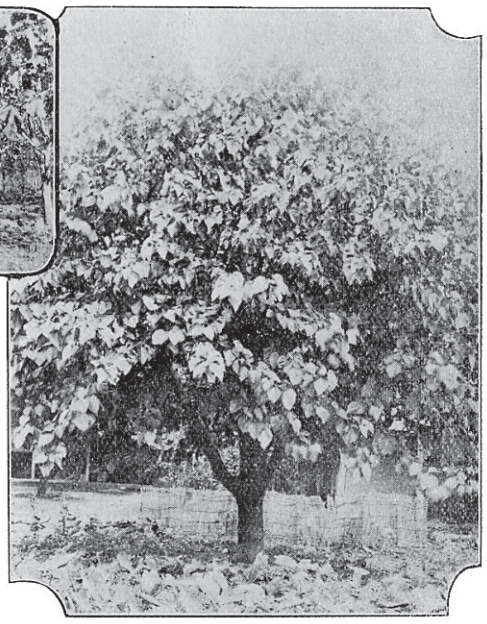
feet above the surface of the ground and is widely practiced in the mountainous districts of Gumma and Yamanashi. According

THE "FULL-GROWN MULBERRY PLANTATION" (*Takagari-jitate*).

to this method of plantation, 300 to 500 mulberry trees are planted per *tan*. For practicing this, a single and most vigorous bud is left remaining after transplanting, and the removing of all of the others, and the trees are so managed as we do those in the preceding method of plantation. In the spring of the third year they are cut off some five feet in height; all buds are then taken off, leaving only two or three at the terminus. Afterwards the same management as in the preceding case is performed.

The *Akita method* of plantation: This is practiced in some districts in the prefecture of Akita. Fifty to hundred trees

THE "*Akita*" SYSTEM OF MULBERRY PLANTATION (*Akita-method.*)



THE MULBERRY TREE OF *Akita-method.*

are generally planted in every *tan*, according to this method of plantation. In February of the next year after transplanting, when the buds will not develop, the vigorously grown shoots are cut off about four feet high above the surface of the ground, and weak ones are taken off near this bases. Thus the main trunk is carefully nursed. On the shoots, thus cut off, three vigorous buds are left in a triangular position, after removing all of the others. Until the autumn they will have grown some five or six feet in height. Before budding in the spring of the third year, each shoot is pruned to from some two to two and a half feet in length, but the weaker ones are shorter. Again two or three vigorous buds are left on each shoot after taking off all the others. Thus in the autumn, the height of the shoots will be over six or seven feet. In the fourth year, the shoots are cut

off to the height of one foot and five or six inches and again two or three buds are left on each of them, which will grow some five or six feet until the autumn. Thus the mulberry trees are pruned and trained until we finish the operation in the fifth year, and we may gather an abundance of leaves in the sixth year.

As described above from the year of transplanting to the sixth, the trees are pruned in the spring but in the seventh, in the summer. After this, spring and summer pruning are alternately performed. We call it "*summer pruning*" inasmuch as that after the developing of the leaves, shoots are cut off, leaving some one or two inches in length and the leaves are applied to rear the annual silkworms, and "*spring pruning*" is that in which shoots are pruned in the middle of February in such a way that the mature or woody shoots are cut off shorter than the unripe ones and the leaves of the new shoots are gathered to feed the *summer silkworms*.

IV. Cultivation.

The mulberry farms are cultivated generally three times, beside tillage for manuring or weeding, namely:—

The first time.....about one month before budding.
The second time.....soon after the gathering of the leaves.
The third time ..... after the fall of leaves in the autumn.

But when the soil is moist or lumpy, owing to heavy clay, one more tillage is necessary at the end of September or in the beginning of October.

The first or spring tillage is in general done by means of the "*level tillage*" but sometimes mounds are opened by tilling both sides or one side of the ridge, and earth is drawn to the feet of the the plants. The soil between the ridges is dug out so as to make a small trench which will be gradually filled up in manuring or weeding. The second tillage, that is, the tillage after gathering the leaves, is done by means of *level tillage*, but if it is difficult to practice it or it is not necessary owing to the light soil, the earth between the ridges is dug up deeply by tilling both sides of the ridge and afterwards the opening is filled up when the trenches for manuring are prepared. The third, or autumn tillage is done by tilling one or both sides of the ridge. The earth on the bases of the plants is piled up between the ridges. The fourth tillage is performed between September and October and the methods of cultivation are changed, according to the conditions of the farms. In the case of level fields, they are cultivated in a shallow manner, by drawing the earth to the feet of the plants, and if there are any ridges, they are leveled down.

The depth to be tilled varies, according to the hardness of the soil and the depth of planting, but as a general rule, about one foot is the standard, except in the fourth tillage, and in the spiring, summer and autumn tillage always the same depth is held. Weeding is practiced rather rarely, because weeds are hoed down, in cultivating and manuring practically they are weeded once or twice from midsummer to autumn. For this purpose, in the wet and stiff clay soil, they are buried by spading over the surface soil not deeply while in the sandy soil, they are picked out or cut down with a sickle.

The manures are nitrogenous and late-acting in many cases, on account of the fact that the mulberry is a perennial crop and requires less phosphate and lastly the soil in Japan is in general rich in potassium salts. The fertilizer which is most widely used, is the compost, consisted of night soil, horse dung, the litter of the silkworms, straw, weeds, fallen leaves and dust. Besides which, there are not only the commercial fertilizers, but also soybean cakes, herring refuse, *Shōchū* refuse, ammonium sulphate, chili saltpetre, *Saké* refuse and *Shōyu* refuse are also popularly in use. The manure is applied generally at the following two seasons :—

The first time.....in the spring after the first tillage.

The second time.....in the summer after pruning or gathering the leaves.

The fertilizers are in many cases given between ridges or stocks and the depth of the manuring is the more variable, according to the properties of the manures and the soils than that of planting, say, eight or nine inches to about one foot for a clay soil and compost or farm yard manure ; three or four inches to six or seven inches for a sandy soil and a liquid or quick-acting manure. In all cases, the manure is applied in the small trenches which are soon filled up with earth. In the cutting of the mulberries, shoots should be taken off close to the stock, without leaving any foot to them, but farmers are so busy in the time of gathering leaves that they are not capable of practicing such careful treatment. For this purpose, the shoots are taken off somewhat higher and are afterward cut off again in the proper position. This operation is done at midday when

the weather is fine, within a week after cutting, by taking off the shoots also to the stock with a sharp sickle and so leveling and smoothing their cuts as much as possible. The cutting is so operated that the outside buds on the bases of shoots, are made to develop, for the purpose of setting many shoots spread outwards from the stock. The pruned shoots of mulberries are bound together during the winter. This is because the shoots are kept from drooping, the surface of the ground may receive such an abundance of sunlight, that the soil would be warmed and dried, the shoots are kept from being broken by snow and the damage, caused by the late frost, is lessened. At the close of the autumn, when the weather is fine, the low part of the shoots is loosely bound together, then after the leaves fall, their upper part is also bound together at two points, and the time, when their ties are unbound, is from the finishing of the spring tillage and manuring, to that of budding.

V. Crops.

The period of gathering the leaves and cutting the shoots is changed, according to that of the rearing of the silkworms, but generally it is as follows :—

For the rearing of the spring breed,—both the gathering of the leaves and the the pruning of the shoots are undertaken in the spring.

For the rearing of the autumn breed,—in the spring the shoots are pruned before budding and in the autumn the leaves are gathered.

PLUCKING OF MULBERRY LEAVES.

For the rearing of the summer and autumn breeds,—in the spring the shoots are pruned before budding and the leaves are gathered in the summer and autumn.

For the rearing of the spring and autumn breeds,—in the spring, the leaves are gathered and the shoots are pruned, in the autumn the leaves are again gathered.

For the rearing of the spring, summer and autumn breeds,—in the spring the leaves are gathered and the shoots are pruned, in both summer and autumn, the leaves are again gathered.

When we gather the leaves and cut off the shoots in spring, it is always to collect the leaves only until the fourth age of the silkworms, but afterwards the shoots are cut off little by little, in order to rear the silkworms of the fifth age with them, without plucking off the leaves.

The yield of the mulberry varies according to the fertility of the soils, the ways of cultivation, the varieties of climate, the varieties of the mulberry and the management, but the usual crop in the *bush-plantation* is about 600 *kwan* of the shoots, including their leaves which are about 200 *kwan*, in every *tan*.

The results of the experiments conducted by the Tōkyō Sericultural Institute, concerning the comparative crops of the early, middle and late mulberry leaves per *tan* respectively, gathered in the proper periods are shown below :—

		Kg.
Early Varieties ...	For the first age	146,851
	For the second age	367,183
Middle Varieties...	For the third age	485,401
	For the fourth age	633,613
Late Varieties.....	For the fifth age	934,728

In the same institute, the crops, concerning the different varieties are also investigated with the following result :—

Early Varieties.

	the number of stocks	the weight of the leaves	the weight of the stems	the weight of the shoots	total	the average weight of leaves in one stock
		g.	g.	g.	g.	g.
Shiro-wase...	48	36,507.	14,117.	89,456.	140,080.	751.
Fushi-magari.	63	45,599.	17,211.	82,386.	145,196.	718.
Tago-wase...	68	422,701.	19,614.	92,836.	159,151.	684.
Ichi-bei	64	46,573.	15,241.	88,622.	150,436.	725.
Ō-chirimen...	69	28,440.	11,078.	63,574.	103,093.	412.

Middle Varieties.

	the number of stocks	the weight of the leaves	the weight of the stems	the weight of the shoots	total	the average weight of leaves in one stock
		g.	g.	g.	g.	g.
Kumon-ryu..	41	50,356.	14,536.	61,792.	119,164.	1030.
Rosō	39	52,966.	15,748.	92,035.	160,749.	1334.
Tsuru-da ...	51	58,576.	21,090.	83,215.	162,881.	1140.
Aoki	59	49,652.	20,412.	80,512.	150,576.	801.
Akaki.....	36	60,754.	22,658.	83,683.	167,195.	1677.

Late Varieties.

	the number of stocks	the weight of the leaves	the weight of the stems	the weight of the shoots	total	the average weight of leaves in one stock
		g.	g.	g.	g.	g.
Nezumi-gayeshi ...	73	63,974.	27,604.	98,335.	189,913.	865.
Jyumon-ji ...	69	67,806.	27,246.	102,371.	197,424.	974.
Kobata	46	53,866.	23,528.	84,927.	162,321.	1171.
Yotsume ...	81	56,191.	23,615.	86,298.	166,104.	690.
Yamanaka-takasuke ..	52	55,934.	20,084.	78,943.	154,961.	1069.

VI. The Injuries to the Mulberries caused by Insects, Diseases and Frost.

A. The Diseases of the Mulberries.

There are different kinds of diseases, namely, mulberry-dwarf-trouble and many diseases, caused by parasitic fungi. Now we will describe briefly these diseases:

1. The Mulberry-dwarf-trouble.

This disease is characterized by the sprouting of many feeble shoots from the stock, after their being cut off for their

leaves, by the shrinking and wrinkling of the leaves on the shoots, and by the fading of the leaves into a pale green for the want of their normal amount of chlorophyl. Some of the varieties liable to be attacked dy this trouble, while others are not, but in general, *Negari* mulberries (the kind of the mulberries cultivated as bushes) are more liable to be troubled by this disease than *Chūgari* and *Takagari* mulberries (dwarf and high-grown-planted mulberries). This disease is caused physiologically by the want of the preserved nutrients, especially nitrogen, in the stock, on account of the cutting off of the shoots while they were growing vigorously. The only cure for the disease is to select the healthy varieties and to gather their leaves and shoots properly.

2. "Mompa" Disease.

This disease is caused by the parasite, called the Stypinella purpurea (Tul.) Scbr. In many cases, the mulberries in the farms which are newly prepared by breaking up the forest land, are attacked, but in the old farms, the disease is found only in a damp soil. On the roots of the diseased plants, one finds the filament entangled like vines which will cause the roots to decay, and a mass of purple and vein, like filaments, on the base of the stocks. The remedy is to open a deep ditch, because this disease is an infection of the roots caused by their having too much moisture.

3. Pourridie.

The cause of this disease is the parasitic growth of a fungus, called Dematophora necatrix Hartig. The fungus shows itself

in the shape of white flakes, like a cotton cover, on the roots which will be soon decayed and then the trunks will die. When the mulberry plants are attacked by this disease, it is better to pull them up at once and burn them.

4. The Agaricus mellens.

This is a disease, caused by a parasite, called Armillaria mellea Vahl.. The roots of the diseased mulberry rot greatly, then their leaves become yellow and soon fall, and at last their trunks die.

5. Bacteria Disease.

This disease is caused by a bacteria, called Bacillus cubonianus Macch. Both the branches and leaves are attacked, especially, the trunk of the diseased mulberry rots into black and finally dies. The shoots of the *Negari* mulberry are injured in many cases and also those of the *Takagari* mulberry are often attacked in the districts, where the mulberries are often damaged by severe frosts.

Beside those described above, there are several kinds of fungi which are the parasites of the mulberry and cause several diseases: namely, Septobasidium pedicellatum (Sch.) pat., Scherotinia libertiana Fuck., Septogloem mori Bris. et Cav., Aecidium mori (Barch.) Diet., Phyllactinia corylea (Bas.) Karst., etc.

B. The Injurious Insects of the Mulberry.

There are many insects injurious to the mulberry, now we will describe in short about the very most injurious ones among them in the following pages.

1. The Scale Insect of the Mulberry (Diaspis pentagona Targ.).

This insect dwells on the trunk of the mulberry and lives on the sap of the tree to its great injury. The distribution of the insect in wide and it injures the *Negari* mulberry and also the *Takagari* one. The female insects attach themselves closely to the branches or the trunk, concealing themselves under the scales where they secrete themselves and live on the juice of the tree, by sucking it with their long rostrums stuck into the bark. They lay eggs in the scales and the larvae which come forth from the eggs are distributed over the branches. The larvae which are female, attach themselves to the bark and secrete the scales, and those which are male, spin white and elongated cocoons in which they are metamorphosed into chrysalids. Then the winged male insects come out from the cocoons to couple, inserting their generating organs into the scales of the female. Thus the insect reproduce its kind thrice a year. In order to protect the mulberries from this insect, we examine, whether the young plants have any scales of the insects or not and get rid of them, if there are any. The mulberry farms should be always made to be so far as is possible exposed to sunshine. If the farms have been once attacked by the insects, they should be scratched with a bamboo spatula and the insects killed during the winter, if this is insufficient, the syringing with kerosene emulsion, kerosene and the mixture of lime and sulphur are recommended.

2. Leafrollers.

There are several kinds of these insects among which the Archips crateagona Hb. and Exartema mori Mats. are common in their injury to mulberry plants. Both of them injure the buds of the mulberries in the early spring. In the middle of May they roll the leaves by sppinning in which operation the insects become pupae. The small moths come forth in June and lay eggs on the slender shoots. The pupae of the insects are often killed by a parasitic bee.

3. Hemelophira atrilineata Butl..

This insect dwells on the mulberry through all seasons and lives on the buds and leaves. Especially, the insect injures greatly the young buds in the spring time. The larvae are grayish brown and just like a dead twig. When fully grown, the insect is 60 mm. in lenghth. The anterior part of the body is small, while tha posterior becomes gradually greater. The thoracic legs are composed of three segments, while the abdominal has two. The insects mature from the middle to the latter part of May, then they are imprisoned within oval, pale brownish and coarse cocoons, that are spun in the crevices of the trunk or on the base of the tree, in which the insects change into a pupa. After about one week, the moths appear and lay eggs on the mulberry leaves or branches which will be hatched about three weeks afterwards. The growth of the insects is sometimes quick and sometimes slow and they are either divoltini or trivoltini. The insects are easily destroyed from winter to early spring, when the larvae stick themselves on the branches like dead

twigs. Here we add that the insects have a parasite called *Kamodoki-bachi* (L Logas sp.).

4. Aprione regicollis Chevr.

This insect injuries the mulberries in both periods, that of the larva and that of the imago. The larvae saw their way into the trunk of the mulberries, especially, *the high-grown-planted mulberries* and dwell in the wood. After two or three years, they become mature. The injured trunk is retarded in its growth, or killed outright. The mature insects deposit eggs in June or July under the bark of the shoots which they turn up by biting. The injured shoots are after broken down by the wind. The imago is one of the large coleopters, 37 mm. in length and a pale green in color.

Their eggs are elongated ellipses of a light greyish white and their longer diameter is 2,4 mm.. The full grown larvae are 60 mm. in length and of a pale yellowish white color. Its head is a dark brown and it has strong mandibles which are quite proper for biting. The method for destroying them are either to pour the insecticide into the holes of the wood which are made by the insect or to stab the eggs on the branches. The eggs have, as an enemy, a parasitic bee which I should be propagated for their destruction.

There is also a small coleopter, called Clytanthus cubineusis Chevr., which injures the mulberries in a similar way. Beside those described, the important insects, injurious to the mulberries, are as follows:—

Anomoneura mori Sehw. (*Ki-jirami.*)
Glyphodes pyloalis Walk. (*Suki-mushi.*)

Diacrisia imparilis Butl. (*Su-mushi.*)
Porthesia similis Fuessly. (*Kinke-mushi.*)
Phyllotreta funesta Baly. (*Himeha-mushi.*)
Baris deplanata Roel. (*Himezo-mushi.*)
etc..

There are two animals that are injurious to the mulberries besides these insects, one is a slug and the other a field mouse. The following is a brief description of them.

5. Slugs.

The slugs injure the mulberries cultivated after the *bush-planted* mulberries by eating their buds, which come out after the leaves have been plucked. They live in a wet place along a stream. This kind of slugs is called Limax agrestis L.. For protection from the slugs, the dust of quick lime may be scattered about on the farms in the evening.

6. Field Mice.

The mice eat during the winter the bark of the mulberries, gnawing the cortical layer of the root to the woody part, until the tree will die at last. This kind of mice is called Microtus montbelli M.E. and they live in every district. During the winter, when the mice can find no food in farms, they do injury to the mulberries; especially in the snowy districts the injury is serious. For killing the mice, Mereskowskys bacillus is practically employed.

C. Frost Damage.

The mulberry leaves are often damaged by the late frost,

after the buds have developed. The frost damage is either severe or light, according to the climatical conditions of the years or the districts, sometimes there is no fear of the damage. In the nothern part of Japan, frost damage has been caused hitherto once in three or four years. The damage is caused by the freezing of the young buds and leaves to death. The frozen mulberries show such a wretched conditions that they have no green leaves but only black. A good method for protecting the mulberries from frost, is esteemed to be the smoking of the mulberry farms, otherwise there are no means except that of wrapping up the shoots with straw or matting, or covering the leaves with these means of protection against the extreme cold.

CHAPTER VI.

THE FEEDING OF SILKWORMS.

I. The Varieties of Silkworms.

The silkworms, reared at present in our country, are only a single species of the insect considered from the point of zoology, but through natural and artificial selections for many centuries, a large number of varieties have been established. These innumerable varieties are classified according to the number of 'crops' in a year as follows:—the annuals, the bivoltines and the polyvoltines. The annuals produce one brood, the bivoltines two broods and the last more than three broods in a year. Among these varieties the annuals are conceded to be the most profitable for silk growers on account of producing the greatest amount of silk for a certain quantity of the mulberry leaves given to them, the bivoltines produce the middle amount of silk, and the last the smallest; while in feeding, the polyvoltines are the most vigorous and the easiest to be reared, the bivoltines are next and the annuals are rather difficult to be fed. In other words, the varieties which produce the great amount of silk for a certain quantity of the mulberry leaves taken by the silkworms are weak, and those of the opposite sort are vigorous.

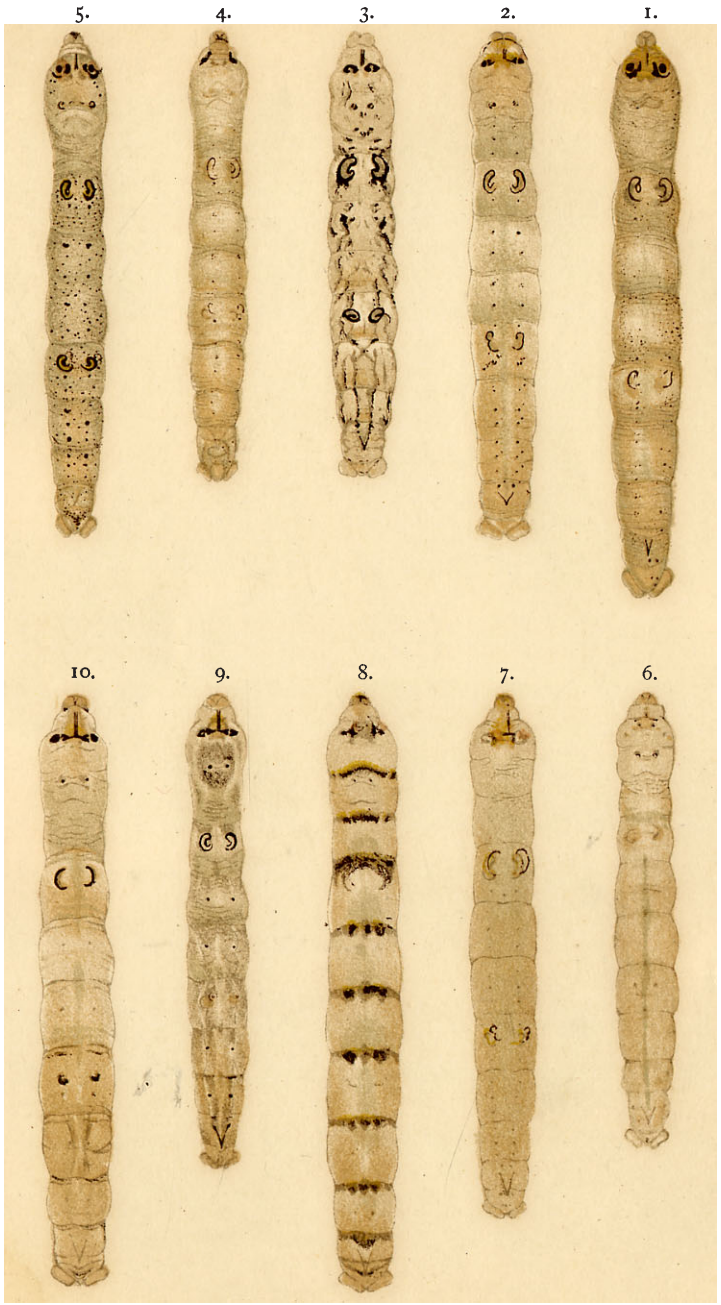
Varieties are often named after the colorations of their cocoons, namely, the white, yellow and green cocoon varieties. Those which are reared at present in our country, are chiefly the white cocoon variety. Although the green ones were papularly

fed formerly on account of their being healthy, now their feeding is very rare, owing to their producing an inferior grade of raw silk, which has not a bright lustrous tint. The remarkable differences between the qualities of the filaments of three kinds of the cocoons can not be found, but from the results of the comparative investigation concerning the boiling off of the raw silks reeled from these cocoons, we may conclude that the raw silk from the white cocoons has the least boiling off, while the others have the greater. Still from the numbers of the moults during their life-periods, the silkworms are classified into two kinds, that is, three moults worms and four moults ones. The former moult thrice from the time of hatching to that of spinning a cocoon, and the latter four times during the same period. On account of the fact, that the latter worms produce a large amount of the better grade of silk, although they have longer 'cycles' than the former, they are widely reared, while the former are very rarely. Lastly, according to the seasons of the cultivation, the worms are classified into the *spring*, *summer* and *autumun* breeds. Though this classification is popularly used, it does not mean that they are different varieties, but only shows the different seasons of their feeding. The *spring* breed is allowed to hatch after the budding of the mulberry trees, the *summer* breed soon after the "*mounting*" of the spring worms and the autumn at about the commencement of the autumn, say, from the former part of August to the middle of September. The silkworms reared in spring, are almost all annuals, but according to colorations, sizes, markings, and the shades of colors on the body, and whether the cocoon is large or small, long or short, oval or round, and whether its granulations are coarse or

not, various names are given as follows:—*Aka-biki*, *Ao-biki*, *Mata-mukashi*, *Koishi-maru*, *Tsuno-mata*, *Kasuri*, *Hime-ko*, *Kuma-ko*, etc. Besides the above, several hundreds of the races may be found, but those which are widely reared for practical purposes, are only two or three races, namely, the *Ao-biki*, the *Mata-mukashi*, the *Koishimaru*, and the *Shira-tama*, which are healthy, easy to feed, comparatively productive, and moreover produce good silk.

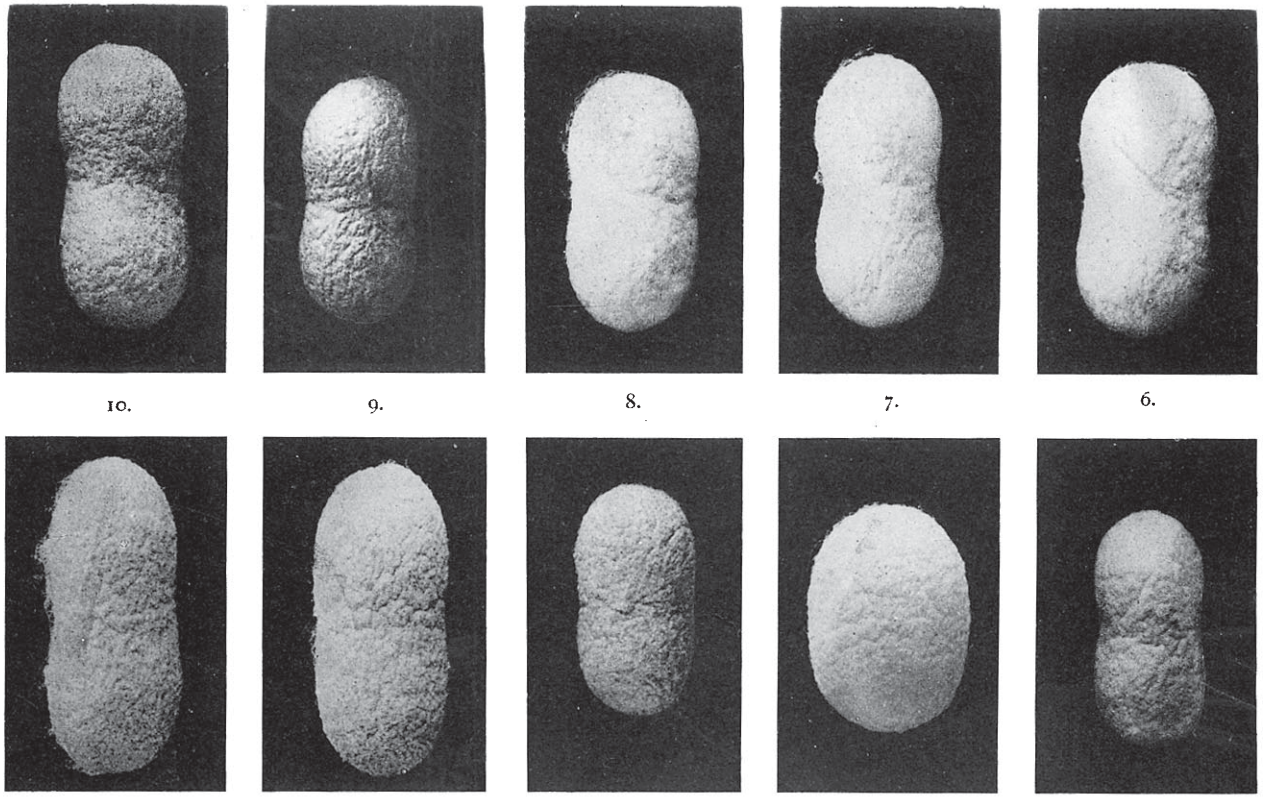
The silkworms fed during the summer and autumn are the annuals, bivoltines, hybrids obtained by crossing the former two races and rarely polyvoltines. So there are many names of the races, but only *Haku-ryū*, *Kasuri*, and *Yanoha* are widely reared, being conceded to be the superior ones.

It is general that the silk produced by the summer and autumn worms, is inferior to that of the spring. Formerly the annuals were commonly reared while the summer breeds were reared only in a certain district, and even those summer breeds were nothing but the second generation of the so-called bivoltines. But about 40 years ago a method was invented, by which the grains of the second breed of the bivoltines were preserved in a cool storage, and by this means the first breed is made to hatch in summer and the second breed in autumn. Thus we achieve the ability to rear the autumn breed. The season of the feeding of the new worm is suited to the leisure of the farming classes, and by this rearing of silkworms they may conveniently distribute their labours. On these accounts, the new genesis of the worms was welcomed by the sericulturists. The invention of the autumn breed has made active progress during a short period.



VARIETIES OF SILKWORMS.

1. *Koishi-maru.*
2. *Ao-ziku.*
3. *Kasuri.*
4. *Kurohane-seihaku.*
5. *Araya.*
6. *Oniwaka-maru.*
7. CHINESE RACE.
8. KOREAN RACE.
9. FRENCH RACE.
10. ITALIAN RACE.



VARIETIES OF COCOONS.

1. *Koishi-maru.*
2. *Ao-ziku.*
3. *Kasuri.*
4. *Kurohane-seihaku.*
5. *Araya.*
6. *Oniwaka-maru.*
7. CHINESE RACE.
8. KOREAN RACE.
9. FRENCH RACE.
10. ITALIAN RACE.

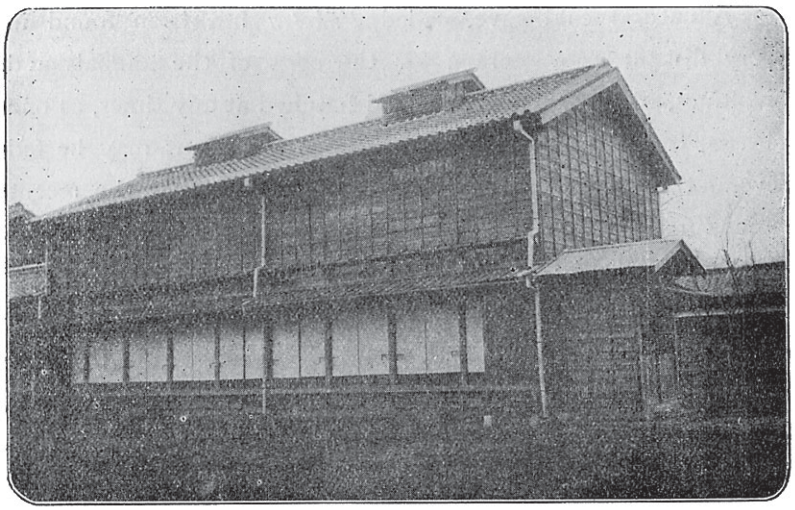
A natural cold cave, called *Fūketsu* has been found in every district as a storage for the eggs of the annuals and bivoltines, which are taken out and hatched at any times, as one pleases, from spring to autumn. Thus silkworms may be fed several times a year. It is said that the fact that the recent sericulture in our country has brought forth such prosperity, is greatly due to the discovery of *Fūketsu*.

A cave or *Fūketsu* is often found in a rocky place in the volcanic districts. Cold air is always blowing in a *Fūketsu* through the crevices of the rocks and the interior temperature is so low that even in the hottest day of summer it is kept below 40 degrees F.. When the eggs are preserved in this cave, their nuclei are in the same dormant state even in summer or autumn that they are in winter. If the eggs are taken out and kept at a temperature of over 70 degrees F., they will hatch after one or two weeks.

II. The Silkworm Rearing House and Instruments.

As the sericulture industry in Japan has been practiced in general case as an accessory occupation of farmers, many of them have reserved one part of their dwellings for the culture of cocoons, and except a few have not built any special building.

Whether the situation and construction of the silkworm rearing house are suitable or not, has a great influence on the health of the worms, and also the facilitation of the actions, and the amount of the labours of the rearers depend greatly upon them. For these reasons, those who wish to build a silkworm rearing house should select at first the situation properly, and



SILKWORM REARING HOUSE.

then construct the house so completely that it may be hygienic for the silkworms, facilitale the actions of the rearers and diminish their labours.

A. The Situations of the Silkworm Rearing House.

A suitable place for building the silkworm rearing house should be dry, open and airy. On the contrary, the moist, narrow and closed place which is surrounded with hills, forests, houses, etc., is not proper for the building. However as it is impossible on account of the topographical conditions in various places that all the sericulturists in different localities can select the fittest situation for their silkworm rearing houses; therefore, the builders should endeavour to search as carefully as they can for the most suitable place and to compensate for the unavoidable defects of the situation in the construction of the house itself.

For example, when the place is moist, trenches are dug out round the house or stagnant water is drained off by the underground sewers, but if this is impossible, the surface of the ground is elevated for drying, by piling up the earth into a mound. The house is built with a high floor and an upper or third story, so that the damp vapours arising from the ground, are avoided as much as possible and at the same time accommodations for ventilation are arranged. Especially should this be so, when hills, forests and houses are close to it. In short, a dry and airy place is suitable for building the silkworm rearing house and damp sultry place is not proper for such a building. But there is no exception in this case to the universal rule that profit always follows loss. Thus a silkworm rearing house built at the most proper place, may have much profit in view of the fact that the silkworms are easily protected from the unfavourable conditions of the climate, such as hot and oppressive weather, and may spin a good grade of cocoons, which may be easily unwinded in reeling. But at the same time the house has such disadvantages that much fuel is needed to keep the rooms warm in the feeding of the young worms of the *spring* breed, and also the growth of the silkworms is often retarded by the drying of their litters too much. On these accounts, the house is suited for the rearing of the last age worms of the *spring* breed and the worms of the *summer* and *autumn* breeds. On the contrary, although the silkworm rearing house in an unsuitable place, as described above, has rather gloomy rooms and often gets so sultry, in the feeding of the last age worms of the *spring* breed and the worms of the *summer* and *autumn* breed, that their health is at times impaired; on the other

hand, the expenses for fuel can be spared in warming the nursery in the first period of the rearing of the *spring* breeds and also there is but little fear of injuring the silkworms by the overdrying of their litters.

In selecting the situation of the nursery for feeding the young worms of the spring breed, and the mature ones of the same breed, and the worms of the *summer* and *autumn* breeds, the rearers usually consider profoundly the above relations.

B. The Direction of the Silkworm Rearing House.

The silkworm rearing house is in general constructed towards the south, for the reason that the room facing the south has something exhilarating and in its influence is always hygienic and also it is convenient to have a rich full draught of the breeze from the south which is the ordinary wind during the summer in our country, the rooms are easily kept at a moderate temperature, both the left and the right sides of the house being exposed to the rising and setting sunshine; while the house built along the north and south directions, facing towards the east and the west, is so brightened on the front and back side, by the rising and setting sunshine, that in spring the rearers may have the profit of sparing fuel by utilizing the heat caused by the sunshine, but in summer, when the temperature becomes gradually high and fire is unneccessary to warm the rooms, the rearers may often be troubled by a too high temperature, caused by the rising and setting sunshine. Moreover bad ventilation is an unavoidable defect in the nursery, constructed in this direction.

C. The Construction of the Silkworm Rearing House.

There are in general two kinds of silkworm rearing houses, one storied and an upper storied house. Rarely there are three storied houses.

Now we will investigate the advantageous and disadvantageous points of these constructions in the following pages. Only on the point of the facilitation of the actions of the rearers, a one storied house is the best of all, but if space is unsufficent to build it or the ground has too much water or any adjacent obstruction prevents it from aeration, the upper or third storied house, is better. Though a one storied house tends to become somewhat damp, it is convenient at the same time to keep warm. On this account, it is suited for rearing the young worms of the *spring* breed. The upper and third story, being quite dry, such constructions are better than a one storied house as a nursery during the summer and as *mounting* house, but the difference of temperature between day and night being great, they are not suitable to rear the young worms of the *spring* breed.

The inside of the silkworm rearing house is usually divided with walls. The common extent is 12 feet to 15 feet by 12 feet to 18 feet. When the depth is too great, the room becomes so damp and unhealthy for the silkworms that they sometimes fall successively into Grasserie, Muscardine, etc., while too spacious rooms are difficult to regulate in respect to the interior temperature as the rearer wishes and also are not suitable for nursery purposes.

The floor is made two feet in height when the place is

moist and one and a half feet when it is dry. A small window with a door which may be easily opened and closed, is made in various places under the floor. The board of the floor is about one inch in thickness and nailed down so closely each other, because if there are any open spaces in the floor, the regulation of the inner temperature is difficult.

The proper distance between the floor and the ceiling is from eight and half feet to ten feet. If it is too low, the air of the interior becomes musty, while if it is too high, it is difficult to regulate the interior temperature. The windows for ventilation, prepared with a door which is opened and closed by means of two ropes, are made at the four corners and the middle of the ceiling. Their sizes depend on the extent of the ceiling. But the common sizes are that the windows at four corners are about one hundredth and the middle ones about five hundredth of the ceiling. It is indispensable for the silkworm rearing house to have also the preparation for ventilation of the roof.

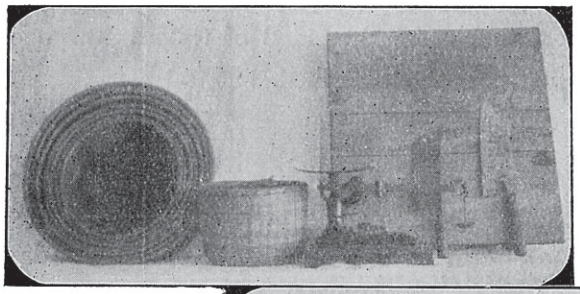
There are several kinds of roofs, such as, tile, shingle and thatched roofs. Among which the last is the best suited for the nursery, so as to slowly conduct the outside heat and the tile roof is next. The shingle one is not suitable for a silkworm rearing house on account of the fact that if affords the least protecting from the influence of the outside temperature. Surrounding the nursery a gallery is made in order to regulate the sudden change of the outside temperature and to facilitate the actions of the rearers. The south and north sides of the gallery are from four and half feet to six feet in width, and the east and west over three feet as one pleases. In the middle of the nursery a hearth is prepared, which is made of fireproof

stones or bricks and covered so as not to hinder the working of the industry.

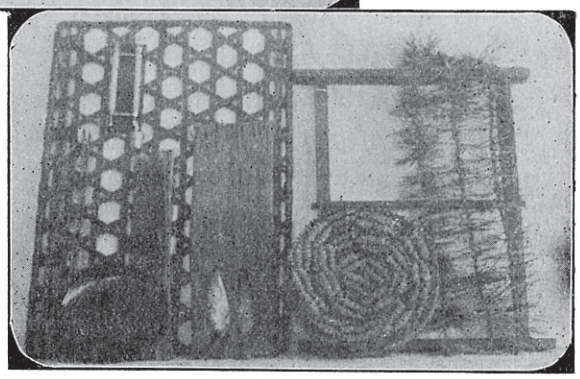
D. Instruments.

Whether the instruments for feeding the silkowrms are suitable or not has also an influence on the health of the silkworms and the facility of their treatments. Finally it concerns the economy of the enterpise.

Now the principal instruments will be explained in the following pages. The frame-work: On both sides of the nursery, it is made along the wall for the reception of the trays. Boards, 1 inch by 8 inches serve as the uprights, the tops touching the ceiling. Light bars of bamboo to support the trays should be suspended across the uprights horizontally with a proper space, about ten inches, between every two bars. The closer distance is not good for ventilation and becomes unhealthy for the silkworms.



IMPLEMENTS FOR PREPARING SILKWORM FOOD.



REARING IMPLEMENTS.

The silkworms trays: These are made of split bamboo; there are two forms, the circular and rectangular, with various sizes, but those popularly used and found to be convenient for practical purposes, are the rectangular 3.5 feet by 2.5 feet with a level border. The circular ones, 2.5 feet in diameter, are also widely used. The circular tray is made very easily, but in actual use, the rearers may have much trouble to cut the mattings and nets, so as to fit to it, their being generally rectangular, and moreover their borders cut, should be repaired. Still their handling is troublesome and they become worn out and wasted in a short time. Another kind of trays is the one connected with a matting which is lined, but it is very inconvenient in handling.

Mats: These are better made as light as possible but not so light that husks (which are often scattered on them) and silkworms' excrements may leak down. The *Itodade* mats (the other name the *Minagawa* mats) woven of cotton or hemp thread as the warp and of straw as the woof, are conceded to be suitable for the practical use.

Nettings: Those which are used until the fourth age, are made of cotton threads. There are different kinds of nettings with various sizes of meshes, 0.1 inch, 0.15 inches, 0.2 inches, 0.3 inches, and 0.5 inches. These nettings serve chiefly for the removing of the litter and the taking out of the late moulting worms after ceasing to give them the mulberry leaves. The nettings used during the fifth age are made of straw ropes, hemp or Juncus communis and are chiefly used for the removing of the litter. The most suitable size of the meshes in some 2 inches. Besides the instruments described above, basins, the

knives for cutting the mulberry leaves, the sickles for cutting the mulberry branches, sieves, winnows, the tray holders and feather brushes are wanted. As the instruments for *mounting*, *Ebiragomo* (the special matting for spinning cocoons) and *Mabushi* (the straw cocoonage) are necessary. There are several kinds of the cocoonage among which *Oriwara* and *Mukade-mabushi* are practically used. The former is a cradle made of straws folded and the latter consists of one or two ropes, with straws inserted cut 6 inches in length, with the shape of a caterpillar with long and thick hairs. The important instrument for graining is a moth frame which is a ring, with a funnel shape, made of thin zinc plate. The suitable size of the large opening is from some 1.8 inches to 2 inches in diameter, the small one 1.8 inches and its length some 0.5 inches to 1 inch. There are two kinds of moth frames, namely, the individual and the connected which consists of 28 rings (these are for one egg-card). Another convenient frame is a board, about one inch thick, of the same size as the egg-card, with 28 holes, some 1.8 inches in diameter, which are lined with zinc plates.

III. The Silkworm Seed or Grain.

The silkworm eggs, laid on a card is sometimes called *seed*. Whether seed is good or not, has a close relation to the crops of cocoons. How expert the rearer may be, he can not raise abundant crops from unsound seed; so the egg-card manufacturers should endeavour to produce sound seed with the most skilful arts and the most profound attention. Or how excellent

the seed may be, the rearer can not get the most vigorous silkworms, if the seed should be improperly preserved and protected, so the rearer should take great care of the seed to keep it sound and free from disease.

A. Egg-card Making.

Egg-card manufacturers select cocoons for *reproductive* purposes after finishing the following examination on the original silkworms and the cocoons collected :—

(1.) The growth of the original worms.

The number of diseases during the period of feeding, is examined and if many of the silkworms are attacked by Flacherie, Pébrine, etc., their cocoons are not used for reproductive purposes.

(2.) The quantity of the cocoons collected.

If the quantity of the cocoons collected for one *momme** of "*ants*" is less than 5.5 kilograms, that is short crops, they are not utilized for the same purposes.

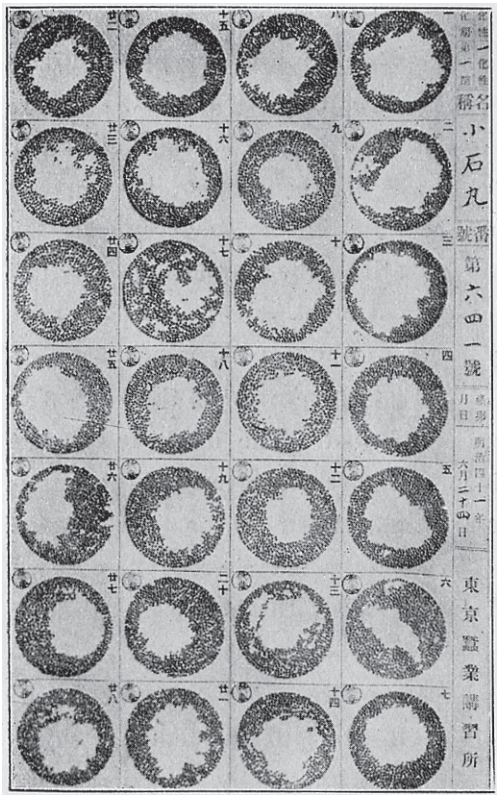
(3.) The examination of Pébrine.

If when the pupae are examined under the microscope, over 15 per cent. of them are found to be attacked by Pébrine, the cocoons are not employed for the preparation of seed.

After the above examinations, the size, color, luster and the roughness on the outside layer or granulation of the cocoons are next examined. Thus the cocoons which have the qualities peculiar to their variety, and a middle size, are selected for the

* *momme* = 3,75 grams.

raising of eggs. The cocoons thus selected, are arranged on trays, placed on the frame-work in the nursery which is ventilated and whose inner temperature is regulated always to keep at from 70 to 75 degrees F. just as in the feeding of the silkworms. Three weeks in the case of the annuals and 17 or 18 days in the case of the bivoltines or the polyvoltines passing, after pupation, the moths appear. The cocoons are covered with papers at night before the moths come forth. Newspapers may serve as the covers, which are perforated in the shape of the feather of an arrow to the amount of at least five or six in every square foot. The moths rest on top of the paper after passing through the apertures of the covers, soon after escaping from their silken prison. The cover facilitates the picking up of the moths and prevents the cocoons, left by the moths, from being stained with their excretions. If the temperature of the nursery is moderate, the exist of the moth is generally made in the morning between four and eight o'clock. The female moth appears soon after the male does. While they are pairing, the couples are kept quietly in a dark room, carefully shutting out the wind. If the room is bright or the wind blows in, an accidental uncoupling occurs. Pairing is allowed to continue for five or six hours. Between noon and one o'clock in the afternoon, the couple are separated. Before the female moths are transferred to the egg-cards, they are allowed to excrete urine. For this purpose, some 60 or 70 moths are placed on a piece of paper which is shaken a little while by one end. Then after some five minutes more they are shaken again, for the purpose of causing them to urinate. After this operation, for *industrial reproduction*, the corresponding number



CELLULAR SYSTEM EGG-CARD

of the moths for one egg-card, is transferred to a card for the laying of its eggs, while, for *cellular reproduction*, each moth is individually placed in a frame. During the laying of the eggs, the proper temperature is between 75 and 89 degrees F. and the proper humidity is about 70 per cent. When the temperature is too low, the moth takes too long time to deposit its eggs and moreover produces less eggs. When it is too wet, the egg-cards are stained by scales from the wings and their attachment to the egg-surfaces. In the proper temperature, the moths commence to lay their eggs at 6 o'clock in the evening and finish the operation at about 10 o'clock at night. In the method of *industrial reproduction*, the moths are soon picked out and disposed of, while in the *cellular* plan the moths are carefully collected. The making of common egg-cards by *industrial reproduction* is the method in which about a hundred moths are allowed to

lay their eggs indiscriminately on a card, 1 foot 2 inches by 9.25 inches, while in *cellular reproduction*, a card of the same size with that of *industrial reproduction*, is divided into 28 divisions to which the number is given, and small frames are placed in every division, in each of which, one female moth is kept to lay eggs. After finishing their laying eggs, each of them is placed in the bag of the *cellular* which has the corresponding number, for their microscopical examination.

B. Precautions with the Seed.

Even if the seed be sound, yet if it has not been carefully protected, it becomes feeble, and in the worst cases, fails to hatch. The seed of the annual remains about ten months in this form, and during another two months, it is metamorphosed first into the larva, next the pupa and finally into the moth, which will lay eggs again. The eggs are exposed to various changes of temperature during these periods, namely, at the beginning they are kept very warm, then they are gradually allowed to become cold, and are again warmed up in the spring, when the egg hatches.

On account of the fact that the nucleus of the egg is constantly changing in the state of its growth, according to the change of temperature, the methods of precaution should be varied in accordance with this fact. Generally, the period of the necessary precaution is divided into four, according to the growth of the nucleus. Now the methods for the exercise of precaution in every period will be explained in the following pages :—

(1.) Precautions during the first period.

The first period is one week after the eggs have been laid, namely, the period during which, the light yellow eggs turn gradually to a drab grayish color, proper to the egg. The eggs change not only their outer aspects during this period, but their interiors also undergo a remarkable change. They are placed on the trays, which are sometimes put into frame-work after supplying them with enough fresh air owing to their strong respiration, and the temperature in the room is kept between 70 and 80 degrees F., thus avoiding away sudden change.

(2.) Precautions during the second period.

The second period extends over from the end of the first period to the close of December. On account of the fact that although at the beginning of the period, it is still warm, the respiration of the eggs becomes gradually weak and their unclei fall into a dormant state in the autumn; the precautions taken during this period are the simplest amongst all.

The egg-cards are put into a frame-work or hung down by means of threads in a room clear and well ventilated. At the end of this period, the excretions of the moths, the scales on their wings, and any other dirt, attached to the eggs, which may often injure the larva in hatching, are washed off. For this purpose, several vessels of fresh water are allowed to remain for a while to permit the water to attain the same temperature as the air; then, the eggs are dipped into the water. After some four or five hours, they are taken out of the water one by one, and placed on a board, which has been prepared beforehand, in order to that they may be brushed softly and washed carefully.