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SUGGESTIONS

ON THE

IMPROVEMENT OF SILK REELING IN BENGAL,

BASED ON

A STUDY OF THE SYSTEMS PREVAILING IN KASHMIR AND BANGALORE.

BY

N. G. MUKERJI, M.A., M.R.A.C., F.H.A.S.,

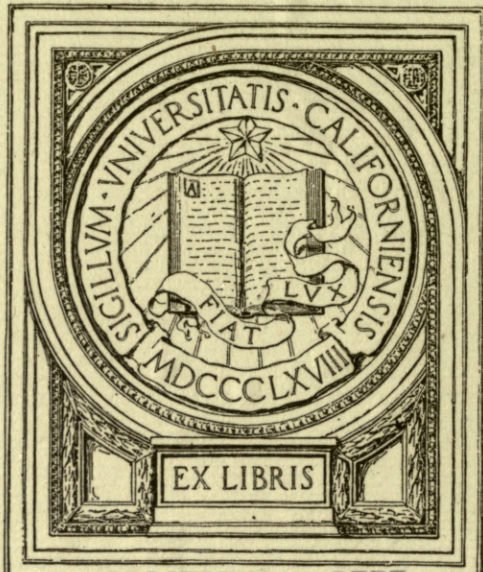
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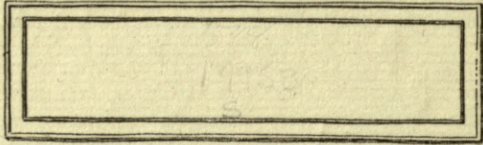
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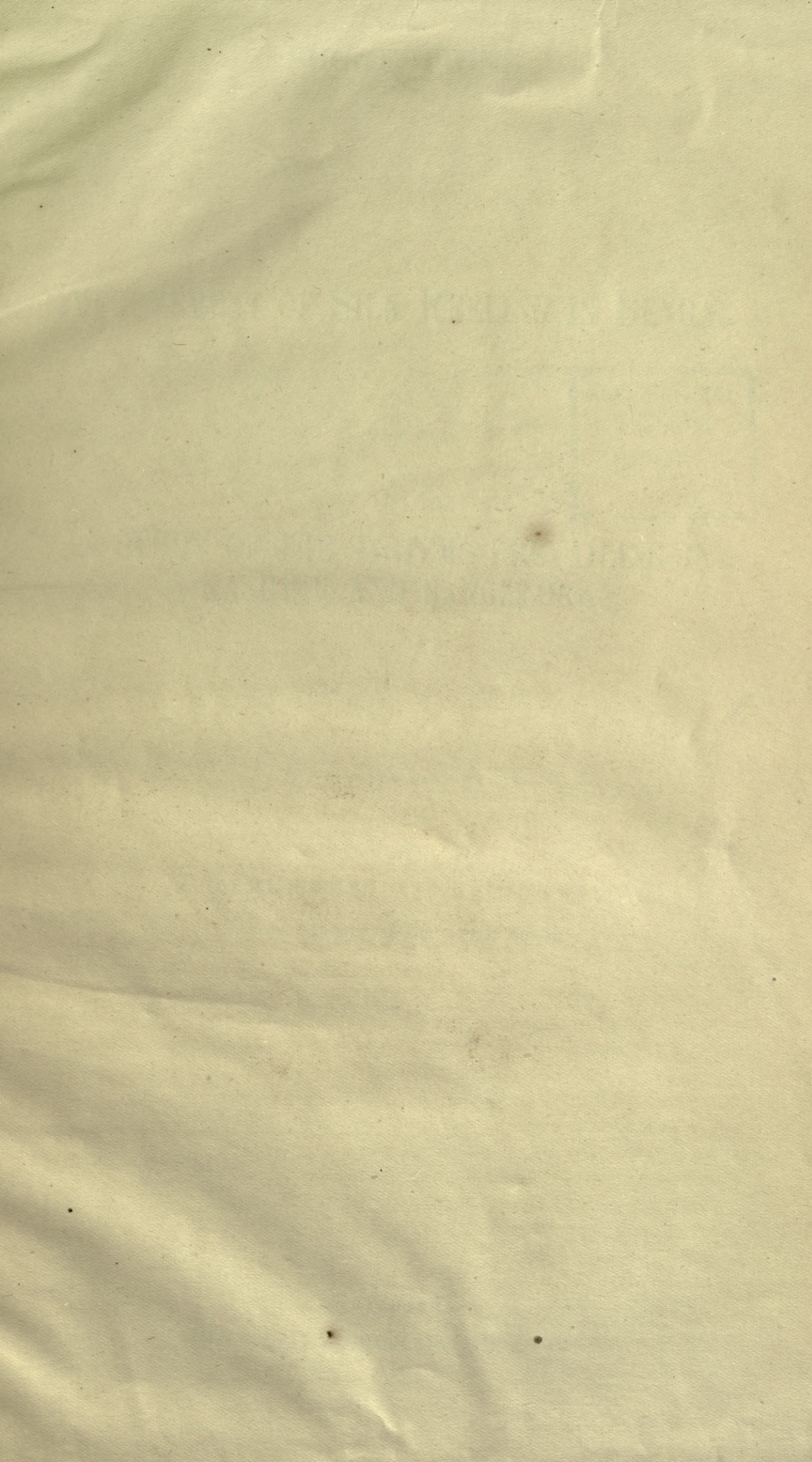
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Agric. dept.

FROM N. G. MUKERJI, Esq., M.A., M.R.A.C., and F.H.A.S.,
Assistant Director of Agriculture, Bengal, on leave,

TO THE DIRECTOR OF AGRICULTURE, BENGAL.

Dated Calcutta, the 12th June 1906.

SIR,

I HAVE the honour to submit a report on the result of my deputation to Kashmir and Mysore with a view to conducting investigations with the object of improving the method of reeling silk in Bengal. The deputation lasted for four months, *i.e.*, from the 1st June to the 30th September 1905. In Government letter No. 1160T.—R., dated Darjeeling, the 10th June 1905, it was further ordered that two or three Bengal reelers, with their native machines, were to accompany me to learn the improved methods. Accordingly I took with me two reelers and a good type of reeling machine from the district of Rajshahi.

2. The systems of reeling followed in Kashmir and in Messrs. Tata and Company's farm at Bangalore were thoroughly studied, and both the Bengal reelers were taught the two systems of reeling until they were able to produce the quantity and the quality turned out by the best local operatives. The reeling was then conducted on the Bengal system with the same cocoons, and as much as possible under similar conditions. In Kashmir I could not arrange for steam connection for the Bengal machine, but at Bangalore steam connection was secured. With steam, which is employed in the filatures in Bengal, both in those under European and in those under native management, cleaner and more elastic silk is produced. But in most native reeling establishments steam is not employed, but a *chula* is placed under each basin.

3. In native establishments, as a rule, the object is to obtain as much produce as possible at the expense of quality, and so two most important principles of reeling are neglected: (1) A knot is not made when a break takes place, but the loose end of the thread is stuck on to the reel anyhow, and the reeling continued as fast as possible. (2) The two sets of fibres reeled are not crossed one with another to give them compactness and roundness, but taken straight from the basin to the reel through two fairly large holes in an iron plate. The worst class of native silk is reeled from a large and indefinite number of cocoons, say, 15 to 30 cocoons, instead of 5 or 6.

4. To make the conditions of reeling as similar as possible, the Bengal system chosen was that which is employed by high-class reelers, and which is practically the same as the European filature system. With big holes through iron plates, with no

crossing, with no knots, and by reeling an indefinite and a large number of cocoons, the native reeler is able to turn out in Bengal up to 70 tolas of silk a day, and in Mysore up to 78 tolas. The Kashmir cocoons being even better than Mysore cocoons, a larger quantity still might be obtained: but the conditions of trial in that case would be quite different. The exact form of the Bengal reeling machine used and the system of reeling adopted are illustrated below:—

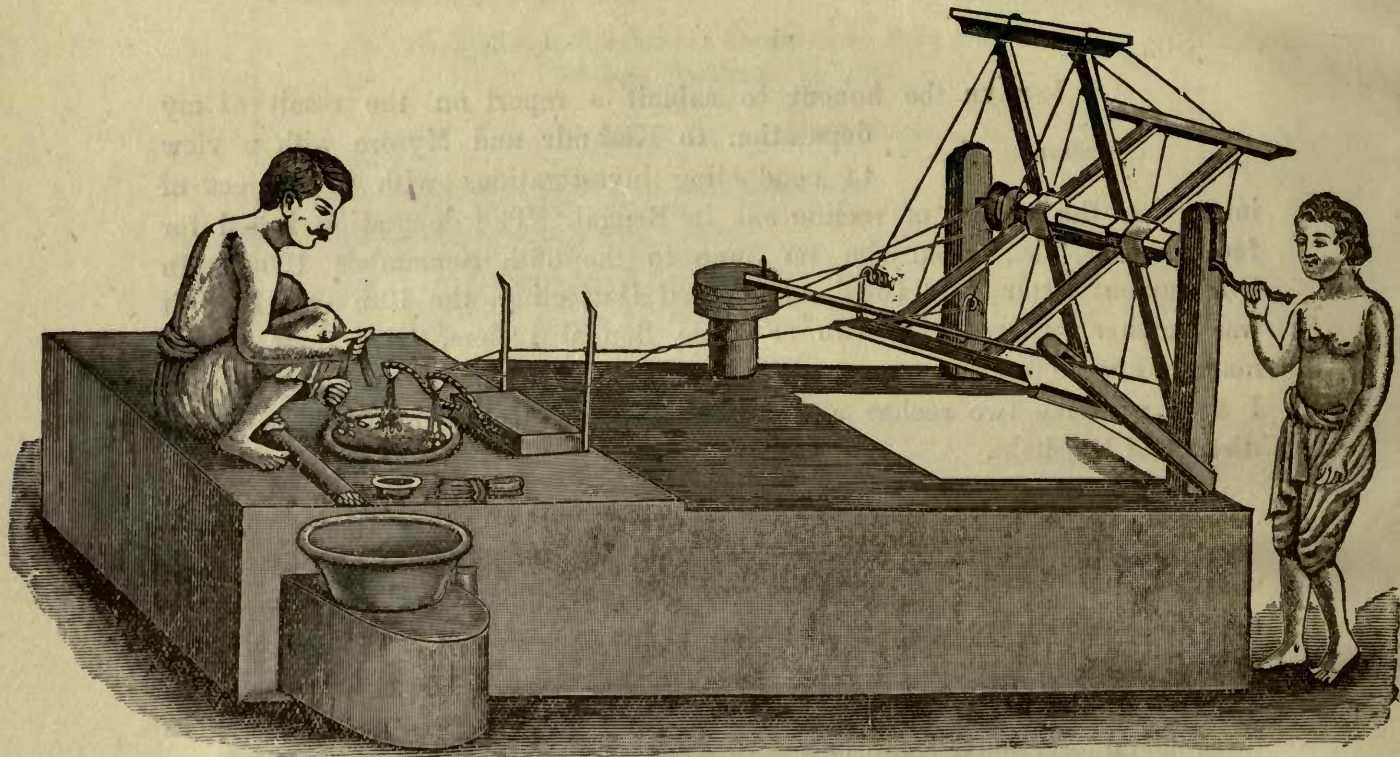


Fig. 1.—The Bengal Reeling Machine used in the Experiment.

The system followed included the use of two porcelain buttons with small holes (the same sort of buttons as are used both in Bengal and Kashmir filatures), a double system of crossing which is common to both the Bengal and the Kashmir systems, and making knots whenever there was a break. The buttons in the Japanese reeling machine of Bangalore have each a very minute hole, inserting the fibre through which involves loss of time, though it be advantageous in some respects. For instance, this method prevents the inequalities and roughness which in the Bengal and Kashmir systems have to be watched by the winder and eliminated as much as possible. With the exception of the fact that the size of the hole in the button was smaller in the one case than in the other, there was no such essential difference between the Bengal and the Japanese methods adopted as should affect the quality of the silk.

The Japanese reeling machine.

5. The Japanese system of reeling, which is illustrated in the following figures (Figs. II, III, IV and V),

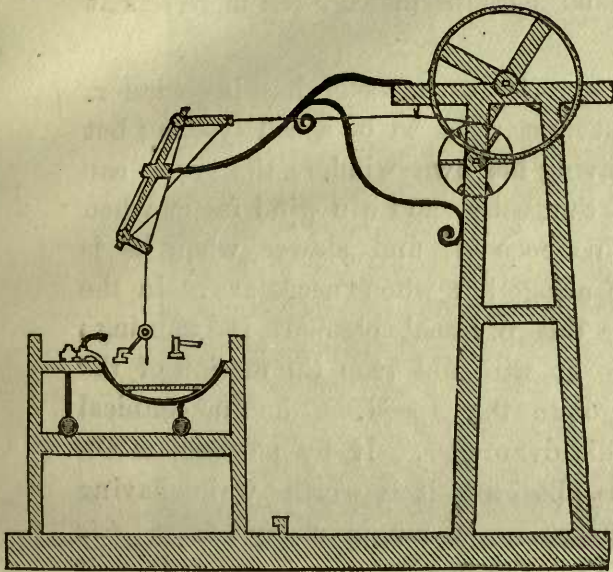


Fig. II.—Japanese Reeling Machine.

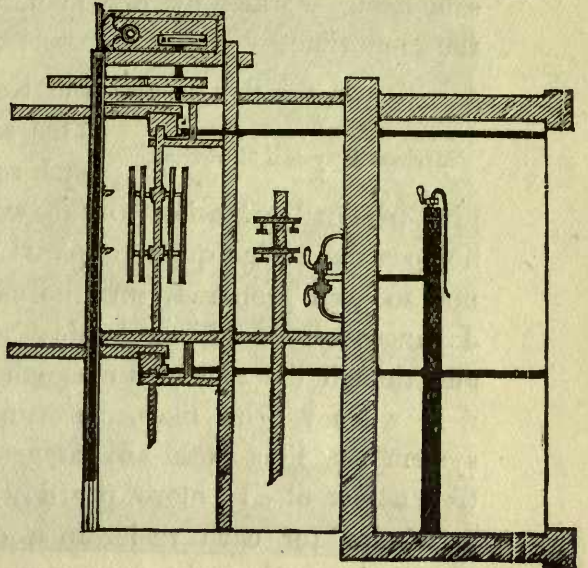


Fig. IV.—The last of a series of ten basins with reel.

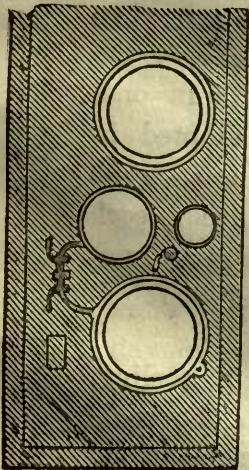


Fig. III.—Plan of Japanese basins, showing boiling and reeling basins separately.

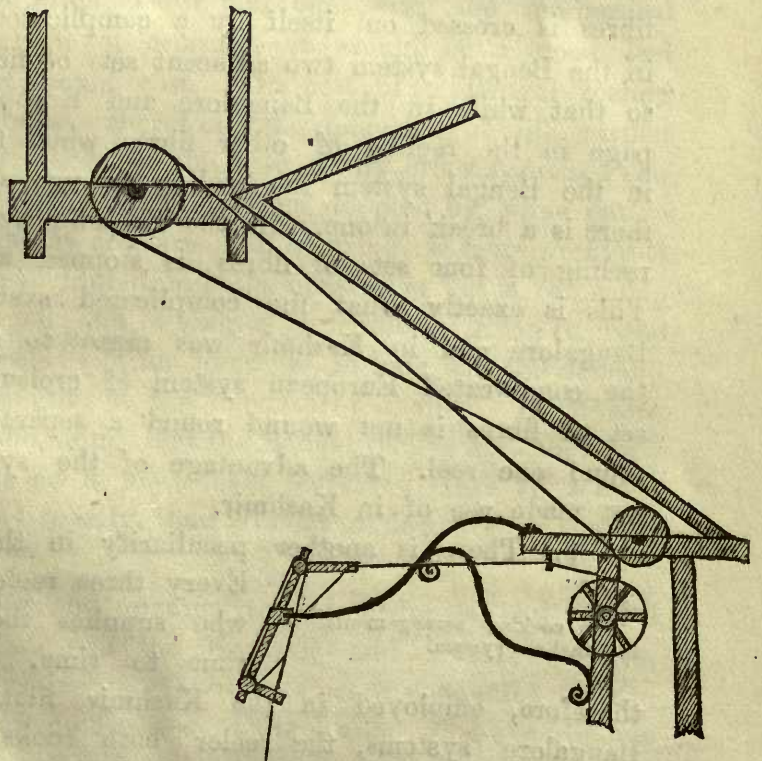


Fig. V.—Attachment of driving gear of Japanese reeling machine to reels.

has a very small reel (*i.e.*, of 3-inch diameter, instead of $2\frac{1}{2}$ feet) to which I chiefly attribute the small produce from this machine as compared with that obtained from the Bengal or the Kashmir machine. It has also a more complicated system of crossing as compared with the Bengal system, though similar to the system in vogue in Kashmir. The holes in the buttons in the Japanese system, as already stated, are very minute. Another distinctive feature of the Japanese system is the method of turning the reel—all the ten sets being worked by one man, who could perhaps manage ten more sets at the same time.

6. In the Bengal and the Kashmir systems each reeler has his winder.

Mechanical system of winding. This seems at first sight to be a bad system; but each reeler having his own winder, the latter can give personal attention to the work of the reeler, and can wind faster when he sees the reeler quite prepared with his cocoons, and slower when he is not so well prepared, and he can stop altogether when necessary. In the Japanese system of mechanical winding this personal element is wanting; and though the reeler can use the brake at will and stop the motion of the reel whenever he likes, he cannot regulate the speed. The mechanical system has thus both advantages and disadvantages. If by personal attention a *tola* of silk more per day can be obtained, it is worth while having a winder for each reeler in a country where labour is cheap, as a *tola* of silk is worth about four annas. It is for this reason that in most Bengal reeling establishments the mechanical system of winding has been supplanted by what seems to be a more primitive system. In Kashmir also this primitive system of winding has been introduced, but here each winder winds the reel for four skeins of silk, instead of two. This is a disadvantage rather than an advantage. When there is a break, all the four skeins have to be stopped, instead of one, as in the Japanese or European system, and of two, as in the case of the Bengal system. In the Kashmir, as in the Bangalore and Italian systems, the same set of fibres is crossed on itself by a complicated system of *croisure*; whereas in the Bengal system two adjacent sets of fibres are crossed on each other, so that while in the Bangalore and European systems there is no stoppage in the reeling of other fibres when there is a break in one place, in the Bengal system the reeling of two sets of fibres is stopped when there is a break in one. In the Kashmir system, on the other hand, the reeling of four sets of fibres is stopped when there is a break in one. This is exactly what the complicated system of *croisure* as adopted in Bangalore and in Kashmir was meant to avoid. But in Kashmir, while the complicated European system of *croisure* has been introduced, each set of fibres is not wound round a separate reel, but four sets are put round one reel. The advantage of the system of crossing is therefore not made use of in Kashmir.

7. There is another peculiarity in the Kashmir system of reeling.

Every three reelers are provided with one cook, who supplies them with boiled cocoons from time to time. There are about 500 cooks, therefore, employed in the Kashmir filature. In the Bengal and the Bangalore systems, the reeler both cooks and reels the cocoons. In Italy I saw a separate system of cooking, where there was one cook

The cooking arrangements in the Kashmir system.

for the whole filature, with a man distributing little baskets of cocoons from time to time from one common cooking place. The following illustration shows the system of reeling in vogue in Kashmir :—



Fig. VI.—Reeling, with separate cooking of cocoons.

8. This system of cooking makes the machinery and the process of reeling very expensive. The Japanese machine, with the more complicated system of *croisure* (Fig. II), its enamelled reeling basin, boiling basin and cold-water vessels and taps (Fig. III), its brake for stopping a reel at will (Fig. IV), and its mechanical system of winding (Fig. V), costs about Rs. 100 per set. Information as to the cost of the machinery in use in Kashmir was not supplied to me, but with the mechanical *batteause* and complicated system of *croisure*, it would be a good deal more than what a Bengal set would cost. The cost of a Bengal reeling set is only about Rs. 8. Unless, therefore, the quantity of silk turned out be larger and the quality better in the case of any other system, I can advise no change in the Bengal method. The system adopted by some native reelers in Bengal, of doing without *croisure* and *knötting*, is more profitable than the filature system, as even in Indian mills the demand as yet is for cheap silks, costing about Rs. 6 per pound; and as long as preference is given to cheap silks over the superior filature-reeled silk for home use, so long will the demand be met by reelers turning out quantity at the expense of quality. In Mysore the native reelers said the same thing that the Bengal reelers say, that they know how to make superior silk, but it pays them better to make 78 *tolas* a day of inferior silk, which sells readily, than 20 *tolas* of fine, even, unbroken and “nervous” silk.

9. To find out the quality and quantity turned out by the best Bengal system and the Kashmir and Mysore systems, respectively, experiments were conducted both in Kashmir and Mysore, which left no doubt as to the result. The experiments were conducted with old cocoons and with new cocoons, with poor cocoons and with good cocoons, and with *gajla* cocoons (*i.e.*, cocoons spun in the rainy

Net result obtained in the trial.

weather in the case of Mysore), and the result was always the same, viz., that with the best method of reeling in vogue in Bengal, silk was obtained as good in quality and quantity as was turned out by the Kashmir machine, and about three times greater in quantity than, and equal in quality to, what the Japanese machine, as introduced in Bangalore, produced.

Details of results obtained in Kashmir.

10. The exact results obtained in Kashmir are stated below:—

Weight.—The weight of skeins obtained from old cocoons after the first three days' practice in the filature by the Bengal reelers varied from $13\frac{1}{4}$ to $14\frac{1}{2}$ *tolas*. This was the average outturn of the best Kashmiri reelers also, though the most skilful of them on some days reeled from 15 to 16 and even $16\frac{1}{2}$ *tolas* from old cocoons, and 17 or even $17\frac{1}{2}$ *tolas* from new cocoons numbering 17 puns. When for a week the two Bengal reelers showed no further improvement and it was ascertained that they produced as much as an average good Kashmiri reeler, I set them to work with the Bengal reel. Then they produced from the same quantity of cocoons, but in an hour to an hour and-a-half less time, from $14\frac{1}{2}$ to $16\frac{1}{2}$ *tolas* from old cocoons. Several Kashmiri boys and men were allowed to practise the Bengal system of reeling, which some of the older men had been accustomed to in former years, and they all said it was much easier to reel with the Bengal machine. The produce from the new cocoons sent for reeling on the Bengal system was found to be the same, namely, $14\frac{1}{2}$ to $16\frac{1}{2}$ *tolas* from 17 puns. This was rather surprising, as I had heard that from the cocoons out of which they were this year getting about 14 *tolas* of silk for every 17 puns, they had last year (*i.e.*, when the cocoons were fresh), in Kashmir, got 18 to 20 *tolas* from 17 puns. On cutting open and weighing the cocoons of last year and the new cocoons that were sent to me for reeling, the anomalous result was readily explained. Last year's cocoons went 56 to the *tola*, while the new cocoons sent to me for reeling went 80 to the *tola*. The net result of the experiment was that with the Bengal machine we got out of the same number of cocoons (17 puns), and in 8 hours instead of 9 hours, about 2 *tolas* more silk per diem.

Unwinding.—In unwinding the silk made on the Bengal method for one hour, there were one to two breaks generally. Once there were three breaks, and another time four breaks per hour. But this was the case also with silk reeled by Kashmiris in the filature. Some of them had six breaks per hour.

Size.—*Kilchis*, or test-skeins, made from the unwinded silk, 476 metres long, weighed generally 9 to 11 deniers, but one *kilchi* weighed 8, two 12, and one 13 deniers. This was the case with Kashmir-reeled silk also, the size of which went up to 16 deniers sometimes, and down to 7 deniers at other times.

Tenacity.—This measured 20, 20 and 35 grammes in the case of silk reeled on the Bengal system, and 20, 20 and 30 in the case of silk reeled by the Kashmiri method. In the case in which tenacity measured 35 grammes, the silk was spun out of new cocoons; and I claim no superiority of strength of silk as being obtained from the Bengal machine.

Elasticity.—In this respect, I think the silk made with the Bengal appliance was slightly inferior. The percentages of elasticity indicated by

the serimetre for half a metre length of silk reeled by the Kashmir method were 11, 7, 7, 8, 7·8, and for silk reeled by the Bengal method 5, 7·5, 7·2, 7·2. Elasticity is greatly affected by the temperature of the water in the basin. Cocoons kept too long in very hot water lose in elasticity. Temperature can be regulated better with steam than over a native *chula*, and I had to improvise a native *chula* for reeling silk on the Bengal method. With steam, which is employed in the Bengal filatures, this could be easily regulated. In fact, our Bengal silk is superior to all others in elasticity; and this is the only respect in which the Bengal silk is appreciated by the European market, and we can, therefore, dismiss this point without further comment.

Detail of result obtained at Bangalore.

11. The results obtained at Bangalore are tabulated below:—

Result of reeling of Bombyx Meridionales and Antheria Mylitta Cocoons at Bangalore.

Serial number of experiment.	System.	Class of Cocoons.	Number of cocoons.	Time occupied.	WEIGHT OBTAINED.		Size in deniers.	Tenacity in grammes.	Percentage of elasticity in half metre.	Breaks in one hour.
					Silk.	Waste.				
1	Japanese	Mysore, 7 months old	1,952	H. M. 10 0	6½ tolas	4 tolas	11½, 13, 13, 13, 14	21 to 25	10 to 13	1, nil.
2	Ditto	Ditto	1,944	10 0	6½	4	14, 14, 15, 16	21 to 25	10 to 13	2, nil.
3	Ditto	Ditto	1,920	12 0	5½	5½	15½, 15½, 15½, 14½	35, 40, 20, 26	10, 12½, 8, 10	3, nil, nil.
4	Bengal	Ditto	3,200	7 7	12	7½	14½, 15, 17	39, 40, 25	12, 14, 13	4, 3.
5	Japanese	Mysore, 3 months old	1,920	19 0	6¾	5½	15½	42, 20	14½	3, 4, 2, 6 nil.
6	Bengal	Ditto	4,480	10 0	17½	8½	15½	45½	14½	3.
7	Japanese	Mysore gajla fresh...	1,600	10 0	7	Not weighed.	15½	38½	12½	3, 2, 1.
8	Bengal	Ditto	4,800	10 0	14¾	13½ tolas	15½	39½	12½	3, 2, 1.
9	Ditto	Superior, but gajla Mysore.	5,120	10 0	27, 20	1¾	13, 15, 15, 16, 18, 18	33, 32, 43, 43, 38, 72	10, 8½, 9, 11, 12, 14	Not taken.
10	Ditto	Average good and fresh Mysore.	4,720	9 0	25½	12	16, 16, 18, 18	55, 31, 45, 55	12½, 9½, 11, 10	Ditto.
11	Ditto	Fresh (but with flacheric) Mysore.	5,120	10 0	23½	10, 10	14, 14½, 16, 18	50, 20, 37, 58	13, 7½, 9, 10½	Ditto.
12	Japanese	Superior but gajla Mysore.	1,600	11 30	8, 10	Not weighed.	19, 28	60, 72	12, 11	Ditto.
13	Ditto	Average good and fresh Mysore.	1,600	10 0	8½	3, 10 tolas	18, 17	45, 45	11½, 10½	Ditto.
14	Ditto	Fresh (but with flacheric) Mysore.	1,600	10 0	7, 10	Not weighed.	Not taken	Not taken	Not taken	Ditto.
15	Ditto	Sambalpur tussar cocoons.	95	5 30	3, 10	Ditto	47	125, 100, 110	13, 12, 15	Ditto.
16	Bengal	Ditto	138	5 30	4, 10	Ditto	37	90, 62, 72	9½, 12, 11	Ditto.

12. The reason for making reeling experiments with tussar cocoons was that a report had been received from Bangalore that the Japanese machine was particularly effective with tussar cocoons, and that 500 cocoons could be reeled by a single person in one day with this machine. As a matter of fact, it was ascertained that only 95 cocoons could be reeled in 5½ hours by one person with the help of another who found the ends of the cocoons while his companion was reeling. This is not such a good result as that attained by the native spinner in the Central Provinces or in Bengal, where from 50 to 100 cocoons are reeled and twisted in the same process by a single person;

while in European filatures as many as 250 cocoons are reeled per diem by each spinner.

13. A subsidiary arrangement for killing cocoons is in use in Kashmir. It is illustrated below:—

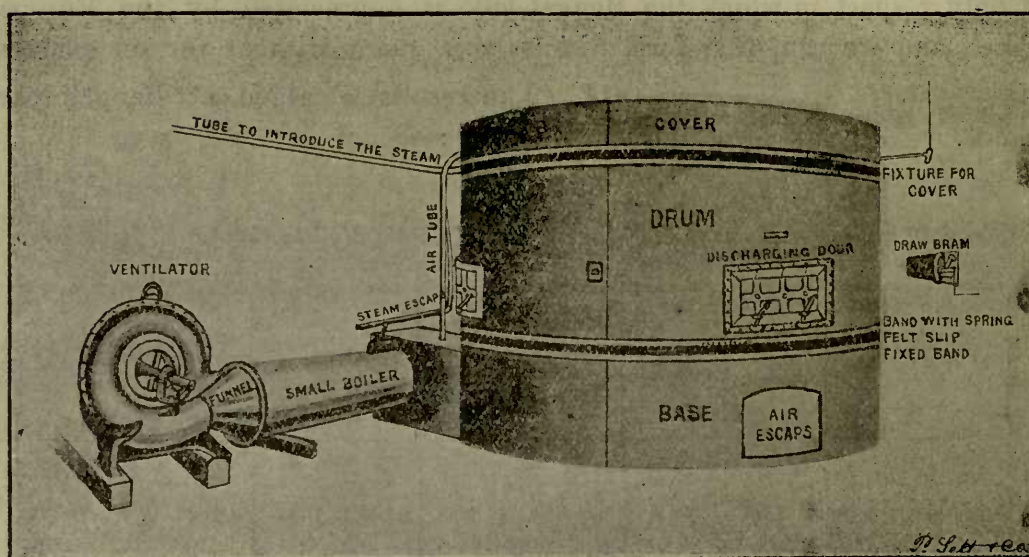


Fig. VII.—The Sechoir Bianca.

It is called *Sechoir Bianca*, and I was given to understand that each machine cost Rs. 5,000. There were eight of these machines at work at Srinagar. The killing of the cocoons takes about 12 hours, and two lots are killed in 24 hours by working the machine night and day. The killing was found to be done imperfectly, and the eight machines were not able to cope with the work thrown on them in a month's time, when 19,000 maunds of cocoons had to be killed. The arrangement in use in Bengal (when solar heat is not available for killing the cocoons) is called *Atas ghar*, and I agreed with the Director of Sericulture in Kashmir in thinking this to be a cheaper and more efficient method of killing cocoons than the *Sechoir Bianca*.

14. There is no doubt the Bengal silk reeled even in European filatures is of less value than the silk made at Messrs. Tata's farm at Bangalore or the silk made in Kashmir. Bangalore silk from Messrs. Tata's farm ranks below Bagdad silk, Kashmir silk below this Bangalore silk, and Bengal silk below Kashmir silk. But this is due to the poverty of the Bengal cocoons, and not to any defect in the reeling machine or the reelers, a Bengal cocoon giving only a fourth of the quantity of silk obtained from a Kashmir cocoon. Bengal cocoons have to be joined four times as often as Kashmir cocoons at the time of reeling, and the result must be more uneven silk. I have shown that with the

same class of cocoons the Bengal reeling machine produces at least as good silk as the Kashmir silk, and probably just as good as Tata's silk from Bangalore. The silk from the Bengal machine is often wanting in "nerve." This defect can be easily removed by insisting on 10 or 12 crossings at each spot in the double system of *croisure* in vogue in Bengal. This I did in Mysore in the case of some skeins, and these did not differ in appearance or in touch from the skeins from the Japanese machine. Kashmir cocoons are at least twice as rich in silk as Bangalore cocoons, and Bangalore cocoons are richer in silk than Bengal cocoons. With the same machine, the best silk should be obtained from the Kashmir cocoons, and comparatively inferior silk from the Japanese and Bengal cocoons. But the fact that the Kashmir silk fetches a lower price than Bangalore silk does not speak very well of the system of reeling in vogue in Kashmir. The Kashmir cocoons are in reality the same as the French, Italian or Japanese cocoons, and they ought to produce a very high-class silk. On the other hand, though the quality of the silk produced by the Japanese system of reeling is very superior, the quantity turned out is so small that reeling by this system has never paid in Messrs. Tata's farm. The appraisal of silk from Bangalore cocoons reeled with the Japanese and with the Bengal machine, made at Lyons, has come through Messrs. Tata's firm, and the two silks are pronounced equally good.

15. The unprofitableness of the Japanese system of reeling as introduced in the Bangalore farm can be inferred from the following figures compiled out of the farm book for a whole month. The filature of 10 basins was worked for 23 days in the month. Allowing for half-a-day's or one day's absence of individual reelers, there were $197\frac{1}{2}$ basins at work during the month. The total amount of silk produced during the month was 1,038.3 *tolas*, or 26 lbs. This gives an average of $5\frac{1}{2}$ *tolas* of silk per basin per day,—a result which I frequently observed during the days I was at the farm. The "waste" produced during those 23 days was $680\frac{2}{3}$ *tolas* = 17 lbs. The amount of fuel consumed during the 23 days was 5,132 lbs., or 64 maunds, which cost Rs. 23. The reelers including the re-reeler, were paid for those 23 days Rs. 30-7-7, at the rate of Rs. 4 a month. The man in charge of the boiler was paid Rs. 9. The winder was paid Rs. 3 and the foreman, Rs. 20; *i.e.*, Rs. 60-7-7 were paid as wages. The 175 baskets of cocoons used weighed 17 maunds of 28 lbs. each, and cost, at Rs. 12 per maund, Rs. 204. The cost of repairs, oil, &c., came to Rs. 3. The total cost of producing the 26 lbs. of silk and 17 lbs. of waste was thus Rs. 300. The 26 lbs. of silk sold for Rs. 234, and the 17 lbs. of waste for Rs. 17. Thus the value of the outturn came to Rs. 251. This calculation does not take into account the Superintendent's pay, house-rent, &c.

16. The Japanese system suggests, however, one great improvement. Every skein of Japanese silk is re-wound before export, and any breaks occurring in unwinding are carefully re-united by knotting, so that the finished skein of silk does not break at all in unravelling in Europe, and it counts therefore as a "100-tavelle" silk; while Bengal filature-reeled silk counts in Europe as

“20-tavelle” or “30-tavelle” silk. The Bengal silk is so troublesome to unravel, that one operative in Europe cannot manage more than 20 to 30 skeins at a time, while 100 skeins of silk from Japan (as in the case of Italian or French silk) can be managed at one time. The following illustrations (Fig. VIII) show the Japanese method of re-winding the silk:—

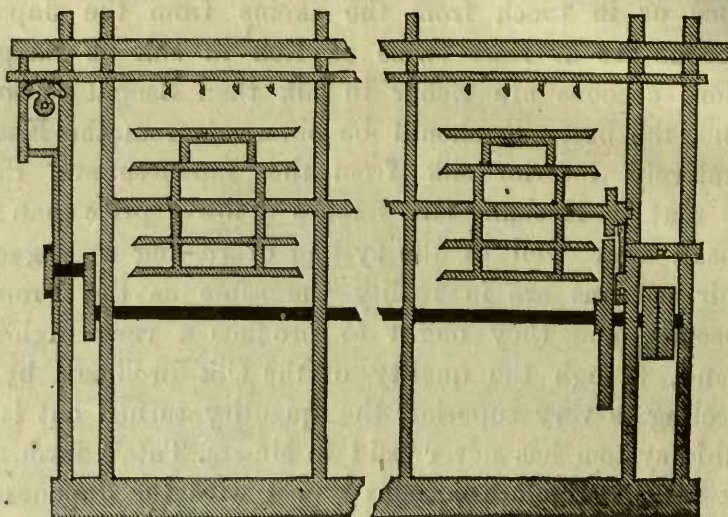


Fig. VIII.—Japanese Re-reeling Machine (the two end sections).

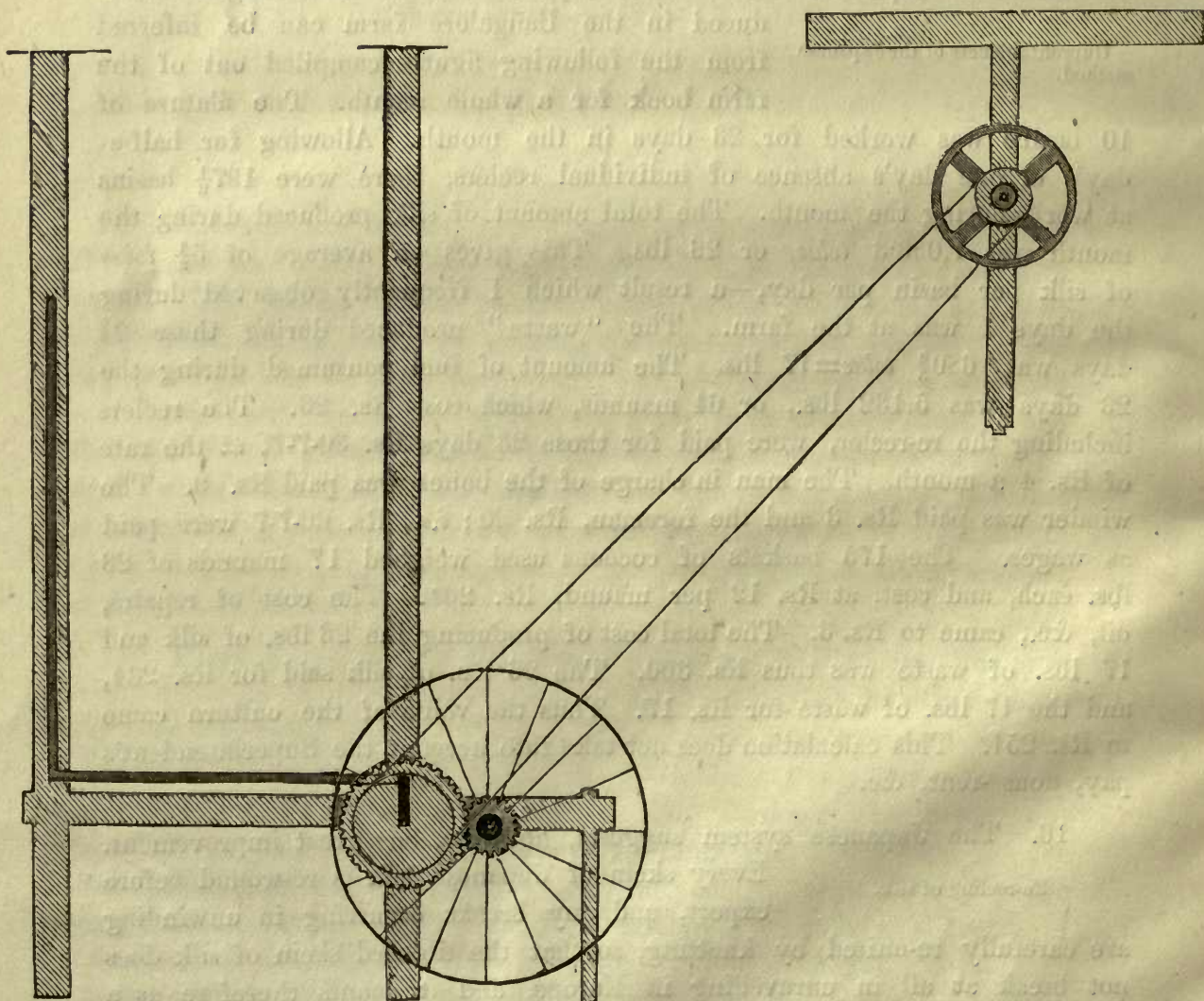


Fig. IX.—Driving gear of Japanese Reeling Machine showing attachment to Re-reeling Machine.

The skeins of silk from the reeling machine while still on the reel, are brought daily to the re-reeling machine, and are wound off into larger skeins, the process costing only a pice per skein. In Bengal this practice should be introduced everywhere.

17. Another recommendation that suggests itself is, that the separate arrangement for cooking adopted in the Kashmir and Bangalore systems should be introduced into Bengal. If the cooking of the cocoons is done at a greater heat than is allowed in Bengal or in Kashmir or Bangalore, *i.e.*, if the cocoons are cooked at a temperature of 100° C, instead of 70° or 80° C, the future reeling can be done at a gentler heat (about 50° C) which the reeler can easily handle, and which tends to preserve better the elasticity of the silk. Though this regulation of temperature is not practised in either Kashmir or in Bangalore, it can be practised. But in the Bengal system, though a different temperature is used for boiling and cooking, by letting in steam and by adding cold water, the high temperature can be regulated better in a separate place, whence 2 or 4 *pun* baskets of cocoons (according as they are cocoons of *Bombyx mori*, or of *B. fortunatus*, *Croesi* or *Meridionalis*) may be distributed every quarter of an hour through the filature. This will make reeling easier for the reelers, and give silk of better quality.

18. Though there is something to be said in favour of having a winder for each reeler, it is a decided disadvantage in some ways that the operation of reeling should require two men (as in the Bengal and Kashmir systems). Each student of the Rampur-Boalia sericultural school should be able to rear and reel, and go out and introduce sericulture in a new locality without the help of a second person. Whether a passed student of that school or a mere professional rearer or reeler or winder is sent to a distant part of the country, the pay expected is at least Rs. 20 a month. It becomes a serious matter, therefore, if two men, instead of one, be required. It is not sufficient to produce the cocoons, as cocoons are bulky and they cannot be conveniently and economically transported to distant places. Sericulture cannot be introduced into a new locality unless silk is made. Silk is easily carried long distances at a small cost, and it can be used by cotton weavers also for weaving. Every student of a sericultural school should therefore turn out an expert rearer and reeler; and without the help of a second expert he should be able to teach the industry practically. For this purpose, and for domestic use, a reeling machine which can be worked by a single person is essential. The Japanese hand-reeling machine can be worked by a single person, but with it not more than 6 *tolas* of silk can be reeled in one day; no *croisure* is admissible in this system.

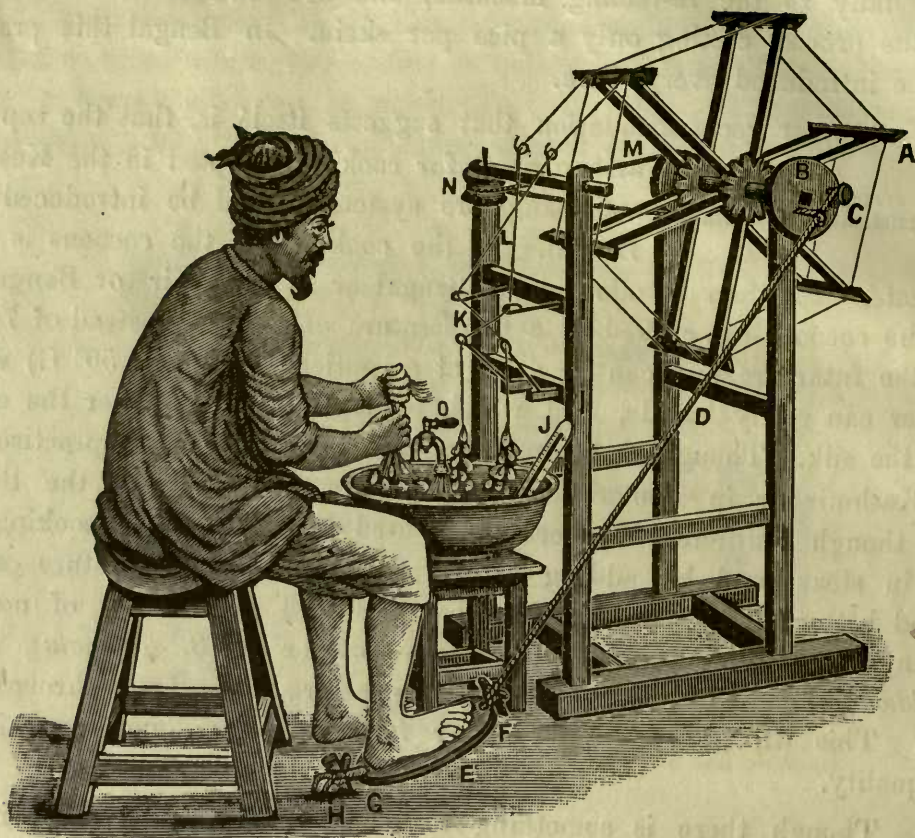


Fig. X.—The new Reeling Machine with pedal arrangement.

- A—Reel ($2\frac{1}{2}$ feet diameter).
- B—Pulley at right-hand end of the reel (weighted).
- C—Pin or screw on B.
- D—String or wire.
- E—Plank (pedal).
- F—Hole at one end of E for tying string or wire.
- G—Hole at the other end of E for tying the pedal to a pin fixed into the ground with wire rope.
- H—Pin fixed to the ground for keeping the pedal in position.
- J—Thermometer for testing the temperature of water in the basin for boiling and reeling the cocoons.
- K & L—Two croisures.
- M—String giving motion to the eccentric.
- N—Pulley on which the eccentric rests.
- O—Steam-cock.

The figure above (Fig. X) represents a reeling machine I have constructed, which can be worked by a pedal arrangement by the reeler and which includes all the parts of a proper reeling machine. It has given $13\frac{1}{2}$ *tolas* of 16 to 18 denier silk in eight hours after one week's practice by the operator, and I expect it will give better results when the reelers get used to it. As a domestic machine, as a machine suitable for schools and for introduction in new localities, it is likely to prove valuable. In European filatures up to 20 *tolas* of silk are obtained for coarse sizes as the average outturn per basin, and whether the outturn of $13\frac{1}{2}$ *tolas* per man per basin will be more remunerative than the outturn of 20 *tolas* per two men per basin, is doubtful; but

I expect that after a little practice, 15 or 16 *tolas* a day could be turned out, and then the machine might come into general use.

19. To sum up, my recommendation for
 Recommendations. improving the reeling of Bengal silk are :—

- (1) The adoption of a reeling machine which can be worked by one person.
- (2) The adoption of a more rigorous system of *croisure*, that silk of greater "nerve" may be obtained. At each place in the double *croisure* there should be 10 or 12 crossings, instead of 1 or 2, which is the rule now even in European filatures.
- (3) The regulation of the temperature of the basin at about 50° C, and the boiling of cocoons in a separate place in little wire baskets holding 4 *puns* (4×80) of Bengal cocoons or two *puns* of *Bombyx mori* cocoons. The length of time for which each lot of cocoons should be boiled must be determined by an experienced person, who will, according to the nature of the cocoons, boil them for one and-a-half minutes up to seven minutes.
- (4) All the raw silk exported from Bengal should be re-reeled.

20. The samples of cocoons, raw silk, etc.,
 Samples. procured are the following :—

(1) *From Kashmir.*

1. Mulberry leaf used for silk-worms in the first stage.
2. Mulberry leaf used in the intermediate stages.
3. Mulberry leaf used at the last stage.
4. Mulberry leaf used at ripening.
5. Yellow cocoons used for seeding in 1905, showing, in my opinion, *pebrine* in uncut cocoons (weight, 64 cut shells to 1 *tola*).
6. White cocoons used for seeding in 1905, showing, in my opinion, *pebrine* in uncut cocoons (weight, 60 shells to 1 *tola*).
7. Yellow cocoons given to me for reeling with the Bengal machine (weight, 80 shells to 1 *tola*).
8. Last year's cocoons used for reeling both on the Bengal and Kashmir systems (weight, 56 shells to 1 *tola*).
9. Waste made in reeling 16 *tolas* of silk by the Bengal system per basin per man in one day ($7\frac{1}{2}$ *tolas*).
10. Raw silk made out of cocoons by the Bengal system, No. 8 of last year, 16 *tolas* out of 17 *puns*.
11. Raw silk made out of this year's cocoons, No. 7, by the Bengal system (30 *tolas* out of 34 *puns*).
12. Raw silk made out of this year's cocoons by the Kashmir system ($32\frac{1}{4}$ *tolas* out of 34 *puns*).
13. Test-skeins from the Kashmir filature reeled silk.
14. Test-skeins from the silk reeled by the Bengal method.

(2) *From Mysore.*

1. Seven months old cocoons (cocoons of March 1905) reeled at Messrs. Tata's farm, Bangalore.
2. Silk reeled and re-reeled with Japanese machine out of 7 months old cocoons ($1\frac{1}{2}$ *kahans* yielding 6 *tolas*).

31. As directed by Mr. Heaton Bill I visited Mr. ...
and Mr. ...
The result of my ...
was the drawing up of a plan of ...
for Messrs. George Atkinson and ...
been furnished to you

32. Mr. ...
method of ...
of ...
not ...
by the way

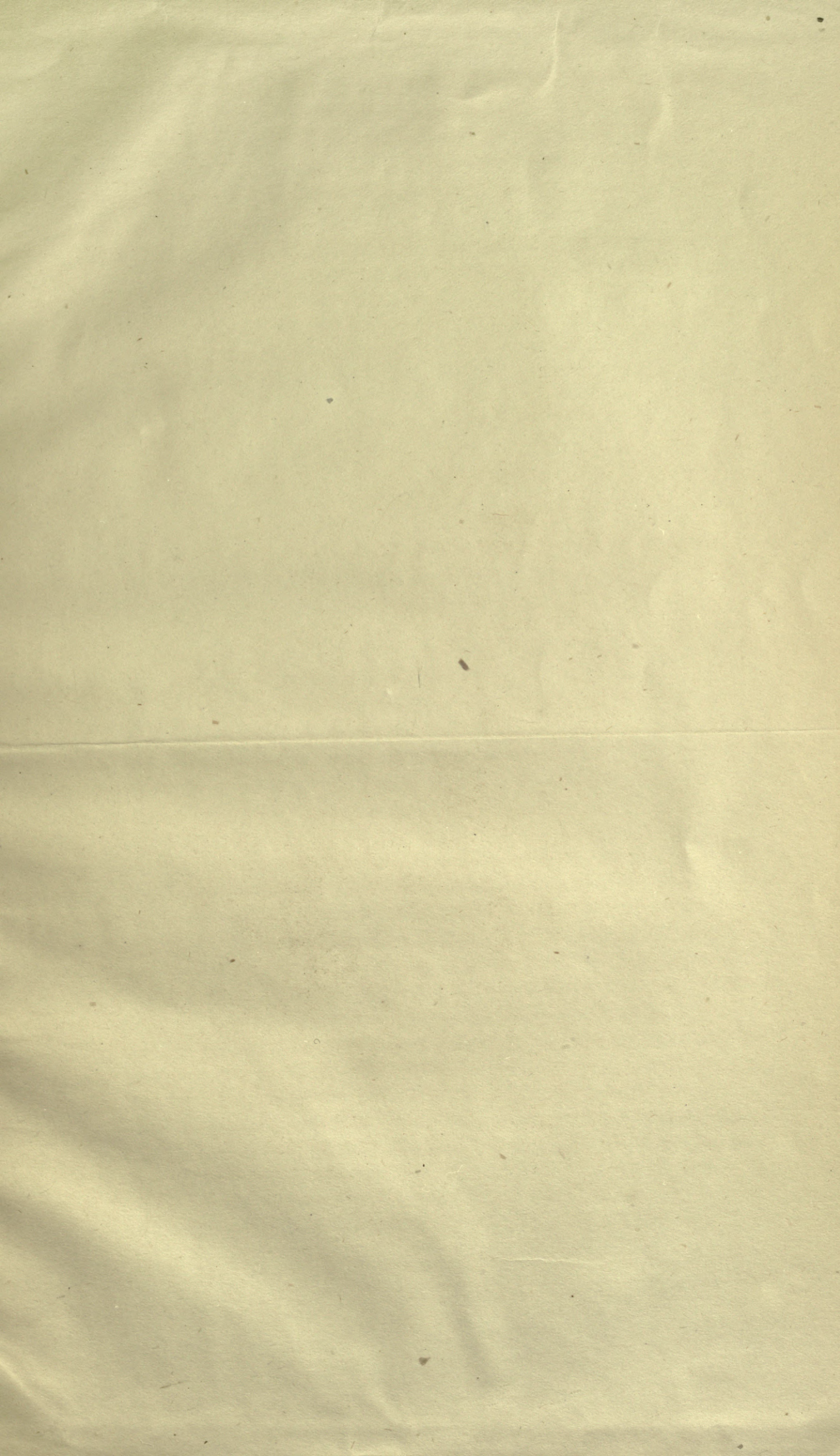
I have the honor to be,

Sir,

Your most obedient servant,

N. G. MURKIN

National ...



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