

unwound as to be transparent enough to show the chrysalis inside.

The silkworm simultaneously always deposits two fibres, one from each side of its head, the single fibre is in France termed *brin*, the double fibre *bave*.

The average fibre of a single cocoon *bave* is  $2\frac{1}{2}$  deniers. A cocoon often gives three deniers at the beginning and hardly two at the end.

The "titre" of silk is the size of the thread. In cotton the fibre is expressed by numbers representing the number of metres contained in one kilometre, but in silk, the fibre is expressed in deniers which are old Italian weights equivalent to 52 milligrammes for one length of thread of 400 *elles* or 476 metres. In Lyons the fibre is calculated in this way with only a slight difference.

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*Defects in the Silk grown in Kashmir up to the present time.*

(1) *Tenacity or strength.*

The compound thread, taking it altogether, is very regular, there are, however, places in it which are too fine. In twenty trials in one skein, there was an average strength of about ten grammes, the highest being 11.65 and the lowest (which was an exception) being 7.16. Such a breakage lessens the elasticity of the thread. An effort must be made to keep the thread more regular

by keeping up the proper number of cocoons going to the tavelette. Saving, however, this one exception the strength is now good.

In reeling and testing the raw silk, the testing ought to stand seventy to eighty tavelles, that is, that a skein being reeled off for two hours should not break four times.

M. Arbousset found in two skeins of Kashmir silk I sent him to give an opinion upon, that, of the irregular threads in them, one of the skeins was reeled with five cocoons and was quite regular, whilst the other was reeled sometimes with four, sometimes with five, and sometimes even with six cocoons, and was consequently of irregular sizes of thread.

Opinion expressed to me by Mr. G. Maurice, of Messrs. Veuve Guerin and Cie., Lyons. "Quality fairly good for Bengal silk, but too soft for a produce from French eggs. Winding irregular, some bales winding ninety to a hundred tavelles and others fifty tavelles. The bad winding does not come from gommées, but from the great quantities of passage, called volle, which can easily be avoided at the filature. Cleanliness, fairly good, although many nibs could be avoided. Some samples sent to New York have been judged not perfect enough yet for use in that market. He believes that the silk can be much improved at the filature by subjecting the cocoons to warmer water and making the croissure as long

as possible which will make the thread rounder and plus agrégé."

I am quite in agreement with him on this *latter* point. I found both Messac and Arbousset gave a croissure of from thirty to fifty twists and with longer croissure; Mr. Maurice also said in a letter to me after I left Lyons. "I have shown the silk to several persons, and of ten who saw it eight of them said I cannot guess what silk it is, it reminds me of Bengal silk, but the feel and touch of it is more like French silk or Italian."

On this I emphatically remark that the idea of resemblance to Bengal silk is absurd, as it is produced by another species of worm and totally of a different nature of silk.

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Copy of a letter from Messrs. Louis Desgrand and Company, very large Silk Merchants of Lyons, Marseilles, Crefeld, and Milan, to Messrs. Durant Bevan and Company, of London, and kindly lent to me by them.

Lyon, February 7/03.

Messrs. Durant Bevan and Co.

Dear Sirs,

We beg to acknowledge receipt of your favor of 5th instant.

Account-sale enclosed, please find account-sale of the remaining 7 Bales of Kashmir 164/170 amounting to £771 13s. 6d. to your credit. We beg to call attention to the question of winding.

Though progress has been made on that point, we still see that the silk is reeled "a bouts volants" instead of "a bouts noues" and the winding cannot be good. All good winding silks are now made "a bouts noues" and no doubt the reelers in Kashmir could easily be taught to reel in that way. The greatest and most useful progress would thus be realised, as winding with 93/100 tavelles the silk would easily find throwsters willing to work it, whilst with its actual poor winding very few will work it and then only at very high rates. The attention of the filatures should be called to this most important point, also to the evenness of the size. This silk can be much improved in regularity.

We have no doubt that with proper care and attention many defects could be obviated, and then the silk would be used with more favour.

Could you also obtain a greater proportion of fine sizes 9/11 deniers (average 10 deniers); our friends could use it in larger quantities but that may be a question of cocoons, as all cannot produce fine sizes.

See also if, by proper treatment, a greater nerve could not be obtained, this silk is rather soft, perhaps it is a question of water; but cocoons produced by French seed ought to have more nerve-elasticity in the thread.

Yours faithfully,  
(Sd.) LOUIS DESGRAND AND Co.

*Reeling by Power versus by Hand.*

My inspection of the filatures in the Cevennes convinces me now that cocoon power-reeling has its advantages and must on the whole be preferred. It is generally used in Europe and gives more regularity and gentleness of action in drawing off the cocoon thread.

I do not see any other advantage of manual labour turning in Kashmir than that of the cheap labour there, but little power is necessary, a single 100 basin filature could easily be driven by a four horse-power engine, or even less, or by a water-wheel.

The power-driven reels are started and stopped separately at will by each fileuse when required by just moving a small lever by her side. No skill is required.

The cost of power-driven reels with the latest model bassines, including boiler and steam engine in France, is 500 francs per bassine. The Kashmir workpeople would be able to manage the new arrangement of bassines as well as the old, and I think it would be well to ask M. Arbousset to send, say, half a dozen, they seem very complete and are a great improvement on the older fashioned sort. Each fileuse can work four sets of cocoons on one reel and from one bassine with four tavelletes making four skeins simultaneously and working at a high speed.

*Artificial lighting of reeling filatures.*

M. Arbousset agrees with me that electrical light is not advisable, it is too costly, too irregular and does not give a sufficiently diffused light. He prefers and uses ordinary gas with the Auer Bec burner. These burners have each an incandescent mantle and are placed about three yards apart, seven feet high, between the two rows of bassines. M. Arbousset allowed me to bring one of the burners. I saw them very satisfactorily at work in the evenings. He told me that in winter they work three or four hours by artificial light and make as good silk as that reeled in daylight and that gas, with incandescent lamps, gives the finest light.

*M. Arbousset's Criticism of the Electric Light.*

It is not steady or regular enough, either the arc or incandescent lamp. It varies too much in strength, one moment it is very bright and the next just as feeble. These variations tire the eyes of the work-people and prevent them from seeing the ends or even the threads of the cocoons. He thinks acetylene might be used with incandescent mantles where gas is not obtainable.

*Ventilation of Filatures.*

I think it would be extremely desirable to induce the reelers in Kashmir to work a few hours each day in the winter months, and for

that purpose the filatures should be made warm enough and all fog and vapour got rid of.

In my dyehouses I accomplish this with a trunk of wood through which heated air is drawn from a stove over a steam boiler, and poured into the rooms, this dispels all vapour and is entirely satisfactory. I have brought a plan of it. M. Arbousset effects this by small stoves placed behind the reels, and by pipes of steam passing close over the reels, these warm the rooms and dry the silk as it is being reeled. Smaller steam pipes run parallel to them which convey steam to each bassine. If the Kashmir filatures are too big to be heated, the new ones should be on the French model which I can explain, and which can be done at a cost of 40,000 francs per 100 bassines; but for much less in Kashmir.

Fog and vapour can only be avoided in winter by elevating the temperature of the air inside the filature sufficiently, say to 60°F. or 70°F.

#### *Temperature of Cocoon-Reeling.*

To batteuse the cocoons boil the water and move the cocoons about for a few minutes to soften them and to find the ends when the cocoons are transferred to the bassines; the water in the bassines should be at the temperature of 70°C. to 75°C. (158°F. to 167°F).

In M. Arbousset's filature each fileuse batteuses her own cocoons; but in Messac & Cie's. filature

a separate girl is batteuse for several fileuses, preparing the cocoons for them.

*Wages of Fileuses.*

Are 1 fr. 50 c. per day; work hours six a.m. to six p.m.

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*Explanation of Terms used in  
Sericulture and in the Conditioning of Silk at the  
Lyons Conditioning House.*

*Purger.*

Means that the cocoons must be cleaned after being treated with hot water by the batteuse; but not to soften them too much, on the contrary the cocoons must be treated, cleaned and reeled in the least possible time; thus they must be boiled and beaten ten minutes in a pan full of water heated to 90°C. (194°F.) to boiling "*cuite*."

Then (the cocoons so treated), bring the water to a temperature of 60°C. to 70°C (140°F. to 158°F.) by the addition of cold water, rapidly clean (Purger) the cocoons as they find the threads and put them to unwind by keeping up the temperature of the water in the bassine during the reeling. In this way any careful reeler can produce raw-silks of the same ordinary value of those of Europe, China or Japan.



*Titre.*

The titre indicates the size or number of the thread.

*Bouchons.*

“Peu de bouchons” means that the thread of the silk is sufficiently regular, clean or smooth, and has none of the little loops or nibs on the baves or thread called *bouchons*, or the still smaller ones termed *duvet*.

*Tavelles.*

The ascertaining by the Lyons Conditioning-House, say 85 to 90 tavelles, shows that a work-woman can reel alone in two hours 85 to 90 skeins or flottes of silk. This is a good average, for the very best reeled silks have not more than an average of 90 to 100 tavelles. If one skein or flotte has broken four times in two hours' testing for one fileuse 40 to 45 tavelles, of 27 turns and making  $1\frac{1}{2}$  per cent. of waste in winding 50 metres, this is considered bad, and too much below the average, as stated above.

*Vrille.*

This is a defect shown when the silk thread is twisted like a corkscrew.

*Aggregation.*

This is the putting together of several threads of the cocoons so as to form the silk threads, the

best aggregation is obtained when the silk is properly reeled and the croissure is properly made whether it be by the system Chambon or the ordinary methods.

*Venures.*

Are formed when bouts are reeled, which have commenced with the first and enveloping layer of the cocoon being less coloured than the lower layers, thus giving veins or venures of paler silk in such parts.

*Vole.*

Vole is the silk thread that is too fine and has not sufficient resistance. It is produced when the fileuse does not keep all her cocoons threads going, for instance, when she is only reeling two cocoons when she ought to be reeling four.

*Gommures.*

Is the glueing of the silk fibres to each other. It is principally produced in damp weather, at the point of contact with the arms of the reels.

*Elasticity.*

The capability of the thread being properly elastic.

*Tenacity.*

Or strength; when the cocoon threads are not sufficiently aggregated together, the silk is considered a little tender, because the pull is on a part and not on the whole thread. In France

the silk should not break at less than with a weight of 18 to 20 per cent. for 9/11 deniers. Three trials of one of the Kashmir skeins last year broke at 25 grammes, whilst others were 45 grammes. The Cevennes well-reeled silk breaks at 30 to 40 grammes.

*The Yellow Colour of the Silk.*

“Un peu veiné” means that on the golden yellow silk there are paler threads that form veins or venures with less colour than the others. This is objectionable, although the fault is not very serious. It can be avoided at the time of reeling by mixing the cocoons half-reeled with those that are only just beginning to be reeled. See venures.

*Usages de Lyon.*

Means that when silk is sold subject to the “usages de Lyon” it is subject to several expenses and conditions which amount to a discount of five per cent., for instance, the price of 40 fr. per kilogramme net is the same as 42 for “usages de Lyon.”

To explain more fully, the official rates of Lyons silk are divided up as follows, say for one kilogramme of silk of a nominal value of 40 francs per kilogramme:—

Commission on sale, 1 per cent. ...	0'40
Del credere (responsibility of agent)	
1 per cent. ... ..	0'40

Brokerage $\frac{1}{2}$ per cent. ... ..	0'20
Discount on 90/100 days 6 per cent.	0'65
Deduction $\frac{1}{2}$ per cent. ... ..	0'25
Half the expense of conditioning...	0'75
Carriage from Alais or Marseilles to Lyon ... ..	0'10
	<hr/>
	2'75

This explains the difference of two francs a kilo in the price of 40 francs between the net price and the price "usages de Lyon." When the seller sells at the net price, he pays the price agreed upon, but when he sells at the old "usages de Lyon" the deduction is made of all the above articles. The discount increases with the price, on 40 fr. it is 2 fr., on 50 fr. it is 2'50, on 60 fr. it is 3 fr., and on 100 fr. it is 5 fr.

*Va and Vieune.*

Is a wire covered with glass tubes which constantly moving from right to left in front of the reel distributes the silk threads, say two to three inches in breadth on the reel, and evenly, preventing the threads falling all in one place on the reel.

*Guindre.*

Means the reel on which the silk is wound from the bassine. In France it is placed behind the reeler. The reels are covered with cloth

which receives the silk and prevents it coming in contact with the wood of the reel.

*Blaze.*

Means short lengths of refractory cotton-like short fibres from the outside of the cocoon which when found in déchets or waste are objectionable as they will not take the dye.

*"Vice rédhibitoire."*

This is a Lyons term, and is used to describe the damage done to raw-silk by mites (dermestes) which get into the bales sometimes when they have been long in stock. They probably come from wool which is often infected by them. They gnaw the silk and make it unwindable. When this occurs the buyers can claim from the merchant or broker for any damage done by them. But before the buyer can claim upon or refuse the silk so damaged, there must be numerous skeins or flottes gnawed by these mites. To avoid this damage, do not allow the silk to remain too long in the warehouse and avoid in packing the use of any woollen materials, or any thing not clean; only use absolutely new cloth. Avoid also contact with bales of wool which always contain great numbers of these mites. Any remedy if applied is worse than the disease, and prevention is the only cure.

*Quality of Silk to be aimed at in Kashmir.*

It would not be wise to aim at the highest quality obtainable by several of the best Cevennes filatures. They chiefly produce 9/11 deniers raw silk for very special purposes and get proportionately special prices, but this is only for a very limited consumption. These silks are called extra and Kashmir would try in vain to get such extra prices. It would indeed be possible to arrive at this extra quality and extra price, but there would be more loss in damaged cocoons than would be gained in the price. If Kashmir will content itself with obtaining silk of the second order of France and Italy it will meet with more demand and make more profit; of this I am convinced. It is very close upon that at the present time. What is required to accomplish very desirable results is to make any necessary modifications here suggested, to encourage greater skill in the reelers and to have thorough supervision of the reelers, especially the younger ones, who are apt to be careless.

I noticed in the filature of Messac and Cie which I visited in Alais, that this firm was making this extra quality, whilst that of M. Arbousset was occupied with that of the second order and most in demand. I have brought small samples of Messrs. Messac's to show. They were kind enough to give them to me.

*M. Arbousset's expression to me of his opinion of Kashmir reeling and raw-silk of last year's production (1902).*

"I find an immense progress in the raw-silks of last year, they are clearer and more brilliant and present themselves in a much better way than the two bales Mr. Walton sent me to sell last year, which notwithstanding realised such a good price.

The cocoons should be reeled up to the end of their exhausting-point, not trying to reel double cocoons, these can be sold for 3 fr. 50 c. per kilo. just as they are in the dry state.

The waste-silk requires a little more selection and arrangement."

In November, 1902, M. Arbousset wrote me as follows: "I think highly of the Kashmir silk of the last few months."

*White Cocoons and White Silk.*

Enquire of Mr. Walton how the 433 ounces of the race of white cocoons which Arbousset sent him in 1901 turned out as to quantity, disease, &c., as compared with the yellow race, and what prospects he thinks there are for producing more white silk, this kind being much in demand in Lyons for silk muslin in white and pale colours just now. Discuss this matter with Mr. Colvin and Mr. Walton carefully as there is no doubt white raw-silk is now a desideratum.

*Indian, French and English Weights.*

One Kashmir maund is ... 82 lbs.  
 One French ounce weighs ... 482 grains.  
 To convert grains to grammes multiply by 0.0648.  
 One ounce of Silkworm seed weighs 30 grammes.

*Purchases of Eggs from M. Arbousset, September 10, 1901.*

Eggs purchased in 1900 for breeding in 1901.  
 25,542 boxes of 1 oz. each, and 42 boxes in  
 excess of the order.

The price is four francs per ounce.

*Purchases in 1901 for 1902 crop.*

25,542 boxes of eggs of 1 oz. each of which  
 25,000 cost £4,000, or 4 frs. per oz., he also sent  
 42 boxes in excess of the order.

In this consignment there were 433 oz. of a  
 good race of white cocoons of Haut Cevennes.

*Crop of Raw Silk, 1901—1902.*

Mr. Walton has sent to Messrs. Durant, Bévan  
 & Co., 553 maunds of silk; 400 more are to  
 follow, he also sent 100 maunds to the local  
 markets, making a total of 1053 maunds. This  
 quantity, he says, he has obtained from 20 maunds,  
 roughly, 20,489 oz. of seed.

*Species of Silk Moths.*

The silk moth whose larvæ produce the Euro-  
 pean, Chinese and Japanese silk of commerce is  
 Bombyx mori.



The Barapaloo of Bengal is *Bombyx textor*.

The Cholopaloo „ „ „ fortunatus.

The Desi „ „ „ „

The Madrassi „ „ „ cræsi.

The incubation of *Bombyx textor* is about ten months.

The incubation in *Bombyx fortunatus* is eight to ten days. In Mysore the *Bombyx sinensis* is cultivated. The Bengal worms feed on the *Morus indica*. It is shrubbed, not cultivated into trees.

The November bund of Bengal silk is the silk of the *Bombyx fortunatus* or Desi worm, that of the July bund is the Madrassi or *Bombyx cræsi*. The silk of this season is not quite so good as that of the November bund.

*Tenacity and Elasticity of Kashmir Silk compared satisfactorily with Japan Silk in 1902.*

The average of 20 trials of Kashmir sewing silk, which I made in Leek, gave a tenacity or breaking strength of 1 lb. 15 oz.  $13\frac{3}{8}$  drams, that of Japan of the same size, viz. three-fold 20's was 1 lb. 15 oz.  $1\frac{3}{8}$  drams; this is my own testing.

*Mr. Kershaw on Kashmir Silk.*

Mr. Kershaw is one of the largest silk manufacturers in Macclesfield.

He informs me that he is much pleased with the silk and would like two bales specially reeled for him of the very best quality when I get out

to Kashmir, one of  $\frac{19}{12}$  deniers, and one of  $\frac{13}{15}$  deniers and that he will probably require a minimum of 50 bales per annum. He also very much requires white silk to replace that of Japan of which he is using a very large quantity, and asked me to enquire if he might depend on a supply.

T. WARDLE.

## CHAPTER XV.

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MY SECOND SERICICULTURAL REPORT, WRITTEN IN SRINAGAR, APRIL 27TH, 1903, BEING SERICICULTURAL CONSIDERATIONS AND DISCUSSIONS ON THE FRENCH METHODS OF PROCEDURE AND SUGGESTIONS CONTAINED IN REPORT No. 1, PUBLISHED IN JAMMU IN MARCH, 1903.

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THIS second Report is mainly the outcome of careful discussion and comparison with Mr. Walton, the Director of Sericulture of the Srinagar Filatures, on the points raised in Report No. 1, consequent on my visit to the sericultural districts of the South of France, where the best raw-silk is produced, prefaced with notes on the proper cultivation of the mulberry tree.

In perusing my present Report it will be necessary to consider in connection with it what I have described in Report No. 1 under each separate heading, here repeated for easy reference.

I have written a chapter on mulberry tree cultivation both as to the state in which I found it in Kashmir, and also as I think it might and ought to be. I venture to commend to the State the high importance of this subject, which,

in my opinion, is so great and so pressing that I feel I ought to give it precedence in the remarks I have now to submit.

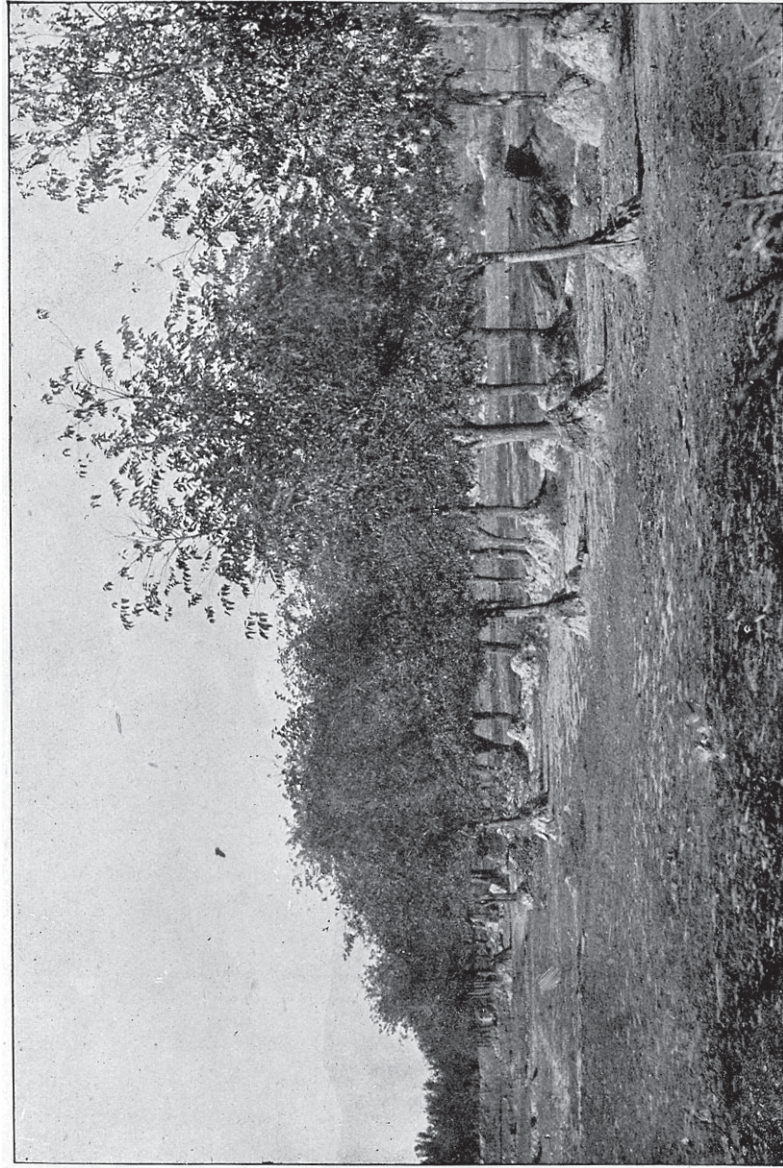
*On Mulberry-Tree Cultivation.*

I have been as much astonished as delighted to see the vast quantities of mulberry trees in the Vale of Kashmir. I have noticed that the prevailing species is *Morus Nigra* or the black mulberry. I would recommend also the cultivation of *Morus Alba* or the white mulberry, which is found to give the best results in sericulture in both Italy and France. Mr. Walton informs me that the white mulberry is found in Kashmir; but probably not to a greater extent than about five per cent. of the black mulberry growth. He tells me the best results are obtained from a fruitless variety or species. The rearers use its leaves where they can obtain them for the last stage of silkworm feeding.

I noticed in my journeys through the villages, small plots or patches of mulberry plants, and on asking why they were so planted I was told that the Maharaja of Kashmir had issued orders for each village to provide a small mulberry-plant nursery. Nearly all of those I saw lacked supervision, and I cannot help thinking it would be well if an expert Mulberry Forest Officer were appointed to attend to this most important branch of sericultural industry.

In examining the mulberry trees over a considerable area of the Kashmir valley, it is painfully evident that they are having little or no correct botanical attention, being of very irregular and in too many cases of worn-out growth, and requiring capable botanical oversight, either in the growth of the tree or in properly pollarding and pruning, as is the case in Italy and France. Instead of which, the trees are hacked in a most ignorant way, and are being so treated at this time of year when the sap is rising. This, I suggest, should be done under proficient European oversight notably by one of the staff of the Indian Forest Department, with a qualified assistant well acquainted with the methods and procedure of France and Italy. The contrast between the careful culture in these countries and the neglected state in the Kashmir valley is most striking. I have seen in the valley, hundreds of trees only fit for firewood. It cannot be expected, nor is it possible for silkworms to be properly fed and nourished by the leaves of such trees as these. In addition to this suggestion, I urge that no time should be lost in extending the area of mulberry cultivation throughout this and the neighbouring valleys, so as to provide leaves for villagers, who have now, in some instances, to fetch them from too great a distance, as well as to those who have not yet shared in the industry of silkworm rearing, and further, what is of great importance,

PLATE IO.



A group of Mulberry-trees near the Filatures at Srinagar.

to give the silkworms a supply of young and succulent leaves instead of those from the old and in too many cases worn-out trees, now existing.

Since I wrote these lines I have been over a considerable area of mulberry tree growth, principally from Avantipura to Arapal, or from Kulbend to above Arapal and even as far up the valley as Narastan.

There are three thousand mulberry trees, chiefly very old and almost denuded of branches. The mulberry chiefly predominates over the willow, the chenar and the walnut (which is abundant and unmolested), but the mulberry is in such a state of devastation as to be incredible except upon actually seeing the remnants of what were once mulberry trees of splendid growth; but now almost denuded of leaf-bearing boughs.

The most valuable parts of the trees have been cut away with axes in order that the leaves could be gathered on the ground, in many cases for firewood, some of it quite recently, and also needless and cruel lopping.

I have spent several days in this locality with Colonel Ward who is equally astonished at the destruction everywhere too evident. He fully supports my statements.

In France and Italy the leaves are gathered by ascending the trees, or by ladders without cutting down the boughs, and no leaf-bearing part is damaged.

If this deplorable state of things is permitted to go on for the next four or five years there will be no mulberry leaves to gather. The use of the axe should positively be prohibited. I have never witnessed a case so illustrative of the fable—killing the goose for the sake of its golden eggs. This state of mulberry forestry is most deplorable and should not be continued, for there can be no difficulty in gathering the leaves, although many of the trees are high the Kashmiris are an agile race and it is wonderful to see them climb a tree; besides other methods than that of the axe could easily be adopted. The present system is wilful destruction not only of the mulberry trees but of the silk industry and calls for immediate reform. In all my experience of forestry in Germany, France and England I have never seen such a deplorable state of devastation. Heavy penalties should be enforced wherever people are found lopping off boughs and all instructions for pollarding, coppicing and pruning should be carried out by disinterested and experienced persons, and only at the proper season.

With regard to pollarding the existing mulberry trees, it must not be understood in the sense of pollarding in France and Italy. There the case is widely different. The pollard trunks are grown for the purpose of producing pollarded branches from their tops, as with the pollard willows of Kashmir. The branches are consequently and



generally much smaller than the boughs of the large Kashmir mulberry trees, which for the most part are fine trees of indigenous existence, self-raised and grown into very large trees in many parts of the vale, with powerful boughs and branches, where they have been left intact.

These should be retained as far as possible to allow the younger leaf-bearing shoots to sprout from, and not lopped off in the present wholesale fashion leaving the trees mere skeletons.

The demand for silk is yearly increasing with the increase of population, particularly in the United States of America, now the largest silk textile manufacturing country in the world. It is almost certain that as soon as Kashmir raw-silk is raised by better reeling to that of the best qualities of Japan silk now chiefly used there, it will be greatly required and the enquiry for it enormously increased.

What I have suggested with regard to the planting of more mulberry trees and on improved cultivation generally, ought not to be delayed as several years must elapse before the younger leaves can be gathered, and it is quite possible, and very likely, that the demand for Kashmir silk both in Europe and in America may exceed the supply of mulberry leaves.

No. 1.

*On Cellular Seed.*

The eggs or seed supplied to Kashmir by Messrs.

Arbousset & Son, are of the kind of race described under this head, in my report No. 1, but sent in perforated paper boxes for greater protection. They are labelled "Graines de Vers A Soie Cellulaire Selectionnées des Montagnes de Mauriers. Preparées Selon le Method Pasteur."

Mr. Walton informs me that he finds very great freedom from disease and that he is quite satisfied with the eggs purchased and which are always guaranteed free from pebrine. The precautions described are necessary to be observed in Kashmir, and great care has to be exercised to prevent the natives bringing in cocoons to the filatures before the silkworms have turned into chrysalides. This they attempt because their labour in rearing the worms from the hatching of the cocoons is paid for by weight, and worms are heavier than chrysalides. The remarks on this important subject in Report No. 1 have been well considered by Mr. Walton. They have his full concurrence, and so far as the instructions therein contained as to silkworm rearing in Kashmir, they are acted upon as thoroughly as is possible.

#### No. 2.

##### *How to obtain the greatest number of Cocoons from the Seed distributed.*

The following subjects under headings No. 3, 4, 5, and 6, being so closely related to that of No. 2, I have classed them with No. 2.

## No. 3.

*The right quantity of Eggs to distribute to the most people,  
i.e. the village-rearers' houses.*

## No. 4.

*Precautions in the Nurseries (Magnaneries).*

## No. 5.

*To prevent loss of Eggs.*

## No. 6.

*The Produce of Cocoons per ounce of Eggs in France.*

These are collateral subjects, the remarks upon which in Report No. 1 have been well noted by Mr. Walton. I have discussed them seriatim with him and there is no necessity to enlarge further upon them. I find them well understood and practised here.

Mr. Walton tells me he obtains from careful rearers quite as many cocoons from the same number of eggs as are obtained in France and Italy, and in some cases more. Last year his average was 39 kilogrammes of cocoons per ounce of eggs, against 36 kilogrammes last year in France, but the yield of cocoons must always be variable, owing to climatic conditions and other reasons.

With regard to trying different races of eggs, Mr. Walton promises me that he will act on my suggestion of trying selections of Italian races.

The high price of Italian eggs is against any

violent change, and so long as the silk produced in the Cevennes enjoys such a high reputation no anxiety for change need be entertained. The confidence in M. Arbousset's great sericultural knowledge and trustworthiness is well bestowed. He and his son have served Kashmir well.

No. 7.

*M. Arbousset's letter on losses of Silkworms after the fourth moult.*

Mr. Walton has carefully considered this letter and is in agreement with it with one exception. He says that the climate of Kashmir does not admit of exposing the worms to the strong currents of air recommended in this letter. He has tried the idea but lost many silkworms, because when a shower of rain follows a very hot day the temperature is lowered to such an extent that the worm dies, no doubt from the close proximity of the snow-clad mountains. If the temperature falls from 70° to 50° the worms die. Regulation and evenness of temperature must be maintained in the Magnaneries, and for that purpose Mr. Walton has provided all the rearers with thermometers.

No. 8.

*Ordering of "Graine" or Eggs.*

Nothing more need be written on this head than to emphasise what I wrote on page 179 in

Report No. 1 and to commend it to the serious attention of the State.

No. 9.

*Non exposure to Light of Cocoons.*

It is admitted that the practice in France should be followed, which is to avoid direct sunlight and daylight exposure of both cocoons and the reeled silk, as much as possible. The golden yellow colour of the silk is very evanescent.

Mr. Walton has discontinued the sun-drying of cocoons, except in the Lolab and Uttermuchipore districts, 40 to 70 miles from Srinagar. These districts are so far away that if the cocoons were to be carried so far they would not only get crushed but the moths would emerge from them. The only other way to provide against this contingency would be to provide these places with séchoirs, not at present advisable. In other distant districts like Khanabal, Achabal, Vernag and other far-off valleys, the case is different, because the cocoons are brought by boats down the Jhelum to Srinagar in less than 24 hours.

I think the present filatures are quite light enough to permit of reelers to do their work properly, but any excess over this should be avoided.

No. 10.

*The Cocoon Sorter.*

This useful machine answers its purpose admirably

*Cocoons of Reproduction, or Etalons.*

The meaning of this is that eggs might be imported from which in the following year silkworms could be bred from eggs hatched here and so prevent the necessity of importing eggs annually. This method was recommended by one of the speakers at the India Office conference at which I presided. I strongly demurred to this opinion and pleaded that we should let well alone. It is an erroneous opinion and has proved so by experiments during two years here. The principal reason and secret of the success of sericulture in Kashmir, has been and still is, in annually importing fresh and healthy eggs from the best European egg-breeding districts. As may be seen in the India Office Conference Report of the 26th September, 1901, from the first I stated that I had recommended Mr. Walton to try eggs of reproduction, but only experimentally. The first year 3,200 ounces of eggs of reproduction *were* bred in Srinagar, the result in cocoons being almost nil. The eggs hatched out very well, and up to the third moult there were no losses, but after the third moult the worms died, some from pebrine and more from flacherie. The second year 6,400 ounces of eggs of reproduction were reared locally from seed at first imported from Italy and France with a result of only 200 maunds of very inferior cocoons. If they could have been reared free

from disease there would have been a crop of 6,400 maunds of cocoons. This branch of sericulture is much too scientific in several ways to be attempted for a long time to come in Kashmir. The remarks of M. Arbousset on this subject on page 181 of my first report are quite conclusive and need to be well kept in view. It is not only in Kashmir that the experimental efforts of buying cocoons of reproduction have proved a failure. It was the same in the Lister Dehra Dhun grant on a large scale and in other efforts to promote sericulture elsewhere. Lord Masham in congratulating me on the Kashmir success, wrote to me that he had lost £50,000 and given the undertaking up. I am distinctly of opinion that the present system of importing eggs of the best races should be continued. It is really the secret of Kashmirian success.

No. 12.

*Production of Silk from Cocoons.*

Mr. Walton tells me he has succeeded in raising his production to 1 kilogramme of raw-silk from  $4\frac{1}{2}$  kilogrammes of cocoons. This is very good; but he says the rearers do not always carefully feed the worms and are often not sufficiently careful in other respects.

The French Reelers only buy selected cocoons and in this way get a higher percentage of silk than is possible in Kashmir, where all kinds of

cocoons have to be taken into the filatures including double and inferior ones.

From 40 kilogrammes of dry inferior cocoons it is not possible to obtain more than about 6 kilogrammes of silk.

No. 13.

*On the respective merits of the Etouffoir and the Séchoir.*

On this important question I find difference of opinion. See Arbousset's statement in report No. 1 page 183.

Mr. Walton says he was aware of M. Arbousset being in favour of the Etouffoir at the time he had only one Etouffoir and one Séchoir.

He, Mr. Walton, is distinctly of opinion that the Séchoir has given him the best results, and for this reason, that in a humid climate like this, the cocoons when passed through the Etouffoir become mildewed by retention of the condensed steam. The atmospheric moisture of the valley prevents their drying sufficiently after the Etouffage. Also that in the filatures there is a want of space for drying such an immense quantity of cocoons. This inherent dampness causes the thread to become tender, and besides that, cocoons having to be turned several times a day to expel moisture cause disorganisation of the fibre and more or less crushing the cocoons, making difficulty in reeling.

Mr. Walton says it takes two or three months even when so often turned over after Etouffage,



before they are dry enough to reel and even then mildew sets in.

It is well to observe that, notwithstanding the merits of Etouffage and its prevalent use in France that even M. Arbousset endorses Mr. Walton's opinion, where he refers to the damp climates of Tonkin and the south of China, see Report No. 1 page 184.

The dampness of climate in Kashmir, caused by the rainy season, the great floods, the great irrigation in the valley and consequent evaporation, happens chiefly when the cocoons have to be dried when the humidity of the atmosphere is from 90° to 100°, saturation being 100°.

The humidity is daily registered both in the filatures and in the excellent Hibernation houses at Gagribal, some distance away, by the ingenious instrument called Lambrecht's Polymeter.

It goes without saying, that the less cocoons are pulled about the easier they can be reeled and with a superiority of quality and freedom from duvet and bouchon, the latter faults being the principal defects now existing, so far as my observations go up to the present time of my visit.

Although I have been and still am of M. Arbousset's opinion, formed from the experience gained in several visits to the South of France, I feel bound to admit that the foregoing reasons prove that the expenditure of adding more séchoirs,

necessary for killing and partially drying the cocoons, is a proper and defensible one. Mr. Walton finds that it is better to only three-parts dry the cocoons in the Séchoir, and he confirms M. Arbousset's statement, that if the cocoons are dried too much, the thread breaks more easily.

If the atmospheric conditions here were those of the South of France, where the humidity is probably not more than 40 to 60 degrees and where there is scarcely any irrigation, I have no doubt it would be preferable to treat the cocoons by Etouffage and that mildew would not set in. When cocoons are taken out of the Etouffoir, they are of course quite wet from the steaming and it is clear that if they cannot be quickly dried mildew will naturally supervene.

On my return through France I will discuss these points with M. Arbousset and report further. I may be now permitted to observe however, that if adequate means were provided for drying the cocoons at once after steaming the French system might prevail and prove the best. My only anxiety is to raise the quality of the raw-silk up to that of the Cevennes.

No. 14.

*The Sale of Cocoons.*

I commend my notes on this subject see page 184 of Report No. 1.

I have spoken about this subject at length with

Mr. Walton. He quite appreciates the importance of the discussion I had with M. Arbousset upon it and argues that although it would be unwise to get into the habit of sending cocoons to Marseilles for sale, instead of reeling them at home, it ought only to be done when the price of cocoons is high, say not less than 11 to 12 francs per kilogramme, as at present; cocoons being scarce and much in demand in France and Italy to keep their reelers employed during the winter; but he quite agrees that Srinagar cocoons should only be exported when the surplus stock left over from the previous crop cannot be conveniently reeled before the new crop is ready for reeling, as has been the case with a large portion of last year's crop, in fact about two-thirds.

The fact however of four more filatures being in a sufficiently advanced state of erection to be ready in June, to receive the new crop, it is hoped that surplus stocks will be reeled in future by the end of the following June, at which time the new crop is ready for reeling. I am very glad to learn that silk-worm rearing and cocoon producing are becoming more popular and wide-spread in the neighbouring villages and valleys, and also are very remunerative to the peasants; there will consequently be a liability to surplus stocks unless the increase of filatures keeps pace with the ever increasing production of cocoons.

The following table shows the yearly increase

since my first purchase of eggs for the Government of India in June, 1897:—

Year.	Quantity of Eggs in ounces imported.	* Ditto Local.	Value of Eggs and Carriage.	Raw Silk produced.	Waste Silk produced.	Local Silk & Waste Inferior Cocoons.	Total Value of Out-turn.	Number of Reapers who took eggs.	Average Number of Reapers engaged.	Quantity of Fresh or Green Cocoons.
1898	1,920	...	£ 766	lbs. 5,412	lbs. 1,863	lbs. 351	£ 4,858	326	1,304	lbs. 1,07,100
...	...	6,400	...	Nil	Nil	Nil	...	1,106	4,424	Nil
1899	6,400	...	1,632	22,509	7,500	7,239	...	803	3,212	3,26,672
...	...	12,800	...	560	320	500	14,684	2,255	9,020	16,000
1900	19,060	Nil	3,000	44,181	23,063	7,739	27,419	4,290	17,160	8,13,792
1901	25,606	do.	4,333	65,931	32,870	12,346	49,118	5,887	23,548	10,65,204
1902	25,527	do.	4,333	†1,20,750	†54,500	†12,000	†96,666	†8,158	32,632	†18,82,692
1903	25,521	do.	4,333	† ...	† ...	† ...	† ...	11,060	44,245	...
1904	35,500	do.	5,500	...	...	...	...	...	...	...

\* The Eggs were of local reproduction, both moths and worms died of Flacherie and Pebrine.

† The exact figures to be obtained later on.

‡ Not yet realized but anticipated to be very satisfactory.

The great advantage Kashmir possesses in the present price of labour is one that puts the south of Europe sericulturally out of competition, especially when the silk in reeling shall be brought up to a higher standard and the reels can be run as fast as they are in France, which is quicker than that of the Srinagar filatures and doing better work, the difference in cost being about three times cheaper than in France; as I shall prove further on.

With regard to the sale of cocoons I may say further, that the question of the employment to the fullest extent of the spare labour of Srinagar, of which there is yet, as I am informed, no paucity, should have prior consideration, because the people are exceedingly poor, some of them being on the verge of starvation. It will be conceded, I think, that this is even of much greater importance to the State than gaining profit by the sale of cocoons.

Should it be ever necessary to export cocoons, the information I have given in Report No. 1, pages 184 to 188, will be a safe guide.

No. 15.

*Cocoon-reeling.*

I have seen trials made with the two tavelettes I brought from France, the ordinary or Dubiné tavelette, which I find is the one I introduced from Italy in 1897 and which Mr. Walton continues to use, and the Chambon in which the croissure is made by the crossing of two separate

threads and not by one, as is requisite for extremely superfine qualities of raw-silk, which do not represent the staple output of French and Italian raws.

I found a difference in the distance between the bassine eyelet and the top tavelette pully between which the croissure occurs; the distance in the Kash'mir tavelettes, copied from the Italian method, being a few inches, at least six, shorter than in the French method.

In my opinion the French method is better than the Italian and is now being tried here.

Mr. Walton gives more croissure than the French, the French being 30 to 50 crossings and Mr. Walton's 60 to 100.

The latter is probably necessary, because the French cocoons, being selected, may not need so much croissure as those of Kashmir. I think it would be better to sort the cocoons.

No. 16.

*On the French precautions necessary in Cocoon-reeling and the modus operandi generally.*

Nothing need be added on this head. I find everything I have stated in my Report No. 1, pages 189-190, is well understood and practised in Srinagar.

No. 17.

*Defects in the Silk grown up to the present time.*

*Tenacity or Strength.*

It will be necessary to refer to the faults found

as stated in Report No. 1, pages 190-3, to prevent repetition here. Efforts are being successfully made to evolve the thread so that it is more regular by keeping up the proper number of cocoon threads going to the tavelette. It is only by unintermitting care by the reeler and the closest supervision over him that a permanent improvement can be effected. The defect arises solely from careless preparing and especially reeling, and also from inexperienced hands allowing one or more threads to be dropped out, thus making in places too fine a thread, which of course reduces the tenacity. I feel sure this defect is being gradually remedied. Even during my stay the average of the testings has been raised.

Mr. Walton always conducts this important operation of testing personally and does not permit any one of his staff to do it. I have watched a number of his testings and find the average has been raised from 50-70 tavelles to 80-90 and some reach 90-100.

A higher average than even 80 or 90, which is fairly satisfactory, can be obtained by more thorough and adequate supervision, in which case the value of the reeled silk would be raised by 1s. per lb.

To obtain this higher excellence of the best French and Italian reeling, I am certain that there should be one European superintendent to each filature and still better with two, and with

a proportionate number of thorough and well trained native assistants. Let me inform the State, that in France I found one elderly man overlooker of great experience in every filature of 100 bassines, assisted by two elderly females, who themselves had been reelers all their previous working lives, and who were highly qualified to superintend the 100 fileuses, 50 on each side the filature. Here, on the contrary, I find two of the filatures with 424 bassines controlled by only one European but with fourteen native assistant overlookers. Whilst I strongly recommend a minimum employment of Europeans and a maximum employment of native overlooker, I feel sure that it is not paying policy to stint either European or native supervision.

Let the boys be encouraged as much as possible to take pride in excelling in their work.

These are my own impressions which I offer for whatever they may be thought to be worth, both to Mr. Walton and the State, but I recommend their consideration to the serious attention of the State; suggestions which if adopted more or less would materially increase the value of the silk, and would do away with the brokers' and manufacturers' complaints, which I have enumerated on pages 190-3 of my Report No. 1.

These complaints I know to be well founded, although often exaggerated by the manufacturers in order to get the silk at a lower price.



I proved the truth of some of these exaggerations by recently having a quantity of raw-silk of Srinagar reeling, thrown, dyed, and manufactured into brocades. These I have brought over to show the Maharaja, Raja Sir Amar Singh, and the Durbar. They are quite equal in quality to ordinary French brocades, and were much admired at the Durbar held at the Palace at Jammu to receive me. Two lengths, for dress purposes, are being offered to the Queen and the Princess of Wales by the Maharaja. Notwithstanding this, the raw-silk is not quite equal to what it may, and, I doubt not, will be, if Mr. Walton is well backed up in everything he may think necessary.

Specimens of these brocades may be seen in the Sir Pratap Singh Museum here where the Maharaja has recently sent them.

In a letter from Messrs. Louis Degrand & Co., in my Report No. 1, pages 192-3, it is stated that the reeling should be "à bouts nouées" and not "à bouts volantes." The former means, that when a cocoon-thread breaks the reeler should tie it together by a knot. "A bouts volantes" means that instead of tying the thread, the reeler to save trouble throws the thread upon the reel instead of piecing it by a knot to the other broken end.

I find that it is forbidden to allow "bouts volantes" and it is only by the closest surveil-

lance that this carelessness, which is here termed "budzati" can be avoided. It takes a little trouble to find the proper end, which the Kashmiri reeler does not like. Only incessant watching will prevent it.

No. 18.

*Reeling by Steam or Water-power versus Hand-power.*

This is an important question, in which Mr. Walton and I are not in perfect accord.

It is well to give his opinion and reasons. He says, that many years ago Messrs. Louis Payen & Co., who have extensive filatures in Bengal, erected a factory of 200 bassines on the French principle of steam-power turning. The quality of the silk turned out proved to be inferior, so much so, that they had to re-reel the silk before sending it to Europe, also they found that by giving up hand-turning by boys, they could not increase the number of workmen, as can be and is at present done by employing juvenile hand labour, which is daily gaining experience by seeing the reeling operations, in helping the reelers and to find broken ends, &c. Besides this, Mr. Walton urges that it is better to have four eyes watching the thread than two, as duvet and bouchon are in this way minimised.

In course of time, Messrs. Payen & Co. had to increase this filature by 300 bassines; but instead of increasing the steam-power reeling they

fell back to hand-reeling, they also built several filatures in other places, and put in all of them hand-power turning.

Mr. Walton says that steam-power is enormously expensive, it takes 300 Rs. in France per bassine, which here would cost Rs. 400. To introduce steam-power into the whole of the filatures at Srinagar, he thinks it would cost more than Rs. 5,70,00; which would double his present outlay. He also says that so long as he has sufficient labour and not fully trained hands, he does not think it policy to introduce it; but later on, should labour get scarce and hands fully trained, it might be advisable to introduce it gradually. As an illustration; he says that by the end of June next he has to find 600 reelers for the 600 bassines about to be placed in the four new filatures. By having his present hand-power, he will be enabled to fill them with boys partially trained, whilst if he had not had hand-power turning he would have to train reelers who would take months to get to any reliable state of efficiency. The present cost of each reel-turner is only two annas per day. Steam-power with its wear and tear, extra supervision and maintenance, would be very costly in comparison. Let me now give my version. In Europe all the turning of the reels is done either with steam or water-power. I do not think steam-power is so costly as Mr. Walton thinks, when once it is

established. There being no coal available at Srinagar is of course a great drawback; but if on calculation steam-power could not be economically employed, water-power could be applied and by being brought from the mountain streams at a sufficiently high level, a pressure sufficient could be found to turn the whole of the filatures without difficulty. Water-power in Italy is considerably used and it gives greater regularity than steam-power. Then there is the highly important question, I think, of education. The boys at present employed to turn the reels are young. Would it not be greatly better for their moral and future physical development for them to be at school with all its educational advantages and tone. I was very much pleased to see the superior intelligence of the boys in the Rev. C. E. Tyndale-Biscoe's school and I could not fail to think that there was something far better worth striving for in the well-being of a State than mere commercial economies. I should be glad to see power supplant hand-turning but only gradually, for as proficiency in reeling increases, a little more work might be done by applying power whether it be by steam or water. May I commend these ideas to the rulers of the State, and also the remarks on page 194 of my Report No. 1. In Europe, especially in England, Germany and France, great efforts are being made by successful manufacturers and others, to provide

sanitary dwellings near their factories, thus greatly preventing epidemics, to see to the education of the young, to cultivate all that is worth having in a boy, trust, faithfulness and all that goes to make character and physique. I could mention many instances even in England where in this way the social position of the working classes is being elevated from what it was a few years ago, a very low state both intellectually and morally. Is it not worth considering in Kashmir?

No. 19.

*Artificial Lighting of Reeling Filatures.*

The question of artificial lighting is briefly treated of under this head at page 195 of my No. 1 Report. In considering this with Mr. Walton, the question of working hours and days naturally comes up. Mr. Walton argues, why should the filatures be worked in winter, when he can work them an equal time by closing during the winter months. He says he works on the Sundays. If he worked in the winter he would have to close on the Sundays. Then there are the Hindoo and Mahomedan winter holidays which would have to be deducted; he thinks there would be no advantage, and that he would not get as good quality of work done: the cost of warming the filatures and of the steam required would be a consideration, boilers and other repairs and furnaces rebuilt, etc. The

whole of the reeling rooms would have to be glazed. Then there is no coal for gas-making, also the bad weather of winter and the unwillingness of the workpeople to come any long distance to work in winter time. Those living near are all employed in the winter in sorting cocoons and re-winding tests to the extent of one-third of the workpeople. During the summer months the whole of the salaried establishment is employed, and also as to the actual work-hours of the reelers as compared with those of Italy the following table will show how small is the difference.

The filatures of Srinagar are opened in spring on the first of March and close on the 15th of December, a little earlier or later according to the weather. They commence at 6 a.m. and work eleven hours per day, less half an hour for a meal at 10 a.m. They leave off work at 4-30 p.m.

Both Hindus and Mahomedans work on Sundays, the Italians and French do not.

Working months in Srinagar in the year.	Working months in Italy in the year.	Working days of 11 hours in Srinagar less half an hour for a meal.	Working days of 10 hours in Italy plus two hours for meals.	Srinagar working hours per day.	Working hours in Italy per day.
$9\frac{1}{2}$	10	290	305	$10\frac{1}{2}$	10

The working hours per year are shown by multiplying 290 by  $10\frac{1}{2}$  for Srinagar=3045, and for Italy by multiplying 305 by 10=3050 which shows a gain of only five hours per year for Italy over Srinagar.

## No. 20.

*M. Arboussel's criticism of the Electric Light.*

It is only necessary to refer to Report No. 1, page 195. It is indefensible.

## No. 21.

*Ventilation of Filatures.*

Reference to my Report, No. 1, pages 195-6, will give explanation of a good and effective method.

## No. 22.

*Temperature of Cocoon-reeling and Batteuse.*

The present system in Srinagar is the same as that in use in France and described in Report No. 1, page 196.

Mr. Walton informs me that the present Italian system in use in Srinagar is satisfactory and enables the reelers to reel more silk than by the French system.

## No. 23.

*Wages of Fileuses (reelers).*

The Wages here contrast very favourably with those of France, the highest wages in Srinagar being more than three times cheaper. The four-

skein or best reelers get 4 annas\* per day, three-skein reelers  $2\frac{3}{4}$  annas, two-skein reelers (the youngest ones)  $2\frac{1}{4}$  annas, boys turning the reels 2 annas per day.

Thus in comparison.

For four-skein reelers, per day	4 annas.
One batteuse for two reelers ...	$1\frac{1}{4}$ „
Boy for turning ...	2 „
	<hr/>
	$7\frac{1}{4}$ annas.

as against the French cost.

1 reeler in France ...	14 annas
Batteuse ...	5 „
Turning by power not costed	—
	<hr/>
	19 annas

Without reckoning the cost of turning, the difference in cost of labour is striking and points to a great advantage over the French, especially when the cost of steam-power is added.

#### No. 24.

Explanation of terms used in sericulture and in the conditioning of silk at the Lyons Conditioning Houses.

I find these terms are well understood at Srinagar, and do not need further reference than to the list in the Report No. 1, pages 197-202.

It is a useful list and indicates how closely the Lyons Conditioning Houses watch and report

\* An anna is equivalent to an English penny.



on quality of silk in all its different aspects, to tabulate the proportion of 'defectiveness and to show the purchaser what he is buying.

No. 25.

*Quality of Silk to be aimed at in Kashmir.*

Mr. Walton quite agrees with what is stated in Report No. 1, page 203, on this important head. It is an excellent guide as to the proper kind of output of Kashmir silk.

No. 26.

*On M. Arbousset's recent expression to me of his opinion of Kashmir Reeling and Raw-silk of last year's production. (1902).*

It is satisfactory and encouraging to learn from impartial outside authority that the reeling in Srinagar improves. This improvement will continue, as time goes on, in fact it is improving a little every day.

Mr. Walton is good enough to say that my visit has been a valuable stimulus both to the reelers and their overlookers, and has proved that by increased attention and care, a better quality of silk can be made.

With regard to M. Arbousset's advice as to the treatment of double cocoons, Report No. 1, page 204, of the above heading, it is well to give Mr. Walton's view. He satisfactorily shows me that it is better and more profitable here to

reel them as far as possible and sell locally the inferior raw-silk produced for inferior purposes in the bazaar. I may mention that a double cocoon, called in Italy *doppio*, is a cocoon built up by two or three silkworms instead of one. This unity of interests at cocoon-making time produces a cocoon which cannot be reeled off from beginning to end like a cocoon constructed by a single silkworm, the threads being mixed together.

The silk produced from a maund of fresh cocoons when reeled to its utmost extent from double or *doppio* cocoons can be sold in the bazaars for Rs. 24. This is better than sending it to France, where only Rs. 20 can be got minus freight cost.

But this *doppio* yarn can be sold in London at 6s. per lb., which works out at Rs. 32 per maund of fresh cocoons.

In the bazaars here Mr. Walton can get 6 Rs. per seer at maund weight of 82 lbs. whereas in London it will fetch 8 Rs. per seer at maund weight of 75 lbs.

With regard to Mr. Walton's methods of output of the waste-silk, which includes waste (or what the French term *déchets*), *doppio*, ties, and *nimtar*, which latter is the refuse silk left on the *chrysalides*, they leave nothing to be desired.

No. 27.

*White Cocoons and White Silk.*

The production of white silk has recently

become an important European question, owing to a greatly increased demand for white raw-silk, and I have been much pressed both in England by manufacturers and in Lyons by the silk merchants there, to call the attention of Kashmir to this subject and to ask for supplies, which would be eagerly purchased.

I have discussed the subject with M. Arbousset, on my way to Kashmir, and also with Mr. Walton.

Unfortunately, white silk does not command a higher price in the markets than yellow, and I think it would be undesirable to change from yellow to white cocoon rearing for the following reasons, given to me both by M. Arbousset and Mr. Walton. Half a seer more silk per maund is obtainable from yellow cocoons than from white ones, this difference amounts to 10 Rs. more money from yellow than from white, and at 10 Rs. per maund on this year's Kashmir output, the loss would be two lacs of rupees, besides which white cocoons contain less gum and cause much duvet, and, in addition, the mulberry leaf as it is at present in Kashmir is hardly succulent enough for white cocoon rearing.

#### SUMMARY.

I would like to conclude my Report with a brief summary of the impressions and convictions I have received during my visit to Kashmir in respect of its State silk production.

I think the Maharaja and the State are highly to be congratulated on the unprecedentedly rapid growth of this important industry, and its sure promise of being a permanent one so long, as it seems to me, as it shall be steadily and carefully conducted by the State.

I cannot omit to put on record the excellent filature administration of Mr. Walton, the Director, and of the successful way in which he has taught the villagers over a very large area to become proficient breeders of silkworms and producers of cocoons.

It will be interesting to record the satisfactory progress of sericulture during the last five or six years by repeating a few figures from the table at page 224.

In 1897 the industry was practically non-existent. It was in that year when, by direction of the Government of India, I made the first purchase of silkworm-eggs from Italy and France for Kashmir, amounting to £766. The purchases of eggs for the past six years have increased by leaps and bounds. For the requirements of the three years, 1901 to 1903, no less a sum has been expended in eggs than £12,999, or £4,333 per annum.

The number of persons engaged in attending to the rearing of silkworms has increased from 1,304 in 1898 to 44,245 in 1903, and what I think is especially satisfactory is the increased employment of Srinagar workpeople, mostly, I am informed,

very poor and greatly needing work. In 1897 only about 100 persons were employed in filature work, whilst at the present time there are 3,500 persons busily engaged in the six filatures, and by June next this number will be increased to 5,000, on the completion of the four new additional filatures necessary to keep pace with the yearly increasing quantity of cocoons produced in the State.

All this could not have been accomplished without consummate knowledge, ability, and fixedness of purpose on the part of Mr. Walton, and the ready and unstinted help provided by the State. No small meed of acknowledgement must be accorded to my greatly esteemed friend, Lieut.-Col: Sir Adelbert C. Talbot, K.C.I.E., Resident in Kashmir during the first three years of the silk enterprise, for his foresight in urging forward the construction of filatures from the initial stage when the industry was but a problem, and also in the progressive interest he took in it, of which I have a vivid and very encouraging recollection.

On his retirement in 1900, he had the satisfaction of knowing and reporting to the Government that the enterprise was a success, and a profitable one to the State.

Along with the name of Sir Adelbert Talbot must be mentioned that of Mr. Dane, whom I had the pleasure of meeting at the conference held at the India Office immediately before his

departure from England to undertake the duties of Resident in Kashmir in 1901. The State owes much to his energy and administrative skill in putting the increased industry upon right working lines.

With regard to the filatures, I find them in excellent order and very fairly up to date. There are a few not very important exceptions which Mr. Walton is gradually having adjusted in accordance with the present practice in France, the particulars of which I have fully reported upon and discussed with him.

I have not avoided plainly pointing out defects, the most important of which is the present state of cocoon-reeling.

Without wishing in the least to cast any blame either on the filature assistants or on reelers, I feel bound to state with some disappointment that I am not satisfied with the present state of cocoon-reeling, which, although good on the whole is not equal to what I found in France on my way to Kashmir.

The reeling must be improved by the avoidance of nibbiness, duvet, bouchons and the better tying of knots, all of which are detracting from the market value of the silk to the extent of one to two shillings per lb. I must strongly urge increasing skill in the reelers, watchfulness and care in the turners, and above all unrelaxing vigilance of every assistant, both European and native.

But besides these suggestions, other points go

to make up the sum total of the requisite perfection attainable. The temperature of the water in the reeling bassines must be constantly minded as well as that of the cocoon preparing bassines.

I advise the constant use of the thermometer; for an exact and invariable reeling temperature will go far to make the cocoons unwind more perfectly. The careful sorting of cocoons for reeling is also of considerable importance.

Besides these curative measures, I have suggested in this report the consideration at once of additional oversight assistance, and I repeat that whilst advocating a minimum of European assistants and a maximum of native assistants, it is for the State to consider carefully what maximum and minimum should be granted to Mr. Walton in order that he may have his filatures worked to the high state of perfection requisite to bring the silk up to European and Japanese standards.

If there are now only three European assistants to six filatures, they will be wholly inadequate to the continuous oversight of the greatly increased number of inexperienced reelers required for the four new filatures.

The total cost of the three present European assistants is Rs. 800 per month; additional assistants would begin at Rs. 150 per month each. When all the filatures are at work, one month's yield of silk of an advanced value of 1s. per lb., by better supervision, would in twenty days pay

for this increase, even if there was one European to each filature.

Considering the wish of the State to prefer native employées, Mr. Walton tells me he could manage with one European to each two filatures, which would be an increase of two when the four new filatures are finished. On this point I do not agree with him, for I consider, judging from my Continental experience, that one European assistant to each filature is an absolute necessity to bring up the silk to the standard, and better still with two.

At the times of distributing the eggs to the villages the European assistants must of necessity be away from their filature oversight, as also when the cocoons have to be weighed in from the country—a large undertaking.

I contend that each filature should have at least one European assistant never absent. Incessant vigilance is the only preventive of careless reeling.

I would suggest that it would be a good thing to send down four or six elderly boys from England to the South of France simply to learn all about cocoon-reeling and to be instructed at one or more filatures there. I could easily obtain the necessary permission.

There would be no necessity for any lengthened stay, as a knowledge of cocoon-reeling only would be required, and not such a study of sericulture



generally as is given in the Government Schools of France and Italy. If a promise of the State were given to parents of boys of something like a permanent prospect of employment, they would not grudge the expense of sending their sons to the French filatures.

It is of especial importance now the Industry has assumed such large proportions; that drastic and sudden changes or alterations should be avoided, and that any suggestions of improvement from whomsoever they may arise, should be first tried experimentally. Even as to what I have written about turning the filature reels by steam or water-power, if it should ever be thought desirable to adopt it, trials only should be made in one of the filatures and their results carefully examined and compared after working for some time and before any large outlay is incurred.

The sericultural ship is now in deep water and requires to be steered and worked with great steadiness and by the avoidance of disturbing elements.

In closing this report, which has been to me a labour of love, I hope on my return home to do what I can to institute preliminaries for the successful introduction of silk-weaving on the lines I ventured to submit to His Highness the Maharaja, General Raja Sir Amar Singh, the Resident and the Durbar, who have so kindly received me, and who fully concur in this suggestion.

That the Silk Industry in which I for so long have taken a purely disinterested interest may continue to flourish and be a comfort to His Highness the Maharaja and a blessing to the people of his State is the earnest prayer of

Their humble Servant,

THOMAS WARDLE.

CHAPTER XVI.

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THIRD REPORT ON KASHMIR SERICULTURE,  
WRITTEN AT LEEK DURING THE LATTER HALF  
OF 1903.

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Leek,

January, 1904.

To the Under Secretary of State for India.

Sir,

I now have the pleasure of completing my final Report, the result of discussion and inquiries in France and Italy, concerning a few points where more technical knowledge was desirable, and upon one or two divergences of opinion between Mr. Walton and myself, which M. Arbousset, Mr. Walton and myself had already discussed to some extent in my Report No. 2.

I have endeavoured to accentuate the results of these enquiries and to put them in the clearest form.

*Mulberry Cultivation.*

First, as to the cultivation of the Mulberry, the practice of which in Kashmir was so bad as to have caused me very unwillingly to pass some

severe strictures, as shown on pages 209-213 of my No. 2 Report.

Following the practice of France and Italy, the Mulberry-tree should be pruned as little as possible, about once in four or five years to shorten the branches, this should always be done in the winter, preferably in February, and before the leaves appear.

In the Cevennes the pruning used to be done annually, but it was found to cause the trees to perish, and for that reason the practice has been given up. The leaf that grows from a branch two to four years old, is far better for the silkworm and more nourishing than that which grows on a branch of the same year.

When a tree is pruned in February its leaves must not be picked in Spring, but only in the following year.

I have already described in a previous letter, the method of gathering the leaves, but it is better that I add the following remarks:

The branches must never be cut in order to get the leaves off.

The leaves must be picked off by hand and put in a bag tied round the waist, and if the trees are very high a bag kept open by a circular wooden ring, must be used, and one that can be hung on the trees with a wooden hook or pole.

I sent a drawing of the apparatus to Mr. Colvin

last August, and young Mr. Thomas will bring an example of it as used in the Cevennes, and he will also have been instructed in its use.

*Ventilation of Magnaneries.*

The Magnaneries must be ventilated, but Mr. Walton's opinion I find to be correct, that variations of temperature from 68° F. must be avoided.

When the weather is cold, *a fire must be lighted*, the draught caused by the fire will give sufficient airing.

On the contrary, when the weather is hot, it is necessary greatly to air the magnaneries without fear of draughts, but the openings must be closed if the temperature gets cooler or becomes damp.

*Etouffoir versus Séchoir.*

I have had a prolonged discussion with M. Arbousset as to the relative merits of each. He maintains his former opinion, and prefers the Etouffoir.

With the Etouffoir the cocoons cannot be burned, and he repeats that the cocoons etouffé by the Séchoir unwind better during the three or four of the first months after the gathering of the cocoons, and give a silk which has not so much fluff, whilst the cocoons etouffé with the Etouffoir unwind better than the Séchoired ones during the rest of the year, their grès, or gum, being less dry; but he admits that in damp climates like

China, the Séchoir is preferable because with it cocoons can be dried and kept. He thinks on learning that the Kashmir climate is damp, it may be better to use the Séchoir, as Mr. Walton does, and he quite approves of his only half drying the cocoons; in that way the grès, or gum, does not get so hard, and the cocoon is more easily unwound. In the Cevennes during the months from June to September, the average of dampness registered by the polymetre is from 30 to 40 degrees. It would be interesting if Mr. Walton would daily register the hygrometric state of the climate by means of his polymetre, and to furnish us with the records.

*Cocoon-reeling Supervision.*

The reeling supervision is greater in France and Italy than I found it in Kashmir. In the reeling filatures in Alais, to each 60 bassines there is one male director, two skilled women superintendents, and one tester, one of the principals generally superintending the whole work.

At St. Cristol for 40 bassines there is one director, and two women superintendents, one of which is a tester.

All this confirms the opinion I so strongly expressed when in Srinagar, and also on pages 227-8 and 243-4 of my No. 2 Report, that the filatures lack more European and native superintendence, and I fear that only by resorting to European

procedure will the reeling be brought up to the high mark of the French and Italian qualities.

It is necessary to do all that is possible to avoid defects in the silk thread, but it is useless to try and satisfy every buyer, who will always try to find defects in order to obtain the silk at a reduced rate.

*Motive Power.*

In spite of Mr. Walton's good reasons, I retain firmly my belief and opinion that it is preferable for the regularity of the motion, the facility of un-reeling the cocoons, and for the regularity of the titre, to have a mechanical motor, either hydraulic, or steam-power, or by electric motors, if this latter system can be economically installed.

My opinion is fully endorsed by that of several of the best European reelers, besides which, all of them practise it.

The expense, even with a steam-engine, would be much less than Mr. Walton thinks; in fact much less than with boys working well even at two annas per day.

If it was not necessary to have steam to heat the pans, and that it was necessary to instal boilers and steam-engines, the expense would be considerable, but as long as there are already boilers to give steam to heat the pans, the extra expense of firing for one steam-engine would be insignificant.

One hundred boy turners at two annas per day cost 16s. 8d., and one three-horse power steam-engine would turn 100 reels at an extra cost of less than one anna per day with coal, but with wood the cost would be somewhat higher.

A water-motor, being even more regular than steam-power, would be preferable, and would cost less when once applied.

*Cocoon-reeling and Apprenticeship.*

M. Arbousset has sent Mr. Walton a photograph of one of the new machines which have now begun to be used in the French filatures. It is constructed with a separate spindle for each skein of silk, and is put out of motion by a lever above the head of the reeler. The advantage in this is that the reeler is able to continue her work at the same time the girl joins the broken ends.

With this new machine the apprenticeship or probation would be made quite as well as with the boy turners, and even better.

Between each two pans there is a small pan, called a "petite bassine batteuse," on a bank or tray which runs the length of the filature. This is the little bassine which is placed in front of and between two fileuses; it is the mode employed in Italy for the battage. The battage in Italy is not done in the same way as in France, there is an apprentice who places a handful of



cocoons in the little bassine, and beats them with the brush, which is much smaller than the one employed in France, only being about half the size. She beats the new cocoons and the detached cocoons separately, and passes them to the reeler to clean as soon as the threads have caught her small heather brush, or rice-straw brush. It is these little girls who working all day under the eyes of the reelers, try to make a good and short apprenticeship.

There are also the young girls who tie the knots or join the ends together again, one for every five workers, and who are placed between the worker and the machines; they tie together the broken threads; a saving of time and a regularity is thus effected. They are able, when tying the knots, to obtain a useful and growing experience with the reeling, and therefore they soon learn how to reel cocoons.

This shows clearly that even if the staff were smaller, those undergoing apprenticeship or probation would be just as successful, and besides the work would be more quickly and better done, especially if a mechanical motor were substituted for boy turners.

M. Arbousset thinks that it is impossible for really good silk to be produced without the use of a motor for turning the spindles, as a young boy is unable to turn with the regularity necessary, and unsteady turning cannot produce good silk.

*Vice Rédhitoire.*

I have fully described this defect on page 202 of my No. 1 Report.

In consequence of an apparently well-founded charge, as well as a large claim for raw-silk said to be damaged by dermestes or mites made by the eminent firm of Messrs. Chabrières, Morel et Cie., of Lyons, I discussed the matter with Mr. Walton at Srinagar, and also carefully examined much of the raw-silk about to be sent to England, but we were unable to find any trace of the defect, or any trace of insect life, exuviae, microscopic or otherwise, likely to gnaw, eat, or damage the silk.

On my return from Kashmir, in May, 1903, I called on Messrs. Chabrières, Morel et Cie., at Lyons, to further investigate the defect, and to fully discuss it with them. I was assured that the cause was what they had stated; and that in their long experience as merchants of raw-silk they had had to make many claims from this cause; they affirmed there could be no doubt about it, and that it was most important for the future of Kashmir silk that a remedy for it should be found.

I helped to open and examine several bales, which at my request were brought up from their stores to their office in Lafont, Lyons.

I found ample evidence of defective silk, and instructed them to open all the bales, about sixty

in number, which they then held in stock, and to send all defective portions to Messrs. Durant, Bevan & Co., to be forwarded to me for a minute investigation, for I was not then convinced that the cause was what they so confidently stated, or "moth-eaten" according to their ordinary parlance.

Messrs. Durant, Bevan & Co., subsequently sent me all the defective hanks they received from Chabrières, Morel et Cie., amounting to nearly 100 lbs.

I gave every hank a thorough examination, chiefly microscopic.

This occupied me upwards of a week of close work. I am glad to say I found no trace of animal or insect life, microscopic or otherwise, but there was ample evidence of damage of another kind.

In many places, chiefly at the end of the hanks which had naturally been the most subject to friction, the silk fibres were much cut and frayed, and so rubbed that the silk thread itself was only recognisable by aid of the microscope. It was also discoloured, and gave rather the appearance of *dermestes exuviae*. I came to the conclusion that the fault lay with the carrier and not with any entomological destructiveness, but to make sure of this I sent some of the defective hanks to the highest authorities in Milan, namely, the "Société Anonyme Coopérative avec capital illimité

pour le conditionnement et l'essai des soies et autres textiles à Milan, Siège Principal, Via Ciovasso 11," who have issued a most interesting brochure entitled, *Compte-rendu des recherches faites de 1894 à 1899, Laboratoire d'Etudes de la Soie*. Published in Milan by L. Zanaboni & Gabuzzi, 12 Via Fontana, 1900. The reply I received was as follows:

"There is nothing in the appearance of the silk which will authorise us to declare that the silk has been cut by dermestes or other insects harmful to silk. Our opinion is that the defect has been caused during the transport, in which sufficient care has not been employed, either by the rubbing of the bales against each other, or against the cords which tie the bales."

But to prevent my assigning an opinion which might yet be found controvertible, I wrote also to the Director of the Royal Bacological Station, Padua, and append a copy of his reply.

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Padua,

3rd August, 1903.

R. Stazione Bacologica Sperimentale.

Dear Sir,

I have given your silk a long examination, and I am of opinion after many experiments that the so-called "moth-eaten" defect depends exclusively

upon a too strong ligature, or from some iron instrument.

I have found no trace of insects, and it is impossible that an insect could cause the mischief.

Yours very truly,

E. QUAJAT.

There is therefore now no doubt that the subject has been thoroughly thrashed out, and whilst the rédhibitoire idea could not be applied legally or justly in this case, I have recommended Messrs. Durant, Bevan & Co., to make a satisfactory allowance to Chabrières, Morel et Cie, and settle the matter. This they have done, and have sold the damaged portions at their lowered value.

Although the silk has been saved from a bad reputation, and from a liability to claims more or less serious for defects *always made the most of*, it is absolutely necessary that better arrangements should be made for conveying the bales from Srinagar to London, as much as possible friction-proof.

I think the damage is caused in transit between Srinagar and Rawal Pindi, along the steep gradients which involve much jolting, and possibly by too tight cording; anyhow the defect is preventable, and it is of interest to find that most of the silk sent to London has not been complained of, in fact, Messrs. Chabrières, Morel et Cie., are the only firm who have found fault or claimed damage.

*The Sorting and Choice of Cocoons for Sale.*

On this question of high importance the opinions I have gathered go all in one way.

The samples of cocoons that were sent to me, as well as those I took to M. Arbousset, were not sufficiently well chosen to be sold on the Marseilles market.

In reeling the good cocoons, the poor ones must not be mixed with them, for in the battage of cocoons, the batteuse brush loosens and destroys the poor cocoons, and the good ones do not become sufficiently boiled or prepared.

The silk from poor cocoons and those "satinés" is also more fluffy than the silk from good cocoons. For this reason it is necessary that the cocoons should be carefully selected before they are sent to the filature or sent for sale. The poor cocoons must be reeled separately for the purpose of making grège or raw-silk of the second quality, which is sold generally at four to five francs per kilo., or from 1s. 6d. to 2s. per lb. less than the first quality.

M. Arbousset endorses my opinion that one European superintendent is necessary for each filature, and hopes that the experiment that is going to be tried with Mr. Thomas will succeed and will favour our joint opinions.

When I left Srinagar, the mulberry trees, owing to the inclemency of the weather, were about three weeks late. I was then very apprehensive

of the success of the silkworm crop, and I am sorry now to learn from the authorities in Srinagar, that owing to a heat-wave or as it is called in French "la touffe" coming on suddenly and severely before the worms were old enough to stand it, there has been a loss of about 25 per cent. of silkworms. On learning this I at once wrote to Mr. Colvin and strongly recommended that in future from 20 to 25 per cent. more eggs should be purchased and distributed than at present, as the ten filatures ought to be fully kept at work, and any surplusage of cocoons could very easily be sold at a profit in Marseilles.

With regard to the eggs purchased last year for this year's crop, I would like to suggest that the hatching and progress of the rearing should be very carefully observed, because owing to great shortness in France of silkworm-eggs there has been the greatest difficulty in supplying the requisite quantity, and although the eggs are always guaranteed each year to me by M. Arbousset, in whom I have the fullest confidence, to be free from pebrine, it would be as well to see if any disease creeps in and for extra precautions to be exercised.

Within the last few days I am informed in a letter I have received from Major Kaye, of his approval of my suggestion to order more seed than is required, and so guard against having to shut down the factories if there should be a short crop of cocoons.

I am glad to be informed too by him that 25 per cent. more country people have volunteered to apply for seed next season, making up the number to 13,000, and as the seed distributed is one ounce per family of four or five, this will bring up the people employed in this industry, young and old, to between 52,000 and 65,000, a most pleasing industrial feature, for they are paid handsomely for all cocoons they bring in.

Major Kaye also informs me that the newly-employed female reelers are on the whole doing well, many of them reeling four skeins of good silk, and he believes the experiment has all the elements of success in it.

I am glad to be informed by him that the weaving industry should be started and continued as a State branch.

Now that the discussion and correspondence on points raised in Srinagar on my No. 2 Report are completed, M. Arbousset modestly desires me to ask that his name may be allowed to be mentioned amongst others, as having assisted in the establishment of sericulture in Kashmir, as much by the carefully chosen eggs he has all along sent, as by the advice and opinions he has so unstintingly given.

With regard to this, I have no hesitation in saying that Kashmir sericulture is under a deep debt of gratitude to him for being so reliable in the great trust reposed in him, as well as



for the advice he has always been ready to give, and for his generosity in training young Mr. Thomas in his filatures, and in obtaining an introduction for him to work in the filature of another reeler of Cevennes reputation.

I wish to state that the 10 lbs. of 24 deniers raw-silk reeled from white cocoons which was sent to me by Mr. Walton on 24th November last for weaving experiments, is turning out most satisfactorily, both in regularity of cloth and in the improved augmentation of size over and above the  $\frac{9}{11}$  or  $\frac{11}{13}$  deniers.

I hope soon to send specimens of the woven fabric and its results in dyeing and finishing.

*Suggestion for Improvements in the Tying up of Frisons or Knubbs for the Market.*

The present plan of fastening the bunches of waste or knubbs with tightly twisted bands involves a great and needless waste of labour in untwisting the aforesaid bands, and untying the knots, and is greatly objected to.

A more loose mode of tying the bunches, and in much larger bunches, would be much preferred and would seem not to be difficult to do.

I again called at Messrs. Durant, Bevan & Co. a short time ago and examined a number of bales they had in their stores, and found a good many of them were very much rubbed and abraded by imperfect carriage, some of them being in holes close to the ends of the bales.

*New French Reeling Modification.*

This recent improvement prevents the stoppage of the reeling of all the four skeins when the end of one of them breaks and enables the reeler to proceed with the reeling of the other three skeins not broken, so that when one end breaks, only one skein stops.

The silk thread is carried from the bassine over the tavellettes and the two portesbouts to the reel or "dévidoir" in exactly the same way as with the ordinary reel or "dévidoir" but instead of there being one long reel holding four skeins, the reel or "dévidoir" is divided into four narrower ones.

A photograph has been sent to Mr. Walton, and when Mr. Thomas arrives he will be able to point out the details of the new "dévidoir" and the connections for stopping and starting each one. I have asked him to take out with him the important parts of the mechanism.

This improvement enables a boy for every five reelers, to be employed in the filature, his work is simply to piece up the broken or detached ends, whilst the reeler continues laying on the cocoon threads as often as required. The boy works behind the reelers.

I have been in close touch, by correspondence, with Mr. Thomas during his stay at Alais. I am sure his work there will prove very useful to Kashmir. He is fully conversant with all the

details of the filature and subsidiary work carried on in the Cevennes. He has sent me many details of procedure there of greater or less importance concerning cocoons, reeling, battage, evenness of thread, avénage, water temperatures, overlooking, duties of managers in France, elasticity and strength, duvet and bouchon, water preparation, labour particulars, titrage of cocoons, regularity of thread, progression of sizes, various "essais," lances, croissures, tying of knots, portefilières, &c., but as he has them all carefully written down, I need not add them to my report; it may however be desirable to print them in Srinagar as a record of his most useful study of economical French procedure in filature work.

*Durant's New Offices.*

I have been informed by Messrs. Durant, Bevan & Co. that they have within the last fortnight, opened a bureau and warehouse in Lyons which will give them greater and closer facilities for the exploiting of Kashmir silk amongst the silk manufacturers of France than they have hitherto had. Mr. Bevan is there at the present time installing a responsible representative of the firm, and making the necessary arrangements for future prosecution of their business as Brokers of raw-silk in France.

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As my life is drawing near its close, I am I hope

not unnaturally desirous of putting on record some statement of my life work for India : and this is my apology for recapitulating thus fully my deep personal and philanthropic interest in the welfare of India.

To me my work for India has been indeed a labour of love, which has increased with years, and still continues.

I have never had any desire to work for the silk interests of India from pecuniary motives, and although the time spent has been enormous, and the hobby a costly one, I have no regrets ; on the contrary, I cherish a pride in my efforts, I hope justified by the success which has attended them, and by their potentialities so far as silk, sericulture and silk weaving are concerned in the future of India.

Thus an historical Industry which had been allowed absolutely to die out after repeated attempts from lack of knowledge and scientific procedure, and which employed only a few hands in 1896-7, now gives employment to more than 50,000 men, women and children, all natives of the country, their number increasing rapidly each succeeding year; the silkworm rearers nearly all working in their own homes in the villages of the valley of Kashmir, and the reelers working in the factories or filatures in Srinagar, the only Europeans engaged in this colossal industry being the Directing Superintendent and his five assistants.

This is a dramatic result, and fortunately as sound and sure as it is startling. And it is not

more gratifying in itself than in the solid hope it justifies of similar beneficent results being obtained in the revival, and even the introduction of other industries into India, of the ruri-urban type of sericulture and silk reeling and weaving.

I beg to offer this Report to His Majesty's Government of India, acknowledging with my warmest thanks the kind encouragement I have invariably received.

I have the honour to remain,

Yours faithfully,

THOMAS WARDLE.

## CHAPTER XVII.

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### THE ROYAL BACOLOGICAL STATION, PADUA, ITALY.

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I HAVE lately received from Professor Quajat, the Assistant-Director of the Royal Sericultural Laboratory at Padua, a most interesting brochure containing an account of the curriculum at the Royal Bacological Station at Padua, and the scientific sericultural investigations regularly carried on there.

In giving a few quotations from this brochure about the Institution and its valuable educational and scientific work, it will serve to emphasise in a marked way my former, as well as present, strong convictions and recommendations to the Government of India on the importance of having in India a similar Imperial sericultural educational and scientific establishment, and all the more so that the Government of Italy not being content with this one famous agricultural teaching institution in Padua, has actually 59 sericultural observatories and laboratories now working in the Kingdom of Italy under the direction and dependence of the Station at Padua. The names of

these stations are given in this brochure, which is entitled "The Royal Sericultural Laboratory of Padua, at the Universal Exhibition of St. Louis, being a summary of information of the functions of this important Central Establishment at Padua, 1904."

It is proved that these sericultural laboratories have given mighty impulse to the revival of the silk industry in those extensive areas in Italy where the inhabitants mostly apply themselves to its production.

The brochure states that the diffusion of healthy eggs incessantly brings further benefit to the industry, especially when it is known that they have been produced under the scientific direction of the Government Establishment.

Many breeders of silkworms, Italian and foreign, come personally to discuss the difficulties that happen to them, and to be more closely acquainted with the establishment in all its details.

Besides the curriculum work, one of the duties of the laboratory obliges it to execute microscopic analyses of eggs, chrysalides and moths, at the request of private applicants, on payment of a fee.

The Padua Laboratory is under the direction of my esteemed friends the learned Cavaliere E. Verson and of his learned colleague, Cavaliere E. Quajat, the Assistant Director, a list of whose Sericultural Memoirs is to be found in the brochure, occupying no less than sixteen pages.

This laboratory was founded by Government in April, 1871, and has already existed for 33 years.

The Ministry of Agriculture, supported by the Province, the Commune and the Agricultural Association of Encouragement of the local industries, provides for its maintenance, and all these corporations have their representatives in the Board of Administration.

The persons appertaining to the Institution, are:—a Director, who directs and surveys the work, gives impulse to scientific researches and is charged with the regularity of the different administrative operations; a Vice-Director, who assists the former and substitutes him when occasion requires; an Assistant; a Secretary, and persons of common service.

The building occupied by the Laboratory belongs to the province.

Adjoining the establishment is a certain space of ground (about a hectare and a half) cultivated with mulberry trees, of which there is a collection of more than 30 different kinds. In the middle of the grounds rises the silkworm nursery; it is completely isolated, and annexed to it is a hothouse for the production of the leaf for the early instruction.

The Cabinets are provided with all that is required for the sericultural researches. Microscopes, balances of precision, physical and chemical apparatus, sterilizing and cultivation apparatus, are the scientific instruments with which the



laboratories are provided. On the other hand, great care has been taken in collecting day by day all that is connected with the technical practice of the Silk Industry. And thus the laboratory now possesses a rich museum, containing numerous models of hibernation and incubation machines; all kinds of implements and apparatus for rearing silkworms, for isolating and selecting moths and cocoons, for suffocating the latter, and in short for all the operations necessary in the production of silkworm-eggs.

The most varied races of silkworms are represented in more than 1,600 vases, containing cocoons and raw-silks. Silk-winders, reels, serimetres and serigraphs and several kinds of basins are used for analyzing the threads of each cocoon, as well as the raw-silk formed by several threads.

Plaster models of healthy and unhealthy worms and large coloured tablets, show in all its details, the anatomy of the *Bombyx mori*; its different evolutive phases, and the delicate structure of its tissues may be seen by the observer in a collection of 8,000 objective laminae bearing more than 70,000 microscopic sections.

I have had the honour of contributing from time to time important sericultural materielle to this museum for which I have received the thanks of the Italian Government and an offer of an Order of Decoration, but which I was not permitted by rules of the British Government to receive.

The Library contains more than 2000 volumes, representing together with technical and scientific works and magazines an average value of 20,000 francs.

The traditional empiricism that governed not long ago the most important treatment for the proper preservation of eggs, has yielded to a rational method, strictly agreeing with the exigencies of a natural evolution. The nature of the diseases that unfortunately still afflict the silkworm, has been studied in all its manifestations, to facilitate the knowledge and application of the best means to struggle against them. Systems of disinfecting the nurseries have been settled, without however damaging the products of the rearing, and several other important problems that greatly interest sericultural industry, have had enlightening.

For sericultural details, the reader may consult the 31 volumes of periodical publications, edited by the Establishment, and the considerable number of Memoirs it publishes in scientific papers or in the reports delivered at several scientific Academies.

This Sericultural Establishment has not only greatly contributed, with its publications, to render silkworm-breeders more careful and watchful in the practice of this industry, but it possesses two other means to reach the same aim more efficaciously; the courses of teaching and the

indefatigable concurrence of sericultural laboratories. The usual teaching is imparted in two separate courses; the first for men and the second for women, and regulated so that they may reach practically useful results, they take up all the activity of the persons employed at the Establishment for more than four months every year. But this heavy task is widely rewarded by the kind reception of the public, if it is permitted to judge by the number of those who draw advantage from their labour. And a considerable advantage is indeed drawn from it, even materially speaking notwithstanding the sad vicissitudes to which the Silk Industry has been subjected during the last ten years.

It is gratifying to find that of 909 pupils who have passed through this Institution, 500 at least have applied themselves to sericulture as their chief, if not their only, means of living.

Two important publications have recently been issued by the Director and Vice-Director of the R. Stazione Bacologica, the titles and particulars of which are given at the end of chapter xviii.

## CHAPTER XVIII.

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### SILK AND THE SILKWORM: PRACTICAL TREATISES ON SERICICULTURE.

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ONE of the most useful and reliable aids to Sericulture is Monsieur Laurent de l'Arbousset's book entitled "Cours de la Sericulture Pratique," published by C. Castagnier, Alais (Gard) France. It is a book I earnestly recommend to all persons interested in the subject.

My daughter, Elizabeth Wardle, has translated it into English, and I have edited it. It will be published shortly by Mr. Eaton, Leek, Staffordshire and Messrs. Simpkin, Marshall & Co., Ltd., Paternoster Row, London, and will be found most useful both in India, our Colonies and America.

My friend, Mr. Nitya Gopal Mukerji, of Naya Dumka, Southal Paraganas, Bengal, India, who was Sericulturally educated at Padua and Montpellier, the Italian and French Sericultural Government Stations, and also under the late Professor Pasteur at Paris, has also written an excellent treatise on the same subject especially adapted to Sericulture in India. It is entitled: "Handbook of Sericulture," and is published by

the Bengal Secretariat Press, Calcutta, both in Hindustani and in English.

The following are two important publications issued from the R. Stazione Bacologica:—

1. Il Filugello e l'Arte Sericola, Trattato Teorico-pratico illustrato da 85 incisioni intercalate nel testo, by E. Verson ed E. Quajat, Direttore e Vice-Direttore. Fratelli Drucker, Padova. 1896. Price L.10.
2. Dei Bozzoli, by E. Dott. Quajat, Vice-Direttore della R. Stazione Bacologica di Padova, Più pregevoli che preparano i lepidotteri setiferi, con 50 tavole contenenti oltre 140 clichés. Padova, Fratelli Drucker, 1904. Price L.10.

## CHAPTER XIX.

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JOURNEY TO ALAIS. BOMBAY. BOMBAY TO SRINAGAR, VIA RAWAL PINDI. SILK FILATURES, ETC. SERICULTURE. MY REASONS FOR GOING TO KASHMIR.

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I VENTURE, I hope, with some appropriateness, to include in this book, two letters I wrote to the Leek newspapers during my absence from England, one on the Sericultural operations in Kashmir, the second a description of its Geology, Natural History, and Sport, also with registers of Temperatures and varying Barometric pressures during the journey.

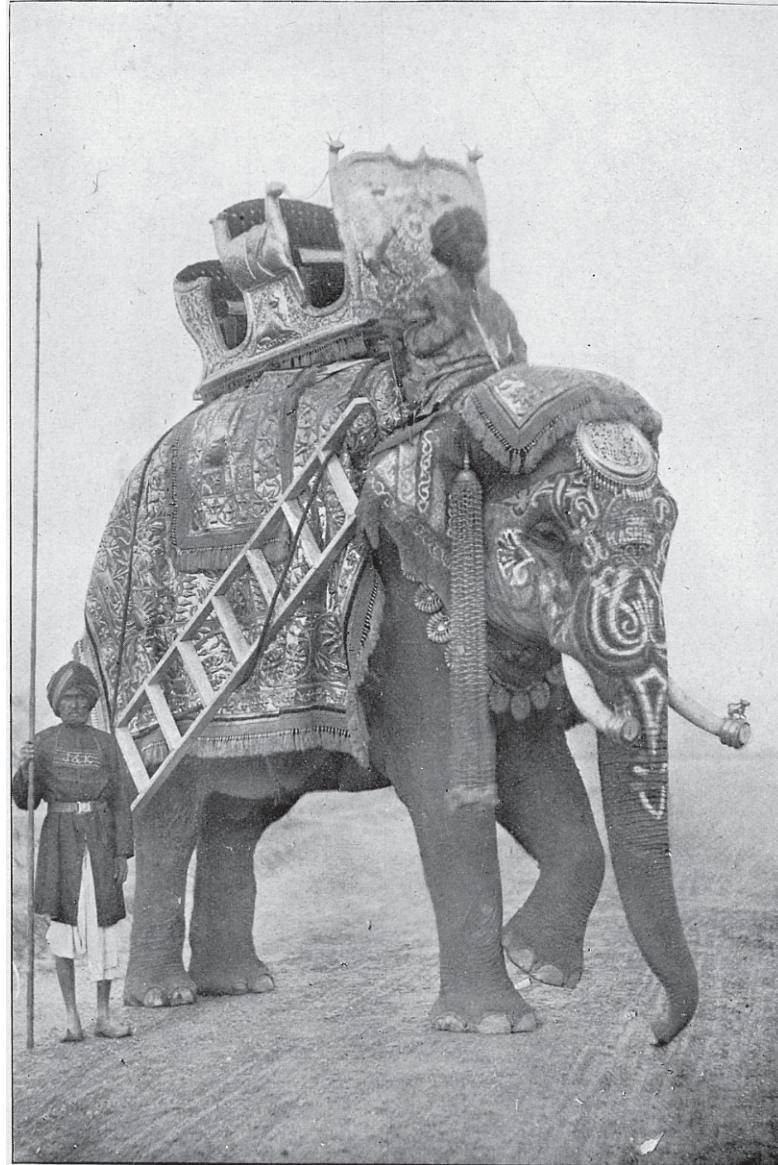
*From the Leek Post, Saturday May 9th, 1903.*

We have received the following letter from Sir Thomas Wardle, describing his journey from Bombay to the Vale of Kashmir, and to the Silk filatures in Srinagar which he has been the means of establishing during the past few years, an account of which will be of the utmost interest to our readers :—

TO THE EDITOR OF THE LEEK POST.

Dear Sir.—On my way out to India I stayed a

PLATE 9.



One of the two State Elephants of H.H. the Maharaja Sahib of Jammu and Kashmir, as caparisoned for the Delhi Durbar of 1902.

week at Lyons and the further south of France, to get the opinions of silk manufacturers and merchants on Kashmir silk, and to study up-to-date procedure of cocoon-reeling, etc.

By the kindness of two of the best filature proprietors in the Cevennes at Alais, I was permitted to work at cocoon-reeling. I made a lengthy report, which took up much of the time during the voyage to compile, both from notes and memory.

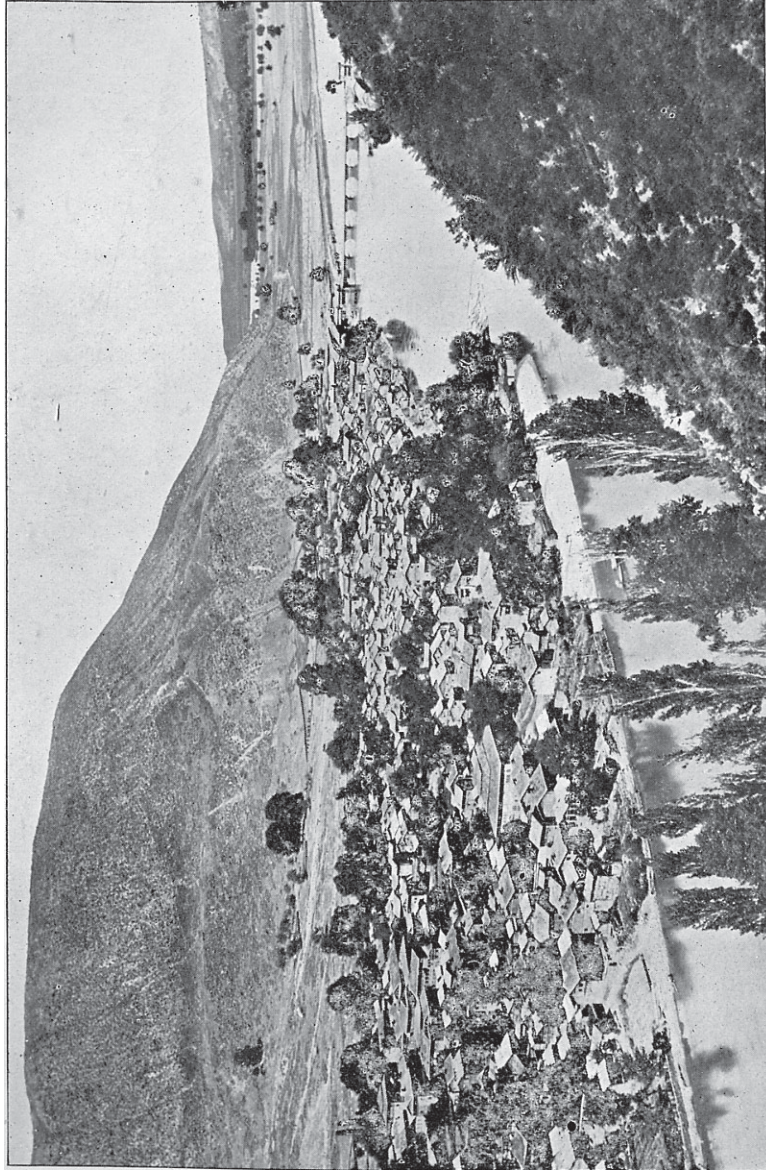
I journeyed alone from Bombay, on Monday, the 9th March, by express night and day, passing Bhopal, Gwalior, Agra, Delhi, Amritsar, Lahore and Rawal Pindi on the way, arriving at Sialkot on the following Thursday, where I met by appointment Mr. Colvin, the Resident of Kashmir. After a day's discussion with him, I went on to Jammu, where I met the Maharaja of Kashmir and Jammu, his brother, General Raja Sir Amar Singh, and the members of the Durbar in Council. His Highness the Maharaja warmly thanked me for the interest I was taking in Kashmir Sericulture, and after hearing my report, and what I had to say, in an interview lasting nearly two hours, he ordered my report to be printed, and after a most cordial reception at the Palace, his brother took me to his house adjoining the Palace. I stayed several days at the Residency, having an elephant and also a carriage placed at my disposal (plate 9). I saw the great annual Hindoo festival of Holi; waited until the Resident came up from the Sialkot Residency, and then, after much discussion with Sir Amar Singh



and the Resident, I left for Rawal Pindi, en route for Srinagar, the capital of Kashmir.

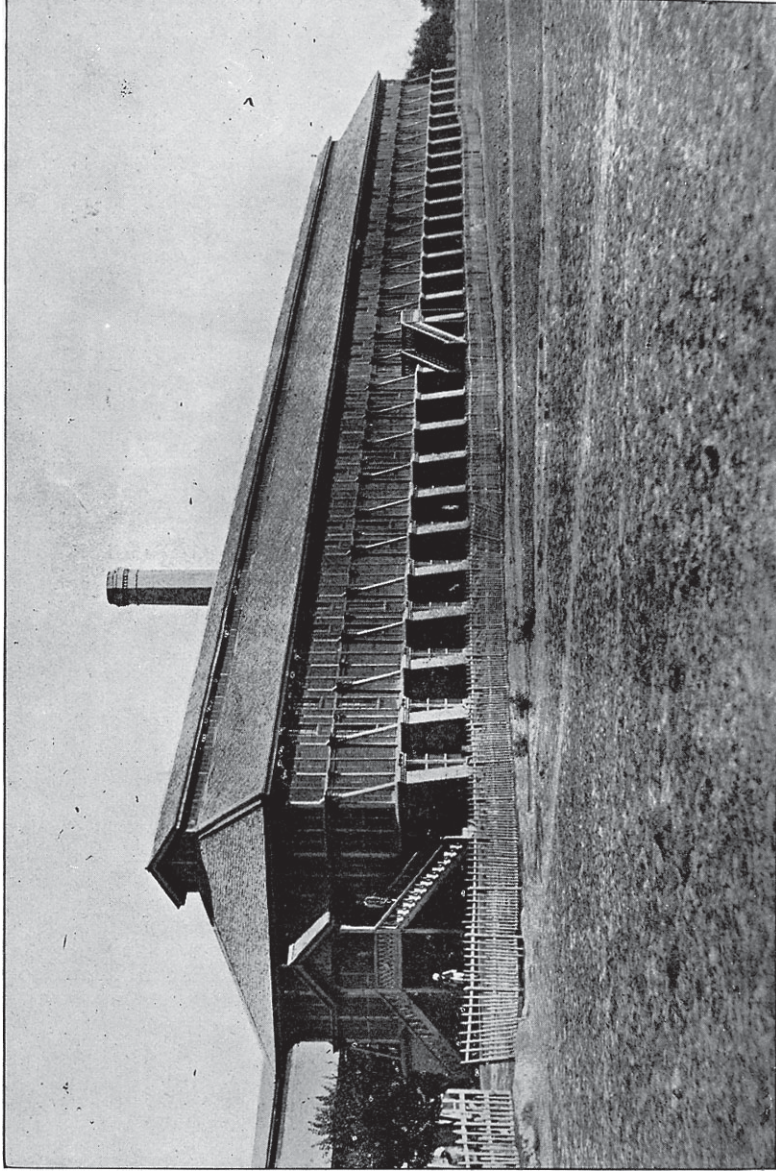
When I arrived at Rawal Pindi, the nearest railway station to Kashmir, 200 miles away, I was informed that the road up to the Kashmir Valley was blocked with snow, and would not be open for ten days; that part of the journey having to be done by Tonga, occupying four days, resting at Dak bungalows each night. I went on to Peshawar for a few days, waiting for the snow to melt. Here the weather was almost tropical. I went a long drive up the Khyber Pass. I returned to Rawal Pindi after four days stay, and learned I might risk the journey if I walked through ten miles of snow. I waited two more days, and news came by wire that the snow was being cleared and leaving only a walk through it of two miles, at Murree, 7,200 feet above the sea. I decided to venture, and set out alone in a tonga and pair, changing horses every five or six miles. The first stage was over the plain of Tret, 25 miles; the second to Dhulia, 47 miles from Rawal Pindi; leaving Dhulia next morning at 7 o'clock, I drove on to Baramulla, 102 miles, arriving there at 9 p.m. the same day, having had a snowy, cold, and very dangerous journey, under high cliffs and over precipitous heights most of the way. My tonga was stopped at one place by a large fall of cliff which had just smashed an eccaladen with luggage. I had to jump out of the tonga to avoid another fall of rock. The

PLATE 29.



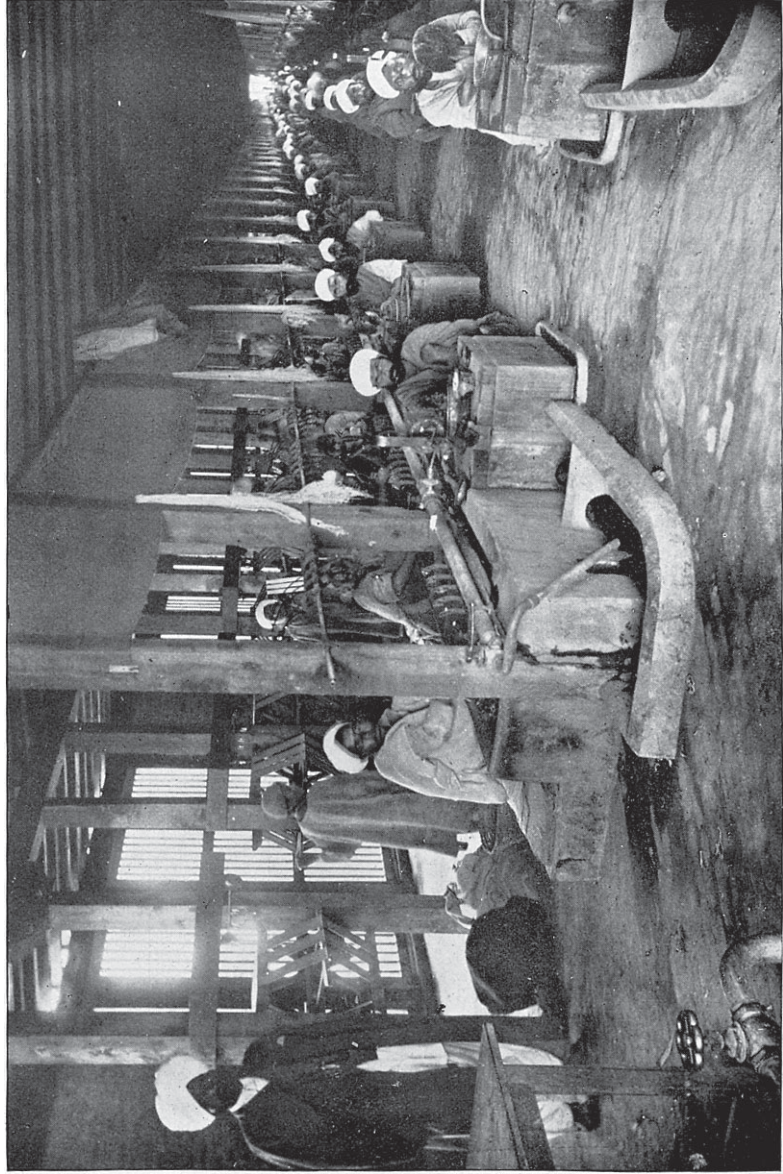
Baramulla, on the Jehlum, entrance into the Vale of Kashmir, thirty miles from Srinagar.

PLATE 33.



Sri.ragar Silk Filature. Length 435 feet, width 42 feet. Containing 550 workers.

PLATE 34.



Interior of Filature in operation.

river Jhelum was foaming in flood 1,000 feet below.

Baramulla is the western entrance to the Vale of Kashmir, and only 30 miles from Srinagar, 5,235 feet above the sea (plate 29). The valley is surrounded by snow-clad mountains of great grandeur, some of them from 12,000 to 26,000 feet high. The valley is chiefly flat, and is the bed of an ancient lake.

I arrived at Srinagar at mid-day on the fourth day. The Governor of Kashmir called on me soon after my arrival, and said his instructions were to see that I lacked nothing, and that as a State guest I should receive every attention to my comfort. His name is Pundit Man Mohan Nath Kaul Sahib; he was most polite. In the afternoon, Mr. Walton, the able Director of Sericulture here, drove me to the silk filatures. There were six fine factories or filatures for reeling and storing cocoons; each filature is 435 feet long, by 42 feet wide, and has two rows of reeling bassines (see plates 33, 34, 35, 36, 37). There are 550 men and boys in each filature, a sight perhaps unequalled in Europe. Four more filatures are in course of erection, and will be completed before June, when the new crop of cocoons is ready; but about two-thirds of last year's cocoons are waiting to be reeled, owing to the large crop and inadequate reeling machinery. To think this immense industry had all developed from the £600 to £700 worth of silkworm-eggs I bought six years ago seemed wonderful, and made one feel thankful.

The number of workpeople now employed is as follows:—Eggs distributed to 11,150 families; Mr. Walton informs me that the quantity of eggs given out depends on the size of the families, and that an average of four per family who partake in the rearing is a correct estimate; so multiplying 11,150 by 4, there were in 1903 the following:—

Silkworm rearers ... ..	44,600
Reelers and Turners in the present six filatures	3,300
Sorters ... ..	200
Packers and deniering ... ..	60
Firemen, wood-cutters (there is no coal) ...	50
Carting wood ... ..	40
	<hr/>
	48,250
Additional reelers to be employed in June in the new filatures ... ..	2,200
	<hr/>
	50,450

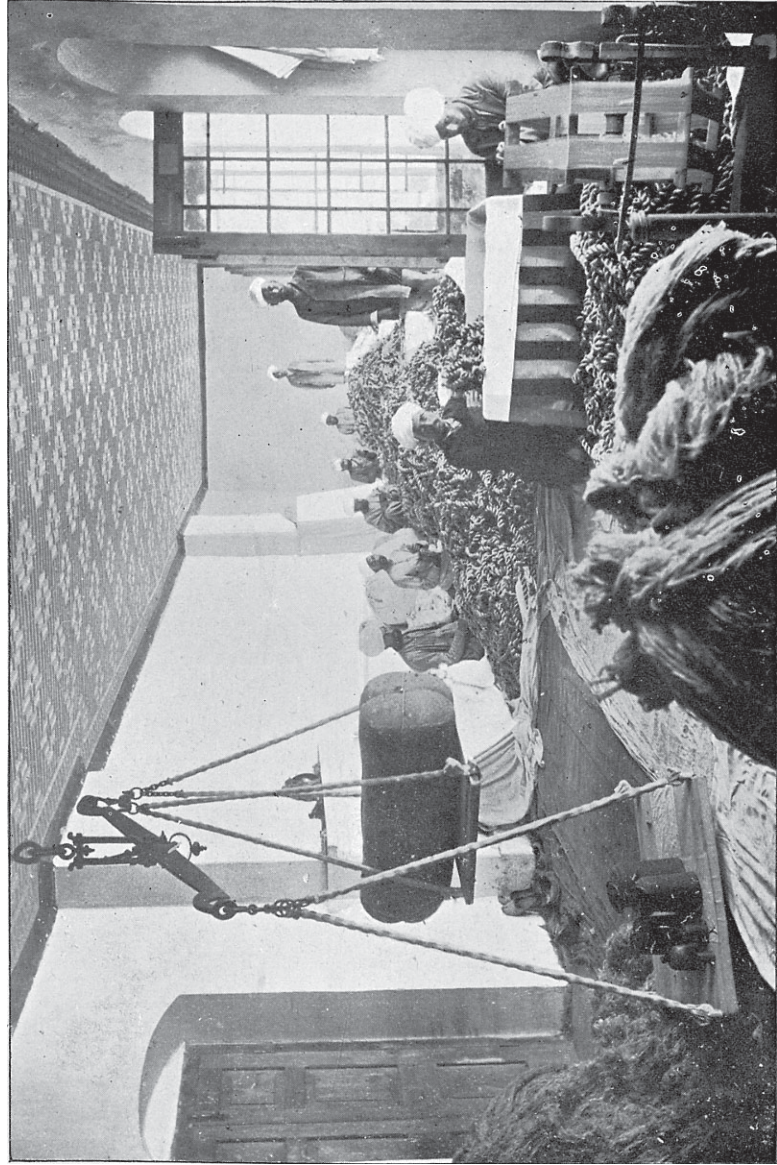
In 1898 the eggs I purchased in 1897 were distributed amongst 500 heads of families in the villages; increase has gone on each year until at the present time £4,000 worth of eggs are supplied to no less than 11,150 villagers; they occupy their families and relations to the extent of 44,600, whilst the number of reelers and turners has increased in the last five years from 80 to 3,300. This reads like a fairy tale; but it is accurate and true; thus making up a total of almost 50,000 people, old and young, in an industry, which, six years ago, did not exist.

PLATE 35.



View showing the ends of Six of the Ten Cocoon-Reeling Filatures at Srinagar.

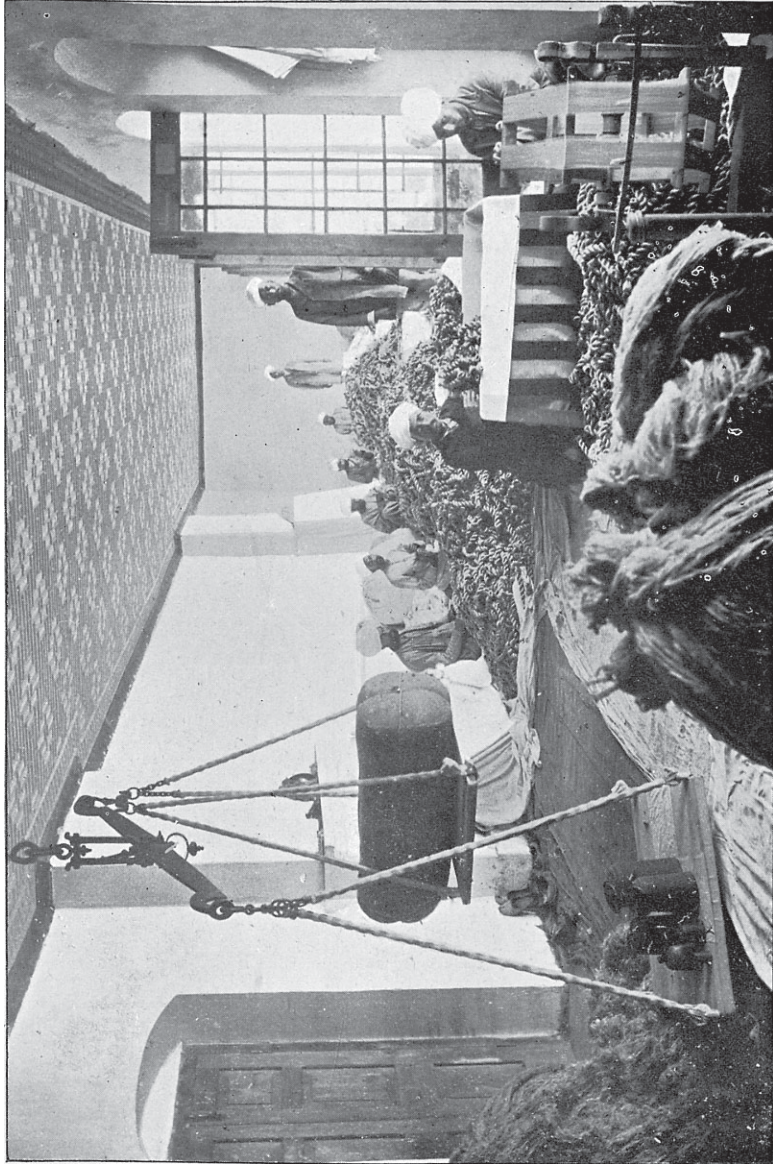
PLATE 36.



Baling Room of the Srinagar Filatures.



PLATE 37.



Two Hibernation Houses for Silk-worm Eggs.

The Chief Judge of Kashmir, Mr. Mukerji, and Dr. Mitra Rai Bahadur, State Medical Officer, told me yesterday that had it not been for the successful introduction of Sericulture, Srinagar would have been famine stricken, and that even now a very large number of people in the city are all but starving, and needing employment.

I have suggested a sister industry, that of silk weaving, which, by the exceedingly clever fingers of the Kashmiris, can, I feel sure, be successfully worked, and I have instructions from the Maharaja, his brother, and the Resident, to introduce it.

It has great possibilities, and may be as important in time as that of Sericulture.

But to return; I have driven through the length of this valley of wondrous beauty, about 80 miles, and 35 miles wide. It seems full of mulberry trees, and secures the home of an industry, which even after its present marvellous expansion is yet but the nucleus of an immense future development, if it can be retained and managed by the State, and so preserved from commercial rivalries.

My mission here has several aspects. First, to show the great advantage to the State to retain the industry and to keep it free from private enterprise and company promotion; second, to provide employment for a large population greatly in need of it and to help them to be fitted for it.

I have never seen a people so marvellously clever with their fingers as the Kashmiris. It is

a sight to go down the bassines in the filatures and see the beautiful way the men and boys can handle the fine threads of the cocoons, even those who have been engaged in it for a few weeks only. They do it with a readiness and skill which compare favourably with the south of Europe fileuses, who have gone through an apprenticeship to learn cocoon-reeling.

Thirdly, another object I am working for is to help to perfect the raw-silk, so that it may hold its own against that of Italy and France.

It nearly does that at present. Already improvements are progressing, and I hope when the mulberry cultivation is better attended to, to see my aims accomplished, and at no distant date, and that this industry, already very profitable to the State, will have a most prosperous future.

Fourth, to obtain a reliable balance-sheet; fifth to suggest silk weaving.

In a second letter, I will describe what I have seen of the geology, mountain sport, and natural history of Kashmir, from the ubiquitous sparrow to the imperial eagle and lordly barasingh.

I wish the weather were warmer; it is very cold and chilly.

Yours very truly,

THOMAS WARDLE.

## CHAPTER XX.

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KASHMIR MOUNTAIN ALTITUDES, GEOLOGY, FOSSILS  
AND ROCKS, ORNITHOLOGY, BIG-GAME SHOOTING,  
TEMPERATURES AND BAROMETRIC READINGS.

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THE second letter was written to the *Leek Times*, and in the following expanded form was read at a Meeting at Swainsley of the North Staffordshire Field Naturalists' Club, when the geological and natural history specimens, as well as my Srinagar purchases in silver work, embroidery, papier-maché and wood-carving were shown and explained.

*June 13, 1903.*

TO THE EDITOR OF THE LEEK TIMES.

Dear Sir.—I had not enough leisure to write my second letter during my stay in Kashmir, that in which I promised to describe something of the natural history of that most interesting part of the world.

I wrote it, however, at intervals during my voyage home, principally in the Red Sea, but I leave it to your discretion to insert it or not as you may think best, as it is unavoidably rather long.

The geology of Kashmir is a big subject, and I

will only deal with a small part of it, and that principally what I saw, over but a limited area of mountain and valley, and during brief opportunities of observation combined with sport in the Western Himalayan ranges at pretty high altitudes, commencing not far from the immense springs at Achábál, Bawan and Islamabad, which mainly form the sources of the River Jhelum, which flows through the entire valley of Kashmir, east to west, through Srinagar to Baramulla, a distance of some 75 miles, bounded all the way by snow-clad mountains, with extensive valleys and nullahs running up from the plains into the heart of the great ranges. The main Valley of Kashmir is eighty to ninety miles long and over thirty broad, with numerous lateral valleys called margas, with nullahs running up into the mountains many thousands of feet high, often ending in glaciers and avalanche accumulations of snow. The whole valley is completely encircled by snow-clad ranges, with very grand and rugged skylines, escaping glaciation by their great altitudes, too high to have been shaped by other than volcanic upheaval, and subsequent atmospheric erosion. The happy valley of Kashmir averages 6,000 feet above the sea and is only approached by Tongas, along a tortuous and dangerous road two hundred miles long from Rawal Pindi, the nearest railway station. From various parts of the valley may be seen the principal mountain heights: Skardu, 8,873 feet; Nanga Parbat, 26,629; Haramukh, 16,903; Gwash Bran, 17,800; Amarnath, 17,321; the Panjal range,

15,000; Kazi Nag, 12,125, Tutakutti, 15,524 feet, etc. (see plate 30). The geology of those parts of Kashmir which I had opportunities of examining I found to be very ancient. Much of it is very difficult to correlate with corresponding epochs on this side of the globe. Yet there are analogies which show such sequence as we are accustomed to find in Great Britain, although not in the same application. For example, if my classification of the fossils I found is correct, there can be no doubt of a corresponding carboniferous epoch, but with an extremely limited zone. I found no signs of coal, nor of any upper carboniferous rocks, but I saw very good developments of carboniferous limestone measures, with their characteristic fossils. Of shells of Brachiopoda I found in the Panducha limestones near Singpura, *Terebratula*, *Chonetes*, *Athyris*, *Streptorynchus*, *Spirifer triangulata*, *Producta*, in which *P. scabriculus* is prominent, *Orthoceras*, and numerous Polyzoan life-forms, *Polypora* and *Fenestella* being very interesting and well developed in the shale-beds. My visit to the famous and beautiful Liddar valley was too short to give me a thorough acquaintance with its geology, for I had only time to go up a few miles, but my friend Colonel Ward, whom I had the good fortune of joining in his camp, gave me a few pseudomorphs of fossil shells in sandstone rock which appear of older date than carboniferous. They resemble very closely those of the Caradoc grits and Wenlock shales of the Lower Silurian formation of

PLATE 30.



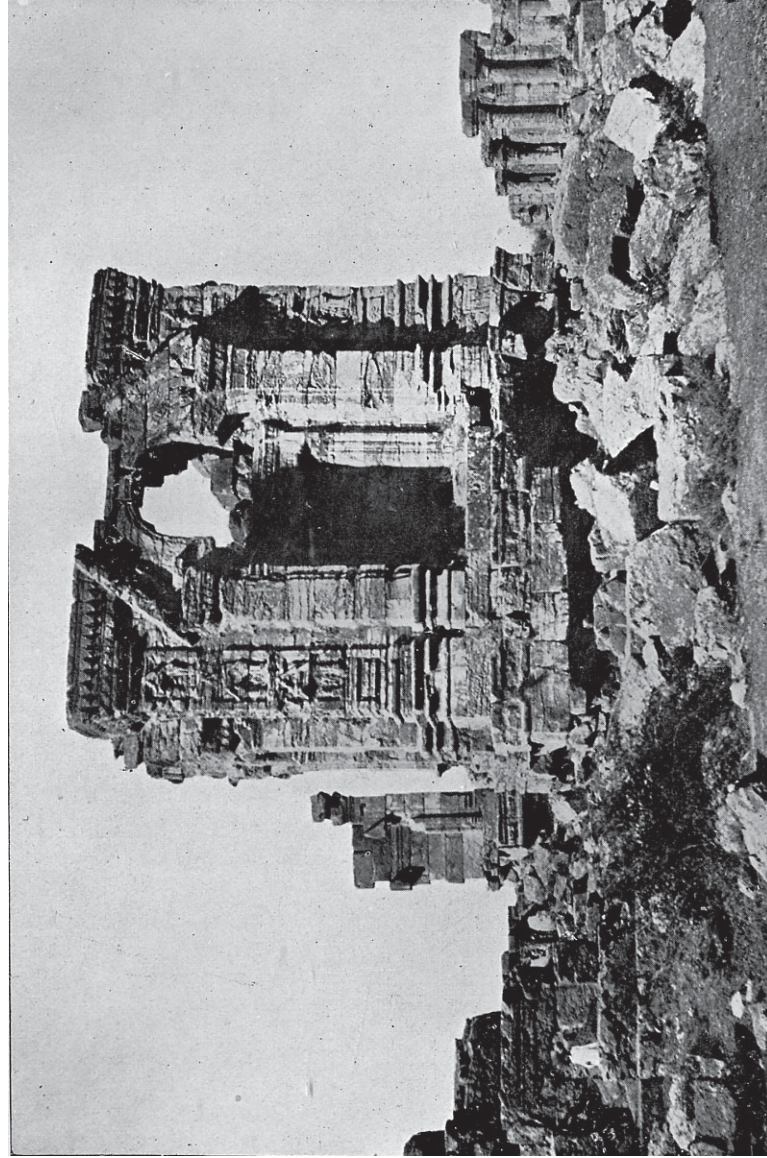
Looking from Rampore, view of Nanga Parbat, 26,629 feet and range.

England, both in the matrix in which they lie and in the appearance of the shells themselves.

I have written out a list of all the fossils I found. I think a few species may be considered new to English geology. I took them up to the Jermyn Street Museum and compared them with the collection there. A few of them were evidently divergencies from the typical and well-known forms, and the authorities of the museum hesitated to bestow specific names although the genus of each is sufficiently apparent. Although this is not a large collection it is I am sure of sufficient importance to interest our North Staffordshire Field Club members, some of whom I hope will be able to define or suggest new names for the species if known. A dark limestone abounds and forms the building stone of which the ancient Hindu temples of some 1,000 years ago were built; all now, sad to say, in ruins from frequent earthquakes, and still worse from the native vandalism in using their massive stones for subsequent buildings. I visited the celebrated Temple of Martand, near Islamabad, plate 31, and many others, and have brought photographs of the most interesting ones. It is a pity and a great loss to Kashmir archæology that these temples, once so fine in form, and with such characteristic details, should have been allowed to be so despoiled. Of unfossiliferous rocks I gathered specimens of schists and sandstones in various localities, notably at Srinagar; also granites, one a porphyritic greenstone, slaty and other metamorphic rocks of appar-



PLATE 31.



The Hindoo Temple of Martand, near Islamabad, Kashmir Valley.

ent Silurian age; but the slates were without well-developed cleavage planes. There occur here and there prominent cliffs of many-bedded whitish rock, possibly Triassic, or even Tertiary, conformable with the overlying limestone and Silurian rocks. In every case they were very much folded, and gave the mountain side a very picturesque appearance. I cannot at present suggest an English equivalent, and there possibly may be none. I could not detect any break of strata between this rock and the lower Silurian measures. I had no opportunity of deciding where to correlate very thick beds of red sandstone, they may be Permian, Triassic, or Devonian, so closely do these formations lie together, and seem to pass into each other. One is led to believe that the whole series of formations from the Trias to the Silurian are here represented, but without that stratigraphical sequence and the breaks characteristic of English geology. There are red sandstones both compact and friable intercalated with the oldest rocks; in some places looking like Trias and in other places like Devonian; I could not find any fossils to identify them by. There is a singular dearth of fossils in much of this strata in this part of Kashmir. Should the shells of the Liddar Valley I have mentioned turn out not to be Silurian, then I did not observe in any of the Silurian rocks, which are of great thickness, the least trace of a fossil. Much of the Silurian measures have undergone great changes by metamorphic action, which very probably has obliterated