

REPORT
ON AN INQUIRY INTO
The Silk Industry in India

BY
H. MAXWELL-LEFROY,
Imperial Silk Specialist and
E. C. ANSORGE, I.C.S.

VOLUME I

The Silk Industry
BY
H. MAXWELL-LEFROY.



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PREFACE.

The inquiry into the Silk Industry in India, of which the following pages are a report, was commenced in India on December 1st, 1915. In proposing this inquiry in the first place, the Government of India pointed out that the industry had for many years been steadily declining: the figures attached illustrate this (Appendix I) and the following abstract from these figures is more definite:—

India's trade.

Raw silk imports (net)	{ 1884-1900 average	. 2,000,000 lbs.	
	{ 1909-1914	.. 2,500,000 "	
Raw silk exports, Indian	{ 1884-1900	.. 1,706,000 "	(Kashmir 0)
	{ 1909-1914	.. 1,712,000 lbs.	(Kashmir 300,000 lbs.)
Silk manufactures imports (net)	{ 1884-1900	.. £ 900,000	
	{ 1909-1914	.. " 1,800,000	
Silk manufactures exports	{ 1884-1900	.. " 135,000	
	{ 1909-1914	.. " 49,000	

Raw silk imports—increase of 25 per cent.

„ „ exports—steady. Deduct Kashmir and there is 17 per cent decline.

Manufactures imports—Increase of 100 per cent.

„ exports—Decrease of 64 per cent.

Imports—Analysis of.

		£	
Silk piece goods	{ 1884-1900 average	.. 675,000	
	{ 1909-1914	.. 1,172,000	
Silk and cotton, etc., mixed	{ 1884-1900	.. 171,000	
	{ 1909-1914	.. 340,000	
Yarn, warps, noils, etc.	{ 1884-1900	.. 66,000	
	{ 1909-1914	.. 286,000	

Increases are:—Silk cloth 74 per cent.

Mixed cloth 100 per cent.

Yarn, etc. 333 per cent.

This decline was attributed to these causes: extension of the industry in Japan—inferior breeds of worms—disease—defective reeling—use of substitutes for silk—ignorance—dirt—want of organisation—introduction of more profitable crops. If these causes could be removed and the industry placed on a sound footing, “very substantial benefits both agricultural and industrial would result.”

2. Attempts had been made spasmodically to revive the industry, with no results save in Kashmir and Mysore: and it was certain that unless more was done, the position of India as a silk exporting country would be lost. After reviewing possible courses, it was pointed out that it was insufficient to rely on provincial efforts alone: “the revival throughout India of an industry which was formerly in a flourishing condition is a matter of more than merely local importance”: but before embarking on any scheme, it was necessary to have a comprehensive and scientific examination of the subject; the problem is not only sericultural but industrial: “the whole industry in its various stages must be brought into touch with modern methods, if it is to be developed on right lines”: the value of co-operative credit development needed to be examined: and the result of the inquiry might well be that the industry could not be saved, or that it had been replaced by more profitable industries, its extinction being then a matter that need cause no concern.

3. The above summarises and quotes from the despatch from the Government of India proposing this inquiry and the report below is the result of the inquiry now concluded.

4. In commencing the inquiry, it was proposed to include an investigation of the industry in Japan and China : and it was found that it was desirable to provide separately for an inquiry into the trade, with reference specially to statistics; accordingly Mr. E. C. Anson, I.C.S., was placed on special duty and toured with the Silk Specialist in Bombay, the Punjab and Mysore : at this point, the services of the Silk Specialist were required in Mesopotamia : Mr. Anson continued his inquiry and his report deals with the trade in the Punjab, Bombay and Madras, and in India generally : it was unfortunately impossible to depute him for a sufficient time to complete his inquiry in Burma : his deputation ended in June and shortly after the Silk Specialist returned from military duty. The inquiry in Japan and China had to be abandoned and this leaves the investigation to some extent incomplete.

5. The inquiry has been pursued in all parts of British India, in Mysore, Kashmir, Travancore, Indore, Gwalior and many Native States. It is impossible to enumerate the great number of persons, official and non-official, to whom the authors of this report are deeply indebted for assistance and for the supply of information : the co-operation of members of the Chambers of Commerce has been of very great value : Messrs. Anderson, Wright & Co. in Calcutta, have been closely associated with the inquiry in Bengal : and the investigation has been made easy and pleasant by the cordial assistance rendered by all who were approached for information.

CHAPTER I.—INTRODUCTION.

1. The following pages contain an account of an investigation of the Indian Silk Industry made with a view to ascertaining whether and in what way the industry could be assisted. In deciding that this inquiry should be undertaken, it was proposed to examine the conditions of the existing industry, to weigh the success achieved by existing efforts, to examine the factors of success in other countries and to determine how far other more profitable industries have replaced silk. On the results of this inquiry it should be possible to decide (1) if any revival was desirable or possible, (2) the factors of a successful revival, (3) the value of an extension of existing efforts and (4) the broad lines of profitable development.

2. The inquiry has throughout had as its object "Can Sericulture and the Silk Industry be Revived and How." Its object was not to obtain an exhaustive account of the existing industry but rather to examine the industry with a view to improvement: this report contains so much descriptive matter as will explain the conclusions reached as to the development but no more; the industry has been exhaustively examined but not described more than to deal with the salient features emerging from the inquiry. Partly owing to the condition of the existing industry, partly owing to an interruption of over two months caused by the war, the inquiry into the factors of success in other countries was not dealt with and the visit to Indo-China and Japan was omitted.

3. The total values of the silk products, imported, made and produced in India are larger than is generally known and the total values amount to about ten crores (£7,000,000). The full figures are discussed in Volume II of this Report: the total value of the raw silk produced is about 177 lakhs, waste silk 8 lakhs: there is an export of 29 lakhs worth of raw silk, leaving raw silk to be manufactured into cloth worth about 294 lakhs: there is an import of raw silk which when turned into cloth comes to about 290 lakhs: there is an import of manufactured goods of a value of 318 lakhs: adding to this the estimated total value of the Assam industry (31 lakhs), gives a total of 962 lakhs, as the value of the silk goods used in India and the exports: this omits small items such as spun silk, the export of manufactured silk and some parts of the transfrontier trade.

4. The Indian Silk Industry affects or recently affected more or less directly nearly a million persons, of whom 335,000 add to their living by rearing silkworms; these are the mulberry silk rearers of Mysore (70,000), of Bengal (43,000), of Kashmir (80,000), of Burma (1,500), of Assam (4,000), of the Punjab (400), of Madras (30,000), the tasar rearers of Chota Nagpur and Orissa (65,000), of the Central Provinces (6,000), of Bengal (5,000), of the United Provinces (2,000), the rearers of muga and eri in Assam (35,000): it provides occupation directly and mainly for 350,000 persons who are reelers of mulberry silk in Mysore, Bengal, Kashmir, Assam, Burma, Punjab, Madras, reelers of tasar in Bengal, Central Provinces and Bihar and Orissa, twistors and preparers in Madras, Bombay, Bengal, Central Provinces, Punjab, United Provinces, Burma and Mysore, dyers chiefly in Madras, Bombay, Bengal and the Punjab, weavers of mulberry silk in Madras, Bombay, Bengal, Central Provinces, Punjab, United Provinces and Burma, weavers of tasar in Bengal, Central Provinces, Bihar and Orissa; the recorded census totals for these are Madras, 75,000, Bengal 49,000, Bombay 44,000, Central Provinces 19,000, Burma 19,000, United Provinces 16,000, Punjab 14,000, Bihar and Orissa 8,000, Kashmir 6,000, Mysore 2,500, Assam 1,700 (should be more). These figures should be very much larger; tasar is estimated to employ 170,000 persons; but the whole census totals of silk twistors and weavers for all silk in Central Provinces are much less than the number who work tasar only; the census figures usually may be taken to relate to men and not to include the family; probably three times as many persons are employed as are recorded. This takes no account of the dealers in cocoons and raw

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silk, the exporters of cocoons and raw silk, the dealers in tasar cocoons, tasar yarns and tasar waste, and the dealers in eri and muga cocoons, and yarns; there are also the dealers in cloths of all sorts, and the importers who handle the very large import trade in Chinese and Japanese raw silk, spun silk, and cloth. There is no means of estimating these as no census returns distinguish dealers in silk from dealers in any other produce: but it may safely be said that it directly affects probably another 200,000 persons, bringing the total to over 900,000 persons.

5. This bald statement does not convey any idea of the number of people engaged between the feeding of the worms and the selling of the silk: there is first the grower of mulberry, the leaf-plucker or collector: the leaf is fed to the worms indoors if it is mulberry or eri; the worms have to be tended on the trees if it is tasar or muga: in Mysore, a class of rearer is found who only prepares and hatches eggs, in Bengal there is the selected rearer who does microscopic examination of moths: in Mysore too another subdivision is found in the chandraki hirer, who hires the trays on which the worms spin: in the jungle is the tasar cocoon collector, a large and numerous class of cowherds or forest people, who collect and bring in cocoons: next is the dealer, the paikar in Bengal who collects cocoons for reelers, the *mahajan* in Bihar and Orissa who deals in cocoons, before or after him is the person who stifles the cocoons to prevent the emergence of the moths. In Kashmir there is the cocoon sorter who classes them into qualities, there is then the reeler, who reels the mulberry cocoons with the aid of the winder (usually a child or old man) or who reels off the tasar or muga cocoons by a very primitive process, this being usually done by women; in the filatures is the chassam-maker, who takes the waste and the old cocoons and prepares clean waste silk for export; there is then the spinner, who makes yarn of waste mulberry, or of the eri cocoon, of waste tasar or waste muga; there is also the cocoon exporter, who buys, kills, dries and exports cocoons, either mulberry, eri or tasar; there is the exporter or dealer in reeled mulberry silk, and in waste mulberry and tasar, in which there is a very big trade; if the locality uses imported silk there is the raw silk importer in Bombay, his agent in the city and the dealers in the bazar.

6. You now come to the large class, included in "Silk spinners and weavers," who do all the multifarious operations between the raw silk or yarn and the finished cloth. The first of these is the winder or sorter, who takes the yarn, opens it up and winds it off, testing it as he does so and if necessary sorting it into qualities; the thread is then run off on to spindles or baby-reels, and the twister takes it, to put twist into the single thread; it is again run off the reel on to spindles, two or more threads together and the two threads twisted again; from the twister, who is a very specialised class, the dyer takes it, boiling it off and then dyeing it; the winder or sorter then takes it and runs off the tangled skein on to a reel and from the reel to the warper's bobbins, the weaver now takes it if it is to be a simple fabric, stretches the warp, sizes and brushes it; if it is to form part of a brocade or elaborate sari, the designer, the pattern pricker, the loom setter will handle it and prepare the thread in the loom; some will be handled by the gold thread drawer and winder, who prepares the fine flat gold ribbon and lays it in a spiral on the silk thread to form the gold thread for the pattern; if the fabric is simple, the warp is drawn in to the healds and reed of the loom, usually by the weaver's women-folk, who also fill the little quills that go into the shuttle; the actual weaver then commences, and if the fabric is a complex one, there will be with him the little boy who pulls the loops on the heald strings for the pattern and possibly the two embroiderers or border weavers who sit beside him and either put in the pattern with little bobbins or weave the border with extra shuttles. The fabric now passes to the finisher, who picks out broken threads, etc., and to the polisher who puts a finish on the fabric with his conch or smooth stone. At stages in this long procession, the dealer and broker (*dalal*) comes in and finally takes the finished fabric; in some cases (but seldom) there enters the last technical person, the cloth examiner who stamps the cloth to show that it is fast dyed.

The following is the approximate series :—

Mulberry grower.	
Egg producer and hatcher (Mysore), Moth examiner (Bengal).	
Rearer—mulberry and eri indoors.	
Rearer—tasar and muga on trees.	
Chandraki hirer (Mysore), maker (Bengal).	
Tasar collector.	
Cocoon dealer or broker.	
Cocoon exporter, mulberry or eri.	
Waste exporter, mulberry or tasar.	
Cocoon stifler.	
Cocoon sorter.	
Reeler, mulberry, tasar, muga.	
Reel turner—mulberry and muga.	
Spinner—eri, mulberry waste, tasar waste.	
Raw silk importer.	
Raw silk dealer.	
Chassam maker.	
Sorter and winder.	
Spindle reeler.	
Single twister.	
Spindle reeler.	
Doubler, two or more threads.	
Doubles twister.	
Boiler-off.	
Dyer.	
Reel winder.	
Bobbin winder.	
Warper.	
Sizer, polisher, brusher.	
Loom setter.	
Warp drawer-in.	
Quill winder.	Pattern pricker.
Weaver.	Gold thread drawer.
Looper (Draw boy).	Gold thread winder.
Border weaver.	Loom maker.
Embroiderer.	Heald maker.
Finisher.	Reed maker.
Polisher.	Cloth dealer.
Stamper.	Cloth importer.
Designer.	Cloth hawker.

This series fall into two classes, the rearers and cocoon producers who are concerned only with the raw material, the twisters, weavers, traders, who are concerned with the preparation and the finished product.

7. The rearers are to be found in distinct areas, the conditions of which are fully discussed below and it is possible to deal with them as units. There is then the question of adding to these by the creation of new producing districts where sericulture is to be introduced. This is a complex problem, and the lesson of the past is an extremely valuable one. (It is that with persuasion and pressure, sericulture can be established and will persist while that personal influence is exerted; and then it dies out. There is no doubt whatever that with persuasion and personal influence sericulture could be started at once in many parts of India, the extent depending exactly on the amount of influence and the thoroughness of the organisation; but it does not seem reasonable to do this unless there is clear evidence that the industry is needed and will improve the people's circumstances. There is no special virtue in sericulture; one does not acquire merit through it; it has to be compared as an industry with the growing of wheat, cotton, cane, jute, rice or any other staple; and it is pathetic to consider the efforts to establish sericulture in places where it never would establish itself.) At the same time

it is equally depressing to see the efforts which would have succeeded had any sort of expert advice been available; and the wise policy with regard to silk, in the light of the past, is to find the areas where silk is needed, and then to develop it wisely on exactly the right lines.

8. Following the rearer and cocoon producer, this long series of skilled operators are concerned in the industry, which is in the main a complex and much divided cottage industry, practised in their houses and but little concerned with factories; there are silk mills at Bombay and Calcutta, there are hand-loom factories where all the operations of handling the thread are done by one set of people under the same roof; there are filatures where the silk is reeled and where large numbers of people work together in one building; but these are concerned with only a small part of the industry and in the main, from start to finish, all these workers earn their living in their own houses, with simple primitive appliances, and often by ways which are very tedious and slow. To see the industry one must go to the bazars and to the villages, one will not be able to get a picture of it by a visit to a mill; all these complex operations are conducted in the bazars, perhaps in the weavers' quarters, perhaps in no special part; one will find houses where one operation is done, houses where a second operation is done and specialised workers living together, the work of all interdependent, each doing his own specialised portion; it is an exceedingly complex industry, not at all easy to investigate or to understand, and the failure of the supply of cocoons or silk at one end or the lack of demand for cloth at the other will affect the livelihood of the whole series, slowly but quite definitely, and to a degree which is not at all easy to ascertain.

9. Owing to its being essentially a home industry, practised by a large number of scattered people, and not in any way an organised industry, the workers in it are a class that are very liable to be forgotten. The industry attracts little attention collectively. In the main its products are consumed in the country and the large commercial centres know little of it and are not affected by its fluctuations. English capital is not invested in it, large fortunes are not made in it, a large proportion of the population are not engaged in it in any definite area. The industry has no representatives on Chambers of Commerce or on Provincial Councils and to learn about it or to improve it, one has to penetrate the villages and the weaver's quarter, to go to the jungles of Assam, where cocoons are grown or to the small shopkeeper and travelling box-wallah, who deals in the finished product.

10. The industry has suffered because it is a scattered one and because it has not been realised how much it is a cottage industry. There has been very little effort at improvement from within. There has been little from the Government because it is so inconspicuous, so out of the path of the official and so little represented. Even in the district, the silk worker is not evident, he contributes little to the revenue, he practises a minor and uninteresting handicraft. The Reports on Indian Trade draw attention to the decline: the European firms in Bengal make a fuss and the methods proposed are those that may suit other industries (*e.g.*, the Weaving School and the Institute) but are not fitted to this elusive and diffused industry. The man who wants help lives in a small village, away from headquarters or in a quarter of a large town, to which no official ever goes.

The whole industry is a scattered home or cottage industry and in these days such are apt to be forgotten, since prosperity is supposed to come with the mill.

11. In one respect the Indian silk industry has been fortunate in that the mill development has never been much. There are now only three mills which handle silk and they affect chiefly the Burma market. The silk weaver, working in his own house, under pleasant conditions, with his family to help with minor operations, still continues. I take the definite point of view that it is better that he should continue and it would be a calamity of no mean kind if the silk weaver went the same way as the cotton weaver. Quite distinctly I would aid the home weaver against the employé in the mill where both were Indian, and taking the wider view of the happiness, health and

prosperity of the worker, the tendency to replace home industries by mill industries appears to me to be utterly disastrous.

12. It is a feature of every branch of the Indian silk industry that the organised co-operation of the workers is absent and that the workers have not the capital, the organisation, the means of getting raw material on a large scale, which the mills have; it is unfortunately another feature that any measure of co-operation to mutual advantage is excessively rare, and still more unfortunate is the almost universal fact that the Indian workers distrust each other, that the employer grinds the workman, that the dealer cheats the producer, and that there is a deplorable amount of sweating and cheating. This tends to put the worker gradually into the hands of the dealer or the money-lender, and the spirit of co-operation, the spirit of fair dealing, which would help all in the struggle, is very largely absent. When one finds such cases of mutual co-operation as the Nagpur instance of the piece stamper, it is so rare that one has difficulty in crediting it; and the general tendency is for the sweated worker to be hostile to his employer and where he can to leave him in the lurch.

13. Another factor that influences silk throughout India is the worker's want of capital. The reeler could buy cocoons when they were cheap, store them and reel at leisure if he had the funds; the tasar spinner would buy his stock of cocoons in the season and spin all the year, the weaver could store his cloths till the marriage season and then sell at full price instead of having to sell at a small price in the off season; then the *mahajan* or *bania* comes in with the capital, he is himself wholly unproductive and frequently sweats the weaver or the reeler or the cocoon producer, by advancing the materials and paying little for the work or by buying in the off season and selling when demand is good. He takes risks of course and is entitled to consideration; but it is often true that the state of an industry depends very much on the temper and attitude of the local *mahajans*, and that while they can sweat the craftsmen, the latter cannot sweat them; so that the abuse if there is any must be on the side of the man with the money.

14. The Indian industry is characterised by another feature, which tends to its decline; acting on the Get Rich Quick principle the dealer, who employs weavers, cuts down wages, cuts down material, cuts down quality; the weaver must make the allotted amount quickly, works badly, makes poor stuff: but it is cheap and sells well for a time: the dealer makes a large profit, but the craft loses its quality, demand lessens, the industry declines, it presently dies out. It is a feature not in silk alone, but in many industries, in which the maintenance of a standard of quality is essential to the maintenance of reputation and demand.

15. It is unfortunately true that in many branches of the silk industry, the commencement of depression has been the signal for sweating and bad dealing, which accentuates the local distress immediately and gives the craftsmen the least possible chance of holding their own in the struggle. In every case where weaving or twisting is slack, one would like to know what the local money-lenders, dealers and brokers were doing, and if one knew, one would be able often to see why things were so bad. As a class these people are too prosperous; when trade is good they flourish abundantly; when it is bad they hold to what they have and do little to help the craftsmen win through the period of depression.

16. I write generally of all India, but there are splendid instances of co-operation and of mutual help from employers to workers, which have enabled both classes to keep going. The year after war was declared was a bad one all over India and some communities came through the depression very well.

The matter is referred to here in a general way because it is one of such immense interest if one is to understand the industry. It is the factor to estimate if one is trying to size up the situation and it has to be considered in every single place where any branch of the industry exists. When the circumstances of the industry come to be looked into in detail, the scope of co-operation will be found to be immense; but no broad general measure will do. It will be by personal inquiry in each community that this form of help will

be brought and one can now only indicate the importance generally of this point.

17. There is a tendency in India among the weavers and craftsmen to make improvement difficult by their wanting too much. It is easily understood if one realises the attitude of the worker, ground down continually by pressure of circumstances and want of capital, and suddenly offered work at reasonable terms without restriction or usury; he jumps to the opposite extreme, wants to make too much and spoils his own market. He is not used to fair treatment and when he gets it, cannot help abusing it, having all his life been resentful of the terms on which he had to work and having always looked for chances of evading it or of retaliating. I think too he is, by generations of struggle, suspicious and especially so of what looks like a good offer. It is too good and he suspects a trap. If he did not and if he realised it was serious business, he would meet one half-way; but he cannot and this has to be allowed for. I think this can be met and will be overcome, but it is a difficulty and I quote it in the hope of illustrating how much will depend on understanding the attitude of the weaver and rearer. To me that is the key to the whole question.

18. In another way the Indian industry is hampered by the total absence of any feeling of patriotism, or of preference for articles of Indian manufacture. In any of the largest silk weaving centres you will find dealers selling Japan, China or Europe made silk while goods of practically the same quality could be and often are made in India. The same applies to raw silk and there is a really remarkable absence of any spirit of patriotism in the dealers and those who handle the products. They would sooner sell the Japanese goods brought to them by an energetic Bombay firm than deal in Indian goods; and the buyer cares not one whit where the cloth was produced but takes what the dealer has.

19. A factor in the position is the relative efficiency of the craftsman in India as regards his competitor elsewhere. India is not an efficient country, it is content with untidiness, disorder, slovenliness and a general inefficiency that is a marked characteristic; there is little finish, little of the energy that is worried by seeing things done anyhow and wants them done right. This applies too in selling methods. Cloth is not washed after weaving, is sold as it is, and is not finished, polished or attractively packed. It is in odd lengths, odd widths, it is unevenly woven, shrinks unevenly. There is immense patience, great skill in carrying out delicate operations and in repeating monotonously motions that require precision. There is not very much artistic ability or skill in designing. There is immense conservatism and the weaver is satisfied with an extremely slow inefficient system of doing any operation if it is one that he has always seen done. This will be hard to change and if it is not changed it is unlikely he will hold his own.

20. A factor in India, whose importance is not always realised, is the diversity of the peoples and of the conditions under which they live. India is talked about as if it were a homogeneous people, all speaking one tongue and living under the same climate; one thinks that if sericulture is successful in one place a knowledge of it will filter through to all and that the methods good in one place apply all over India. This is of course not so. The conditions, the people, the climate vary very much and often in the limits of one area, one has to deal with extreme diversity of custom. This makes any process of organisation exceptionally difficult and it is of course often a fact that religious observance or public opinion make the development of sericulture impossible. Even if one set of people can and do practise it successfully, it does not follow that men of any other religion or caste will learn from them and follow suit.

21. The want of co-operation and of enterprise applies still more to any attempt to trade outside India. The export of cloth, raw silk and cocoons has been in the hands of European firms. There is no real reason why the place of the firms who have abandoned the filatures in Bengal should not be taken by native firms. But this is not done and there is a great absence of the kind of organisation that is necessary if any export trade is to be possible. This is partly due to the fact that, as a broad principle, Indians do not invest

capital in such industries as silk; the result is a vast number of isolated unco-ordinated workers, trusting to local markets, waiting for the orders to come to them and not knowing how to organise, co-operate or seek wider fields. Where there is any kind of organised effort it is practically always associated with a European firm, and until the Indian learns to deal fairly, to keep his word, to be content with reasonable profit, to have enterprise and to risk his capital, the outlook for export is not a very good one.

22. I deal in Chapter XXVII with the details of what I call Trade Organisation. In these pages I am trying to give a picture of the main features only and this aspect of the whole industry is a very important one. It largely explains why the Japanese sell their cloths in India, why China raw silk sells in Assam in the same villages that produce silk. It accounts for the failure of India to supply any part of the world's markets with the raw silk or cloth that she formerly exported; and if a change cannot be produced, the Indian industry must gradually die. Whether it is possible to alter this state of things is to be seen. (My experience is that it is possible but that it will be possible only by an organisation that is backed by Government, that succeeds in getting the confidence of the trade and that always and absolutely keeps to the strict letter of the bargain.) No one appreciates this more quickly than the Indian rearer, reeler or weaver, no one responds more loyally or quickly; but dealings with their own people are in their minds associated with fraud while dealings with English firms are regarded as reliable and safe. For the start it will require a Government organisation, and this organisation will not be at all easy to create. It is for this reason that so much attention has been paid to the section on the Development of the Silk Industry. The one outstanding factor in all centres where silk is utilised is the want of organisation, the limited outlook, the want of knowledge of what is being done elsewhere and what is in demand. If it were possible, one would inaugurate a Silk Association but at present it is difficult to see how this would be effective. So far as co-operation is required in the limits of a province there has been a beginning made but the silk industry does not follow political divisions and something wider is surely needed.

23. The situation may be very shortly expressed by saying that whereas India is still a primitive country whose industries are organised mainly to supply local demand, other competing countries have developed with the development of communications, of methods, of trade organisation. When communications were slow and international trade was less, the Indian silk industry supplied India's demands and prospered; but now other countries have developed, India has stood still, and this is especially so in regard to trade organisation. The question is whether India is to remain primitive or is to develop and whether this is to await natural internal development or to be pushed in from outside. So far as silk goes, waiting is probably suicide; but the alternative is no easy or pleasant one.

24. For these reasons this report deals with sericulture from the two aspects, the production of silk, the utilisation of silk; it is impossible to consider one without the other. At the same time the problems involved are different. The production of silk from silk-worms is a matter that depends so much on climate, agricultural factors, and economic factors, that every part of India has to be separately considered. The utilisation of silk is not a matter of climate but the factors are much the same over all India. We can therefore treat the latter from a much more generalised point of view, applicable to nearly all India irrespective of geographical position. The first portion of the report then deals with the production of silk, the second deals with its utilisation in the larger administrative units of India, the third deals with the trade, the fourth details the recommendations made for all India, the organisation that is considered necessary, the methods that should be used. An attempt is made to show what the existing industry is, what it might be, how each administrative unit can make it bigger; and finally what the inter-provincial requirements are.

25. An industry that is very much a home cottage industry requires very careful handling and I cannot pretend that in this inquiry I have done as

much inquiry among the actual workers as I should have liked. It is impossible to deal with the silk industry from the average or the statistical point of view entirely. One must be able to get at the workers, to know what they are doing, how they live and judge as well as one can how to better their condition, but it is impossible to bring up statistics and detailed figures to support an opinion. In Pusa, silk of all sorts was produced, spun, woven and sold in order to give an experience of actual conditions; that knowledge imperfect as it is, has been used as much as possible and an attempt has been made to understand the silk worker's condition and difficulties. This brings one to the conclusion that if anything will be done to better the silk industry, it will be largely by detailed improvements which cannot be laid down now for each or any area, but which will need to be found. But the inquiry brings out prominently the need for expert advice, the necessity of some form of commercial organisation and the possibilities that there are if these two are sympathetically brought to the Indian silk industry. What the improvement in the industry can amount to cannot be estimated; it might be small, it might be considerable. At the best it improves the condition of a million workers and traders, at the worst the industry quietly diminishes to the point at which the foreigner does not find it worth while to compete because of the smallness of the trade; and in this case half a million craftsmen will gradually turn over to other occupations which are better paid.

In conclusion, I would quote Mr. Cumming, in reference to the silk industry in Bengal:—

“ I may place on record here that my enquiries have shown that in this province what the capitalists, who are anxious to embark on industrial enterprise, most desire is disinterested advice, and this can best be obtained from a Government officer who possesses a scientific training, direct experience of the country, enthusiasm and business capacity and the primary object of whose appointment is to advise and assist such capitalists in industrial enterprise. * * * I hold strongly that one practical enthusiast who would inspire confidence is more required at this present juncture than any departmental scheme, in order to break down the dead wall of want of enterprise, absence of mutual trust and lack of business capacity, which are the real obstacle to indigenous industrial development in the province.” (Extract from Report on Technical and Industrial Instruction in Bengal, 1888-1908.)

26. I think this is the only conclusion one can come to for all parts of the industry except the production of cocoons, not only in Bengal but all over India. Large administrative measures will effect very little. The routine provision of experiment stations or trained persons will do nothing. A mere consulting bureau will help if it gives accurate information. A higher tariff on imported silk goods would do some good. The training of many men in sericulture or weaving will do nothing. The despatch to Japan of Bengali graduates will do nothing and improvement depends very largely upon the success in reaching the individual workers, in bringing knowledge and organisation to their help and in applying this sympathetically over the whole industry. It is an unfortunate conclusion to have to come to that on the quality and attitude of the administration will lie the success or failure of the improvement of the industry.

An organisation in which routine efficiency is insufficient and certain personal qualities are a necessity is not ever going to be a permanent success in India, and this limitation cuts down the possible lines of work to those in which efficiency of routine administration is fairly certain to achieve some improvement.

The recommendations made are based upon that and are limited to the provision of actual expert advice, the provision of seed and plant for silk cultivation, the provision of a bureau of technical information. It is suggested that an effort be made in one area to test the value of commercial organisation and that if this succeeds, it should be extended. This seems to me the most difficult and the one least easy to show results in. At the same time it is the most important and the one which would give the best results.

PART I.—THE EXISTING PRODUCTION OF SILK.

CHAPTER II.—BENGAL.

(a) HISTORICAL.

The early history of silk in Bengal is to be found in Pariset *Histoire de la Soie*, in Geoghegan's *Silk in India* (1872), in Watt's *Dictionary of Economic Products* and in Rondot's *L'Art de la Soie "Les Soies"* (1884). The East India Company were interested in silk and exported raw silk to England. Interesting details are given in "Reports and Documents connected with the Proceedings of the East India Company, Cotton, Wool, Raw silk and Indigo" (21st December 1836), and figures of the export of raw silk are reprinted as Appendix II. From the middle of the 18th century the Company dealt in raw silk, sometimes purchasing the raw silk from native reelers, but after 1775 purchasing cocoons which were reeled in factories established by the Company. The principal defect in the native-reeled silk was its inequality in the same skein and as early as 1757, the Company sent Mr. Wilding to their factory at Cossimbazar to inquire into means of improving this; there were also great variations in the yields and qualities of the different cocoons and *bunds* (broods).

2. In 1771, the China worm was introduced with a view to improving the quality of the cocoon. There was already the boro-polo or univoltine worm (said to have been introduced before 1710), the desi or chota-polo, and probably the Nistari or Madrassi, both multivoltine. The China worm introduced may be the variety still known in Midnapur, the white variety of which is called *bulu*, while the three others are the main varieties grown at present. It is probable that no improvement was effected by introducing the China variety and the Nistari is now the best.

3. Between 1770 and 1775, the Italian method of reeling was introduced in the Company's factories and there was a great improvement in the quality. At this time the Company imported yearly an amount of silk fixed by the Directors in England, which was arranged for in the factories and was reeled there to fixed qualities on fixed scales of payment.

4. From 1776-1785, the import of Bengal silk to England averaged 560,285 lbs., while that from Italy, Turkey and other countries averaged 282,304 lbs.; in 1796, the Company's silk, when thrown into organzine, succeeded so well that the importation was increased to 4,000 bales (656,000 lbs.). Thereafter the disturbance to trade caused by the French Revolution and the Napoleonic wars led to the cessation of the import of European silk to England and to the importation of Bengal country-reeled silk to supplement the Company's supply. In 1812, 5,500 bales were imported by the Company and from time to time, as private trading in silk by the Company's officials was allowed, large quantities of country-reeled silk were exported from Bengal privately, see Appendix II. From 1820 to 1830, the question of throwing Bengal silk in England and the question of tariffs against continental thrown silk affected the import, and in 1832 the Company threw open the trade and ceased to import directly from its own factories.

5. It is worth noting that the Italian mulberry plant and silk-worm were imported to Bombay *via* St. Helena in 1832, and that the plant was sent over to Bengal, where it is now probably the bush variety known as the "Bombay."

6. Little is known of the silk industry from then onwards for a series of years. It may be noted that pebrine broke out in Europe and was definitely recognised in 1845-46 and between 1855 and 1865 was at its height: that it led to the almost complete ruin of the European industry to the advantage of the Indian industry, as the export figures show: and that the complete failure of European stocks of seed led to the demand for seed from all parts of the world, which was filled mainly by the enterprise of Japan, where the disease was unknown; immense quantities of seed were produced in Japan from 1865 to 1875, were exported to Europe and led to the regeneration of the European

production. It led also to an enormously increased production in Japan, to the production of better qualities in Europe, the Levant and Persia and in 1873 the demand for Bengal silk began to fall. (See Appendix II for figures.)

7. From this point one may say that the demand for Bengal silk was for special purposes only and that other silks took its place in the trade generally. These special purposes are connected with the lustre, that is a property of Bengal silk, and its faculty for dyeing black: it is deficient in tenacity, elasticity, durability: it is less able to dye light colours: and from the time that increasing supplies of better reeled and better quality silks became available, the demand for Bengal silk has lessened. The production of Japan has increased enormously from 1872 onwards till at present Japan is the leading producer of raw silk in the world. So far as figures make this clear, they are to be found in Appendix II.

8. From 1872 onwards, the production of Bengal silk has decreased and the area under mulberry now is much less than it was formerly. To understand how, if at all, the mulberry silk industry is to revive, it is necessary to endeavour to understand the factors that have brought this about. The first factor is clearly that of price. The following figures show the actual prices obtained for raw silk from 1855 to 1886, as contained in a letter from a prominent Calcutta firm to the Government of Bengal: they show the very great rise in price about 1865, when the pebrine was at its worst, and the drop in 1872, when the Japanese seed supply had righted matters.

Average price per seer of Bengal raw silk sold. (Figures in a letter from Jardine Skinner & Co., to Government of Bengal.)

Season.	Price.	Season.	Price.
	Rs. A. P.		Rs. A. P.
1855-56	22 15 0	1871-72	23 10 7
1856-57	20 4 11	1872-73	18 2 8
1857-58	19 8 9	1873-74	15 9 4
1858-59	21 1 9	1874-75	12 8 4
1859-60	20 13 0	1875-76	16 4 4
1860-61	18 1 11	1876-77	20 2 3
1861-62	18 15 11	1877-78	14 8 9
1862-63	18 3 9	1878-79	16 1 0
1863-64	16 9 8	1879-80	17 8 8
1864-65	21 0 9	1880-81	17 6 0
1865-66	24 0 4	1881-82	16 15 10
1866-67	23 6 2	1882-83	15 10 6
1867-68	24 14 7	1883-84	13 12 7
1868-69	23 6 2	1884-85	12 11 5
1869-70	23 8 6	1885-86	17 6 9
1870-71	20 12 10		

The following figures give present prices, average price per seer, of Bengal raw silk sold by Anderson, Wright & Co. :—

Season.	Price.	Season.	Price.
	Rs. A. P.		Rs. A. P.
1900-01	14 3 6	1908-09	12 9 8
1901-02	14 8 0	1909-10	13 1 9
1902-03	15 14 10	1910-11	14 2 8
1903-04	15 0 8	1911-12	14 12 2
1904-05	15 11 4	1912-13	15 1 8
1905-06	17 3 11	1913-14	17 6 1
1906-07	18 8 7	1914-15	13 6 2
1907-08	14 2 7		

As the great part of the export was in the hands of a few firms in Calcutta, the fact that they were offering low prices for cocoons, based on their contracts for raw silk, would very greatly check production for export.

9. The second factor, whose importance it is very hard now to estimate, is the question of the rents of mulberry lands. Liotard in his "Memorandum on Silk in India" lays stress on this and is still of the same opinion (1916). He states that when in the late sixties prices were very high, the zemindars charged excessive rates for mulberry lands, as much as Rs. 50 per acre, which rearers were then able to pay. When prices fell, the rents remained up and

the cultivator accordingly turned from mulberry cultivation to other crops or the rearer restricted his purchase of leaf or his renting of mulberry land. Liotard's opinion must carry weight and there can be no doubt that this was one of the factors that led to the decrease in the production of raw silk in Bengal, in the years immediately following the revival of the industry in Europe.

10. In 1886, at the conference held in Calcutta, evidence was brought forward that the industry was then suffering from excessive rents, as much as Rs. 12, 14, and 16 per *bigha*, being charged for mulberry lands in Malda, Rajshahi and Murshidabad, while rice land was rented at Re. 1-8 to Rs. 2 per *bigha*. Under the permanent settlement of Bengal, the rents charged are fixed by the zemindars and there was evidently a decided feeling in 1886 that the zemindars were killing the industry by the exorbitant rents. With a product of such fluctuating value and demand, the question of rent becomes a difficult one. There is no evidence that this factor is still of any importance in this problem.

11. The third factor referred to by authors is the question of "degeneration." It is held that the variety of silk-worm grown has degenerated and is now a less prolific silk producer than formerly. An examination of the yields of silk in 1831, as given for the Company's factory at Soonamooky, does not bear this out but rather tends to show that at present the races are slightly better. It required 48 kahans to give 2 seers 12 chittacks of No. 1 and No. 2A quality in 1831, *i.e.*, about $18\frac{1}{2}$ kahans to the seer. This was for the October-January crops, and this is slightly worse than the present, where 17 kahans would yield a seer of silk. The Manager of the Rose Silk Filature, Bengal, is of opinion that the yields now are slightly better than those recorded in 1831 and that there is no evidence of degeneration.

12. The fourth factor is disease. Grasserie, flacherie, muscardine, and the fly pest are and have been long well known diseases in Bengal, but there is less certainty as to the appearance of pebrine. So far as the records show, the disease was first definitely recognised by Wood-Mason in 1886, when he was deputed to enquire into it, and it was then held that the disease "kata," had been recognised by rearers for the last 10 years. We may assume pebrine to have become a factor of importance about 1875 in Bengal. In 1887 Mr. Finucane wrote "while kata, which has only been noticed within the last 12 years, is yearly becoming more and more destructive, and is at present causing most serious alarm" (17th March 1887).

13. As will be seen later, the members of the Silk Committee, who sat in 1908 were very definitely of opinion that pebrine was the main cause of the continuance of the decline in the production of mulberry silk in Bengal and assuming that it became epidemic about 1875, it would very largely account for the decrease in production. Pebrine has this peculiarity that it kills the ripe worm before it spins so that the rearer has the entire labour and expense and then loses his whole return inevitably.

14. In this connection, it is worth noting that pebrine is supposed to have become serious about the time that prices were falling heavily. When the prices fell, dealers were prepared to pay less for cocoons, and the price of the green cocoons fell very rapidly. When this occurs, the rearer strives to cut down expense, and to increase his brood. The tendency is too big broods, too little leaf, too frequent plucking; immature leaf is given in insufficient amount and any tendency to disease is intensified. I think we may assume that the rearer, in the years of falling prices, probably brought out the pebrine epidemic by bad feeding and directly brought on the condition that ruled for some years.

15. A factor of very considerable importance in the recent position of the industry has been the withdrawal of firms that bought cocoons, reeled the silk in factories with paid labour, and exported the raw silk and chassam. At the present time a single European firm is engaged in this business. Twenty years ago several firms were engaged in it and the silk-producing districts were dotted with filatures in which the silk was reeled for export. Wherever I have made inquiries, the withdrawal of these firms has been regarded with

dismay by the silk producer. The silk-rearer now has to sell his produce to native reelers under worse conditions than he did to European firms. The latter fixed a price, varied according to the current price in France of raw silk, and announced exactly what they were prepared to pay; they paid that price, whatever the fluctuations of the market in the interval, and the rearer knew very fairly what price he might expect to get for his cocoons when they were ripe; but the rearer distrusts his own countryman and has not the same feeling of security. If he can be beaten down and compelled to sell at a small price, he will be and in every village in which I made inquiry, the same opinion was expressed to me. There is also the fact that European firms bought for export while native reelers buy to reel for the Indian market, Benares, Nagpur, Amritsar or Murshidabad: so that every pound bought for export was an extra demand over the fairly steady native demand and so made for better prices.

16. The European firms ceased to trade, when the prices for raw silk sank so low that the price they could afford to pay for cocoons did not attract a large enough volume of cocoons to keep the filatures well employed. With a fixed establishment, with large factory charges, filatures could be kept going only with a large volume of trade, and once this ceased, it was not profitable to continue.

In this connection, a further very important point is that, while the European firms paid attention to quality in reeling, native reelers will not do so and the silk is reeled by a process no better than was used a century ago.

17. When one considers that fundamentally, from climatic reasons, the Bengal silk fibre is less strong than that from Europe or Japan; that large producing countries such as Japan, Italy, France, have immensely improved and perfected the reeling process, one can understand that, with no corresponding improvement in India, the silk has been less in demand abroad. At the same time production of silk, particularly in Japan, has enormously increased in the last fifty years. If the Indian reeler persists in his antiquated method, which allows of great inequality in the same skein, which has no system of testing and standardising, then the demand for his silk must lessen even in India. India must keep pace with improvements outside India if its silk is not to be ousted by foreign silk, and this factor is not the least of those that have produced the fall in production.

18. Lastly, a factor whose importance is very considerable, lies in the rise in the value of produce such as rice, as compared with silk, which has fallen and then remained stationary. For mulberry silk cultivation to remain on the same scale as formerly, its price should have increased proportionately to that of competing crops, which has not been the case. This factor is complicated by the fact that, as a rule, mulberry land is not suited to jute or rice cultivation because it has been so raised above the level of the surrounding fields by tank-silt dressings that it will not grow rice or jute, but potatoes and vegetable crops can be grown and the land is therefore cultivated for suitable crops; where it is possible the land formerly devoted to mulberry is put into jute or paddy. A district such as Bogra for instance has developed jute cultivation while it has almost abandoned mulberry. Berhampur and Malda rely still on mulberry, the land being unsuitable for jute and it is probably generally and widely true that mulberry cultivation has to a large extent been abandoned in proportion as each district has been able to substitute jute or paddy for mulberry.

The same applies to wages, which have risen very much while the rearer and reeler are unable to earn any more. The result is that a rearer or reeler can earn as much with less skilled and risky work at present rates of pay and there is little inducement to keep up the industry. Further details are given below.

19. The figures given in Appendix II show the position reached in 1886 as far as the export of silk is concerned, and this is the only available criterion of production. There is in addition a large production of raw silk, which is used in India, but from the point of view of the European exporting firms the situation was very serious and the great reduction in production,

well-known to all the staffs of the companies, was ominous of the eventual decay of the industry.

20. The factors that produced this situation have been discussed at this point in order that the subsequent action and the present position may be fully understood. We may now resume the historical sequence of events.

21. In 1886, Sir Thomas Wardle visited Calcutta to collect specimens of silk and silk products for an Indo-Colonial Exhibition, and a Conference was held in Calcutta on the silk question. Mr. Wood Mason and N. G. Mukherji were directed to investigate the problem of disease in silk and, in 1887, there was a further Conference in Calcutta. Some work was commenced with the improved hybrid races of Mr. Cleghorn. In 1888 N. G. Mukherji was sent to Europe to see French and Italian methods, and he returned and started nurseries in Bengal to rear and supply disease-free seed.

In 1896, the Government of Bengal offered a sum of Rs. 3,000 per annum for the nurseries and in 1898 a Silk Committee was formed by Government and the European firms interested in the trade, which in 1899 commenced to receive this grant from Government. From 1899 to 1907, seven nurseries were opened, for the issue of disease-free seed.

In 1908, a Committee was appointed by the Government of Bengal to consider the industry and to formulate proposals. Their conclusions were expressed in a report, in which much interesting evidence is detailed and their recommendations were as follows :—

Measures proposed by the Silk Committee in Bengal in 1908.

These measures omitted the districts of Malda, Rajshahi and Bogra, then included in Eastern Bengal. So far as the measures themselves are concerned, we may assume that they could be applied to these districts equally with the Bengal districts, the problem in Malda and Rajshahi being similar to that in Bengal.

(1) *The establishment of many model rearing houses, where seed would be examined and reared under supervision.*

This has been carried out in this way that 7 Central Nurseries are supplying seed, to the extent at present of some 16 per cent. of the requirements estimated. Its further extension has been checked, partly by the substitution later of the system of employing selected rearers.

(2) *Leasing houses to rearers, who were able to use the microscope for seed selection.* One was leased and then given up and sold.

(3) *Trial of a system of giving advances to rearers to enable them to construct model houses and examine seed.*

No action.

(4) *Leading rearers were to be provided with microscopes on the hire-purchase system.*

Is being done.

(5) *Granting advances to rearers, on the same terms as loans under the Agriculturists' Loans Act, through district officers.*

Not done.

(6) *Encouragement to be given to the planting by rearers of tree mulberry by the supply of seedlings and cuttings from a central farm.*

Not done.

(7) *In silk growing districts, the District Boards to plant trees along road sides; and Government should plant trees along canal banks and public embankments.*

Not done except in Birbhum.

(8) *The establishment of a farm at Berhampur to contain a nursery of mulberry varieties, to test the value of different leaf, and to determine the value of manures.*

Farm established, no more done.

(9) *A sustained effort to be made to produce improved seed of boro-polo, chota-polo and nistari worms, by selection. Cross-breeding not to be undertaken. The work to be offered to Miss Cleghorn.*

Not done but another scheme substituted.

(10) *Appointment of an European Superintendent recorded as vital by Oldham's Committee.*

Not done.

A permanent Silk Committee was formed, to administer the scheme and to control the expenditure of funds. This Committee consisted of the Director of Agriculture (President), the Collector of Murshidabad, the Manager of L. Payen & Co., Mr. Malcolm, Manager, Berhampur Division of Bengal Silk Co., and Babu Bhupati Sain. It meets quarterly and has continued to control the sericultural operations up to the present; it now consists of the Director of Agriculture, the Collector of Murshidabad, and three members representing the firms interested in Bengal filatures or silk export.

The Minutes of the Silk Committee show the subsequent development of the scheme.

In 1908, Babu A. C. Ghose was appointed Sericultural Superintendent. It may be noted that the original proposal was to make him Deputy Superintendent, and to appoint a European Superintendent. The land at Berhampur was taken up and a Central Nursery formed. It was decided not to experiment with Italian seed at Berhampur, and Miss Cleghorn was to be approached as to commencing work on selection. (Item 9 of the Recommendations.)

At a meeting held in May 1909, it was noted that all the nurseries had worked at a profit (*i.e.* apart from cost of supervision and Manager).

At the fourth meeting held in June 1909, it was decided to drop the scheme for seed selection, the provision of more nursery seed being the most urgent necessity.

At the fifth meeting the proposal to lease the Purandarpore nursery to a rearer was agreed to. (Item 2 of recommendations.)

At the sixth meeting held on 4th December 1909, a scheme was approved for training rearers' sons at Berhampur, and for granting money to not more than three, annually, to erect model rearing houses.

At the seventh meeting held on March 5th, 1910, it was decided to proceed with the issue of posters giving information about the *hats* to which buyers of cocoons would be sent (this was abandoned later).

At the eighth meeting held on 4th June 1910, a statement showing increased profit from the sale of seed, etc., was accepted.

At the ninth meeting, held on 10th September 1910, a statement of loss and profit for three years was produced, showing a loss of Rs. 226 in 1908-09, of Rs. 91 in 1909-10, and a profit of Rs. 1,126 on the first five months of 1910-11. After discussion of a letter from the Imperial Entomologist suggesting that cross-breeding might yield good results, it was decided to prepare a scheme for the employment of Miss Cleghorn. A scheme for the disinfection of rearers' houses with sulphur was agreed on.

At the tenth meeting, held on 3rd December 1910, the scheme for instituting experiments in cross-breeding was further discussed. It was decided to commence the work at Berhampur with the existing staff.

At a special meeting, held on 20th February 1911, the above scheme was further discussed. Messrs. Anderson, Wright & Co. offered to contribute part of the cost, provided a properly qualified European officer could be obtained. It was decided to address Government on the subject.

At a special meeting held on 2nd April 1911, a general discussion arose on the Committee's work. It was decided to approach Government for more funds to add more rearing houses to the Central Nurseries, and to appoint 25 supervisors to advise the rearers in their own houses.

At this time the principle of Central Nurseries with supervisors for every five square miles was definitely adopted by the Director of Agriculture and we find the Central Nursery policy finally decided on.

At the fourteenth meeting, held on 9th March 1912, the programme of work of M. Lafont, the new expert, was discussed and it was decided that he should devote himself to hybridising.

At the fifteenth meeting, held on 1st June 1912, a representation was made urging that more progress should be made in supplying seed and that legislation should be introduced to prohibit the sale of all but Government produced seed. The accounts presented showed a diminution in the sales of seed, with increased expenditure. The Eastern Bengal Nurseries were taken over at this time.

At the sixteenth meeting, held on 7th September 1912, the general position was discussed and it was agreed to prepare a scheme for Government; a mulberry census was also to be undertaken.

At the special meeting, held on 18th January 1913, it was agreed to carry on M. Lafont's work by the Superintendent of Sericulture.

A special meeting was held on 31st March 1913. It was agreed that the present scheme for seed supply was sound; that no legislation need be undertaken; and that Re. 1-8 a kahan should be obtained for seed.

At the twenty-first meeting, held on 16th March 1914, the work of M. Grangeon, the new expert, was discussed.

He left for service at the war, and his work was transferred to the Superintendent of the Berhampur farm; arrangements were made for keeping worms at Kurseong in the rains.

At the twenty-sixth meeting on 3rd July 1915, the proposal of the Director of Agriculture to utilise selected rearers to produce cocoons was discussed. Further nurseries could not be made, as owing to the war Government were not prepared to supply the necessary funds, and only by using rearers could the seed supply be extended. It was adopted as a temporary experimental measure: it had in fact already been decided on.

22. Further details of the sericultural work in Bengal will be found in the Annual Reports of the Department of Agriculture. The most important paragraphs are those referring to the work of the experts engaged from Europe. Mons. F. D. Lafont, commenced work in January 1912, and left in 1913. He was specially appointed to attempt the production of a hybrid between the univoltine race and a multivoltine race, which should be superior to the existing multivoltine races. A report on the results obtained was issued in 1915; the hybrid question is discussed in Chapter X of this report, as well as Mons. Lafont's results. His idea of the industry was that it could be improved by the following sequence:—

Issue hibernated European Univoltine seed in February: Cross resulting males with Nistari females for March-April brood.

Issue Nistari for June to September.

Issue Cross of Univoltine Male \times Nistari female and the reverse cross, from cold storage, in October.

Mons. Grangeon was appointed to succeed Mons. Lafont and he worked in Bengal till the war necessitated his return to France in 1914. He had produced in Madagascar a multivoltine race from univoltine French stock and had sent this to Mons. Lafont in India. This is the race referred to as the Madagascar race.

Mons. Grangeon had experience of tropical sericulture and expressed the following ideas as to the best line of progress for Bengal:—

1. Improve the indigenous varieties by selection and keep selected strains for rearers and for crossing.
2. Have a hill station and keep there the Madagascar and the selected races from May to August. In October use males of these to cross with the rearers' females, for providing their stocks from October to April.
3. Use Medium Madagascar, Crossed bivoltine Japanese, and Accidental French bivoltines experimentally.

It will be seen that neither Mons. Lafont or Mons. Grangeon were long enough in the country to know it or to understand how to assist the silk rearer; nor has their hybridising borne fruit as yet. The question of the hybrids is discussed in Chapter X.

23. It will be understood from the above pages that a fundamental part of the scheme from 1886 onwards was the supply to rearers of seed, from stock examined by Pasteur's method, which should be reasonably disease-free. The nurseries referred to below are entirely devoted to this purpose, and putting aside the minor points, the main care of the Silk Committee has been the carrying on of these nurseries. This scheme was regarded as vital by the Silk Committee that met in 1908, and the object to be attained by the Silk Committee that met since has been the full attainment of this scheme.

24. In July 1915, the Director of Agriculture propounded a new scheme whereby the activities of the nurseries were to be supplemented by that of selected rearers. As this scheme was a reversal of previous policy, and as it is critically examined in the memorandum which will be found in Appendix III, the full text of the letter proposing it is also reproduced in that Appendix.

25. After careful examination of the nurseries and of the conditions of the industry in Bengal, I prepared a statement of the position for a special meeting of the Committee held in January 1916 (Appendix III). It was drawn up in consultation with the non-official members of the Committee and Mr. J. Goodman of Messrs. Anderson, Wright & Co. If parts of it appear to be unintelligible, the account of the silk industry and of the nurseries, which is to be found below should be consulted.

(b) THE EXISTING INDUSTRY.

REARING.

26. The silk-rearing industry in Bengal is largely carried on by a special class of men, who rent land and grow mulberry on it or who buy mulberry standing in the field and pluck it.

A rearing house is usually similar to the dwelling house and is also used for sleeping in many cases. It is a mud-walled thatched building, with a single door and small windows, which should be closed with a bamboo lattice, wire gauze or cloth to exclude the fly parasite. Inside the house is one or more bamboo frames (*ghora*) supporting rearing trays one above the other, usually not more than 16. The trays are made of split bamboo and palm leaf and are not easy to disinfect or clean. Trays must be used owing to the moisture in the air, which induces fermentation of the litter. As a rule, nets are not used in rearing though it would be a good thing if they were; the rearers will not incur the extra expense and if nets are issued or sold cheaply, they do not take care of them. The result is that there is a considerable loss of young worms at litter cleaning. The perforated paper used in Mysore might possibly be used if the nurseries were to issue it at cost price, but it is doubtful if the rearer will, under present conditions, adopt any improvement.

Nets cost about Rs. 45 per 100. Two nets are required per *ghora* of worms; a *kahan* of seed cocoons at present yields worms for two *ghoras*, which should produce 80 *kahans* of cocoons worth, say, Rs. 64. The cost of nets would be Rs. 2 and an increase of yield to 90 *kahans* would pay for four times that number of nets in one brood.

When the worms are full grown, they are placed on *chandrakis*, of the usual pattern, to spin; the *chandrakis* being placed usually in the open air. As the *chandrakis* are the rearer's property, the worms are given ample time to spin. The cocoons are then removed, and either killed in the sun or sold green.

27. For the principal broods, the cocoons are sold at fixed places, where fairs are held to which cocoons are brought; at these representatives of English firms used to buy largely; some cocoons are sold ahead to agents of reelers; being paid for on green weight when the spinning is done. At some centres, the cocoons purchased for filatures are stifled with dry heat in large

drying chambers heated by steam. This avoids the bleaching effect of the sun and the reeled silk has a better colour.

28. As there are three varieties grown, and as the principal crops are in November-December, February-March-April, the rearer has to be able to get seed for each crop. As a rule chota-polo is the crop in November and March, nistari in the rains, July to September, and the Univoltine boro-polo is grown in February-March to a very limited extent. For the rearer to keep his own seed he would have to maintain his stock of chota-polo and Nistari right through the year. As he also has a prejudice against local seed and likes to get fresh seed from a distance once a year, the rearers go to another district for seed cocoons. The purchasers like to see the worms spinning so that they can see for themselves if they are healthy, then they buy the cocoons, usually at a rate higher than that for filature, and carry on their brood from the eggs laid by the moths that emerge. The rearer will not take eggs, he requires seed cocoons and is particular about them. The result is that there has been a steady process of selection for quality of cocoon and a definite standard is kept up to by those who rear seed-cocoons.

There is no distinct class of seed-producers, but if a rearer has a good crop or if he lives in a place which has a reputation for seed, he will sell all or part of his crop at a higher price for seed. The Murshidabad rearer goes to Malda and *vice versa* and so the idea is prevalent that seed should be got from across the river. Birbhum is a seed supply area and Bogra produces chota-polo seed-cocoons.

It is to be noted that the rearers are conservative and do not want a different worm; above all they do not want a larger worm that will eat more. The worms are by no means over-fed now, but they certainly would be seriously under-fed if they were of a larger size requiring more leaf.

REELING.

29. The cocoons are reeled on a very simple system. They are placed in a pot of water over a fire, the threads pass through holes in an iron plate fixed beyond the pot, then cross a few times, pass through fixed wire loops to guide-pegs fixed in an oscillating bar and so to a large wood reel turned by a small boy. Reels are of different sizes to suit the Nagpur, Poona or other markets which want skeins of special sizes. In some cases there are porcelain buttons in the iron plate, but in most native filatures no one minds if the button is there or not. There may be two sets of threads being reeled at once, that is, four threads in all, but the cocoons are not usually good enough to allow of that, as they require constant attention and most reelers do two threads only.

Filature reeling is done on a better system, with steam heating to the basins, with porcelain buttons and a proper Croisure (crossing of the thread); the hanks are inspected twice daily and bad ones picked out. The silk is sorted into qualities, is tested for breaks and for variation in denier and is sold on grade according to denier, quality and colour.

At Ramnugger, the tavelette system for reeling and machinery for re-reeling was put up but the quality of cocoon is not adapted to the system and the extra cost of this reeling and re-reeling was not met by higher price for the product.

At the filatures the Chassam is carefully prepared as tape waste and fetches a high price. Here also the cocoons are prepared for reeling by being placed overnight in the *tundoor* or oven, which is heated with a fire and then saturated with steam by throwing water on the heated walls and floor, after which the cocoons for next day's reeling are put in; by next morning the cocoons are in good condition for reeling. At the filatures reelers earn 3½ to 4 annas a day. They reel four skeins each of about a chittack (two ounces), so reeling costs about Re. 1 a seer in labour. As the children and the aged relatives of the family also work at turning the reels or making chassam, the family may earn as much as one rupee a day; work can of course be done in daylight only and is not heavy or exhausting. The native reeler usually earns not more than Rs. 10 a month, the winder earning Rs. 7 a month.

DISTRIBUTION OF THE INDUSTRY.

30. Eighty years ago, the industry existed in Rajshahi, Malda, Birbhum, Murshidabad, Midnapore, Hooghly, Burdwan, Bogra, Howrah, Nadia, Jessore, 24-Pergannahs, Dinajpur, Rungpur and Pabna. In 1880, it no longer existed in the last three and was almost confined to the first five districts. There appears to be no means of estimating either the total production of silk or the total acreage of mulberry at that time. A census of mulberry cultivation was taken in 1913 and the following is an abstract:—

Abstract of Mulberry census.

Names of Districts.	Whether any mulberry land has been given up within last five years.	Quantity of lands under mulberry last year.	Quantity of mulberry lands newly cultivated.
	Acres.	Acres.	Acres.
Murshidabad	2,121	3,028	96
Birbhum	133	932	26
Rajshahi	621	365	330
Malda	1,751	13,459	311
GRAND TOTAL	4,626	17,784	763

There are also the following areas in other districts:—

Bogra	55 acres.
Nadia	50 "
Burdwan (Kalna)	85 "
Hooghly (Arambagh)	60 "
Midnapore	400 "

The industry fluctuates quite distinctly and it is clear that it is easy to extend the industry if it pays. This is important because it shows that if improvements can be effected they will be worth doing and the industry will probably respond.

The Eastern Bengal Gazetteer, written in 1909, states that in Malda the cultivation of mulberry and the production of cocoons had nearly doubled in the last 25 years. The annual output of cocoons was put at 100,000 maunds, of which about 60,000 maunds are exported. The annual export of thread was 1,650—1,700 maunds.

In Rajshahi the annual output of filature raw silk was 400,000 lbs., in 1899-1900 was only 96,684 lbs., in 1903-04 was 67,790 lbs. Since then the Companies owning the filatures have ceased operations, so that this production has ceased.

In Bogra, the East India Company formerly had filatures; in 1834, these ceased and the industry declined; in 1871 one filature was working and since then the industry has declined till in 1901 there were 13 acres under cultivation, in 1906, 130 acres, in 1908, 149 acres. The figures in 1913 were 55. (Jute in 1872 occupied 100,000 acres, in 1908 about 250,000 acres.) In 1909, there were 41 Hindus and 259 Mohammadaus engaged in the rearing. The cocoons are sold to Malda and Murshidabad, only 10 per cent. being used locally. Bogra produces chota-polo and is a source of seed supply; the Agricultural Department maintain a nursery there.

Another seed-producing area is Birbhum, which supplies chota-polo seed in September for the November crop. This district also grows boro-polo worms producing white silk. It has two mulberries, the one suited to boro-polo, the other to chota-polo. The District Board have also done much tree planting along roadsides, and the district is one which is capable of developing sericulture.

Midnapur produces also the *bulu* race of worms, which spin greenish cocoons like Mysore's. There was 20,000 lbs. of raw silk produced in 1907-08 derived from the four breeds of worms.

ORGANISATION.

31. There is great scope in Bengal for co-operative organisation particularly in regard to silk reeling. The silk-rearer is better off as he has a definite local market for cocoons but the reeler has not.

The reelers complain that the raw silk dealers cheat them and they ask why British firms will not deal in raw silk. The complaint about the native dealers is chiefly based upon this procedure. Raw silk is quoted in Malda at Rs. 13 and the reeler goes to the Marwari and contracts verbally to supply so much raw silk; he buys cocoons at a price based upon selling raw silk at Rs. 13 and then having reeled it finds the dealer will pay him only Rs. 12 or Rs. 11-8, the current price having fallen in the interval. There are other complaints connected with the number of tolas in the seer and so on. If better silk is to be produced and if it is to find a market outside the silk districts, co-operation will greatly assist this. A great deal of Bengal silk is sold to Poona, Nagpur, Benares, Amritsar. This trade could be very well conducted by the reelers' co-operative societies aided by a little technical advice as to the best way of producing the exact qualities needed in each place.

RETURNS.

32. It is not easy to ascertain the profits made by rearing or reeling, but a typical case gives an idea of the position.

A Murshidabad rearer took 12 puns, 16 gondas of seed cocoons from the nursery (*i.e.*, 1,024 cocoons) and obtained 80 kahans cocoons. He paid Rs. 25 for leaf, and Rs. 5-6 for labour and cultivation of half a bigha of land. He sold 20 kahans at Re. 1 per kahan for seed cocoons, and 60 kahans at Rs. 50 for reeling. Including cost of seed he spends Rs. 32, sells his crop for Rs. 70 and is engaged over the whole business for two months. He will repeat this four times a year, with fluctuations in yield and return. His seed cocoons in March for instance would fetch Rs. 2 to Rs. 3 per kahan, if sold to Malda, but a single attack of pebrine would reduce his return from 80 kahans to anything down to 10, depending upon the number of trays attacked. As a rule a return of 80 kahans of cocoons from one kahan of seed cocoons is considered good if the crop is healthy.

A rearer has 3 ghoras, giving 3 maunds of cocoons each brood, and giving perhaps 10 maunds in the whole 5 bunds in the year. He has to buy 10 kahans of seed cocoons costing perhaps Rs. 10, and he has 5 bighas of land, the land costs him Rs. 25 and he spends another Rs. 30 on leaf. He spends in all some Rs. 70 and has a return of perhaps Rs. 300. His income then is something near to Rs. 20 per month, and the whole family are engaged in silk rearing as their main occupation.

REELING PROFITS.

33. A maund of cocoons will give 3 seers of Khungru silk, native reeled or 2½ seers of filature silk.

	Rs.	A.	P.
A maund of cocoons (green) sold in November 1915	32	0	0
Cost to reel, labour	3	0	0
Cost to reel, fuel	2	0	0
TOTAL COST	37	0	0
Raw silk 3 seers at Rs. 12	36	0	0
Chassam 5 seers at Rs. 1-4	6	4	0
Godur, etc.	1	0	0
	43	4	0

This is the local value of the product. At Rs. 12 a seer, the silk is equivalent to 23 francs a kilo and the quotation then for Bengal filature silk was francs 35 to 40 per kilo. There would be 2½ seers of filature silk, the charges would be much the same; so that at a cost of francs 59, you get a little more than 2 kilos of silk worth, say, francs 75, and chassam worth francs 8. All charges for establishment, packing, testing, rail-freight, port dues, insurance, steamer freight, landing charges, conditioning charges, brokerage, commission and interest on capital have to come from this margin.

If the price of Bengal filature silk goes up in France and stays at a high point, the filature agents buy cocoons freely, the filatures work at full capacity, the raw silk is turned out rapidly, baled and sent off. The demand for cocoons may be very large and the supply to native reelers interfered with, stimulating further rearing.

On the other hand, if prices in Europe are down, and filatures are not buying cocoons, the rearer has only one class of purchaser, must either hold on to his cocoons or sell at their price, and the production is very directly affected. It is easy to understand what an effect on the industry the withdrawal of British firms has produced and how directly the industry depends on the fluctuations of price and demand outside India.

MULBERRY.

34. The plant is usually grown from cuttings, placed 6 to 8 in a bunch, in rows about 2 feet apart. Manuring is by top dressing with tank silt and as some fields have continued for as long as 40 years, these are raised to a height of 10 feet or more above the general level of the country. If the plant is not sold for feeding worms, it may be cut and fed to cattle.

The indigenous or *deshi* plant is generally grown, regarded as being *Morus alba* var *indica*. It suffers in the dry hot months from "Tukra," a disease that may be due to a mealy-bug (*Dactylopius nipae*), a *Psylla*, or a Micro-organism such as a bacterium, as has been described from South Africa. The disease is a serious matter as the leaf yield is very much lessened at a season when an important crop is to be obtained. Tukra should have been properly investigated.

A variety of mulberry called the "Bombay" is grown on the nurseries; its origin is obscure, but it may be the Italian variety brought over in 1832, or a European variety introduced recently. It is resistant to Tukra, yields well and is replacing the *deshi* on the nursery plantations.

TREE MULBERRY.

35. The cultivation of tree mulberry would be a difficult matter. It is recommended by several persons and there is evidence that the leaf of tree mulberry would be good as a standby when leaf fails, especially in March, and April when Tukra disease is prevalent, and would probably save much disease. Also it would become a necessity if other varieties of worms were to be grown. But there are many difficulties, it will not give more than two pluckings, it will not give a plucking in November, and so one of the best bunds would be lost. If grown as a field crop, say 20 feet apart, not much else will grow and the yield will be small. If grown on bunds, on road sides, etc., cattle will eat it, theft will occur, there will be difficulties about ownership, also the trees have not even yet been planted or provided. I am inclined to think that a standard bush, as at Pusa, may be the best system, but one cannot recommend that for adoption without much experiment and trial.

YIELD PER BIGHA.

36. The following figures were obtained for the yield of 25 bighas of land at a nursery:—

1 bigha—					
November Bund	.	.	16 maunds leaf	35 kahans	30 kahans.
March	"	.	12 " "	30 "	30 "
Asahri	"	.	16 " "	30 "	25 "
Ashin	"	.	12 " "	30 "	25 "
			56 " "	125 "	110 "

The second figures for cocoon yield were those of a filature employé with long local experience.

This land is poor, and not at full bearing. A general estimate of yield is that a bigha should give one big plucking of 30 maunds of leaf and a total for the year of 100 maunds. As on the whole it requires 20 seers leaf per seer of green cocoons, there should be a return, if the worms are not diseased, of 5 maunds green cocoons per annum. Further details of yield of mulberry will be found in the section on mulberry on pages 87-88.

DISEASE.

37. The serious diseases are pebrine, flacherie, grasserie, muscardine and the fly pest.

38. Pebrine—*Nosema apicis*. Kata. This is the most serious disease both from its effects and from the fact that it kills the worms frequently in the last few days before they spin when all the labour and leaf has been expended on the crop.

The object of the nurseries is to combat it by the issue of disease-free seed, but they have not been very successful. Even in the nursery stock, examined in every generation for disease, there is a small percentage of pebrine, two per cent. The nursery managers state that in one generation of cultivation in a rearer's house this goes up to 8 to 10 per cent.

The whole question of pebrine in Bengal urgently requires investigation. The ideas of Pasteur, based on European study, are blindly accepted in text books. No proper process of disinfection is known; the rearing houses with thatched roofs, bamboo racks, bamboo trays, mud floors, are not easy to disinfect, the length of vitality of the organism is unknown, its method of infection is unknown, and stereotyped ideas are accepted, are blindly taught and standardised, without any real investigation having been made. Pebrine is as bad now as it was 20 years ago, despite the large sums of money spent.

39. The diseases known as Muscardine—*Botrytis bassiana*—(Chura koti) Flacherie (Kalsira) Grasserie (Rasa) as well as the obscure diseases Gatine (Salpha) and Court (Lali), are less important but equally deserving of proper enquiry. The climatic and general conditions of silk rearing are so unlike those obtaining in Europe and Japan, where these diseases have been investigated that it is desirable that independent investigation should be made in Bengal.

40. The fly pest is a very serious enemy. I am not aware of any figures showing the loss annually, but it must amount to quite 15 to 20 per cent. of the crop. Green cocoons, which contain attacked worms, are pierced with a small hole at the end, where the maggot emerges, and at a collecting station when cocoons were being collected for stifling, there were hundreds of maggots under each heap of cocoons, emerged from the cocoons and seeking a suitable place to pupate.

Wire gauze is issued to selected rearers, but the ordinary rearing-house is unprotected and the fly evidently does great harm. Here again, a proper investigation by a competent entomologist would probably reduce the damage. The only original work on the pest known to me is that of Mr. J. Cleghorn; this should be supplemented by fuller enquiry and the pest adequately dealt with.

NURSERIES.

41. Following the practice of Europe, the method of dealing with pebrine has been to provide rearers with stock free from pebrine, the method of insuring freedom from the disease being that originated by Pasteur. The parent moth, after laying eggs, is pounded up, a drop of the fluid taken, examined under a microscope, and if the characteristic large bright corpuscle of pebrine is seen, the eggs are destroyed, if not, the eggs are taken as being free from the disease. In Bengal rearers will not take eggs, so these "disease-free eggs" are reared in the nursery and the cocoons sold; if infection from

pebrine has not occurred during the rearing, the cocoons should yield moths that will lay disease-free eggs, but even in the nurseries, there is a continual small proportion of diseased moths, showing that either infection is occurring or that the method of examination passes a certain number of diseased moths.

The fact that pebrine is not understood has been discussed in Chapter X but it is a vital fact in understanding the position in Bengal that even after years of nursery selection and of rearing carried out regardless of expense, disease-free stock does not exist.

42. The nurseries are planned on one system throughout; each has a number of rearing houses, in which the worms are grown, and a house in which the moths are examined and lay eggs. The rearing houses are on two plans, the latest has a large rearing room at each end with 4 ghoras and between a small room in which leaf is stored and which has a low ceiling; to enter the house, you enter this room and any flies entering also can be killed. The capacity of this house is 8 ghoras, *i.e.*, eight sets of 16 trays or roughly 320 kahans of cocoons. Each house has a high thatched roof, a plinth of two to three feet and a wide verandah all round.

A single rearing house costs from Rs. 2,000 to Rs. 3,000 depending on the locality; the minimum of accommodation for worms is provided at the maximum of size of building, but there is no doubt that the buildings are well adapted to their purpose. Attached to each set of rearing houses is an area of mulberry cultivation partly irrigated from tanks. The mulberry is of the *deshi* or Bombay variety and is grown at various distances up to five feet apart.

The staff of a nursery includes a manager, one or more supervisors and perhaps a travelling inspector or overseer. A statement of the number and outturn of the nurseries and of their cost will be found in Appendix III.

The nurseries exist for the purpose of producing disease-free seed of the chota-polo and nistari races, for sale to the rearers at the appropriate bunds. About four-fifths of the seed actually produced was sold as seed in 1915, the rest sold for reeling. Rearers come to the nursery, see the worms spinning and buy so much; they may have come from another district or from villages near by. The nursery staff are in touch with rearing villages and to some extent follow up the seed supplied, but rearers do not yet seem to have sufficient confidence in the seed to either use it entirely or for an entire village to use only nursery seed.

One would expect that, with the resources of the nurseries as regards food, trays, houses, staff, and with the rigid disease-examination, the nursery seed would be so superior that it would wholly replace other seed in localities where nurseries have been established for some years. Mistakes have been made in the past and the nurseries have not yet fully got the confidence of the rearers.

43. The prices paid for nursery stock vary according to the season and the demand, just as prices vary for rearer's stock. On the whole the price is slightly higher than that paid for rearer's stock. Until pebrine is properly understood the real value of the nursery stock cannot be estimated. The rearer buys cocoons, and there has been the whole rearing period in the nursery for infection to have occurred; the brood he gets from this lightly infected stock may be good enough for filature purposes, but still have (in this, the second generation from examination) too much pebrine to be good for seed purposes; the rearer must then get fresh seed from the nursery or from a rearer. If the rearer would take eggs, he would start a generation nearer to the disease-free condition; as it is there is the wholly unknown risk of infection in the nursery before the rearer takes the cocoons, then in the rearer's house in the second generation, and it is only then that the rearer gets cocoons of his own breeding.

44. Since the nursery system has been in use, the "selected rearer" system has been commenced, utilising rearers in the villages to produce seed to supplement that of the nurseries. The new system is to give the selected rearer either layings of seed to rear to cocoons or seed-cocoons, which cut out in his

house and the moths are then microscopically examined by the farm staff or a supervisor.

In both cases it is the system to inspect him and when the worms are put on the chandrakis to label or mark these; this is meant to prevent him from selling as nursery-seed-cocoons, other cocoons that he has mixed in or cocoons from worms that he has added to the chandrakis. Also a list is taken of the rearers, who take cocoons from each selected rearer, and the amounts; if he gets 1 kahan of seed cocoons, and from these gets 2 maunds seed cocoons, he should be able to sell 60—80 kahans of seed cocoons. The above checks are designed to prevent him selling another 30 kahans of other cocoons from other sources.

The success of the whole system turns on—

- (1) Freedom of the nursery stock from pebrine.
- (2) Rigid examination and issue of only good stuff.
- (3) The thoroughness of the inspection of the selected seed rearer.
- (4) The integrity of the staff.

45. Seeing that there are only four bunds of importance, the inspecting staff must be a big one *at those seasons*. The success of the present nursery system in Bengal is largely dependent upon the zeal and energy of the Superintendent, who has been identified with it from its inception. What the system would do when administered as a matter of routine is doubtful. No system of checks will prevent the issue of bad seed if the administration is faulty or slack; the value of every laying depends wholly upon the examination made by the farm staff and it would be a very easy matter to examine perfunctorily, to reject in each lot what was likely to be the percentage of infected seed, without necessarily rejecting actually the diseased seed. In that case the results would ultimately get bad, as the key to the whole thing is the actual microscope examination of the individual moths. This applies still more to the system of selected rearers, who are particularly liable to temptation if not very closely supervised. The scheme is a new one, it is in the hands of an energetic enthusiast, but whether it would work in the ordinary way with ordinary routine administration is distinctly open to question.

It is abundantly evident that the Silk Superintendent is devoted to the disease-free seed issue and is not interested in any other phase; though he claims that the idea of hybrids originated with him, he is convinced that no hybrid will work in the second generation in the rearers hands. He is averse to the whole idea of hybrids and there would seem to be only one way out, to put the Berhampur Nursery entirely into the hands of the man doing hybrids and selection, and to cautiously have seed tested by rearers who are indemnified against loss. Selected seed and hybrids are successes often under experimental condition, where their value is assessed not by percentage outturn, but by the value of those cocoons produced. No experimenter gives his percentage outturn. A rearer should get, say, 2 maunds per kahan of seed cocoons or 1 maund per oz. of seed, but we do not know what gross yields are given by these hybrids, etc., while we are told what the increase in weight is of individual cocoons. Hybrids and selected or ameliorated races are as yet experimental and have not been exposed to test under industrial conditions, but this must be done.

It is significant that no returns of outturn are given. In Japan an ounce of eggs yields a definite amount and they know exactly what percentage they get. I have tried to get this and failed.

Estimate—

1 kahan = 1,280 moths.		
640 females, lay . . .	{ 300 } eggs each	{ 192,000 eggs.
	{ 400 } "	{ 256,000 "
1 kahan then should give . . .		{ 150 kahans cocoons.
		{ 200 " "

Rearers get

1 kahan seed cocoons give 80 kahans.

Nurseries get

1 kahan seed cocoons give 100—110 kahans.

Their calculation is

from one kahan they get 400 female moths after examination, *i.e.*, out of 1,280, they reject 10 per cent.—1,160. Less than half are females giving only 400. Then 400 lay 400 eggs = 160,000, *i.e.*, about 125 kahans, but they reject all the late hatchings, taking only the first and reject in that way, 25 per cent.

Personally I doubt it. I think a larger percentage should be got and that the figures should be given for the broods. All through there is no evidence of percentage yield from broods.

HILL STATION.

46. A hill station has been started at Kurseong at which varieties are grown with a view to improvement of seed for the cold weather bunds. The races kept there have improved by about 8 per cent. in richness of cocoon. There is no evidence yet as to the effect of this migration on the race and the question having a hill station is doubtful. It was originally proposed by Grangeon as a means of investigating some of his crosses of Madagascar races which were not able to stand the rainy season of Bengal.

It is extremely doubtful if Kurseong with its great humidity is a suitable place; if one could find a place at an elevation, say, of 4,000 ft. or less, with a moderate rainfall, the worms would probably do better. Such a station will become necessary if the existing broods are to be improved, as this station could supply seed cocoons to the nurseries for the winter broods. But a better place than Kurseong will probably have to be found.

ECONOMIC.

47. The Farm Manager of Piasbari, with six years experience of Berhampur and Malda, puts forward the view that the increase in the price of agricultural produce and the rise in wages is responsible for much lessening in the number of people willing to rear silk. Coolies on the farm work from 8-12 and 3-5 and get 5 annas a day; in good times, such as paddy harvest, they can get 8 to 12 annas per day. A reeler, employed by a native, gets perhaps Rs. 10 per month, while most coolies get as much. A man willing to take paddy from Malda by bullock cart, to markets 12 to 20 miles away can earn easily 12 annas per day. It seems to be a question as to how far the rise in wages and the increase in the value of other produce has diminished silk rearing, it is also a question as to whether there is any distress from the decrease in the production of silk. It is stated that 25 years ago, a coolie got 7 pice a day, rice cost Rs. 2 to Rs. 2-8 a maund, inferior rice cost Re. 1-8, Re. 1-12 a maund. Now a coolie gets 5 annas a day, rice costs Rs. 7 to Rs. 7-8 a maund, inferior rice costs Rs. 5 a maund, yet the price of silk and accordingly of cocoons is the same or lower and the reeler or rearer earns no more. The price of labour and the value of produce have gone steadily up, while silk has gone down. This means—

- (1) Increased cost of cultivation of mulberry.
- (2) Greater living expenses of rearers.
- (3) Better value of land for other crops as compared to mulberry.
- (4) Worse mulberry plant as cultivation becomes more costly.
- (5) Less actual return on a crop of worms.

In fact the value of labour as applied to staple crops has gone up out of all proportion to the value of labour applied to silk, in which values have gone down. Coolies on the farms work from 8 to 12, and 3 to 5 and get 5 annas, *i.e.*, they get Rs. 9-4-0 a month, while on the average the reeler of silk gets less. A rearer with a good house and three ghoras of worms, gets 10 maunds a year worth, say, Rs. 320, out of which he has to pay rent, cultivation charges, cost of buying extra leaf; he must have at least $\frac{1}{2}$ acre of land, and buy leaf costing him in all Rs. 60 to 70 annually.

48. Enquiry has been made as to whether the diminution in the industry has led to any distress or has affected the economic condition of any large number of people.

These reports are reproduced in Appendix IV with a letter from the Collector of Murshidabad, dated 1912. The conclusion to be drawn from these and from direct observation in the districts is that the decline in prices of the silk has led to a decline of the industry with a definite amount of distress and crime: that if the issue of disease-free seed or the growing of better races leads to an increase in outturn there are many who will benefit: and that the area under mulberry and the production will very largely increase by these measures. A factor of immediate importance also is the high prices of cocoons and silk now: but this may be a temporary condition only and cannot be definitely counted on.

49. What is the present position of Bengal silk? It is exported by a very small number of European firms, in one case from the firm's own filatures, mainly for special uses in which its peculiar qualities are required. It is still largely used in India, but is being replaced by imported silk of low grade. Its price in Europe is at a well defined grade below that of other silk and so long as it is available at that price it will be used. If the export diminishes to a certain point its use in Europe will cease as unless a manufacturer can count on a steady supply of a definite grade he must abandon the use of that grade altogether: if very much larger quantities of this filature quality were available the demand would increase as, if manufacturers could count on supplies, its cheapness would induce them to use it wherever possible, but very much larger supplies must be forthcoming, and if this is so, the demand and therefore the price would rise. If it be possible to increase the production, to improve the quality, to increase the amount available for export, the demand and therefore the price will improve, but this can be done only by direct efforts addressed to the cocoon rearer, the cocoon reeler and the raw silk dealer. If the Bengal rearer and reeler cannot be influenced, the industry will persist just so far as it supplies the native demand and so far as it cannot be replaced by other industries such as jute.

50. With an improved breed, with disease-free seed, with some measure of co-operation in reeling and selling and some technical improvement, there is no reason why Bengal silk should not increase and why the price obtained for it should not improve to the point where the industry will be as profitable as any other agricultural industry. Messrs. De Minvielle, Goodman, Malcolm, the trade representatives of the Silk Committee, all agree that there is no real evidence of degeneration in the worms. They expected to get 1 seer silk from 14 to 15 kahans green cocoons at Nazirpur. They think that from the filature records on the whole the cocoons have improved in produce and that there is no real degeneration. Nor is there now any real trouble about excessive rates for mulberry lands: this may have been a factor but is not so now.

They think that, were the outturn of mulberry silk to increase, all would be absorbed in India or outside. They lay stress on this point, there is a definite demand for Bengal silk as a separate quality. It is necessary to distinguish quite clearly—

- (1) the regeneration of existing nistari and chota-polo,
- (2) the introduction of the production of other qualities. The problems are different.

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- (2) the introduction of the production of other qualities. The problems are different.

They are all of opinion that the main cause of the decline is pebrine, it kills the worms at the last stage after all the money has been spent and people have been ruined, and gone to other occupations.

51. In any attempts to produce other qualities of silk, such as the imported univoltines or crosses, it will be very important to keep this apart from the production of nistari and chota-polo breeds in Bengal. Whatever is done must be done separately. It must be clearly understood that this is a new and separate thing and that the endeavour is to stimulate the production in Bengal of a different silk which will find a separate market. Otherwise failure will result from both the efforts to improve indigenous silk and to introduce the cultivation of better silks. If once the rearers get distrustful, then great harm will be done. It should be made plain that there is a market for other qualities of silk, that these are to be sold separately and that this is a special case.

I would advise these being first handled on a large scale in a separate rearing house on an industrial scale. If the produce sells well, the rearers near by can be told and can be advised where to sell their produce or the produce can be bought by the nursery. If the rearers get a higher price, they will take to the new breeds and want them.

52. A certain amount has been done on the question of improving silk-reeling. A bulletin has been issued on the subject by the Agricultural Research Institute, Pusa, "How to improve Silk Reeling in Bengal" by M. N. De. In this 13 detailed defects in reeling are described, and an improved method of reeling is discussed, whereby the Tavelette system is adapted to the existing Bengal reel by the addition of two small pulleys. The bulletin contains a great deal of information, but its issue clearly does not in any way affect the actual reeler in Bengal. The second thing is that an improved reeling machine has been devised by N. N. Pillai, the Weaving Master of Bengal, and has been adopted to a small extent.

No improvement in silk reeling will be affected without the matter being gone into thoroughly. The reeler who adopts a new system will need help in disposing of his product. Demonstrations should be arranged for with native filatures and the fact that they can earn more with better reels should be proved by the actual disposal of produce; and it will be necessary to continue pushing this until there is a channel of export for superior reeled silk so that it can realise the higher prices that Europe will pay.

There is and always will be a steady demand for rough Khungru silk and this should not be interfered with, but improved reeling will mean another outlet, a second demand, a further use for cocoons and a revival in the output.

Looked at from the exporter's point of view there is no doubt that a very great extension of the industry would follow if natives reeled better. They reel badly, with no care, they sell hanks of all sorts, none even. Yet in the filature here, women, old men and children are all well employed. Why should not native firms go in for it? The capital required is not large, but better methods must be used. De Minvielle says there would be a very much larger demand if there were more silk. People cannot start using it if they are not sure of a large supply; if the supply trebled, the demand would more than treble.

How this is to be organised is not clear. It would require capital, time and effort, a partial effort would be quite useless, unless very large amounts were available, it would be no use. At present only one firm buy cocoons and reel fine silk; when they stop, no one will do it and only coarse silk will be produced.

53. The problem in Bengal is a two-fold one, the first is to make certain that full crops will be got from the existing varieties grown on bush-mulberry, on the system understood by the people; whether this yields fine silk to sell in Europe, or coarse silk to sell in India is immaterial so long as the supply is absorbed. It is the opinion of those interested that a very much larger output than at present will be absorbed for Indian use and for export for special use. Full crops are not being got mainly because pebrine destroys the worms just as they should spin; therefore the first endeavour should be to stop this.

If it is also possible, by selection or crossing to increase the yield of nistari and chota-polo types, all the better.

The second problem is whether, given the people, the conditions and the markets, it will pay to try to grow a different quality of silk altogether, such as the Italian or boro-polo; the latter has been grown from time immemorial and is still small. Tree mulberry is not grown and these qualities want tree leaf; it can be got for 2 bunds at least, but the silk will be an inferior Italian, will want a different market and will compete with much other silk of better quality.

There are many difficulties in the latter, but there is no harm in trying provided the first is not interfered with and provided a market can be found for the univoltine silk produced. The first necessity is disease-free Bengal breeds, the second is to try other varieties in selected localities on a small scale.

(c) THE DEVELOPMENT OF SERICULTURE IN BENGAL.

54. A consideration of the history of the industry and of its present circumstances leads one to pretty much the same conclusions, and the measures recommended for reviving the industry are here discussed.

1. The appointment of a European Superintendent. This was regarded as vital by the Oldham Committee and has never been carried out. The only work seriously undertaken is that of disease-free seed distribution which has to some extent been a failure. The only organising officer available has been the Director of Agriculture, who has many other duties. For the last few years, the Silk Committee has been scarcely even advisory, and there has been nothing real done except seed issue.

For reasons stated on pages 21-22 it is certain that the leading idea of microscopic selection of moths, in India, is unreliable and uncertain; and this probably accounts for the inability of any nursery to produce wholly disease-free seed.

2. It is now possible to issue seed of a variety which resembles nistari but which takes 12 kahans to a seer in place of 18. I would at once start the issue cautiously from one nursery only to selected villages. If the cocoons keep up, the demand should be large and that nursery should pay well. The supply of the hybrid from Calcutta must then be maintained and fresh seed be available for each *bund*.

3. The production of better races at Berhampur should be inquired into, the best races kept and industrial trials made.

4. The question of the hill amelioration of chota-polo, nistari or other races should be put on a proper footing, if these races are still required. I think that the province would benefit more by supporting the proposal for a hill station outside the Province for all India, as proposed in Chapter XXVIII and get all their races ameliorated there. Madagascar race should be grown there and seed should be available.

5. The problem of improved plant and of the disease *tukra*, needs to be tackled, and if a better variety can be found, which resists *tukra*, which will stand drought, it should be introduced.

6. The organisation of better reeling and the disposal of the produce are subjects of first importance and go with the introduction of a better race.

In this the help of an organisation outside the province is all important, as new silk, reeled to certain sizes, would probably replace at once the imported Chinese of Assam, the Punjab, Bombay, Nagpur, etc.

7. The continuance of the nurseries on the lines laid down above, till the question of the issue of a hybrid race or of the issue of really disease-free seed is settled.

55. The really important point is, not the details of the hybrid or of the plant but the change in policy. Since 1886, the development of the industry

has been mainly in the hands of N. G. Mukherji and his pupil A. C. Ghose. The Pasteur ideas regarding disease were accepted blindly, without investigation, without reference to the wholly different conditions. For 30 years disease-free seed has been issued, but no disease-free race exists at present even. The scheme has manifestly failed; every suggestion of any other improvement has been dropped; there has been a rigid narrow policy and when one considers that over a lakh of rupees was spent in 1914-15, *i.e.*, over five rupees per acre of cultivation, one is driven to the conclusion that this policy has failed and that a new one is required.

For this reason I regard the appointment of a proper European officer as the key to the situation; and he should be guided by the Silk Committee, who should be more than advisory. I think that a vigorous policy is needed, utilising to the full the expensive resources available and designed to make the reeler produce a better silk and become so prosperous that the industry will turn and mend.

I think that the policy outlined is possible and will pay, but the policy of the whole organisation must change, its attitude to new ideas must improve and there must be behind an organising expert not devoted solely to the one idea, of issuing disease-free seed, which is not really disease-free.

56. The prospects of improvement are good, especially if the Madagascar, the Cleghorn hybrid, or the Berhampur and Pusa hybrids are found to do well: there is no reason why the industry should not extend to double or treble its present extent if a determined effort is made now while prices are high: and if silk of the Madagascar type can be produced, it should compete well with the inferior Chinese so largely imported into Bombay, Madras and Burma, if this silk is introduced into the weaving centres. There is every justification in Bengal for a large effort being made to help the silk-rearer, with good prospects of a rapid extension of the industry.

CHAPTER III.—MYSORE AND MADRAS.

MYSORE.

The Mysore silk industry is an old one, supposed to have been started by Tippu Sultan between 1780 and 1790 with seed from China. It is significant that the worm is of a peculiar breed and the cocoon remarkably uniform in quality.

Writing in 1915, Mr. K. Subha Rao estimates the acreage of mulberry at 28,233 acres, 17,000 in the Mysore district, 6,000 in the Bangalore district, 4,000 in the Kolar district and 1,000 in Tumkur.* The Kolar district was estimated to get Rs. 16,00,000 from the industry and the total value is put at not less than Rs. 50 lakhs now, while formerly it stood at quite double this figure. It is confined to the four southern districts, and spreads over into the Kollegal sub-division of the Coimbatore district and into the Salem district of the Madras Presidency.

The population figures for all districts are to be found in Appendix IX; the distribution of the industry does not follow any particular distribution of religion; it is connected with population if anything, and the "pressure of population" may have something to do with it. But it is more likely to be connected with conditions of climate, soil and occupation combined.

The Census of 1911, returns only 508 persons whose occupation is the "raising of small animals" including bees, silkworms, etc., but this is no guide at all to the number of rearers concerned. An acreage of 30,000 means at least 70,000 persons directly engaged in rearing, and at least another 10,000 engaged in reeling, etc.; for all but reelers it is an occupation subsidiary to cultivating crops.

2. The mulberry plant is grown as a small bush, and is cut down several times a year. In some places it is irrigated and is used for feeding worms

* A very much higher estimate was supplied officially to Mr. Anarge and will be found on page 38 below.

also in the dry hot months, in others it is not irrigated, and is used only in the rains and winter; the plant survives the hot weather but does not yield leaf then.

It is possible that the present system of planting and cultivation is the best and the plants I saw were usually extremely good, but it is likely that a better system of planting would give much better leaf and higher yields. The cuttings are planted very thick in the row, the rows being very close together; fewer or even single cuttings, planted at 2 feet apart in the row, and the rows made three feet apart, might give better results; possibly the dwarf standard system referred to in Chapter X would be better still. Only experiment can decide.

The plant generally grown may be *Morus Indica*, the Indian mulberry, or *Morus alba*, possibly from Europe or China, or some other variety. The question of the identity of the mulberry is discussed in Chapter X.

As the plant grows from cuttings, other varieties are at least worth trying, notably male varieties and such varieties as the Cleghorn.

It is impossible to suggest detailed improvements without an intimate knowledge of the soil, climate, etc.; the question of manuring is, I believe, being investigated in the Agricultural Department. Mysore should benefit from any results obtained in leaf production by the Indian Tea Association's experiments on leaf production; there is however nothing that immediately calls for improvement or inquiry, though the points I mention may be usefully considered in any scheme of experiments. There is apparently no serious disease of the plant and care should be taken not to introduce any.

REARING.

3. The worms are reared on trays placed on racks, which stand in a part of the dwelling house; the trays are usually round, made of bamboo and leeped with cowdung. As the fly pest is not known, wire gauze protection to the windows and doors is not required. The racks are made of wood or bamboo, holding usually ten trays one over the other. The bamboo cross pieces on which the trays are laid are liable to attack from the usual wood boring beetles, which produce abundant dust; this is believed to be bad for the worms. The art of treating the bamboos, or of soaking them to make them immune to the beetle appears to be unknown.

The moths emerge from the cocoons, and lay eggs on the tray, the eggs hatch and the young worms are transferred by means of a feather to a bed of chopped leaf in the usual way; in one case, a very careful rearer was protecting the eggs from the dry heat by placing over the tray a frame on which wet cloths were placed; in this way the hatching was quite uniform and the young worms healthy. As a rule the rearer who hatches the eggs rears the worms only to the second moult; he then sells them at Rs. 4 a tray to other rearers, who buy from him on the understanding that if all the lots fail he is not to be paid, but that if one of the lots succeeds, even if the rest fail, all are to be paid for. This method enables one man to specialise on seed production and uniform hatching.

A single tray of second-moult worms will make 9 or 10 trays of worms to spin, each yielding 13 seers of 28 tolas weight of green cocoons; this amount is the unit, the thooka, as the kahan is the unit in Bengal. A thooka sells for Rs. 3-10 or Rs. 3-12 at present.

4. The rearer from the second moult onwards either grows leaf or buys it; in the latter case he buys it on the land, paying a fixed price for the area of mulberry from which he takes leaf or paying for the amount of leaf needed for a definite number of trays. When the worms are full grown, they are placed on chandrakis to spin; the chandrakis are of the usual Bengal sort and are placed in the open air under a tree; many rearers do not own their chandrakis but hire them at from 6 pies to one anna each per day. These rearers are anxious to cut down the cost and so allow the cocoons to remain only a short time, removing them in 24 hours from the time the worm starts spinning. This is too short a time and the cocoons should certainly be allowed

a second day, especially if any are to be used for seed purposes. Those rearers who own their chandrakis allow three days. In the demonstration rearing houses, the worms are allowed to spin on twigs laid on the trays; this is a custom in Italy but there are better methods also used in Italy, notably the hurdle of twigs placed over the trays. The former method has presumably been introduced by Signor Mari, but, from inspection only, I am of opinion that cocoons spun on twigs are not so good as those on chandrakis. The system of spinning on chandrakis in the open is better than spinning in twigs and trays in buildings, as the worms at spinning have to eliminate a very large amount of moisture and require also a free supply of air; this the chandraki provides.

Unless there is direct evidence of benefit I would not attempt to introduce the twig method; and if no experiments have been made, I would suggest testing the value of cocoons from say 10,000 worms on the chandraki and on the twig system. If twigs are good, then the more recent Italian method of hurdles will probably be better than the present practice of laying the twigs over the worms.

5. In rearing no nets are used and Signor Mari has introduced the perforated paper method. This is probably sound, especially if a machine is provided for stamping the paper and so enabling the perforated sheets to be supplied cheaply.

6. For reeling purposes the cocoons are killed by being steamed in baskets placed over hot water or near a fire: it is likely that the use of the dry heat of the sun would be better.

• The reels are extremely primitive and simple; no buttons are used; only iron plates with large holes; the threads only cross once. The guides on the rocking bar are usually absent and at best are large iron rings; but the thread is surprisingly good and the workers evidently very skilled. Most do two skeins, but in some places all do four skeins at a time; the usual amount reeled in a day is $2\frac{1}{2}$ to $2\frac{3}{4}$ seers of 28 tolas, *i.e.*, $1\frac{1}{2}$ lbs. of raw silk; an equal amount of waste silk is produced, and it requires some 11 seers of green cocoons to make a seer of silk.

The cocoons are very much better than those in Bengal. They reel better, they give more silk and the product is, despite the poor reel, very much better than the average *khungru* silk of Bengal.

The waste silk from the reeling is dried and sold. It is of poor quality and fetches about Rs. 60 per maund of 80 lbs. The winding waste is as a rule not used but allowed to waste.

The inner unreelable shell is mostly unused and wasted; while the pierced cocoons are made into a very coarse inferior thread, which is used for making cords, threads, etc.

7. The industry is very much sub-divided. There may be the following series:—

- the mulberry leaf grower,
- ✓ the egg-producer who rears to second moult,
- ✓ the rearer from second moult to spinning,
- ✓ the chandraki hirer,
- ✓ the reeler, who dries the cocoons and reels,
- ✓ the raw silk dealer,
- ✓ the waste silk dealer,
- ✓ the pierced cocoon spinner.

A single individual may combine these, growing his own leaf, hatching his own eggs, rearing them to cocoons and employing reelers to produce raw silk. The egg-hatcher and the chandraki-hirer are peculiar to Mysore; the former may be a desirable sub-division of labour, as he can specialise on seed production, and as the class may be easily approached by the State; but the latter is a very undesirable sub-division that should be eliminated.

8. Diseases are of the usual kinds, so far as is known, without the fly pest. Pebrine is believed to be the most serious disease, and supposed to have been the cause of the great restriction of the industry during the last ten years. Flacherie, grasserie and muscardine also occur. The methods of disinfection with copper sulphate and with the fumes of sulphur are not practised nor apparently known; after disease has destroyed the worms the trays are leaped with cowdung.

9. The industry is clearly a profitable one. A rearer buys 4 trays of second moult worms for Rs. 4 a tray; he gets 40 thookas of each 13 seers of 24 tolas as green cocoons; selling each at Rs. 3-12, *i.e.*, he gets Rs. 150. He will do this on a smaller scale 6 times a year, he will have say 4 acres of wet mulberry on which he pays Rs. 30 assessment and his total expenditure will be perhaps Rs. 200. Allowing for failures, etc., he will get cocoons worth say Rs. 500, making between Rs. 200 and Rs. 300 on the year.

Another case: 1 acre of wet land gives leaf 5 times a year; sold for Rs. 60 a time; in addition, the man has leaf enough to rear 2 thookas of second moult worms, four times a year. His cocoons will be worth Rs. 270, his leaf Rs. 300. This is an exceptional case and the owner applies 10 bandy loads of cattle manure per acre to get this yield. He gets during the year some 360 maunds of leaf probably, of which he sells 240 probably and uses himself some 120.

This is a higher yield than is got in Bengal but the plant is better treated, better manured and is itself probably a better variety.

The reeler's profits are as follows:—

	Cost.	Cost.
	Rs. a. p.	Rs. a. p.
25 thookas of green cocoons of 13 seers each	100 0 0	
give 30 seers raw silk . . . . .	. . . . .	135 0 0
" 30 " waste . . . . .	. . . . .	8 0 0
		143 0 0
Cost of reeling is—		
Reeler 10 days at 7 annas	4 6 0	
Winder 10 " 4 "	2 8 0	
Fuel	3 2 0	
	10 0 0	
Total outlay . . . . .	. . . . .	110 0 0
Total return . . . . .	. . . . .	143 0 0

} = 33 = 00

These figures are of course only typical.

10. The raw silk is sold to local merchants in skeins just as taken from the reel. It fetches from Rs. 13 to 16 per seer of 80 tolas. It is sold in Bangalore, and other weaving centres for use by local weavers and is sold extensively as well in Madras weaving centres. Mysore returned 2,478 silk spinners and weavers in 1911, and 33,673 cotton sizers and weavers. Madras returned 74,773 silk spinners and weavers, and 1,118,628 cotton spinners, sizers and weavers. The raw silk produced in Mysore is used by these people.

The waste is collected by merchants, who export it through Madras. It is used for spinning yarn in mills in Europe.

Dealers inform me that the raw silk used to go in large quantities to Glasgow, then to London and now all is sold locally, the demand abroad having ceased.

output
OUTTURN ESTIMATE.

11. There are 20,000 acres of dry mulberry giving 4 crops a year and 12,000 acres wet mulberry giving 5 or 6 crops. Assuming on the average 120 maunds leaf per acre, 20 maunds leaf per maund of cocoons, and only 6 lbs. raw silk per maund of cocoons, you get a yield of 192,000 maunds cocoons, giving 1,152,000 lbs. of raw silk and about a million lbs. of waste.

YIELD.

Irrigated land, 10,000 acres.

	Rs.
1st crop,—40 trays,—Rs. 150	70
2nd „	60
3rd „	50
4th „	50
5th „	30
6th „	30
	290

Unirrigated land, 20,000 acres.

1st crop	60
2nd „	50
3rd „	40
4th „	30
	180

Total Rs. 65,00,000 — allow loss from disease $\frac{1}{4}$ (Rs. 13,00,000)=Rs. 52,00,000.

The return per acre to the grower varies and is difficult to estimate. Most use part of the leaf and sell part. The cultivation is less popular than garden crops such as potato or sugarcane. Where there is irrigation, cane is a surer crop than silk worms which run the risk of disease and the extent of the industry will clearly depend on the competition of other profitable crops.

EXTENSION OF THE INDUSTRY.

12. The Mysore State is climatically the most suitable area for multi-voltine silk in India and there is scope for a very large extension of this profitable industry. But the utmost care will be required to improve the industry and great harm will be done if the lines on which improvement is possible are not carefully considered beforehand. More harm than good will result by pressing injudicious measures; the industry is at present a large and profitable one.

13. During recent years, the Mysore State has had the advice of a number of experts, and a great deal has been done to stimulate the industry. Mr. Tata was the originator of improvement, in that he started the Silk Farm at Bangalore under the Japanese Expert Mr. Odzu. After some years this farm was taken over by the Salvation Army, who still carry it on. At the instance of Mr. A. Chatterton, the Director of Industries, an Italian expert has been appointed, partly at the suggestion of Dr. Gorio, the Italian Consul-General in Bombay.

As Director of Industries, Mr. Chatterton, has been interested in silk weaving and so becomes concerned with the quality of the silk produced in Mysore. He has commenced experimental silk reeling and having concluded that better silk reeling is required he is proposing to erect a filature on Italian lines at Bangalore.

Dr. Gorio is interested in the industry from the point of view of the export of cocoons or waste. Italy is an importer of cocoons. Dr. Gorio is connected with a firm that spins waste silk and exports spun silk to India. His interests are quite definite and his advice has been to develop the production of cocoons and to improve their quality, while abandoning silk-reeling as a cottage industry. Signor Mari is interested in the production of seed in Italy and is part proprietor of a "Grainage." His work has been partly in the direction of introducing improvements such as wood frames for trays, spinning on branches, etc., partly in the direction of introducing univoltine varieties from Italy or of producing a hybrid race. The Salvation Army are dealt with fully in Chapter XI, but their interests lie in the employment of

orphans, criminals and others, and they find silk-reeling a profitable occupation; their efforts are directed to making profitable the labour they can command with the zealous and cheap supervision of their staff and their interests do not lie in the direction of improvement of any part of the industry, except the production of cocoons. The above cover the sources of 'expert' advice that the Mysore State have engaged, with the addition of one or more natives of India trained in Japan, who have been employed by the State.

STATE ACTION.

14. The industry is now being fostered by the State authorities and its development is being stimulated in common with other industries. A staff is employed by the Agricultural Committee of the Economic Conference, to improve and extend sericulture; a summary of their activities, prepared in 1913, is published; it comprises—

- (1) General sanitation and ventilation of the rearing rooms.
- (2) Reserving rearing rooms for rearing only.
- (3) Having eggs laid on paper,
Keeping fewer worms on each tray,
Regulating size and number of trays according to the room.
- (4) Demonstrating the use of nets, magnifying glasses and sprayers.
- (5) Disinfection of rearing rooms.
- (6) Distribution of newspapers, sulphur, copper sulphate.
- (7) Having more frequent cleaning of trays.
- (8) Better feeding, removal of sick worms, etc.
- (9) Raising healthy seed cocoons.
- (10) Collecting statistics.
- (11) Generally assisting the ryots to use modern methods.

These are detailed improvements, mostly of a minor nature, aimed at improvement of the rearing.

15. Signor Washington Mari took charge on 26th December 1913 and worked until his departure in 1915. His reports, that I have seen, end with July 1914.

His policy has been to introduce Italian methods of rearing, and to endeavour to substitute for the Mysore worm either an Italian race or a hybrid. His influence in getting the people to use wood frames instead of bamboo is apparent, but there has not been time for more to be done. He started the Central Station at Chennapatna, put up buildings there, planted mulberry, started seed examination, disinfection, and hybridisation. He trained a number of men in Italian methods and started model rearing houses in various silk centres. These rearing houses contain frames for trays of solid wood bolted together and the worms are made to spin on branches; other improvements are introduced and the well-to-do rearers are being encouraged to adopt Italian ideas.

I have no sympathy with a policy designed to introduce Italian methods to a new country and to a different people. The condition of the people, their customs, the climatic conditions, the nature of the silk worm have all to be considered. There is no evidence that Italian methods in Italy are better than Mysore methods in Mysore and the policy being followed is not necessarily the best. The industry as it exists is one that brings in from sixty to eighty lakhs of rupees to the country, that gives a subsidiary or whole time occupation to some 70,000 to 100,000 people and that is in a reasonably prosperous condition. One does not wish to disturb that industry without the most careful consideration without very definite assurance by experiments that the alteration is an improvement, and without the very best evidence that the alteration or improvement will be suited to the conditions of the people.

I would urge that before any further efforts are made, the industry be very carefully scrutinised, the nature of the improvement very carefully examined, its value tested by exhaustive experiment, before any attempt is made to urge it on the people.

The following extract from the Report on the Administration of the Mysore Revenue Department deals with the position in 1914-15:—

Sericulture.—The Deputy Commissioner of Bangalore reports that there has been steady progress in sericulture during the year under report, though owing to the war the trade in silk suffered much and new seeds could not be imported for experimental purposes. Successful experiments with imported seeds are stated to have been conducted at the Silk Farm at Chennapatna.

The Silk Rearing Farm originally established at Chikballapur was transferred to Kolar town. As an adjunct to this farm, mulberry cultivation on improved methods was started on a plot of ground placed at the disposal of the Agricultural Committee by the Agricultural Association at Kolar.

The question of improving sericulture in the Tumkur District is receiving attention. Mulberry was grown on a larger extent of land in the Mysore District than in the previous year. The construction of a model rearing house at Karohatty in the T. Narsipur Taluk was sanctioned by the Agricultural Committee and the building is said to be nearing completion. Attempts are being made, it is said, to introduce sericulture in taluks where the industry is not carried on now. A silk farm has been opened in Hassan town. The experiments conducted in the Kadur District regarding the possibility of introducing sericulture to the district on a large scale are stated to have been very successful. It is reported that the conditions obtaining in the Shimoga and Chitaldrug Districts were found to be unfavourable for sericulture.

IMPROVEMENT.

16. Looking at the industry as a whole, seeing what a prosperous one it is and how it is, in its present conditions, suited to the people, I would consider improvement very carefully under two classes; fundamental measures, of first importance, which can be done only by the State; detailed improvements, which may be rigorously tested and then cautiously introduced after full experience of their working in selected localities.

1. The first and most important measure is the issue of seed, which can be reasonably guaranteed as free from pebrine. As in Bengal, the rearers in Mysore like to have their seed from a distance and there are prejudices in various districts as to suitable places to get seed from. A beginning has been made with small farms such as Chennapatna, where moths are examined and from which layings are distributed.

In this respect Mysore has one advantage; the rearers will take eggs and do not object to them, as in Bengal. The difficulty will be to supply the demand, which will be large. It may probably be assumed that it will be necessary to supply disease-free seed in each locality once a year, *i.e.*, that in any locality or area in which say four broods are taken, the aim should be to work up to a production of a quarter of the total seed required in each brood, so that every one may get disease-free seed once a year, and as rearers like seed from a distance, the stock required from which to produce the eggs will need to come from a distant station at which it is examined. What is required then is a series of rearing houses with mulberry plantations, which can distribute between themselves disease-free stock, from which they can issue disease-free seed locally.

A preliminary to this is the mapping of the producing areas and the selection of sites that will cover the whole area eventually.

This is no small work; it requires judgment in selecting sites, intimate knowledge of the places and requirements; it involves a large staff, a considerable expenditure. But if properly developed from small stations carefully chosen, the seed supply should almost pay from the start.

The experience of Bengal will be useful in showing what mistakes to avoid. Above all it will show what a great failure can be achieved if the scheme is planned badly without the judgment necessary to select the proper sites.

It is necessary to select sites very carefully after full consideration. It is then necessary to start on a small scale but always to endeavour to supply seed up to the demand, and above all it is necessary never to make mistakes. I think such a scheme will work well in Mysore, but it is essential to plan it as a whole from the start and not just to begin here and there anyhow. It should be planned on the assumption that it is ultimately to supply all the seed required. Clearly, the work on pébrine above referred to will be of vital importance in this connection and no action should be taken till Mr. Hutchinson's enquiries indicate how pébrine can be best dealt with.

2. Assuming that it is determined to supply seed, I believe the greatest improvement will be to produce the stock for that seed at an elevation of some 1,500—2,000 feet above the general level of the country, maintaining there a disease-free stock of the pure Mysore breed, and issuing from that invigorated disease-free stock to the rearing and distributing stations. This seed station should be in a place with a suitable climate, not too wet. Nandi Droog is probably suitable but there may be better places. Having visited Nandi Droog in April, I think it is suitable if the humidity is not too low. I attribute very great importance to what may be called "Hill Stock." I think it is the cheapest, quickest and easiest way of improving the race. This improvement may be accentuated by selection; assuming that the rearer has no prejudices about the cocoons, I would select for breeding good average cocoons neither very small nor very large, with round ends, and endeavour, year by year, to make the cocoons better; side by side with this selection, the largest cocoons may be separately selected and bred as a distinct race till it is seen to what extent the stock improves; experience of selection elsewhere (see page 95) shows that permanent improvement is not usually attained by selecting, beyond a definite limited point.

3. The next problem is the substitution of the Mysore race by a better or its improvement by hybridising.

The Mysore race is a good one, better than any Bengal race, suited to the country and the silk suited to the weaver. No attempt should be made to replace it till it is certain that something better has been found, that the whole country can adopt and that the trade can use. I regard it as a great mistake to give out any other race to rearers tentatively or until the most exhaustive examination has been made. Great and irreparable harm may result from the rearing of univoltine or other races by rearers who may cross this with the Mysore race and ultimately mix the race. The present race is a very uniform one; and the introduction of other strains may do enormous harm if the strain passes out of control, if the resulting silk loses its qualities and if there is not uniformity. Whatever is done with other races must be done under absolute control and if given to rearers must be done under rigid conditions of isolation.

In considering other races there are—

- (1) univoltines,
- (2) the Madagascar or accidental multivoltines,
- (3) bivoltines or foreign multivoltines,
- (4) existing hybrids—Pusa, Cleghorn, Berhampur, Mysore,
- (5) the creation of hybrids.

If a central sericultural station existed where a fully qualified assistant was producing hybrids, from a great variety of stocks, Mysore would be well advised to rely on this station and not to attempt a difficult problem, when there is so much else to do. Should such a station be created I would advise that Mysore benefit from its work; in the meantime, advantage might be taken of the existing work on hybrids and some might be tried under strict control at an experiment station in Mysore.

The question of growing univoltines in Mysore is out of the question. There will be one brood a year from hibernated seed from some outside source; to get more broods will mean special cold-storage arrangements either natural cold-storage in the Himalayas or artificial storage in an ice-factory. Mysore needs a many-brooded race and if the French quality of race is wanted, can find it in the Madagascar race; but there are objections to this: the silk is yellow, is of a different quality to the Mysore and the lustre of the Mysore silk is absent; the worm is larger, needs tree mulberry and will not easily be taken by the rearers. I would advise having the Madagascar race available in Mysore under strict control but not introducing it.

There is then the question of other multivoltines or bivoltines. No Indian race is so good as the Mysore, so one must go outside India for these; this should be the business of a central station and not of Mysore; it is possible a better race will be found that suits Mysore but to find it would be a serious tax on the resources of Mysore.

There is next the question of existing hybrids, produced (1) by Miss Cleg-horn, (2) at Pusa and at Berhampur; these have been aimed at the production of a better Bengal Yellow race but there are hybrids existing with the Mysore race. I think as yet these are too untried for any opinion to be expressed but certainly Mysore should benefit by the existing hybrids and test them in Mysore; if they are better, if they are the same quality of silk, if they are fixed in brood and silk characters, they may be cautiously introduced after very careful trial in Mysore. I think none have reached this stage but the available hybrids should certainly be brought to Mysore if they can be reared there under control.

There remains the creation in Mysore of improved hybrids from the Mysore stock. This would be the natural course if Mysore were an isolated country with only its own resources to draw on and if the existing hybrids are of no use; if there is no prospect of a Central Station where a proper staff can concentrate on hybrids and foreign races, then the question of producing in Mysore an improved hybrid, fortified by selection and hill-rearing would need to be considered. The difficulties are not great in the experimental stages but they are so when seed has to be produced on a really large scale. If it is possible to do this on a large scale under existing circumstances, and to really do it properly, then it is clearly a desirable thing; but I am of opinion other things should come first.

4. Among the improvements that are of vital importance I class the improvement of the waste; the waste silk or chassam produced by the Mysore reeler is very poor and a higher price, and probably a better demand would follow if a better quality were made: this would require the training of an assistant in the best methods, and the demonstration to reelers; if dealers would not give the higher prices, some State action would be required in buying the better waste and finding markets for it until the usual trade channels handled it. The price obtained for waste varies so much according to quality, which is a matter of extra trouble and better methods, that probably a considerable extra amount can be earned by improvement.

5. Mysore is happy in not having the Bengal fly-pest and it is to be hoped it will remain in this condition. If the Bengal fly-pest ever gets in, the industry will suffer very heavily indeed. Some day an enterprising rearer will get live cocoons from Bengal to try a new stock and the pest will come in. I think that in view of the increased activity in sericultural experiments and the blind way in which experimental sericulture is being done in India without expert advice, the importation of live cocoons should not only be prohibited but really actually made impossible. Whether this is possible or not, I have not the necessary means of knowing but the State should certainly consider its feasibility.

6. It is a typical Indian anomaly that one part of the continent should produce a quality of silk and export it, while another part imports a similar quality from a foreign country. If Mysore were to improve the race of worms, get better seed, get a larger crop, an effort should be made at the same time to find a wider market and this market exists in India. The greater

part of the silk imported to India is the coarser grade from China, and much of this could be replaced by Mysore silk if this silk was known. I refer specially to the ordinary reeler's silk and not to improved silk produced on some other system of reeling. I think that Mysore should benefit in this connection from an interprovincial organisation such as is recommended in Chapter XXVII which would be able to place users and producers into touch, which could help Mysore to know what grades to produce and where to find markets. I place this among the most important improvements and Mysore would benefit very materially from the existence of such an organisation.

17. The above seem to me the really important things that require to be done and the one on which I think the activities of the department should be concentrated first is the issue of improved disease-free seed. I believe in having as simple a plan as possible and not in dissipating energy in a number of small things. What is wanted is a real survey of the rearing areas: the establishment of a Central Nursery at an elevation, where selected, regenerated disease-free stock is produced; there is then required a number of small nurseries from which the seed is issued and these must, from the first, be placed in strategic points; there must be permanency of policy and continuity of effort; when this is well in hand, other and minor things can be undertaken.

18. Before discussing minor improvements there is one subject that needs treatment, the improvement of reeling. At first sight, the reeling looks abominable and an improved process would seem to be the first essential. But the reeling, though with primitive appliances, is skilful and the result good (an easy and simple improvement would be to get breaks knotted and not simply joined on). It is the class of silk in demand in Madras, there is a good market for it and any real success in effecting improvements might very seriously dislocate trade. Re-reeling might do much more good than improved reeling but it is a question of whether improved prices would be obtained for re-reeled silk without some form of marking and a good deal of organisation in getting this known. The first thing that is done by weavers is to wind off the silk, knot up breaks and sort out bad bits; that can be done more rapidly with re-reeling machines in small hand factories than by the weavers; but it would be necessary to fix a stamp or mark and to get this known, before the weavers would pay more for it. It is probably more a matter for local enterprise than for State action.

It is worth noting that the silk produced by improved reeling systems, such as the Japanese, finds a poor local market and I was unable to find that the Tata Silk Farm had in any way influenced local reeling. The Salvation Army buy cocoons, reel them at Bangalore and Closepet with cheap labour and very cheap supervision, yet they require grants to keep the establishment going. It does not look as if improved reeling is needed, unless there is a short demand for the local reeled silk and new markets have to be found. If that is so, there is still the question of whether it will be better to find markets in India for the ordinary Mysore or to reel and re-reel fine silk and find a market in Europe. An intelligent study of the local demand would show when it was necessary to find an outlet for surplus silk by improved reeling and sale in Europe; that moment does not seem to have come yet.

19. There are small improvements which the department would endeavour to introduce, always remembering that the really important things come first; there is a tendency to attempt too many improvements, some of a trivial nature and to fritter away money and energy uselessly. One is the chandraki-hiring, a pernicious system that should be abolished. A better system of providing for spinning would probably do away with the chandraki and it should not be beyond the ingenuity of local talent to devise a better system, not necessarily a Japanese or Italian one.

20. Another is the use of nets or perforated paper, which is being grappled with. The State is increasing the number of model rearing houses with fine solid-wood frames and all improvements. I class this among the things

done for show and not really likely ever to do the slightest good) They are on a par with the "Silk Farms" referred to in the Administration Report and the Salvation Army "Silk Farm" at Bangalore; they occupy the staff, they take time and effort, but they seem to me to be not essential or really much use.

21. An improvement can probably be effected in the plant and its method of cultivation, but this is purely a matter of local experiment; the various varieties need to be tested, the several methods of cultivation tried and the one found which is best suited to Mysore conditions.

Statement showing the area under mulberry from 1902 to 1912 and referred to in footnote on page 38.

Year.	Mulberry. Acres
1902-03	42,244
1903-04	44,605
1904-05	41,069
1905-06	71,821
1906-07	57,160
1907-08	64,485
1908-09	67,942
1909-10	69,520
1910-11	80,192
1911-12	69,022
1912-13	67,778

N.B.—As per statistics compiled by Mr. K. B. Srinivasalingar.

MADRAS.

SILK REARING.

22. The only area in Madras now known to produce silk is the Kollegal taluk of the Coimbatore district, bordering on Mysore and geographically part of the Mysore plateau. The acreage reported under mulberry varies from nine to fourteen thousand acres, so that some twenty-five to thirty thousand persons are presumably concerned in silk rearing as a main or subsidiary industry. The race grown is the Mysore race, and the mulberry cultivation is the bush plantation similar to that of Mysore. The methods are those of Mysore and the industry is similar to that described for that State.

Improvement of the industry has been taken in hand and a fieldman appointed to teach improved methods. The following note shows the lines upon which work has been done:—

The Director accompanied by Mr. Ballard made a careful inspection of the work done by the fieldman B. V. Raghavendra Rao during the year 1914 and also of many of the rearing houses in the villages surrounding Kollegal. The ryots had undoubtedly been prevailed upon to exercise more care and cleanliness in rearing, but it appeared clear that so long as the Fieldman's time was spent solely on touring and preaching, it would be difficult to obtain any clear idea of the value of his work. He was therefore directed to concentrate his attention on a few of the nearest and most important silk rearing villages, rear himself disease-free seed and sell it to ryots at rates well above market rates and not at half rates as was done in the previous year. To this end, the shed in the taluk compound was improved and repaired. Arrangement was made to obtain from the Bengal Central Sericultural Farm at Berhampur a supply, on payment, of seed guaranteed to be free from disease.

The idea to plant up part of the land with Philippine mulberry which is considered better than the local kind could not be carried out as the Salvation Army at Bangalore demanded an exorbitant price for it. The seed obtained from Berhampur had to be discarded as it was found to be diseased. A fresh supply of 1,000 guaranteed seeds was next obtained from the Mysore

Central Sericultural Farm. The Mysore seed was successfully reared up to the fourth month at which stage some 14,500 healthy worms were obtained. A spell of cold weather and rain intervened and 13,500 cocoons were spun. Of these, 13,000 were sold for seed purposes without any difficulty at a rate of Rs. 2-12-0 per thousand when dealers in Mysore were prepared to sell cocoons at the rate of Rs. 2-4-0 and Re. 1-8-0 a thousand—an excellent index to the superiority of the Government seed. The Director mentions that all the seed was absolutely free from pebrine and flacherie, the two diseases which are most difficult for the untrained to detect in the early stages and to which is ascribable 75 per cent. of the loss which attends the rearing of silk worms. All the Government seed was sold in Doddindavadi and the neighbouring villages so that the Fieldman could see that it was properly treated by the rearers during the later stages. In consequence of this supervision on the part of the Fieldman, the general results are reported to be thoroughly satisfactory.

The Director states that an attempt was made to rear univoltine species from seed obtained from France through the Salvation Army at Simla. Although the instructions connected with this work were carefully followed, none of the worms survived the second moult. A similar fate is stated to have befallen eggs obtained from Pusa. The French seed was also tried at some of the local Salvation Army settlements with no better results except at Bettupadi. But the success obtained here is ascribed to pure chance. Samples of the yarn and cocoons produced at Bettupadi were shown to the dealers in Kollegal and the Director reports that they impressed them favourably. Arrangements have been made by the Director to continue the trials with the French seed and to make trials with the Philippine mulberry.

The Director considers it desirable to continue the silk rearing work for some years to test it thoroughly. He observes that if flacherie and pebrine, the most deadly of all silk worm diseases, can be reduced to a minimum in Doddindavadi alone so that the village may obtain a reputation for producing disease-free seed, a very considerable increase in the output of silk from the surrounding villages is sure to result.

23. It is fortunate, that the seed imported from Bengal failed, as its success might have introduced an inferior variety, which might have been crossed with the Mysore race and led to an impure race. The introduction of a Bengal race cannot be an advantage until Bengal has a race better than the Mysore, and if an attempt to introduce a new race, by means of seed cocoons, led to the introduction of the fly-pest, great damage would be done to the industry in South India. If the acreage of mulberry is correctly reported and it is used in the production of silk, it would be desirable to work on similar lines in Kollegal to those for Mysore, and a small hill plantation for the production of selected ameliorated Mysore stock would be easily provided near Coonoor. Possibly the Madagascar race would succeed, if introduced under very strict control and in one selected village, until it could be fully tested. It would also be desirable to test a hybrid of Madagascar and Mysore under the same rigid control. Whatever is done, however, should be done in co-operation with Mysore. If in Kollegal one policy is followed and in Mysore another, there may be difficulty; especially is this the case with regard to the introduction of any new variety of silk-worm; it would be satisfactory if in regard to this Mysore and Madras could agree to work together, having a joint Committee to decide as to the proper lines of progress.

CHAPTER IV.—KASHMIR AND JAMMU.

KASHMIR.

The three salient features of this area are the abundance of natural mulberry, the elevation and climate (see Appendix VIII), the indigenous silk industry that has existed for long years.

2. A silk industry has been in existence here for a long period and an indigenous variety of silkworm was grown here, the silk was locally reeled and used for weaving or for shawls, the waste was used for embroidery and there is no reliable information as to the character and extent of this industry.

The original worm was a univoltine, producing yellow and white cocoons, when the pebrine epidemic occurred in the year 1855, attention was drawn to fresh seed and during succeeding years the world was searched for seed. Duseigneur Kleber records the journey of two Italians to Kashmir and the results of their inquiry, with also the description of the cocoon.

Appendix V. contains an extract from the above work, with a technical description of the cocoon: I have added an extract from Sir Walter Lawrence's "Valley of Kashmir" and the Annual Report of the Director of Sericulture, Kashmir, for 1915-16: these are valuable for reference and as showing the early history and the present state of the industry. I have also included copies of the Rules regulating the use of trees and the possession of cocoons.

3. The history of sericulture in Kashmir is obscure and probably would not be of much value if we knew it. There was the indigenous industry with the indigenous worm, trees grow wild in the valley and are extremely abundant, and silk was produced for local use in weaving and shawl making many years ago probably. According to Liotard, the development of the industry was taken in hand in 1869 and the State developed the production, which was made a state monopoly. The following figures show what was done:—

1869	976 maunds of cocoons.		
1870	994	"	"
1871	697	"	"
1872	3,337	"	"
1873	3,973	"	" of which 42½ in Jammu.
1874	5,427	"	" 232 "
1875	7,819	"	" 258 "
1876	10,025	"	" 308 "
1877	3,898	"	" 512 "
1878	562	"	" 538 "
1879	338	"	" 337 "
1880	44	"	" 43 "
1881	144	"	" "

According to N. G. Mukerji, pebrine was introduced with introduced seed and led to this downfall. His statement can be read in Watt's Dictionary of Economic Products, but it is not clear what evidence he bases it on. In 1890, some seed was obtained from Italy, but both indigenous and introduced seed was used.

The Department of Sericulture was organised in 1888, Babu Rishibar Mukerji, the Chief Judge, being in charge. Its history commences in 1895-96 with an annual report. In that year 27 seers, 5 chittacks (896 oz.) of local seed gave a crop of 296 maunds of cocoons. In 1896-97 13 seers, 5 chittacks, seed, 297 maunds cocoons and 26½ maunds of silk were produced and sent to London.

In 1897-98.—Imported seed was used in part, 4 seers (131 oz.) of European seed being imported and 8 seers, 11 chittacks (284 oz.) local. The crop was grown by 400 rearers, was 469 maunds and was bought for Rs. 4,000.

In 1898-99.—There were 1,452 rearers, the local seed failed, the produce of 1,968 oz. imported cost Rs. 11,500 and amounted to 1,250 maunds of cocoons.

In 1899-1900.—There were 2,871 rearers, the local seed failed again. 9 maunds 19 seers (12,431 oz.) local seed given to 2,074 men realised produce worth Rs. 2,800. 5 maunds 12 seers (6,953 oz.) imported seed given to 797 men realised produce worth Rs. 55,000.

In 1900-01.—No local seed was used. There were 15 maunds (19,680 oz. seed), 4,278 rearers, who got 9,637 maunds cocoons, bought for Rs. 1,25,645.

In 1901-02.—There were 20 maunds seed (26,292 oz.), 5,887 rearers, 12,681 maunds cocoons.

In 1902-03.—20 maunds (26,292 oz.) seed, 8,158 rearers, 22,000 maunds cocoons.

In 1903-04.—26,292 oz. seed, 11,066 rearers, 16,325 maunds cocoons.

1904-05.—30,928 oz. seed, 11,362 rearers, 13,142 maunds cocoons. The produce is only 17 seers per oz. In this year weaving started with 12 looms.

In 1905-06.—26,675 oz. seed gave 22,351 maunds, *i.e.*, 33.8 seers per oz., there were 12,139 rearers.

In this year 500 maunds of cocoons were sent to Bengal to be reeled.

The profit balance was Rs. 4,22,089. The position is well shown by the Director's statement:—

*“ Ten Filatures have been built, containing 1,800 basins for reeling cocoons, fitted with Italian machinery, giving employment to over 5,000 people in Srinagar.

The quality of the silk steadily improves, and it now commands a price slightly below Italian silk. The present price is a little over 15 shillings a pound.

In 1897 only 406 ounces of eggs were imported, while for 1906 the import was 27,500 ounces.

The number of Zemindars taking seed has risen in the same period from 150 to 14,400, and the weight of cocoons reared from 375 to 21,400 maunds, while the payments to the rearers increased from Rs. 4,300 to Rs. 3,28,500, all the eggs and mulberry leaf being given free of cost.

The total production of silk in 1905-06 was raw silk 1,09,072 pounds, and silk waste 43,349 pounds.

The profits since 1897, when the industry was started on a scientific basis, have been Rs. 15,35,000, last year being Rs. 4,58,000.

The total outlay on capital is Rs. 7,25,000, whilst the working expenses are about Rs. 7,00,000 a year.”

In 1906-07.—27,544 oz. gave 21,409 maunds, *i.e.*, 31 seers per oz., there were 14,427 rearers. As the Bengal reeling paid, 1,500 maunds were sent there, 770 maunds of double cocoons were sent to France. The production of seed from the imported stock was tried.

In 1907-08.—28,221 ounces, 28,421 maunds of cocoons, 17,433 rearers. The yield is 40 seers per oz. The return per rearer is nearly Rs. 25 per head.

In 1908-09.—27,954 ounces, 23,490 maunds, rearers 18,949, yield only 33½ seers per ounce.

In 1909-10.—32,060 ounces, 36,428 maunds cocoons, rearers 26,234, yield 45 seers per ounce. The biggest crop yet obtained, return per rearer less than in 1907-08.

In 1910-11.—34,156 ounces, 40,407 maunds cocoons, rearers 35,034, produce per oz. 47 seers.

In 1911-12.—34,251 ounces, 37,565 maunds cocoons, rearers 41,552, produce per oz. 43 seers. Locally produced seed gave as good results as imported seed.

Cocoons sent to Europe realised Rs. 55 per maund, after paying expenses. The illicit rearing of eggs is noticed and prosecutions took place.

* From the Sericulture Annual Report File for 1906 and 1907 of the Director of Sericulture, Srinagar.

In 1912-13.—36,006½ oz. eggs, 37,487 maunds cocoons, 46,363 rearers, produce per oz. 41 seers. 6,777 maunds of green cocoons were sold to Europe at Rs. 53-4 per maund after deducting all charges for carriage, etc. Also 1,146 maunds of double cocoons at Rs. 18-15 net. Unsorted cocoons were sent to Europe and sold at Rs. 41-4 per green maund net.

In 1913-14.—36,735½ ounces eggs, 37,927½ maunds of cocoons, 47,501 rearers, produce per oz. 41 seers. 3,719 oz. of locally produced seed with good results. 814 maunds of cocoons were sold to the Reliance Trading Co. (Salvation Army) at Ludhiana at Rs. 150 and Rs. 120 per dry maund. Cocoons were sold to Europe at Rs. 55 per maund picked, Rs. 41-10 per maund mixed, and Rs. 21 per maund double.

Fire caused damage in this year to filatures and cocoon stores.

In 1914-15.—Local seed did better than imported. 3,502 oz. of local seed used. 36,738½ ounces produced 33,672½ maunds. 48,936 rearers, produce per oz. 36½ seers.

In 1915-16.—The situation produced by the war is fully dealt with and the report of the Director is reproduced in Appendix V.

The above summary does not pretend to lay bare the real history of the development or the way in which it came about. There was once a question of turning the industry over to private enterprise. The existing tree is a State monopoly, the production of cocoons is still a State monopoly. The rearer is not allowed to keep cocoons, reel them or produce seed. Since the failure of local seed, imported seed has been relied on; now seed is being produced from stock from imported seed. Where formerly persuasion and pressure were needed to get rearers to grow cocoons, the difficulty now is to limit the rearer to the amount he can handle and the poor yield of 1904-05 was partly due to too much seed per rearer. The industry is now on a good footing and the chief difficulty is the supply of trees. Some saving would be effected if seed could all be produced locally but this is being worked up to and will increase. The present position will be best understood from the following account of the present industry.

THE INDUSTRY IN KASHMIR.

Mulberry.

4. The mulberry grows in the valley with great vigour and is easily propagated. Large numbers of trees are to be seen in the fields, near villages, along water courses; they grow to a considerable height and are in some areas the predominant trees. Who planted them or how they came is not known. From the scarcity of young trees it may be presumed these trees were planted and are not spontaneous; the alternative and more likely explanation is that restrictions were put on the cutting of trees, which led to no one wishing spontaneous mulberry to grow, this being effected by the Zemindar not protecting them from cattle.

The variety of mulberry is not known. There appear to be two or more but the majority are probably the local variety of *Morus alba*, while the "Shah-toot" (?*Morus atro-purpurea*) also grows. The local variety is a late leafing one which suits local conditions; the fruiting variety is used for rearing only when large amounts of leaf are needed in the last two days before the worms spin.

Existing trees are the property of the State and may not be cut. If a tree dies, its wood may be used under definite conditions, and efforts are being made to increase the trees, since the production has almost reached the limit the trees admit of. The rules regulating the production of trees as also the rules regulating the possession of cocoons will be found in Appendix V.

New trees are being planted under two systems. In the first, trees ready to plant out are issued free to zemindars and others who apply; these trees become their property and can be cut as they like. The method is slow, less than 300 persons applying for trees in 1915-16. In the second system, blocks of trees are planted near suitable villages, and the leaf given free to the

rearer. The trees are allotted by the lambardar to each rearer according to the amount of seed he gets.

This system was advised by the Imperial Mycologist as a control on the disease which attacks the trees. The number of trees depends on the number of houses, of rearers and of seed issued, as many as 200 trees being in a block. They allow from seven to 10 full grown trees to an ounce of seed, which bears testimony to the way in which the tree thrives in the Valley. To supply the trees there are three nurseries in the Southern Division to supply 1,100 villages with 27,000 rearers, and three for the Northern Division to supply 1,070 villages and 21,000 rearers. To encourage tree planting, the bonus (lambardari) paid to the lambardar, is paid half on the maunds of cocoons produced, half on the mulberry cultivation, the latter assessed by inspection; this differs from the practice in Jammu. The nurseries grow from seed, transfer out to the three district nurseries, and three years later to the villages. Seed sown in April 1916, the seedlings go to District Nurseries in February 1917, to villages in February 1919. In some cases trees are got quicker. They are planted out at 18 feet apart: the object is to get good trees, branching from seven feet high so as to be above cattle-reach. The local varieties are being grown but a big leaved China variety is also grown in the nurseries. There is scope for testing other varieties and it would be worth while establishing a nursery in which all obtainable varieties were tested. The Cleghorn male might prove to be a valuable variety.

SEED ISSUE.

5. The seed used is issued by the Department shortly before it will hatch. The amount issued per rearer depends on the size of his rearing house and the number of the family. There must be 70 square yards of space for each ounce, and the rearing of two ounces would occupy four people probably, five if some were children. The Director lays much stress on having much space. It is better to issue 1 oz. and get 60 seers on 70 square yards than to issue 2 oz. and get 30 seers per oz. on the same space. Seed is issued now to 48,000 rearers; this means probably 100,000 persons directly engaged on rearing. The actual issue is from half an ounce per rearer to 50 oz. to a lambardar or zemindar who re-distributes; for a single family it goes to as much as four ounces if they have the accommodation. The rearers are notified through the tahsils of the date and place to which to come: they come in, are identified and get the seed they are registered for. If the lambardar reports that a man has built a fresh house or is able to take more, he may get an extra half ounce; but if he fails to increase his output accordingly he is not only cut the half ounce but fined. Every rearer is fined one rupee per ounce if he gets less than 40 seers per ounce. If a rearer gets 4 oz. and does not give 4 maunds he is deducted Rs. 4 and is therefore paid at the rate of Rs. 10-6 per maund. Similarly a man with 3 oz. and less than 3 maunds will be deducted Rs. 3 and paid at the rate of Rs. 11-6 per maund.

All the available officers do seed distribution, five in the Northern, five in the Southern Division; the work must be done quickly. As each rearer gets his, he goes off home. Rearers combine to put their seed together in small rooms which they keep up to 75° F. by fires of charcoal in earthen pots; the eggs hatch and are reared much as in Jammu. Some use trays, but most rear on the floor. Rats are a serious trouble to eggs and to worms, and arsenic is issued to destroy them with. The two diseases of the worms are flacherie from wet leaf and muscardine due to want of ventilation and damp. Pebrine has not been found in any worms and the fly pest is unknown. The time from the hatching to bringing in the cocoons is about 33 days. The worms spin in dry straw or mustard stalks laid in lines over the worms so that worms not ready to spin can continue to be fed. This is a time at which loss occurs as the careless rearer, which includes most of them, lays straw over the lot and the feeding worm has trouble. The worms are left five days for spinning, the cocoons then picked out. It is believed in the Valley that the zebra worms are the most heat resistant and if this crystallises into a common belief, a zebra race will be needed. The cocoons as picked out are

brought in to the factory in large baskets made of willow twigs. The very distant rearers bring in sun-dried cocoons which are taken by measure. Most rearers bring in successive lots as they are picked out.

COCOONS.

6. As the cocoons come in, they are inspected. Crushed cocoons are put on one side and paid lower rates, cocoons with worms in are paid at Rs. 10 a maund. As all the cocoons come in between June first and thirtieth there are days when over 1,000 maunds come in. After inspection, the cocoons are weighed under the eyes of an European or Indian officer, the weight recorded and credited to that rearer. They then go straight to the Séchoir (Hamman). The rearer is credited with each successive lot and finally gets his cash for his total. A distinction is made between good and bad cocoons but not at present between the best and second best; possibly this will eventually be done but there are obvious difficulties in immediately judging by the eye some hundreds of lots in a day. This ends the rearer's share; he has worked for a month, he has brought in on an average cocoons worth ten rupees, which he gets in cash with no deductions. A good rearer from 2 oz. seed got 3 maunds 26 seers, worth Rs. 38, and most good rearers get Rs. 20 clear. The cocoons after weighing go at once to the Séchoir where they are exposed for six hours to air heated to 80 degrees C, the air being driven out by fans electrically worked. The cocoons come out dry. They are examined to see that they are fit for the store. The temperature is closely regulated and the thermometer readings registered every fifteen minutes. The Director would use steam but the large quantity of cocoons and the damp climate necessitate drying. The cocoons go to the godown and are stored on racks. The cocoons there are turned daily by boys with wooden rakes, one boy in each range of racks. No cocoons are reeled for a month, and the *Dermestes* pest of Jammu is unknown in Srinagar; mildew is the only pest.

The cocoons are then issued for sorting, and with this goes fluff-removal. Formerly this process was done by machine, now by workers who hold a stick between their palms, put it into the cocoons and rapidly rotate it, the fluff adheres to the stick and clean cocoons are produced. The fluff is sold locally as a form of waste at Rs. 10 a maund.

Reeling qualities are—

No. I A which sorts into No. 1 Export and No. 1B.

No. 2, No. 3, Puda (old cocoons, spoilt cocoons).

Double, pierced and rat bitten.

7. Reeling is done in large filatures. There are three systems; steam heating of basins and cookers, with electric reeling or hand reeling, and electric heating of basins, steam heating of cookers and electric reeling; the last is to be general. As the temperature in the basins can be regulated to 145° F., 150° F., 155° F., by the assistant in charge of each filature the reeling must be done at the proper temperature. The electric heater is a local invention. The reeling is all on the self-croisure system and the boys do 2, 3, 4, 5 or 6 skeins. The unit is to be 2 reelers, one cooker; and the three will be jointly responsible for the cocoons. At present, a test is done to ascertain what amount of silk can be produced from a particular grade of cocoons of a certain denier in so many hours. For instance if No. 1B, 1915 crop cocoons are to be reeled to 18 to 20, six basins in each filature are put to do it, then a scale is made for each filature for that cocoon and denier and that time of the year, and the boys get cocoons issued in puns (*i.e.*, by number), and from that they should produce so many tolas of raw silk; a four skeiner doing 9 to 11 denier would get say 18 puns (1,440) of cocoons and have to give up 22 tolas (9 oz.) of raw silk. If he turned in 19 and 18 he would be cautioned, if he turned in 17 he would be fined: if his silk proved to have more than three ends per hour he would be fined half a day's pay; if extra good silk was done, he would get a bonus of 1½ days' pay. A reeler gets 1 anna per day per skein; they reel all sizes from 9 to 11 to 100 denier.

The following table shows the issues of cocoons on one day :—

Scale of issue of cocoons to Filatures in puns.

1 Pun=80 Cocoons.

	10 Hours.			9 Hours.			8 Hours.		
	4 Sk.	5 Sk.	6 Sk.	4 Sk.	5 Sk.	6 Sk.	4 Sk.	5 Sk.	6 Sk.
9/11	18	22	26	16	20	24	14	18	22
11/13	20	24	28	18	22	26	16	20	24
13/15	22	26	30	20	24	28	18	22	26

Cocoons issued on 24th August 1916.

		No. 4 FILATURE.			lbs. oz. dr.		
4 Sk.	No. 1 Cocoons	9/11	74 basins	18 puns	1	15	4 per basin
5 Sk.	Ditto	9/11	229 "	22 "	2	6	3
50 Denier	No. 3 Cocoons	45/55	25 "	35 "	3	8	0
		No. 5 FILATURE.					
4 Sk.	No. 1 Cocoons	9/11	23 basins	18 puns	1	15	4
5 Sk.	Ditto	9/11	256 "	22 "	2	6	3
6 Sk.	Ditto	9/11	16 "	26 "	2	13	2
50 Denier	No. 3 Cocoons	45/55	25 "	35 "	3	8	0
Double Cocoons . . . . .	....	..	1 basin	22 "	5	0	0
Basin " . . . . .	....	..	1 "	..	..	..	..
		No. 6 FILATURE.					
4 Sk.	No. 1 Cocoons	9/11	21 basins	18 puns	1	15	4
5 Sk.	Ditto	9/11	102 "	22 "	2	6	3
50 Denier	No. 3 Cocoons	45/55	24 "	35 "	3	8	0
Double Cocoons . . . . .	....	..	1 basin	22 "	5	0	0

The cocoons are prepared in bags for the reelers of each filature and the reelers, at the end of day fetch each their own bag and put it at their basin ready for next day. If two shifts are working, each reeler fetches for the reeler of the next shift at his basin.

Reeled silk is collected and brought in for examination. All is examined by eye, and the skeins twisted; selected ones are taken for test, the rest are locked up till there is a bale of 164 lbs. The skeins are then examined for defective, stained or oily ones and are packed in a cloth bag in a cradle. The full bag is then compressed with cords, covered with waterproof material and gunny. Each is 164 lbs. net and marked outside No. 1 or No. 2.

Skeins for testing are run off, 3 breaks in an hour's running means half a day's pay fine, no breaks may mean a bonus of 1½ days' pay, and the variation of denier is carefully recorded and fined for, if too bad.

WASTE SILK.

8. Chassam is of the usual kind from the basin and is prepared by the cooks. At present the filatures are in sections and each section is responsible

for its tale of chassam, based on its cocoon issue. The *Guda* is a form of waste from the chassam. The *Nim-tar* is refuse cocoons, reeled mixed into a very coarse thread used for embroidery locally. Pierced and rat-bitten cocoons are boiled, pulled out and worked into chassam, and double cocoons are worked into a very coarse thread used locally in carpet weaving.

The proportion of each quality is as follows:—

COCOONS.

No. 1A	71 per cent. which con-	} No. 1 Ex., 25 per cent. } of 1 md. of { No. 1 B, 75 " } No. 1A.
	tains	
No. 2	20 "	
No. 3	5 "	
Dopost	2 "	
Puda	1½ "	
Pierced	½ "	
Fluff	½ "	
	100	

Chassam or Sarnak	18½ to 20 per cent. }	} of 1 green md. of cocoons.
Goddar	4 to 6 " }	

The following is a statement of the destination of silk, waste and cocoons:—

List showing the places where Kashmir silk, waste and cocoons were sold in the year S. 1972 (1915-16).

Name of place.	Name of stuff sold.
London	Silk and waste.
Lyons (France)	Ditto.
Marseilles (France)	Silk, waste and cocoons.
Italy	Cocoons.
Srinagar (Kashmir)	Silk and waste.
New York (America)	Ditto.
Siam (Bangkok)	Silk.
Amritsar (Punjab)	Silk and waste.
Calcutta	Silk, waste and cocoons.
Patials (Punjab)	Silk.
Bombay	Silk, waste and cocoons.
Simla	Cocoons.
Salvation Army, India	Ditto.
Rangoon	Silk.

SEED SUPPLY.

9. The seed is mainly supplied from Europe and has to be ordered early in May: if possible this is put off till reports are got of how each lot have hatched. The seed comes in November and is put into a hibernating house near Srinagar. When the spring comes and the trees bud, the seed is brought up to 50° F. and taken out for distribution. This is a difficult time as temperature variations may occur and the seed hatch prematurely or be injured by cold in transit to the distributing centres. This year's report refers to this.

Locally produced seed is being used to an increasing extent and 7,352 ounces were issued this year, out of 37,610 ounces in all. The seed imported for 1916 was of the following kinds:—

SEED.

S. 1973 (1915-16).

Arbousset—					
Var	.	.	.	3,262½	
Pyrennies	.	.	.	4,390	
Rousillon	.	.	.	2,098½	
Var Liban	.	.	.	816	-
Arbousset	.	.	.	446	11,013
Chabrier	.	.	.	.	3,990
Ferran	.	.	.	.	3,988
Tomasso Ferri	.	.	.	.	8,814
Gorio	.	.	.	.	2,980½
Mixed	.	.	.	.	24
					Crop up to date 33,854½. 35 seers per oz.
Local	.	.	.	.	7,116½
					<u>37,926</u>

There are 11 Tehsils or Divisions and seed is distributed at 7 different centres.

Order for the year 1916-17 (S. 1974.)

Variety.	Name of Supplying Firm.	Quantity ordered.
		Ozs.
French (Chabrier)	Messrs. Chabriens Perri, France	4,000
Do. (Ferran)	Messrs. Ferran Guintrand, France	5,000
Do. (Arbousset)	Messrs. Laurent del' Arbousset, Alais (Garde), France.	10,000
Italian No. 1	Messrs. Tommaso Ferri and Company, Ascoli Piceno, Italy.	3,000
Italian No. 2	Messrs. B. G. Gorio and Company, Bombay	5,000 (500 white).
Local	.....	7,500
		<u>39,500</u>

Statement showing the Averages of Imported and Local seed per oz. for the year of S. 1973 (1916-17).

No.	Name of Tehsil.	Quality.	Oz.	Crop.	Averages.
				Mds. Srs. Ch.	Mds. Srs. Ch.
1	Khas Lar	Local	395	512 3 8	1 11 13
2	Ditto	Imported	1,702½	1,900 19 0	1 4 10
3	Khas Phak	Local	236½	231 22 0	0 39 3
4	Ditto	Imported	1,083½	999 32 0	0 36 14
5	Partabsinghpura	Local	362	397 31 8	1 3 15
6	Ditto	Imported	1,610½	1,495 30 3	0 37 2

Statement showing the Averages of Imported and Local seed per oz for the year of S. 1973
(1916-17)—contd.

No.	Name of Tahsil.	Quality.	Oz.	Crop.		Averages.	
				Mds.	Srs. CA.	Mds.	Srs. CA.
1	Khas Lar	Local	395	512	3 8	1	11 13
	Do. Phak	Do.	236½	231	22 0	0	39 3
	Partabsinghpura	Do.	362	397	31 8	1	3 15
	Wantipura	Do.	1,066½	1,148	22 0	1	3 1
	Kulgam	Do.	981½	908	26 0	0	36 14
	Anantnagh	Do.	1,468	1,030	17 8	0	28 1
	Baramulla	Do.	799	699	39 0	1	5 0
	Uttar Machepura	Do.	1,513	1,537	20 0	1	0 10
	Jagir	Do.	234	240	25 8	1	1 2
	Khond	Do.	24½	20	38 8	0	34 15
	Uri	Do.	36½	42	24 0	1	7 5
		TOTAL	Local	7,116½	6,970	29 8	0	39 2
	Total Local Seed Issued . . . . .	..	7,110½	6,970	29 8	0	39 2
	Total Imported Seed Issued . . . . .	..	30,809½	20,910	10 8	0	34 15
	GRAND TOTAL OF IMPORTED AND LOCAL ISSUED SEED.	..	37,926	33,881	0 0	0	35 11

SEED PRODUCTION.

10. Selected cocoons from special rearers are kept for seed, 1 maund per 100 oz. seed. They are hung up till they emerge; the moths are coupled for 6 hours, and placed in a cloth bag to lay. The dead female moth is examined for pebrine and flacherie, the head and thorax pounded up, the abdomen left for check. There are men specially trained as microscope examiners; their work is checked by the supervisor. About 10 per cent. of the moths are rejected for pebrine or flacherie, and after examination all the passed ones are hung up in the next room. Four thousand ounces of eggs means 400,000 moths, i.e., say 500,000 to examine. A man does there about 600 per day. Local seed is better than imported but it is disquieting to realise that some 4 per cent. to 6 per cent. of moths from newly imported seed are pebrinised.

There can be no question that this production of seed is of vital importance, not only to Kashmir but to India, and it is of the greatest importance that it be put on a proper footing. The worms should be specially reared under ideal conditions; the seed examination, the storage before and after examination needs to be done in new sterilisable rooms under the best possible conditions and the Durbar would be well advised to provide for this in the best possible manner in a good site, away from the factory or from any other rearing. I attach great weight to this because if under present conditions local seed is better, under better conditions it would be better still. Miss Cleghorn has abundantly shown what can be done with really perfect rearing. Kashmir could then provide all its own seed, it could provide exactly what it wanted on the basis of each man's cocoon yield, which it cannot do now, and the risks and vicissitudes of the journey would be lost.

The present production should not be increased suddenly but I would plan the ideal rearing, seed examining and seed storage place now, plant the necessary mulberry and get it working in a year or two. It will not be easy to plan it but if time is taken it can be done.

In this connection, the work being done by Mr. C. M. Hutchinson will be of vital importance; it is incomplete and I cannot now discuss it but the section on disease in Chapter X should be read.

The following is a statement of the examinations of moths, some of which laid in muslin bags, some in paper squares :—

Statement showing the rejection of moths under different heads.

Year.	Method of reproduction.	REJECTION.										Total moths examined.	REMARKS.
		FEBRINE.		FLAESHIE.		EMPTY.		*YELLOW.		TOTAL.			
		No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.		
1915	Muslin Bag . . .	12,074	4.8	7,003	2.8	22,844	8.4	8,053	3.0	51,473	19.0	271,035	
	Paper . . .	1,480	2.6	1,457	2.8	3,138	6.8	1,092	2.1	7,212	13.4	54,273	Oviposition in paper.
1916	Muslin Bag . . .	18,992	10.3	7,140	3.9	9,905	5.4	5,120	3.8	41,157	22.4	1,84,069	
	Paper . . .	786	0.0	295	3.4	508	5.8	398	4.6	1,982	22.3	8,715	Oviposition in paper.
1915 and 1916.	Average total of muslin bag and paper.	34,172	6.6	15,895	3.1	36,390	7.1	14,663	2.8	1,01,824	19.6	5,18,082	
	Maximum . . .	(Muslin) 1916	10.3	(Muslin) 1916	3.9	(Muslin) 1915	8.4	(Paper) 1916	4.6	..	27.3	..	
	Minimum . . .	(Paper) 1916	3.0	(Muslin and Paper) 1915	2.8	(Muslin) 1916	5.4	(Paper) 1915	2.1	..	12.9	..	

* Yellow means unfertilised eggs.

PRESENT POSITION.

11. The industry in the State has escaped one danger, the method of growing the worms in large rearing houses with hired labour, which brought to a close the Lister Co.'s efforts in Gurdaspur and the Dun. This was proposed by Sir T. Wardle in 1896, when it was thought that the methods of the Kashmiri as regards cleanliness, ventilation and the like were so bad that the industry never would develop as a cottage industry. It was proposed to hand it over to private enterprise, backed by English capital, and to develop it on the large rearing house system. The present position shows that the Cottage Industry system has succeeded, and the progress made has been steady and continual. The Director of Sericulture at that time, Babu Rishibar Mukerjhi, opposed the proposal and subsequent events justify his attitude. The large rearing house policy does look attractive and is still being used by the Salvation Army and is proposed for other parts of India. Comparing the present position of the Kashmir industry with the utter failures in Gurdaspur and the Dun emphasises the relative value of the two methods. Another attempt to transfer the industry to private enterprise was made in 1901, when an agreement was drawn up for the transfer of the industry to Mr. C. M. Hadow; Mr. (now Sir Louis) Dane, who took charge as Resident in November 1901, reported strongly against this on the ground that the figures on which it was shown that the industry was working at a loss did not include the value of silk lying unsold in Europe. When this item was put in, the profit was definitely shown and the proposed private monopoly was not allowed; the development of the industry has been traced above and the State benefits now to the extent of some Rs. 11 lakhs a year.

The industry is undoubtedly popular in the Valley now and the Department are selecting the class of rearer they think best; its popularity is probably in large measure due to the fact that the Kashmiri realises actual cash in hard coin. The Valley is isolated, there is little trade, and little means of getting money as such. They grow what they eat but cannot easily take their crop and realise money on it, so that while they can live, they can get little money and it is this that appeals to them.

If this view is correct, it needs to be borne in mind in considering the slowness of development in the Punjab, where grain and cotton sells for money, the man there can get his money and is less favourably inclined to silk.

The Development of the Industry.

12. The cocoon producing industry has nearly reached the limit of the available trees and it is obviously necessary to increase the trees. This is being done and the only useful suggestion I can offer is that all the available varieties of mulberry should be tested with a view to making certain that the local ones are the best. Seeing that imported seed is used and that there is a good deal of flacherie, it is possible that other varieties will do better and the Pusa experience distinctly supports that. It is also quite likely that the Cleghorn fruitless variety will do well. I think this point is worth testing as can be easily done by collecting existing varieties from Pusa and elsewhere and doing a small experiment each year. The development of the industry has been so rapid and continuous that there has not been much scope for this kind of experimental work.

13. The second question is that of seed production in the State. In considering this, these points must be remembered.

- (a) Local seed, though from cocoons reared by the Kashmiri, does better than imported 'industrial' seed; better rearing would produce better seed still.
- (b) It is necessary to proceed steadily and it is impossible to suddenly increase from 4,000 to 40,000 ounces of seed and have it all good.
- (c) Until the very important investigations of Mr. Hutchinson, the Imperial Agricultural Bacteriologist, are more complete, no definite step can be taken, as the very means of spread of pebrine are unknown.
- (d) Whatever is done must be thorough and the seed should be from cocoons reared under ideal conditions. The State should now proceed to prepare for the production of their own seed, so that action can be immediately taken when the matter is decided.

I attach very great importance to this matter and I do not think that any development is likely to be of such value to the development of the industry. But I would not attempt to increase seed production under existing circumstances; the present methods, in unsuitable buildings, are too unfavourable.

14. The third problem refers to the utilisation in India of Kashmir silk and the question of finding a good market in India for much of the raw silk. No one can foretell the outcome of trials in this direction but a little organisation would enable it to be tested. If the commercial organisation described in Chapter XXVII is created, then this will at once enable the Indian demand and the Kashmir supply to be correlated and the market tested. I believe that it would be to the mutual advantage of the Kashmir production and the Indian consumption if the Kashmir silk took the place of the imported and I would make a determined effort to effect this.

If the organisation to develop this is not created in India then I think the State could, on the lines laid down on page 173, make the necessary inquiries themselves and test the markets. It could be done by the officials during the winter when work is less pressing.

15. It is not necessary for me to describe in detail the proper methods of producing the best seed; the State at present produces seed at a very little over one rupee per ounce which costs them to import nearly three rupees per ounce. To put up the necessary ideal rearing accommodation, and the necessary buildings and plant for microscopic examination will not cost more than the sum saved in the first year probably; but when it is done it must be irreproachably done. I would at the same time go further with experiments in varieties. A pure zebra race is wanted perhaps; for India, a white cocooned race: a bivoltine race may admit of two crops a year. It is possible that the accidental hatchings of local seed would provide a bivoltine suited to the Valley; the Madagascar race may suit the country and give two crops: the best Japanese races need to be tried.

Here again there is scope for experiment and though the staff are very busy, I would attempt it; if India develops the experiment station referred to in Chapter XXVIII, Kashmir will benefit from that.

JAMMU.

16. Sericulture was commenced in 1909 on lines similar to those on which the industry is run in Kashmir. It has increased steadily and rapidly till in 1915, 4,000 ounces of seed was issued to about 3,000 men, in some 650 villages, a crop of 3,000 maunds of green cocoons was purchased at a cost of about 47,000 rupees, the rearers getting an average of Rs. 16 each. The industry may be regarded as a settled one, that will probably increase up to the limit of the rearers and of the available trees.

The development of the industry is told in the Annual Reports issued by the Sericulture Department and it is not necessary to do more than summarise the main points. The table shows the facts for the years 1909 to 1915 :—

Year.	Village.	Oz.	Men.	Mds.	Rs.	Price.		Amount per rearer.	Oz. per man.
						Rs. a. p.	Rs. a. p.		
1909-10	157	1,501	875	1,234	19,039	15 6 10	21 10 0	1.7	
1910-11	240	2,100	1,057	1,686	26,166	15 8 3	24 12 0	1.9	
1911-12	289	2,399	1,463	1,415	21,975	15 9 1	15 0 0	1.6	
1912-13	303	2,970	1,559	2,007	31,691	15 12 0	20 0 0	1.9	
1913-14	574	3,963	2,798	2,316	36,163	15 9 0	13 0 0	1.4	
1914-15	655	4,013	2,922	3,001	46,960	15 10 0	16 0 0	1.4	

SEED.

17. The seed is imported from Europe and is hibernated at Batote. The amount of seed required is estimated in May, when the rearers bring in their cocoons and is ordered then. In 1915 the kinds and yields per oz. of the seed were—

1915—Seed—		Md. Srs.
4.5 oz.—G. Gorio—Yielded		1 7 per oz.
1,000 Brousse from Durant Bevon & Co.		34 10
500 B. Perrier		30 0
500 Chabrieres et Fils		29 0
1,500 L. Arbousset		27 0
504 de Lonca		26 13
6 local Kashmir		11 6

The seed is imported in the usual 30 gramme boxes and is distributed to the rearers in their villages about 10 to 12 days before it hatches. The uniformity of the hatching varies: the seed hatches over 3 days as a minimum up to 12 days or more as a maximum: irregular hatching is a disadvantage since it prolongs the work and keeps the staff longer employed: and the Director is experimenting with the distribution of hatched eggs, hatching the eggs required for a tehsil in one place under proper conditions of temperature and then issuing the worms. Irregular hatching is also a serious matter for a man bringing in green cocoons for sale, as the first may be emerging as moths, while the last have barely spun: worms are reared in baskets, winnows, trays, etc., while young and are transferred to mats, etc., as they grow. There are no uniform methods adopted: in some cases the worms are on the floor, in others on charpoys, or on mats spread on a machan, or on cloth: machans are very rough temporary ones made of sticks: they may be of one or two tiers, in one case I saw worms on mats laid on stick frames hung from the roof and I am surprised more do not do this.

Leaf is brought in morning and evening, stripped, cut if necessary, and strewed over the worms: the bed under the worms varies in depth up to a couple of inches or more: flacherie and grasserie are known but evidently are

not serious : the rearing is done in the usual mud walled houses, either cattle sheds or the dwelling itself : these houses are very cool in the day and keep warm at night.

The worms are white, zebra or clouded : some are almost pure white or zebra, most are mixed. I was not able to see any worms spinning : the rearers spread twigs over them, or straw, dry leaves, dry linseed stalks, etc. : they prefer to lay them horizontally, with the result that the worms not ready to spin must crawl up and get fed above : the Director is introducing better methods, but the best method is not yet settled : the Assam method of bunches of twigs or stalks hung up so that the worms can crawl into them seems likely to be useful or the Italian system of twigs laid on 2 hurdles placed like a roof over the worms so that they can crawl up as they like.

It will not be easy to get a good system adopted as the rearer is averse to taking trouble or exerting himself.

Cocoons are either killed in the heat of the sun under a cloth or are brought in green to Jammu or one of 7 other centres : it depends on the distance, the dry cocoons being brought in to the centres if the distance is at all considerable : in some cases rearers bring them over distances as great as a hundred miles. As a rule, an allowance of 2 pice per mile per maund is made for carriage and this amounted in 1915 to 14 annas 6 pies per maund brought in : this amount is included in the heading " price " in the Table on the previous page : in 1914-15, the price is shown as Rs. 46,960, of which Rs. 43,174 is the actual price paid, Rs. 2,759 is carriage, and Rs. 1,027 is lambardari : this works out at Rs. 14-6-0 per maund as price, Re. 0-14-6 as carriage, and Re. 0-5-0 as lambardari.

There are difficulties about green cocoons in the weights : if the cocoons are so fresh that the worms have not changed to pupae, they weigh more and the maund contains fewer cocoons : the rearer endeavours to get in as much of them as possible : if all the worms have changed and the cocoons have dried, before the moth emerges, the cocoons weigh less. Dry cocoons are bought by measure, not weight, as the weight variation is so enormous.

TREES.

18. Seed is distributed by the State officials to rearers in villages where there are trees and the supply of trees is a serious consideration. Existing trees are regarded as the property of the State and it is forbidden to cut fuel from them or to fell them for timber. The State maintains nurseries and trees are issued to zemindars and they are allowed to regard these trees as their property to be dealt with as they like : but trees are only issued to zemindars who are doing rearing. Existing trees may be used for leaf supply by any rearer : if a rearer takes seed, he can cut his leaf from trees growing on the land of any one but another rearer : so that a man having trees must either rear worms himself or must see the trees cut about by others.

The State maintains a staff to look after the mulberry trees and the trees are under the control of the Director of Sericulture : so far as possible they regulate the use of trees and it is an offence to cut a bunch thicker than one's thumb : but this is constantly done, not only because it is easier but because it supplies wood for fuel.

THE INDUSTRY.

19. It is interesting to note that while in the Punjab, the industry has since 1909 grown to 600 oz. producing some 300 maunds, in Jammu it has grown to one of 4,000 oz. producing 3,000 maunds. Yet in Jammu, the population is smaller, the means of communication are very poor and the country is very mountainous and inaccessible.

The rearer in Jammu receives Rs. 14-6-0 per maund, the rearer in the Punjab receives Rs. 27 to Rs. 35 per maund : both get leaf free, while from the Punjab man is deducted on the average Rs. 7 per maund for seed.

On the whole the Punjab rearer is better off, yet the industry in the same time has only grown to one seventh of the Jammu industry.

The reasons lie in a nutshell: in Jammu there has been organisation and pressure: in the Punjab there has been neither.

In Jammu in 1909 there was a Director of Sericulture and staff, a Mulberry Head Inspector, 2 Mulberry Assistant Inspectors, 1 Jamadar, 4 Gardeners, 10 Beldars, 20 Mulberry Khalasis: there are also Girdawars, usually from Kashmir, who inspect the rearing and look after the worms, and there is now an Assistant Director of Sericulture.

Rearers are sought out and encouraged, helped with charpoys, mats, etc.; if a rearer is short of room the Lambardar turns some one out of a room for him and arranges room for him; if he wishes to build a house he gets an advance for it: the rearer can cut the trees, whether his own or anyone else's: he has the branches for fuel and cuts large branches accordingly, while the owner of the land cannot stop him, and cannot himself get fuel from the trees. The Lambardar gets commission (5 annas per maund) on the village crop and accordingly puts pressure on the people to rear worms and to do it properly: the report for 1914-15 says "a wider application of the gentle pressure now exercised by the Heads of Tahsils over those that are in power under them will not be amiss," meaning that the Zaildars and Lambardars are in turn to put pressure on the villagers to rear worms and to look after mulberry trees: the good rearer gets a *lungi* as a reward and is generally encouraged by the State officials: the tehsildars and officials know that the interest they take in the industry will be taken into account when promotion is made and the whole of the officials and staff are encouraged by the personal devotion they feel to the Maharajah; the profit if there is any, comes into the State treasury and so helps the country.

20. It is not necessary to contrast the Punjab with this because there is no real comparison: the Director of Agriculture takes up sericulture as part of his duties: the Assistant Professor of Entomology does same, knowing nothing of the industry to start with: four fieldmen, a mukadam and a rearer are the staff: and there is no encouragement of any sort given except rewards in money at the Exhibition held in May. Tree planting is not being done: restrictions are put on the use of trees near towns: and there is no kind of "gentle pressure" exerted to make the industry attractive to the people. The district officials may be interested or not, but they certainly do not exert gentle pressure on their subordinates or actively urge the growing of mulberry trees and silk worms.

21. The Jammu system seems to give very good results and there can be no doubt as to its being a benefit to the people. A difficulty is arising in the fact that rearers near the British frontier find it better to sell their cocoons in India than in Jammu; and as the State supplies them with seed, and contracts to buy the cocoons the rearer has to declare the loss of his worms from disease, or rats, to account for his apparently small crop. If the Punjab ever actively develops sericulture on a similar scale to Jammu, this difficulty will be still greater and some means of meeting it will need to be found. The easiest will probably lie in not buying from any rearer more cocoons than he was issued seed for. It is not a very important matter but will need to be adjusted.

The cocoons in Jammu are reeled at the filature and the raw silk sold in Europe. This is fully dealt with under Kashmir.

CHAPTER V.—THE PUNJAB.

The problem of growing mulberry silkworms has attracted the attention of district officers in this province from the year 1836 onwards and there is a record of a long series of experiments made to test the feasibility of growing in the Punjab the silk that was so largely imported from Central Asia, Kashmir and Afghanistan. The fact that fruiting mulberries grow vigorously was an inducement; the East India Company had been making

efforts to stimulate silk production in Bengal and from time to time encouragement was given to district officers to attempt the problem afresh. As a rule the experiment promised well and was abandoned on the transfer to another district of the officer who had initiated it. (Umballa, 1836, Ludhiana, 1836, etc.). The district list in Appendix VII shows 12 districts and three Native States in which at some time experiments have been made, chiefly without any permanent result. Cocoons were produced, in some cases silk was reeled and even sent to Europe but sooner or later some untoward accident put an end to the venture.

2. It is not necessary to further refer to these experiments which are fully dealt with in the Monograph by W. M. Hailey, published in 1899. (A summary appears under "Experiments" in Appendix XI.) Failure was due to—

- (1) Inexperienced officers started, who got experience and were transferred.
- (2) The seed used was from varied sources, often mixed, not of the right race and often diseased.
- (3) Uniformity of hatching was not secured.
- (4) The importance of rearing a single brood only, in the spring, was not realised and multivoltine seed was used in some cases.

3. In 1854, Jaffer Ali commenced in the Gurdaspur district and a crop of 56 seers of cocoons was also obtained in Hoshiarpur; a colony of Musalman weavers started at Soojanpur, Pathankot and some success was achieved, this continued and Jaffer Ali's effort was carried on for some 20 years; it was helped and extended by Mr. Halsey at Sujanpur, who offered prizes and stimulated the people to take seed and produce cocoons; at his death (1879), the Lister Company started in Gurdaspur and in Kangra; exhibitions of cocoons were held and at Kangra, in 1879, 79 maunds of cocoons were produced, and in 1881, 251 maunds of cocoons. Disease had broken out among the worms and from then on to 1890, the cocoon supply decreased. The Lister Company who had been working on the old lines changed their methods (as they did at Dehra Dun), built large central rearing houses and had such losses that they left the district in 1892. The industry died out in Kangra and very much declined in Gurdaspur. Mr. Hailey states that in 1899 the only place where silk rearing was practised was Gurdaspur and there only on a small scale. There must have been some rearing still in Kangra.

4. From 1892 to 1907, the industry seems to have attracted little attention but in the latter year, Sir Thomas Wardle addressed the India Office and urged the revival of sericulture in the Punjab, on the lines of the revival in Kashmir. The essential facts of the Kashmir industry were either not known to Sir T. Wardle or were passed over: nowhere in his book on "Kashmir and its Silk Industry" does he mention the price paid by the State for the cocoons nor the fact that cocoons must be sold at the fixed price to the State only, nor the fact that the State owned all the mulberry trees.

5. The question was accordingly re-opened and the Department of Agriculture took it up. Sir Louis Dane stimulated the revival of the rearing in the Gurdaspur district and in 1909, with the assistance of the Department of Agriculture, cocoons were produced experimentally at Gurdaspur, Changa Manga and Lyallpur. These were sent to Bengal for reeling and were reported on favourably. Thereafter Sheikh Ghulam Sadiq of Amritsar, took up the industry in Gurdaspur, obtaining seed from France, hibernating it in Simla and distributing it in February to selected rearers according to the amount of leaves available. The Department of Agriculture also distributed seed in Sialkot, etc., the Canal Department experimented and the Education Department co-operated with the Agricultural Department in having silkworms reared in schools in order to familiarise the children with the industry. This is a very brief statement of an active campaign that was carried on by the Agricultural Department, some information of which will be found in the Annual Reports.

6. At the present time, the whole amount of seed distributed is between 500 and 600 oz., of which Ghulam Sadiq distributes 400; he distributed 3 oz. in 1909 and since then has distributed as follows:—

			Yields.		average per oz.
1910	199 oz. to	59 men	17 maunds	29 seers	3 seers 7 ch. (dry).
1911	274 " "	68 " "	33 " "	16 " "	4 " 14 " "
1912	306 " "	73 " "	43 " "	37 " "	5 " 15 " "
1913	399 " "	158 " "	46 " "	34 " "	4 " 11 " "
1914	338 " "	157 " "	54 " "	20 " "	4 " 10 " "
1915	374 " "	187 " "	62 " "	0 " "	6 " 0 " "
1916	400 " "	....	49 " "	18 " "	4 " 15 " "

These figures are supplied to me by Mohammad Jamil, Agent to Khan Bahadur Ghulam Sadiq. The Department of Agriculture in 1913 issued 51 oz. of which 5 oz. were eaten by rats, and 44½ oz. gave 7 maunds 32 seers, 14 chittacks of dry cocoons, an average of about six seers per oz. on the seed accounted for. In 1914, 136 oz. were distributed, of which 10 oz. were eaten by rats, and 110 oz. gave 23½ maunds or some 5½ seers per oz. In 1915, 165 oz. were distributed but the total results are given with Sheikh Ghulam Sadiq's, *i.e.*, 515 oz. accounted for gave 85 maunds or an average of 6½ seers per ounce. These figures are for dry cocoons; to get weights of green cocoons it is necessary to multiply by 3.

7. It will be seen that there has been steady progress and that the failures of the past have not recurred. This is in the main due to the fact that fresh seed, from moths examined for pebrine, is imported every year from France and that no attempt is made to get more than one crop nor is seed ever taken from the insects in this country. The importance of this method of proceeding was first ascertained in Kashmir and the success of the industry turns wholly upon this point: had disease-free seed been available in the forties and fifties, and had the fundamental fact that only a single crop can be taken been realised then, the failures of the past would probably not have occurred: quite certainly there would not have been the decrease in production that took place from 1883 to 1900.

8. The seed is also distributed by the Department to schools and arrangements are made to distribute the resulting money between the master and the pupils, usually in the proportion of one-third and two-thirds. The number of schools varies from year to year; in 1913, 46 schools commenced, situated in these districts—Sialkot, Amritsar, Hoshiarpur, Ambala, Gurdaspur, Lahore; in 1915, 50 schools are taking each ¼ oz. The net result is that where the teachers are interested, the worms are well tended, the pupils are interested and the fact that the cocoons fetch money is well advertised; but that where the teachers dislike the new work, they easily make it fail. Under the limited circumstances of space, etc., of primary schools in villages, one can easily understand such an innovation being resented and while it may have some educative value to rear silkworms, it is unlikely to have any practical effect in ever stimulating the production of cocoons. It would be better to have a small rearing house at every railway station in suitable tracts, so that people could see the industry. This suggestion is strongly endorsed by Mr. McNamara, the Director of Sericulture in Kashmir. The question of the educative value of the silkworm rearing is one for the Education Department. My experience of teaching in India and England, my knowledge of India and its people, convince me most strongly that so far from its having an educative value, it is prejudicial to what I conceive to be the object of real education. Nor do I think any good is being done by familiarising pupils with silkworm rearing; as far as fostering the industry is concerned, it is treating what should be a serious livelihood as a joke; Europeans who have kept silkworms in their young days would not dream of connecting this with a serious profes-

sion and means of earning a livelihood; it is as if we tried to foster agriculture by giving children toy ploughs and little toy fields of plasticine; if sericulture will progress it will be because it is a paying business that will make life less hard; that is a serious matter, not to be trifled with in schools. My opinion may be wholly wrong as the value of the method depends wholly upon what the scholars and their parents think of it: but I think they look on it as a play, and that it does not encourage them to treat it as a serious business. This is also the view of the Kashmir Director.

9. The silkworm rearing practised in Gurdaspur, Amritsar, and Hoshiarpur is in the main done by Mussalman weavers and cultivators; in Sialkot by Hindu cultivators, shop-keepers, etc.; the seed is distributed in February by the agent or the Department, the former giving an advance of Rs. 2 per ounce if necessary; this seed is in the original 30 gramme boxes stamped with the inspection marks of the French Republic. The seed hatches in early March and the worms I saw were healthy, well cared for and kept under good conditions. Trays or winnows are used for the young stages; the use of regular trays on bamboo or wood *machans* (frames) is not general; after the second moult the worms are placed on the ground or on mats, on *machans*, etc., and leaves or branches up to a foot long are placed over them; they are kept in mud-walled houses, which remain very cool in the day time; these are either the separate houses used at other times for cattle, or part of the rearer's dwelling.

When the worms are full grown, they spin in dried leaves or straw spread over the mass of twigs on which they are; spinning trays are not known, nor the use of nets for the young worms. There is the minimum of expense; but cleanliness is looked after and the dry climate prevents the fermentation of the litter which would be so detrimental in Bengal or Mysore.

The cocoons are killed by exposure to the heat of the sun under a cloth, so that they shall not bleach; and in May the dried cocoons are brought in for sale or for exhibition at the fair held at the end of the month.

Since no fly troubles them, wire gauze is not needed; arsenic is issued for rats which are a pest; the use of disinfectants is not called for as there is no disease and since they take only one crop of worms a year: and there are only two points that call for comment: one is the race of worms used, the other is the supply of leaf.

10. The seed used is obtained from France and the worms are of three kinds; white, Zebra and clouded; the cocoons are fairly uniform in colour, silk, shape and size; but the colour characters of the worms show that the breed is not pure and the evidence goes to show that the clouded worms are the least satisfactory. Sheikh Ghulam Sadiq thinks that a Japanese race would do better and it appears that the Japanese race introduced by Mr. Halsey is still maintained and is regarded as being better than the French.

I think it is fairly certain that a better race than the mixed French will be found, whether it be Japanese or some other, and a race that will stand heat is obviously required: it is a mistake to adhere wholly to one or a few races of worms that suit Europe if better races can be got for India and I think this point requires attention.

11. The second question is that of leaf; mulberry is grown chiefly as a roadside tree, mixed with mango and sissoo; the revenue from the latter trees is greater than that from mulberry and District Boards incline to planting them; but the existing trees are being fully used; not more than 600 oz. of seed can be grown on the available trees near villages where there are rearers and on suitable canal trees: I am told that, were there trees, 2,000 oz. of seed could be given out at once in the villages where rearing is being done; it is obviously important to increase the trees and to do so near the existing villages that rear silk; if this is not done, the existing old trees will die and the nucleus of a very flourishing industry will disappear.

At the present stage, it is not likely that land will be used for growing bush mulberry and if bush is grown at the instance of the Department it should be only to supply leaf to provide for immediate needs; the cultivation of bush mulberry as a regular practice is not to be encouraged and reliance

should be placed upon trees. These trees should be in part of the early leafing variety; I am inclined to think they should also be male trees grown from cuttings and of the variety that Miss Cleghorn is growing in Calcutta; there is considerable confusion as to the species and varieties of mulberry; I see that the Economic Botanist at Lyallpur says that crossing has taken place; but the Superintendent of the Horticultural Gardens at Lahore tells me there is no difficulty in supplying large quantities of plants of the early kinds and that there is no difficulty in planting them and getting them grown.

I would emphasise the very great importance of proper pruning of the trees especially during the first few years, and the employment of a properly trained assistant to supervise planting, and to attend to proper pruning is desirable. If this is not thought desirable, the present arboricultural assistants should be trained in pruning and the trees should be properly grown so as to give shade and so as to make plucking easy. The importance of having the right type of tree is very great and this can only be secured by proper pruning in the young stages.

The classification of the various mulberry varieties in India is being attempted by Dr. Carter, Economic Botanist to the Botanical Survey; and it is important that this point should be cleared up if possible.

12. A total of 2,000 oz. of seed means nearly 1,000 maunds of green cocoons worth Rs. 50,000, so that a certain initial and recurrent expenditure to secure this is justified; as the trees increase the revenue from their rental increases and ultimately the district and the District Board will benefit. I am convinced that if the present rearers would take 2,000 oz. the ultimate expansion of the industry will be many times that amount if trees or bushes are available; the industry suits the people, it comes in as light indoor work just before harvest, it is a clear additional source of income without capital expenditure or extra cultivation; and under present conditions, with imported seed and with active buyers, it is sure. Provided the present lines are adhered to and the best seed is issued, I think the industry is one that will grow and increase very much in proportion as the trees are planted; and the most vital question at present is to increase the trees.

It is, I think, most important to concentrate effort at the best points; I would entirely stop the school effort; I would concentrate on tree and bush planting in the submontane tracts, in the villages where rearers now occur and as this spreads I would cautiously expand outwards till the limit was reached at which the onset of early hot winds jeopardises the industry.

In 1884 the Forest Department bred worms at Changa Manga successfully; so also the next year; but the third year hot dry winds wiped 75 per cent. of the worms out. There is a line, between the hills and the dry areas, at which the early hot weather will prevent successful breeding and this line has not been found, so I would expand outwards from the hills till that line is found; it is unlikely that the industry will ever pay west of a line through Delhi—Karnal—Umballa—Ludhiana—Ferozepore—Lahore—Wazirabad—Rawalpindi, i.e., west of the Grand Trunk Road using this as a convenient demarcation limit; and it will be in areas between this line and the hills that it will be carried on.

I note that the opinion is held that the extension of the irrigated areas is affecting the climate of the Punjab particularly in delaying the onset of the very hot dry weather which is so fatal to the worms: if this is taking place, a time may come where it will pay to grow silkworms in areas not now suitable: but at present the possible extension in more suitable areas is so great that it is not worth while attempting to foster the industry under difficult circumstances.

13. Interest has been awakened in Changa Manga forest this year by the action of the Salvation Army in having a widely advertised experiment there. It is necessary to realise at once that it is impossible to profitably produce cocoons at places like Changa Manga on the lines of the Salvation Army: it does not pay to erect temporary houses, to transport labour, to rear half a million worms in each house: the recurring cost is high, the risk of disease is great, the loss if heat sets in early is too large: even at the best, with a full

crop, the expenses are greater than the returns; as an advertisement, the rearing of 100 oz. of seed at Changa Manga may be of value: as a practical and profitable operation, it is not.

If Changa Manga and similar plantations were split up in strips and of such small size that the inhabitants of neighbouring villages could utilise the leaf in their own houses, silkworm rearing would be profitable if the climate allowed: but it is fairly certain that the climate will, in at least one year out of three, make the rearing unprofitable. Plantations such as Changa Manga will help forward the industry, only if they are situated near villages where there are rearers, and then only quite small areas can be utilised: and so far as the Forest Department can help it will be chiefly in the provision of small areas of mulberry cultivation situated at suitable places as regards climate and available people.

14. The Salvation Army have been actively advertising their work by means of communications in the Press and have started a Silk School at Simla. I deal with the activities of this body in Chapter XI and their influence in the Punjab is there discussed. I am not of opinion that the Silk School will be of any benefit to the Punjab: I do not believe that training people in sericulture in a school will tend to increase the amount of silkworm rearing done. It is unfortunate that the extravagant statements of the Salvation Army as to yield and out-turn, and their injudicious advocacy of sericulture as an industry in wholly unsuitable areas, should have done harm and undoubtedly their activities will make the work of developing the industry more difficult than it would otherwise have been.

15. In view of the fact that the chief obstacle to silkworm cultivation is the heat of the plains, one is led to think that in hill areas the industry should prosper: the example of Kashmir is also before us and at first sight it seems a foregone conclusion that there alone could the industry be profitably conducted. I have not the local knowledge of the hills of the Punjab to fully discuss the matter and it has not been possible to go carefully into the question on the spot: the areas that suggest themselves are Kangra and Kulu, Chamba, Mandi and the Simla Hill States. The proportion of Hindus in these areas is very large: Kangra has a population of 770,000, of which 725,000 are Hindu, 39,000 Mussalman, whereas Gurdaspur has a population of 837,000, of which 284,000 are Hindu, 408,000 are Mussalman; it is probably not a coincidence that the districts in which sericulture has been practised are those in which the proportion of Mussalman is high: and if one glances at the figures of religion in the various Hill States (see Appendix IX), the small proportion of the Mussalman element will be noticed. It is possibly unlikely that any great extension of sericulture will take place under these circumstances and it is probably a waste of time to make any great efforts towards it. Ambala, Hoshiarpur, Jullundur, Ludhiana, Lahore, Amritsar, Gurdaspur, Sialkot, Gujranwala, Gujrat, Jhelum, Rawalpindi, Attock, are all predominantly Mussalman and offer a far better field than Kangra and Native States which are very predominantly Hindu. It is of course true that there are in these areas enough Mussalman families to carry on silk: but it is probably true that only a very small proportion of Mohammadans will do silkworm rearing, and these are mainly weavers or descendants of weavers: if there is a large Mussalman population, there will be enough weavers or other suitable people amongst them to take it up: but unless there is a very large population, it is probably useless to attempt to find people who will do the work.

It is also to be noted that in the Sialkot district the silkworm rearers are mainly Hindus and though they are few they show that one cannot dogmatise about the likelihood or not of any people taking up the industry: in Kashmir, the figures show that the rearers are almost wholly Mussalman: in Bengal two-fifths are Hindu, three-fifths Mussalman: and it is evidently a matter to be ascertained in each district or tract whether the people will take to the industry or not. In Jammu, Hindus take to sericulture as the Mohammadans do and there is apparently no difficulty from this point of view. In Kashmir, Pundits and Sikhs have now taken to it, after opposing it in the early years. If there is in the Kangra district any large number of people who will take to

the industry, it is probably capable of becoming a very important centre of production, since more than one crop can be taken in a year unless the heavy rainfall of the monsoon months prevents rearing them : the problem requires separate and special investigation on the spot and the conditions under which sericulture is started, even experimentally, will want to be very carefully ascertained and no mistakes made : it looks as if there is scope for a very good breed of improved worm of the hybrid multivoltine or the accidental uni-multivoltine type.

For the present, and until this area can be properly investigated and expert advice be obtained as to exactly how to start, it is probably best to concentrate effort on the submontane areas.

16. At present the cocoons are brought in when quite dry and sold to Ghulam Sadiq, to the Salvation Army, or to buyers from Bengal, usually at the exhibition held at the end of May. In some years the rearer certainly does not realise the full value of his produce owing to want of buyers and the Salvation Army secure the crops on very low terms. The grower realises some sixty to a hundred rupees per dry maund, equivalent to Rs. 20 to Rs. 30 per green maund. There is apparently a difference in the price according to whether the seed has been supplied by Ghulam Sadiq or by the Agricultural Department; in the former case, the man gets seed, gets leaf, gets an advance if he requires it and contracts to sell to Ghulam Sadiq at say Rs. 60 to Rs. 80; in the latter case he gets seed, gets leaf, gets no advance, and sells in the open market to the Salvation Army or any other buyer at prices fluctuating from Rs. 60 to Rs. 100; the cost of his seed is then deducted. Now Ghulam Sadiq has to pay his staff, has to pay for leaf, has to risk advances and lose interest on the amount, and has to pay for this on the difference between buying and selling; he cannot obviously pay Rs. 150 for dry cocoons nor would it be business if he did. The Department, not having to pay for their staff, or their leaf, can let the rearer realise the full amount if he can do so minus the cost of the seed; obviously no one else can do this and unless the department continue doing it to the end, there will some day be a set-back to the rearers who will not be able to get the full amount if the buying is taken over by a private agency; it would be well to stop the system at once or at some convenient moment when prices are high, and when the private agency can afford to give the usual price; an attempt should be made to get private agency to take over all the seed distribution where Ghulam Sadiq does not do it or at least with the Hindu rearers of Saikot: otherwise, as the industry grows, the shock eventually will be all the greater. The present position is that the rearers are getting uneven prices, either too low from the department's sale or too low from Ghulam Sadiq: and there should be one sale and one price. If Ghulam Sadiq can manage 400 oz. on his terms, then the industry will continue on the same terms everywhere and the sooner it is put on a proper footing the better.

The alternative is to develop the industry directly through the department alone, exactly as is done in Kashmir and Jammu, paying the rearer a proportion of the value and disposing of the cocoons to the profit of the State: in this connection it is worth reading the section of this report on Kashmir and Jammu. If this is to be done, it must be done at once and the price to be paid for cocoons must be settled.

The experience of Jammu and Kashmir is that it pays best not to reel, but to dispose of cocoons: eventually it will pay to reel: also at the present time conditions are so abnormal that there is a high market for cocoons. If the State controls the business, it is not desirable to go further than to sell the cocoons as such and to leave reeling wholly to private agency. A curious difficulty has arisen and will increase: that is the smuggling into British districts of cocoons from Jammu, the rearers getting a higher price, if they can sell their cocoons, in British districts than in Jammu. This is referred to on page 53.

The cocoons are reeled by Ghulam Sadiq, by the Salvation Army or by the Bengal filatures and there is as a rule no difficulty in finding a market for the cocoons. Silk from these cocoons is of a class different to that produced in Bengal and Mysore: it reels well into thread of a low denier, say 10—12,

11—13, and there is not usually a local demand for such thread. The Salvation Army dispose of their thread in India, in England, in France: they can reel to almost any denier, and are in a position to execute small orders for any special quality. The filatures in Bengal and that of Ghulam Sadiq are in the same position, but all would benefit by the advice of a central co-operation and commercial expert; there is a demand in India, (*e.g.*, Lahore), for the grades of silk that can only be produced from these cocoons: there are facilities for producing from these cocoons these grades of silk, if the organisation existed that could put the reelers and the users into touch: and the appointment of a central organising expert for the disposal of silk would undoubtedly make it possible to obtain the best market for the raw silk produced and reeled in the Punjab.

17. Equally there is scope for the improvement of the reeling: at Amritsar the reeling is done in a similar way to Bengal: the Salvation Army use three different reels at least, and it would appear as if the best reeling system for the Punjab has yet to be found. If expert advice is obtainable, these questions can soon be settled and the Punjab will benefit by the provision of such expert assistance: the industry is not big enough to justify the employment of an expert for the Province alone but it should be able to get such advice. With this provision the industry will be on sound lines throughout and its ultimate extension depends probably wholly on the proportion of the population that will engage in it. It is the most promising area for sericulture in India at the present time and it is not possible to place a limit on the amount of silk that may ultimately be produced.

18. The question of whether the Province is to become a silk-producing one *depends entirely upon the amount of effort put into the planting of trees in suitable places*, the distribution of eggs and the stimulating of the people to take to the industry. There is no doubt that in large areas cocoons can be produced, and the main obstacle to development now is the lack of trees. It is necessary to settle the lines on which this development will take place: whether the Department will continue to issue seed, supervise rearing and dispose of cocoons for the rearers, whether it shall be left to private enterprise or whether the whole business will be taken into the hands of the Department. The present system by which part is in private hands, part in the control of the Department should be stopped. Trials should be made of the best plant and the best variety of silkworm: a better system of hibernation will ultimately be necessary: the question of seed supply in India requires to be taken up: the disposal of the cocoons, the best methods of reeling and the most profitable disposal of raw silk require to be investigated: these questions can be left to the care of an expert if such is available in India: the immediate pressing need is to develop tree planting and so extend the industry.

It is inadvisable to attempt to utilise the mulberry forests such as Changa Manga or to develop a "Silk School" at Simla.

On the analogy of Jammu, the best way to establish sericulture in the Punjab will be to plant trees, to exert pressure, to buy cocoons and to give rewards for outturn.

The existing roadside trees can be used as they are District Board trees: but it is more important to plant up trees on two systems; one is to issue trees to villagers for their own lands, the other to plant blocks of trees near villages where rearing is being done and to let the leaves be taken solely for rearing worms. In this case, either the leaves must be paid for or a deduction must be made from the price of cocoons or a fixed sum must be paid for cocoons. The proper thing to do is to visit every village where there are rearers, to plant either waste land or field margins or roadsides or railway embankments or land taken up for the purpose. I would plant early leafing bush at once and use that till the trees were big enough.

This will require a small permanent staff to plant and look after trees. The village headmen can be responsible and the district officers will have to use their influence freely to get trees protected.

Having planted up the rearers' villages, one wants to plant up others near by till the area increases.

District officers must use their influence or nothing will be done. The Department will have to buy cocoons at a fixed price, deducting cost of seed.

Ghulam Sadiq has a large experience of the district and his advice is to plant trees on roadsides everywhere. Until the industry develops, it is unlikely that zemindars will plant trees in blocks on their land and as a rule the rearers are not zemindars but are weavers, shopkeepers and others who do not themselves cultivate land.

While it is easy to say plant mulberry it is a more difficult matter to actually get this done. Very little mulberry exists and that chiefly as roadside trees, which are planted for shade and which look unsightly if badly cut about in plucking. Also the trees are old and in planting trees now mango and sissou are preferred as they yield a larger revenue. If District Boards will not plant trees, the industry cannot develop.

Trees could be planted round villages but there are many difficulties. It would be no one's business to protect them, to water them or prune them unless a special staff were employed. The rearers are usually weavers or shopkeepers or low caste people who have no land on which to plant mulberry. The zemindars and cultivators will not, as a rule, have anything to do with sericulture and it seems unlikely that the free issue of young trees will do much to stimulate the growth of trees. The third possibility is to acquire land, plant mulberry and sell the leaf to the rearers, starting first at the villages where rearers exist, who definitely want leaf.

These difficulties exist and vary from district to district; to what extent they are coped with depends clearly on the amount of effort made and on the support given by the Deputy Commissioners and tahsildars. The industry offers a very definite return to rearers who take it up: but the number who do so is small. There is no special virtue in sericulture and if the industry will not be taken up it will be because it is not needed.

There is no question that the industry can grow to any limits if it is required and if help and guidance is given in developing it: but whether it will develop seems uncertain.

Its development would be much aided if the full value of the cocoons was always realised and if the crop was not bought too cheaply at the sale, for want of competition. The Punjab rearer gets Rs. 20 per green maund for cocoons far superior to Bengal's, getting Rs. 32 to Rs. 38 per green maund; and the industry would probably develop very rapidly if the sale was better managed. This is a matter that should certainly be inquired into and it might have a large influence on the development.

CHAPTER VI.—ASSAM AND BURMA.

ASSAM.

As a mulberry silk-producing area, Assam is distinct in that the bulk of its produce is used locally, its production is one of the many activities that families there practice in addition to many other occupations, and it is extremely difficult to estimate the extent and possibilities of such an industry. It is limited to a Hindu caste called Katonis or Jugis and to some Mohammandans. It is practised by some 4,026 families according to the estimate prepared for Mr. B. C. Basu; and the total production of the province is estimated at 150 maunds of raw silk worth about one lakh. The recorded exports of raw silk are most confusing and end in 1912-13 with a minus quantity of 51 maunds; but the bulk of the silk produced is used locally and is not recorded. Basu states that there is no export of mulberry silk from Assam at all.

The mulberry silk industry of Assam is fully dealt with in B. C. Basu's "The Silk Industry of Assam" published in Shillong in 1915. The author was my guide in my tour in Assam. His report contains a very full account of the whole industry. Here I discuss only so much of the industry as is necessary to explain my points. The rearing is done on trays in the dwelling house of the rearer; as the climate is moist, the litter must be changed though

this is not done as often as it should be; neither nets nor perforated paper are used, though Mr. Basu thinks the rearer would readily take to the use of nets. The worms spin on a chandraki of the usual kind and the general practices of the rearer are similar to those of Bengal. Rearings are small and the cocoons are reeled off before the moth has emerged as a rule. Tree mulberry is grown and bush is unknown. The variety of mulberry is not known and there are several. The industry is a small subsidiary one, and Mr. Basu estimates the production of each family at 3 lbs. of reeled silk, or 30 kahans of cocoons, in the year. Rearing is done from November to March by all but the few who keep the stock going to provide the seed for next year. This applies of course to the multivoltine race only, the *horu polu*; there is a certain amount grown of a univoltine race, the *bar polu*, generally regarded as being the same as the Bengal *boro polo*.

The cocoons of both are poor. Mr. Basu finds it requires 20 kahans of *horu polu* to a seer of silk and 15 kahans of *bar polu*; in Bengal it would be 16 and 13 as a rule for the corresponding races.

2. The silkworm in Assam is as diseased as it is elsewhere and the fly is a very serious pest. As the worms are kept in the dwelling house with no means of keeping out the fly it is an inevitable pest. Pebrine is another disease which is prevalent as there is no examination of seed. The whole industry is casual, badly done and is not of any great importance; the family wants silk to weave or to sell, has some mulberry and gets a stock of seed cocoons to rear from; the rearer may be a cultivator and a fisherman as well, is well to do and is not dependent upon his silk for his living.

3. Mr. Basu discusses the caste problems that stand in the way of the extension of sericulture, and considers that only the *polupohas* of the Katoni caste and the Mussalman population will take up improved sericulture. The population of the Assam Valley is 3,267,000, of which 2,200,000 are Hindu, 364,000 Mussalman, 27,000 Christian and 663,000 Animist. Mr. Basu mentions the Mechs of Goalpara, a people numbering 45,000, who might take up improved sericulture. Assam is a country of many peoples and very diverse conditions. Until trials have been made in Assam of better races, etc., it is impossible to say to what extent caste scruples will limit sericultural development. But there is no doubt as to the need for improvement; and what extension is possible if there were good seed of better races from which a full crop was always obtained cannot be foretold.

4. In no part of India will the question of improvements be so difficult to decide. There is scope in Assam for rearing the best univoltine in summer, for rearing a multivoltine race such as Madagascar through the year, for rearing a good two-brooded race from November to March in the plains, and for improved selected hybridised *horu-polu* from a hill station. The conditions vary so much, the population factors are so diverse, the climate conditions are so different, that it is impossible to lay down a broad scheme as in other parts of India. Harm has already been done by sending seed of the wrong varieties to rearers; and the greatest care will be required in this matter.

5. In addition to the climate and race complications are the plant difficulties since the rearers grow and use tree mulberry and do not know about bush. The policy will be to proceed in one way if it is a case of new development where sericulture is not practised and in another where it is to be improvement of existing processes and breeds. For the first, the very best race, the most suitable methods, the best plant can be adopted after consideration of the circumstances. For the latter, it will be a case of getting individual rearers to adopt a better breed, similar to their own but disease-free and improved by selection, hill cultivation and if necessary by hybridising. Existing rearers will probably welcome a better breed and might even take to a race such as the Madagascar, but only trial will determine this.

6. In Mr. Basu's report, the suggestion is made that a special effort in the Khasi Hills with the co-operation of the Roman Catholic Mission, would establish sericulture there. The climate is suited to growing the European variety in the summer and a summary of the Shillong experiments will be found in Appendix XI. The war has put a stop to the activities of the

Mission at Shillong and no further progress has been made, but it seems probable that a comparatively small effort would establish an industry among the Khasi Hill Christians and Animists. The 1911 census records 192,453 Animists, and 31,527 Christians in the Khasi and Jaintia Hill district, with 9,454 Hindus and 1,528 Mohammadans. There is therefore no difficulty on that score.

Another area of interest is Manipur, where sericulture has been carried on from early times on a small scale. In Appendix XI will be found a statement of recent experiments there. These experiments have been a failure though done under the auspices of the sole European firm who still manages silk-filatures in Bengal. The question of caste seems to have been a difficulty and also the enormous initial expense in fitting out rearers with houses, cattle, trays, etc. The growth of mulberry is stated to have been bad owing to water logging of the soil. If Manipur does ever become a silk-producing area, it will only be after a larger sum has been spent than a business can afford to and the State does not at present appear to be a promising area.

Below is an extract from Watt's Dictionary of the Economic Products of India on silk in Manipur.

"The author had the opportunity, while on a visit to Manipur, to witness the system followed of rearing the worms and reeling the cocoons. The worms were to a large extent allowed to run wild on a scrub of mulberry bushes, and absolutely no care was bestowed on them. Yet the silk obtained was of superior quality and the manufactures highly creditable. The people were, however, so superstitious on the subject that it was impossible to learn more than the most ordinary facts. Judging from the rampant growth of the mulberry bushes and the prevailing climatic features of the State, Manipur, next to Kashmir, would appear to offer the best prospects of a future extension of sericulture in India. Labour could be had plentifully, and large expanses of rich land, perfectly level, would be available, which for centuries have not been cultivated, and which bear a wild vegetation that in many respects resembles that of China and Japan. The average height of the northern portions of the Valley is about 3,000 feet, but much land could be got at even 5,000 feet, in which the humidity and temperature closely resemble that of France or Italy. Perhaps no better country exists for the oak-feeding *Antheraea pernyi* than Manipur, so that both "Chinese tasar" and mulberry worms might be reared. Manipur might, in fact, be described as a land of oaks, and in many respects it possesses the characteristic features of Shantung, the home of *Antheraea pernyi*, which might be characterised as the best of all the so-called wild silkworms."

BURMA.

7. The production of silk in Burma is summarised in J. P. Hardiman's "Silk in Burma" (1901), and some information is to be found in Watt's Dictionary of Economic Products. Hardiman gives a table from the Census of 1891; abstracted as follows:—

	Rearers.	Spinners.	Weavers.	Printers.
Rangoon . . . . .	..	..	359	19
Prome	1,603	2,454	2,020	11
Henzada	21	..	535	105
Tavoy	2	..	1,107	..
Toungoo	776	2	244	..
Mandalay	2	6,821	3,073	146
Shwebo	7	..	1,117	2
Lower Chindwin	70	155	517	1
Pakokku	32	118	432	..
Magwe	279	..	368	46
Pyinmana	310	2	49	1
TOTAL	3,102	9,552	9,821	331
ACTUAL TOTALS	3,229	9,724	11,660	386

The actual totals included figures of less important districts not here tabulated.

8. As regards rearers, it is difficult to know the present position, the Census of 1911 records "rearers of small animals" but in Mysore for instance this does not include the rearers nor probably does it in Burma where probably all were classed as cultivators; the following is a summary of available information regarding the present silk rearing industry:—

Prome.—Forest villages near reserves, and those planting teak inside reserves in the Nawin, often grow mulberry and rear worms (D. F. O., 5th April 1916). The rearing is done in the neighbourhood of Shwedaung and is in the hands of Yabeins, who reel thread and sell it for Rs. 5 to Rs. 6 per lb.

Thayetmyo.—At the villages of Tindaw and Inle near the East Yoma Reserve, worms are cultivated. If mulberry was extended the industry would increase (D. F. O., 8th May 1916). Silkworms are grown for sale of eggs at Tanyinmaw (District Gazetteer).

Tharrawady.—Cultivation referred to by the Personal Assistant to the Conservator of Forests (June 1916). The Conservator of Forests, Tenasserim Circle, refers to its having flourished here 15 years ago (19th June 1916).

Pakokku.—Gangaw Sub-division. An account of the industry will be found in Appendix VI.

Magwe.—Agricultural ledger, 1897, No. II. Cultivation by Yabeins in 11 villages. Raw silk sold for Rs. 16 a viss (3.6 lbs.) and refuse for Rs. 10 a viss. The Divisional Forest Officer refers to rearing at Thekkemyaung in the South but the industry is in a declining condition (6th May 1916).

Yamethin.—Silkworms are reared at Taungnyo near Pyinmana. (See Appendix VI.)

Northern Shan States.—The Wa and Lao States produce silk which is woven in South Hsenwi.

Southern Shan States.—A little silk is produced. (See Appendix VI.)

Chin Hills.—Silk is grown in the South bordering on the Pakokku Hill tracts and the Gangaw sub-division of Pakokku by the Burmese.

Sandoway.—In the Gwa sub-division, bordering on Henzada, the acreage of mulberry for silkworms was 1,140 in 1845, 20 acres employing 128 persons in 1873 and in 1891 the industry was no longer in existence (District Gazetteer).

Toungoo.—Silk is produced in villages near Yedashe: rearers who came into Yedashe told me they gave it up partly for religious reasons, partly because they did not care to go to the forest for the leaf. They reckon that a rearer doing nothing else will have ten to twenty trays in his house, each 4 feet across, and that ten trays will give cocoons enough to yield a viss (3.6 lbs.) of raw silk. They buy seed at Re. 1 per 6 papers, each paper being 20 layings, a tray holds 3,000 worms, so that 30,000 gives 3.6 lbs. of silk, which is equivalent to about 15 kahans per seer of raw silk. Seeing how primitive the reeling is and the coarseness of the silk, this is probably equivalent to 18 to 20 kahans per seer of khungru silk.

Prome.—There are 55 villages near Prome, in the Paukkaung area, where silkworm rearing is carried on. In its main features, it is similar to that of Leiktho near Yedashe in Toungoo; the rearer clears his bit of forest (Taung-ya) and puts in mulberry; he takes leaf from it for two or three years and then plants another clearing. He keeps perhaps ten trays of worms at suitable seasons of the year, getting seed from hawkers who come from another village. Most rearers live up on the hills at from 200 to 500 feet elevation; few are wholtime rearers, most do it as a subsidiary occupation. The women reel the silk, and it fetches about Rs. 15 a viss. A dealer in Prome estimated the present production at 400 to 500 viss, where formerly it was 3,500 to 5,000 viss.

9. The silkworm of Burma is referred to as *Bombyx arracanensis* and is a multivoltine giving white and yellow cocoons; it is said to have been intro-

duced from China, and feeds on two varieties of mulberry, with red and white fruits; the Philippine variety of mulberry is said to have been introduced by the Agricultural Department shortly before 1884 (R. A. Mannel).

It would assist in understanding the position in Burma if the history of the industry were better known; but it appears to be certain that the worm and the plant were introduced into Burma from China at an early date, that Manipuris were captured and brought down to Burma in 1755 and 1822, who worked at the weaving industry, that some of the silk they used was produced in Burma but was ousted by better silk imported from China and the Straits, and that the industry of growing silk has declined steadily during the last century. Whether the industry was ever a large one seems to be doubtful. Hardiman refers to the possibility of the industry being older than Buddhism and of the Yabeins being the only race who maintained their industry in spite of the religious prohibition, but there does not appear to be any certain information.

Improvement of the Industry.

10. The Burma Sericultural Industry is a small scattered one, carried on by a small class of people who live in the hills or near forest areas. It is never likely under present conditions to become large or to occupy any large proportion of the people, both from economic, climatic and religious reasons. The only question that arises is whether it is desirable that the present classes from which the rearers are drawn should be helped to take up sericulture or to make it more profitable: if this is desirable, the lines on which improvement is possible are quite clear.

The real question is as to how far the rearers have decreased on account of their finding other occupations more profitable or how far they are compelled to keep to their occupation, and whether they are in distress. In the time at my disposal it has been quite impossible to make the detailed local inquiries required, even if I were the proper person to do so; but I think this is the first point to clear up. The questions to answer are:—

- (1) Are there silk rearers who have no other occupation?
- (2) If sericulture paid better, would any who have abandoned it or any new people take to it again?
- (3) Are silk rearers in distress or less prosperous than other classes and is there a need for improving their condition?

If for any number of people, the answer to these is in the affirmative, then improvement can be effected: if not, the silk rearing industry will probably finally die out and no one will be any the worse.

The first and simplest improvement is a better race of worm: I would issue the best available multivoltine race, such as Miss Cleghorn's hybrid, and see what the results are; it is probable that the returns would be distinctly larger than from the present race, to the extent probably of quite 50 per cent. In this case, the further improvement of the plant can be undertaken and quite probably a better variety can be introduced. The third point is to better the reeling; this will be done probably best by showing a simplified Bengal system; to show it, it will probably be best to devise a reel suited to the rearers' circumstances and teach a local rearer how to work it.

The fourth point is to find a market for the reeled silk, probably a very easy matter if from the first the silk is reeled to a size suited to the Mandalay weaver.

11. If these four effect an improvement then other minor improvements can be considered. To carry this out requires little expense: good seed can be obtained in India; for the first, distribution can be limited to two or three places where there are rearers easy of access: the distribution of seed can be extended if the first rearings succeed and in this case the distribution of seed and the economic enquiry into the circumstances of the rearers must go together. If the economic enquiry shows that the industry will expand enough to justify some further expenditure, then a properly trained man can

be appointed to carry on more extended development. It is probably unnecessary to incur any large expense or to appoint any staff permanently. Seed of Miss Cleghorn's hybrid has been experimentally sent to Yedashe for trial by two rearers; if this succeeds, the plant which Miss Cleghorn uses can be introduced there also; and a trained fieldman can probably be obtained from India for further extension of work. If there is likely to be extended development a young Yabein or other rearer could be trained. All this can be readily arranged for if there is in India any Sericultural Department or staff; if there is not, the entomological section at Pusa can train a man or supply a trained fieldman probably. The principal of the Amarapura Institute is anxious to try silk production there employing in the first place Mohamadan families. If this is done, then men from any suitable tracts, such as the Chin Hills, can come there to be trained in rearing and eventually in reeling. This is probably the simplest course and is the easiest way to start the industry in places that are considered to be suitable by the Forest or Agricultural Department. If the proper principles are followed, bush mulberry planted, small rearing houses erected such as the rearers would use, and each man rears say one ounce of seed at a time till he understands how to get a full crop, the industry can be started on good lines from the start. For new areas, the Madagascar race would be the best or a hybrid, for existing areas the Cleghorn hybrid or a Madagascar hybrid. This has been fully discussed with the Director of Agriculture, the Chief Conservator of Forests and Mr. English in Burma; they express the opinion that there are areas in hill tracts such as the Chin Hills where the people need such an industry and would take to it; in some areas forest villages are to be formed and a subsidiary industry of an easy kind is required for the women; the portability of the raw silk is an advantage where transport over a long distance has to be considered, and it seems worth making a trial of sericulture under these conditions. The best plant, the best variety of worm, the best methods can all be used from the start, and it is clearly desirable to test the value of sericulture in this way. In this question the value of expert advice is evident and the further development of the industry will depend to some extent upon its being available; an annual supply of seed will be required, which could well come from a Central Sericultural Station, if such is created, and assistance will be wanted from time to time in connection with reeling, the best breeds of worm, the best plant. If Burma can obtain this, then the expenditure to be incurred is very small; if sericulture does not succeed very little will be lost and the expenditure is well worth incurring.

12. In estimating the possibilities of producing silk in Burma, it may be remembered that while the mulberry will not grow on flat paddy lands, it will grow and thrive on the hill sides and the ideal climatic conditions are to be found in the hill tracts for a large part of the year. In no part of Burma can silk be grown the whole year, but in all it can be for some part of the year, and in most hill tracts quite four crops a year are possible. Given the people to practise sericulture, the conditions are favourable for the plant and the worms everywhere above the flat paddy lands.

PART II.—NEW AREAS FOR SILK PRODUCTION.

Introductory.—The conditions under which silk is produced have been discussed for the large areas, Mysore, Bengal, Kashmir, the Punjab and Assam. Are there other areas in which the cultivation of mulberry silk is likely to be possible and profitable? In considering this, there are two sets of factors concerned, the first the natural conditions of climate, soil, people, etc., the second the results obtained from experiments and the value of these results. Both these are discussed here, the natural conditions first, the experiments second and the suitability of every area in India is considered.

In doing this, I first attempt to present the factors as they would appeal to the district officer, then broadly for each area: the ultimate unit is the district and it will usually be the officer in charge of the district, who will, with advice, decide whether sericulture can or cannot be taken up as an industry.

The list of districts in Appendix VII follows the natural divisions of the country used in the Census of 1911, and not the political divisions. In this list certain information is conveyed by means of figures, etc., and these are supplemented by Appendices VIII to X.

CHAPTER VII.—CONTROLLING FACTORS.

RELIGION.

This is a difficult factor, to which too much weight must not be given. Broadly speaking high-caste Hindus will not take up sericulture directly or indirectly: Mohammadans will do so and it will be noted how great is the Mussalman predominance in Kashmir: but the religion figures for other silk-producing districts do not really coincide with marked religion figures. Some classes of Hindus take to sericulture in Jammu and in the Punjab districts. It is probable that Hindus generally will not do so in the United Provinces and Tirhut: but in Tirhut, for instance, there are separate Mohammadan villages scattered among the predominant Hindu ones and these would take it up. In spite of Hindu predominance in the Deccan, there would probably be no difficulty in getting a large population for sericulture if other conditions were right. In Kashmir there was opposition at first from Hindus and Sikhs, now they and the Pundits engage in rearing. Far more important than figures is the local knowledge of each district but the figures may help and the religion figures for all districts are reproduced. Broadly speaking, a high Mussalman population is encouraging; a high Animist population occurs in tasar districts; a high Christian population points to Missions which are good media for starting the industry and to a population ready to take up this industry (*e.g.*, Khasi Hills). A high Buddhist figure means a class of people adverse to the industry as it requires the taking of life. So that however good the other factors, a Buddhist district will probably not be a silk-producing one.

If one could present these figures, the climate figures and the other factors all in one table, one would be able to see exactly why sericulture is limited to certain districts; and this religion factor is a definite one, but a difficult one to assess the importance of. The figures are produced in Appendix IX.

CLIMATE.

2. The question of whether silkworms can be grown or not is, in the second place, a question purely of temperature and moisture. By artificial means, the temperature and degree of humidity can be very largely modified: but it may be accepted as fundamental that it does not pay to grow silkworms if any considerable modification has to be made in the degree of temperature and humidity by artificial means. No one would attempt to grow silk-worms for instance in Jaipur in May: the mean maximum shade normal for the month is 107°, the percentage humidity for the month is 37 per cent. In

ordinary language that means intense dry heat and to try to rear silk-worms under those conditions involves very great difficulties, and a certainty of its being commercially unprofitable. If then one wishes to decide as to the possibility or not of sericulture, one must first consult the climatic conditions of the locality.

In a report of this sort, it is not possible to discuss this minutely for every locality in India : but the necessary data are presented for considering the matter and the question is treated generally.

3. India is considered under the 16 natural divisions based upon rainfall and climate, which are tabulated in the introduction to the Census of 1911. It is useless to follow political divisions and the natural divisions are obviously those indicated.

Taking these natural divisions, the districts and Native States are listed in order : for a typical locality, the climatic normals of temperature and humidity have been extracted from the Memoirs of the Indian Meteorological Department, Vol. XXII, Part III (1914). See Appendix VIII. An intelligent interpretation enables one to decide in what months, if any, the climate is suitable and for each district or State, the months are indicated in which the climate will allow of sericulture being possible.

4. The normals are reprinted as Appendix VIII. To get an idea of the proper climatic conditions under which sericulture is possible, it is best to study those conditions under which sericulture is done at present :—

Srinagar : the mean maxima for May, June, July are 76°, 82°, 85°.

The mean minima are 52°, 58°, 64°.

The mean humidity is 83 per cent., 82 per cent., 84 per cent.

Mysore and Bangalore have mean maxima between 82° and 95°, for three months only does the mean maximum go above 90°, the mean minimum lies between 57° and 70°, the humidity between 69 per cent. and 86 per cent. Except for the months when the mean maximum is over 90°, the conditions are good. Jorhat.—The best months are February, March, and November : mean maxima of 74°, 80°, 81°, mean minima of 52°, 59°, 60°, mean humidity of 94 per cent., 86 per cent., 94 per cent. Unsuitable months are June to September ; and these are unsuitable because there is a high humidity and temperature. So long as the temperature maximum is under 85°, a humidity of over 80 per cent. is immaterial ; but when both are over these, then the conditions are wrong : (pupation is rapid, evaporation is slow and the worm cannot rapidly eliminate moisture). This is well shown in Berhampur : the best months there are February, March, November, and December. The months from June to October have—

Maxima, 92°, 89°, 89°, 89°, 88°.

Humidity, 87 per cent., 91 per cent., 91 per cent., 89 per cent., 89 per cent.

These months are very bad, the worms are poor, the cocoons small and flimsy.

So far as normals or means help to decide on locality, one may say that the proper conditions are maximum, 70° to 85°, minimum, 50° to 76°, humidity not below 50 per cent., and not above 80 per cent. When the maximum is over 85° a wet bulb of 60° to 70° is needed and if this goes to 75° or over, the conditions are then hopeless. That the means do not express all that there is to be said is obvious : take Darbhanga : the three means for March and April are 88°, 62°, 63 per cent. and 96°, 71°, 65 per cent. In any year there may be in these months a few days when the humidity falls below 50°, and such figures as 43 per cent., 45 per cent. are reached, with maxima of over 100°. A week of this may be disastrous to silkworms. So that it can be concluded that with a consideration of the means must be taken a knowledge of the local conditions and fluctuations. It is impossible to have this knowledge for some 300 districts and States : but the climate problem has been discussed below for each area, and the unsuitable months distinguished clearly in the detailed means given in Appendix VIII for the typical localities.

5. Dr. Gilbert Walker has very kindly suggested a further method of estimating the factor—temperature \times moisture—which is so important: it is sufficient to look at the mean wet-bulb reading and if this is over 75° , it practically always means that the maximum temperature \times humidity is too high. Wet-bulb means are added below (Appendix VIII), for the districts in which they were obtainable from Dr. Walker: they give a very simple method of at once seeing when the humidity is too high to make sericulture practicable.

*LOWER BURMA.

6. The characteristic of the records is the number of months with high maximum and humidity: in practically all months at Akyab, Rangoon, Bassein and Mergui, the maximum \times humidity is more than $85^{\circ} \times 85$ per cent.

The records are for the coast: the country slopes up to 5,000 feet, so that there must be a strip of quite suitable country above sea level and inland.

UPPER BURMA.

7. There is very great variation in climate in this area, corresponding with the elevation and distance from the coast. Generally the wet months are too hot, in some districts the April and May maxima are too high, and in a district of any elevation, the three winter months are on the cold side: but in all the districts, there are quite suitable months between November and April and the extent of this period varies much according to the elevation and the local conditions.

ASSAM.

8. The climate is generally unsuitable from April to November on account of the high temperature—humidity factor: the hill areas such as Shillong are suitable in those months: the Surma Valley is less suitable from December to March than is the Assam Valley, owing to its higher humidity.

In the Assam Valley, silk-worm cultivation is general from November to March, but is too precarious in the moister months.

BENGAL.

9. The maximum—humidity factor is too high from June to October, the maximum alone too high in April-May: the conditions are best from November to March. In some districts such as Bogra, the conditions are favourable over nearly 7 months, in others over less.

High humidity is the dominant feature, heavy rainfall for the wet months, suitable conditions for a varying period of the colder weather. The figures are given for several districts near the hills, where the excessive humidity is still a marked feature, with cold from November to February: it is either too moistly hot or too cold in these districts.

The figures for Padong are taken as typical of Sikkim: and there are not figures for Hill Tipperah or the Chittagong Hill Tracts, in which there should be areas at low elevations in which the conditions are quite suitable.

ORISSA AND MADRAS COAST, NORTH.

10. Places actually on the coast and in the South have excessive maxima or too high a humidity \times maximum factor. Sambalpur and Angul offer better conditions from October to March.

The area contains hilly country, little opened up, and little known. Much of it would offer extremely good conditions climatically from October to March, some perhaps from June to October, if it is cool enough then. Experiments have been made in the Mayurbhanj, Dhenkanal and Keonjhar States.

BIHAR AND UNITED PROVINCES EAST.

11. Excluding part of the Bhagalpur Division, the conditions are suitable only from October to March : April and May are too hot, and the prevalence of the hot dry west winds is uncertain but disastrous : the rainy months are too hot : the best time is October-November, spoilt in some cases by too early onset of cold, or February-March with the risks of an early hot west wind to scorch the worms up.

To those who think that silk-worms can be grown in all parts of India, it will be encouraging to know that at Pusa in the Darbhanga District silk-worms are reared all the year : but no one with experience of this would advocate attempting to do this, except from October to March, on an industrial scale.

As you go west, you get December and January getting cold, March to April getting hot, but lower humidity in October and November. The two seasons are getting more definitely separated by a cold period. It is clearly a case for a single spring brood hatching naturally as the thermometer rises, and a possible brood in October, from incubated eggs or from seed of an accidental multivoltine breed brought from a colder area. It is not clear what are the conditions in the Rajmahal Hills as Naya Dumka is too low : probably there are areas where the conditions are suitable from March to November.

UNITED PROVINCES WEST, PUNJAB EAST.

12. An area of which the predominant characteristics are December and January too cold, May and June too hot and dry, the rains with too high a maximum \times humidity factor, and two suitable periods in October-November and either February and March or March and April. The further one goes towards the west, the greater is the risk of an early disastrous dry heat in April. The nearer one goes to the Himalayas, the risk becomes less. Bareilly and Agra may be compared.

There are many hill areas such as Almorah, Kumaon, Tehri Garhwal, the Simla Hill States, Kangra and Kulu, in which every kind of condition can be got depending upon elevation and distance from the outer hills : and in Jammu, the industry is already established, the worms being reared during March and April in the low level areas that border on the plains. The higher the elevation, the longer the winter when rearing is impossible, the shorter the excessive heat period when it is too dry ; at elevations over 5,000 feet one finds temperatures too low to be satisfactory. The figures for Muktesar, Simla, Murree, Sarain, Chakrata and Ranikhet, should be seen and the low humidity of April and May noted.

It is impossible to make any other general statements with regard to the hill areas. For every separate portion, the elevation and situation as regards rainfall must be taken into account and with a large scale map one could plot easily all the suitable areas.

KASHMIR.

13. The limiting factor is partly cold, and this varies with elevation : while Jammu is politically Kashmir, its outer areas are climatically in the last division. The difference in humidity between Srinagar and Gilgit is worth notice. The rearing of silk-worms in the valleys in Kashmir is limited to one brood in May and June, climatically the right conditions continue probably till the end of August.

NORTH-WEST DRY AREA.

14. Generally speaking there is not a long enough interval between the cold winter and the dry hot period from March onwards. Peshawar is better than Multan. There may be quite suitable spots in the Salt Range. Sind is bad as represented by Jacobabad. Bikaner is either too cold, too dry or too

hot. Ajmere is interesting and might be possible in the rains; but it is the only possible area, the Aravalli Hills, and really this strip should be considered with paragraph 16 below.

BALUCHISTAN.

15. The places for which there are records are not apparently suitable, being either too cold or too dry: but the country is hilly, and the right conditions exist in the valleys, for at least long enough to rear one brood with success.

RAJPUTANA EAST AND CENTRAL INDIA WEST.

16. An area in which the cold of winter, and the dryness of spring is unsatisfactory, while the months July, August, September, October and November offer the best period. Jaipur to the North is less promising than Indore or Neemuch to the South, owing to its higher temperature. The country here is hilly and there is some variation in climate: but on the whole it would look as if the more exposed parts would be suitable in the rains, the lower and more sheltered possibly suitable in February and March.

GUJARAT.

17. There are two unsatisfactory conditions, the excessive temperature—humidity factor of the districts near the coast, the excessive heat of places inland. Dwarka and Veraval may be contrasted with Rajkot and Ahmedabad. There is a period of six months in which conditions are right near the coast and even inland in Kathiawar, but Ahmedabad for instance is either too hot or too dry.

CENTRAL INDIA EAST, CENTRAL PROVINCES, BERAR AND CHOTA NAGPUR.

18. The dry hot months are too dry, the rains too hot, and the best months are from October onwards except where the elevation is enough to make the minimum too low in December and January, in which case the rains are the best time. The area is one which embraces large stretches of low hills, often too limited to be unaffected by the surrounding plains districts, and in which the climatic conditions are suitable only in very small areas.

The most significant is the almost universal dry heat of March, April and May, and for every place the best time for sericulture requires very careful selection.

THE DECCAN AND MYSORE.

19. It is significant to contrast Poona and Balgalore or Ahmednagar and Mysore. The former are unsatisfactory in February, March, April and May on account of low humidity or high temperature. Only from July onwards are conditions at all suitable there. In the latter the conditions are good all the year, verging on too high a temperature × humidity factor in July, August and September. The latter places are in the largest silk area in India, the former produce no silk.

There are places in Hyderabad with suitable conditions after the dry heat of May which gives place to the moderate humidity of the rains and these are the most likely areas; but these depend very much on elevation and on aspect.

There is probably also a good area of Belgaum and Dharwar which is suitable; picking between the excessively wet outer area and too hot dry inner border.

Banganapalle is interesting from its position but records are not available. Experimental sericulture has commenced.

SOUTH WESTERN WET AREA.

20. The two climatic features are even maxima on the dangerous side and high humidity; but all months are suitable except the very wet ones. The

fact that in this area there is usually a rise to 2,000 feet is important, as probably suitable conditions can be found in a very well marked strip from Bombay to Trivandrum, at a proper elevation.

MADRAS, SOUTH EAST.

21. Too high maxima give the limiting factor for all but hill slopes, on which the right conditions are a matter of elevation and aspect mainly. The plains areas are not suitable, as too hot. The hill areas provide suitable conditions up to say 5,000 feet above which the minima may be too low.

It is significant that sericulture is now confined to the Mysore plateau, and is not practised in the hotter districts of this division; that is not solely due to climatic reasons but the temperature is a definite factor.

SOIL.

22. The third factor is that of soil and the cultivation of the plant. Mulberry will grow in almost all (probably absolutely all), parts of India as a bush, a standard, or a tree. Districts in which mulberry is definitely known to grow or is growing now are marked in the district list. (See Appendix VII.)

The really essential point with mulberry is to decide, if it can be grown as a bush without irrigation and, if irrigation is required for the bush, in how many years will trees get established with watering in the hot weather. If irrigation is required, then the value of mulberry and silk must be estimated against other irrigated crops, which usually pay better and are not so risky. If bush mulberry is not to be grown but trees for univoltine silk, then it is a question of how soon trees can be established; and there are districts in which other factors are exceedingly favourable and in which this factor puts the industry completely out of consideration.

COMPETING CROPS.

23. The fourth factor is that of other crops. In Bogra for instance, there is no doubt that mulberry was largely abandoned as jute came in, since jute pays better. In Malda and Murshidabad, the rearers say that mulberry has been kept on simply because jute will not grow well. So for new districts, one has to consider what crops are grown and whether mulberry can pay as well as the usual crops. Where cane, jute, American cotton, rice are the big crops, it is hardly likely that mulberry with a risky silk crop is going to succeed unless on poor land where these crops will not grow: and it is worth noting that the biggest and healthiest mulberry crop is in Mysore, where the land is poor, where there is much rock and waste land and where there are not the long stretches of alluvium characteristic of jute, rice and cane.

I think that most agricultural officers will agree that the Indian cultivator is fairly quick to grow paying crops: that a change in the value of a crop leads to a corresponding change in the amount cultivated: and that if mulberry and silk were shown to pay better than existing crops, there would be an expansion in mulberry silk cultivation.

PRESSURE OF POPULATION.

24. The fifth factor is the "pressure of population," and this is a very vital one. Where the population breed up to the feeding capacity of the land, as in Tirhut, a subsidiary industry such as sericulture, coming in at a quiet time before harvest, is a very valuable asset and this is why the industry is growing in the Punjab. It provides a clear sum of say twenty rupees per family with no additional expense and little labour. Where the pressure of population is really great and there is only just enough food for all, this extra earning means comfort as opposed to the mere means of living. So too

where, owing to changes in industry there is a population, who are in distress and who would take up silk. If the tasar industry finally shrinks to its limit, there will probably be a large class of people to whom mulberry silk would offer a good occupation.

So too in districts where weavers as a class are in distress: for every district, if one had the local knowledge one could say "this is the class of people to whom silk would be a boon" and then one would consider if the other factors were suitable. It is impossible to do so here and no one man can have the local knowledge of India's districts to discuss it for each: but it is a factor of prime importance and one which the district officer alone can answer.

25. In the district list Appendix VII certain other points are marked. If the district is a weaving centre, then there may be a class of weavers, out-of-work, who would take it up. Tasar districts are marked as there the cocoon collectors and weavers may be a large factor and they would probably take to the industry. The districts in which eri and muga are grown are marked and also all districts in which silk is actually grown at present.

In this way an attempt has been made to present the factors which will ultimately decide whether silk will succeed or not and which will be considered in estimating if silk as an industry should be introduced in any particular district: with these are certain technical points that can be dealt with only by experts and which are discussed below under the Technical Section.

The chief of these is the question of the race of silkworms, whether it is to be a race having one brood a year in spring (as in the Punjab), a race having four or five principal broods a year (as in Mysore and Bengal), a race giving two or three broods in winter (as in Assam), a race giving two broods during the rains (not practised but possible), or combinations of these races. The choice of race is governed by the climatic conditions but the value of the silk depends upon the race of worm and so the expert is required to decide how far the industry will pay. Another factor, which only the expert can decide, is as to the relative cost of the appliances required: the success of the univoltine race in the Punjab has been partly due to the fact that in that dry climate, trays are not needed for keeping worms on: this dispenses with a definite item of capital expenditure. In Bengal and in all wet areas, there must be proper trays and the cost of these is immaterial, if they are used for several broods a year. There are many parts of the country, where silkworms can be grown for a short time in the wet season: but a single brood then will not pay as trays must be used. In other districts where a single brood can be got in the dry spring weeks, it pays well as no trays are needed, the litter does not require to be changed and there is literally no expense whatever except a few annas for matting, which the rearer probably makes himself.

LOCALITY SELECTION.

26. In considering a locality, the sericulturist thinks practically in this sequence:—At what time of the year is the temperature \times moisture or wet-bulb factor suitable: does this time coincide with harvest or sowing or some period when the people are very busy: can mulberry be made available then and if so must it be tree, bush or standard, and does it require irrigation: what variety of mulberry is indicated: what race of worm shall be grown; what shall be the source of seed; is a sequence of broods possible: will trays be required or any other capital expenditure or can the rearer manage without any special expense: given these factors right, what class of people will do it: are there people who want a subsidiary or a main occupation: are there Animists, Mohammadans, Christians: are there jails or criminal settlements or other sources of special labour: is the pressure of population such that a subsidiary industry is really needed?

Having decided this, what will be the ultimate extent of the industry based on the possible acreage of mulberry and the number of people available: what are the competing crops and what is their value: finally the destination

of the cocoons or raw silk has to be considered, the question of local reeling or of sale of cocoons, the question of market for the raw silk and its utilisation there : if the cocoons are to be sent out of the district, what will be the freight and charges and is there a steady market for the produce.

Finally is there any other unforeseen factor which will entirely prevent sericulture in that district ?

I have attempted here to present the factors from the abstract point of view : I will indicate below the steps to be taken to test the truth of the conclusion reached by practical experiment : We have now to turn to the existing experimental evidence and to learn what we can from that.

CHAPTER VIII. EXPERIMENTS.

In Appendix XI, I shortly summarise the experiments recorded that I consider noteworthy, with my own comments as regards results. These are of two classes really, those conducted before the perbine remedy was found, and those conducted since. Most of those recorded since are of recent date and very little can be ascertained about some of them ; some are still going on and it is impossible to comment on them in the absence of information. I think that on the whole there is very little information obtainable ; for every district marked E in the list (Appendix VII), an experiment has been made at some time and this may be worth looking up ; but on the whole there is little to learn.

2. To those who are interested in the problem of sericulture, one may safely recommend Geoghegan's "Silk in India," an admirable and impartial account of the many experiments made. I have summarised them briefly in Appendix XI. In the main they are a record of experiments made by enthusiastic officers, who had no expert advice, who grew the wrong kind of worms, fed them with the wrong plant, and were each transferred to a fresh district when they had begun to get experience. Further they had in the early days no knowledge of disease, and the great choice of races which is available now was not then available.

3. Of recent experiments, including some still in progress, the predominant factor has been the utter want of real expert advice. Native States have embarked on sericulture, without expert advice, with a staff utterly inadequate and often badly trained. The experiments have been hampered in various ways, often financially, have been fundamentally wrong from the start in many cases and then abandoned before any definite result could have been obtained ; and as a rule there has been nothing learned at all (see Indore for example). To determine the proper lines on which to start sericulture is a very skilled and difficult business. I have tried to indicate the factors to be considered and I question whether in any single case any large proportion of the economic and technical factors were considered at all.

4. One single experiment seems to me to stand out as a beacon above the waste of futile efforts : that is the trial made by the Deputy Commissioner of Chhindwara, when Mr. (afterwards Sir) J. B. Fuller was Director of Land Records in the Central Provinces. A single brood of silkworms was grown, at the right time, on the right leaf. The breed was of the sort suited to the climate and the results were good. The experiments were apparently not proceeded with, probably on account of the population factor. On the other hand, the colossal failure of the Lister Company in the Punjab and the Dun is the worst example on the other side ; and the climax of a long effort came when a Director from England, with no technical knowledge, ordered the change from cottage rearing to rearing in large houses, thus surely and finally bringing to an end the largest experiment yet made in India.

So far as individual districts go, we learn chiefly where not to grow silk. But as regards the wider question, every experiment shows the absolute need of expert advice and of full consideration of every detail before embarking on

sericulture at all. Had this been realised, much money would have been saved in the past and there is still time to save much money now being wasted on futile efforts, not only in Native States but under various agencies in districts in Northern India.

5. The lesson of the past is an extremely valuable one. It is that with persuasion and pressure, sericulture can be established and will persist while that personal influence is exerted; and then it dies out. There is no doubt whatever that with persuasion and personal influence, sericulture could be started at once in many parts of India, the extent depending exactly on the amount of influence and the thoroughness of the organisation; but it does not seem reasonable to do this unless there is clear evidence that the industry is needed and will improve the people's circumstances. There is no special virtue in sericulture; one does not acquire merit through it; it has to be compared as an industry with the growing of wheat, cotton, cane, jute, rice or any other staple; and it is pathetic to consider the efforts to establish sericulture in places where it never would establish itself. At the same time it is equally depressing to see the efforts which would have succeeded had any sort of expert advice been available; and the wise policy with regard to silk, in the light of the past, is to find the areas where silk is needed, and then to develop it wisely on exactly the right lines.

6. There is one factor which must be taken account of in estimating the value of experiments: that is, whether any trial has been made in the way that the rearer would himself actually engage in silk-rearing: as a rule experiments show only the mistakes made on the technical success or failure of a particular breed: they do not show what would be the profits to the actual rearer if he reared silkworms in his own house with his own plant: short of actually paying rearers to do this, it is difficult to find out what their attitude would be or what they would make of it: but it is usually forgotten that ultimately the rearer, be he cultivator, weaver or any other man, is going to practise sericulture as a means of making money and that it must be looked at from his point of view and shown to him in a way that he can copy. The Gwalior and Indore experiments, discussed below are cases in point: most of the experiments are cases also of what not to do: and I do not know of any serious trials which have been aimed at finding out what the rearer himself can do or will make of it: most show if silkworms can be grown: none show if the cultivator can grow them: but this is the vital factor.

7. As illustrating this, the following three notes on existing experiments in Indore, Gwalior and Travancore are given in full: they are my account of these experiments in the case of Gwalior and Travancore. The official reports of the local department will be found in Appendix XI.

Indore.

The following shows the present position:—

8. An experimental silk station has been maintained since August 1912, at which mulberry is cultivated (2 acres), worms are reared, the cocoons are reeled, the silk is twisted, dyed and woven. Eri is also grown, the cocoons spun, the yarn woven. The silk is grown from July to March: Bengal and Mysore races have been grown in the monsoon and autumn, and French univoltine in February and March. The work is generally well carried out, the rearing and reeling is rather inefficient: in its planning it bears the stamp of the Salvation Army, whose expert, T. K. Achaya, spent six months organising it. In some details weaving has been improved by the Bengal Weaving Expert, and in general efficiency it is the product of its Superintendent, V. G. Joshi, not himself a trained expert in any branch. The cost to the State is put at Rs. 7,000 per annum, and a certain amount (Rs. 800—1,000) is realised from sales of cloth.

9. The experiments show that silkworms can be grown, the silk reeled, dyed, and woven at Indore, at a total cost to the State of some thousand of rupees, but at present they show nothing else. They serve to demonstrate how it is possible to produce silk and to make it into fabrics, and this may have some

educational value in the State and the experience is certainly valuable to the Superintendent. But it is not clear how this is to do more; no one, who saw this institution would repeat it unless as a hobby, on which he could afford to spend money; there is no attempt to work out in detail how a business in weaving could be established as a commercial undertaking. I understand that no one has taken up any branch of Sericulture as a business and indeed no one could at present. It is another instance of the truth of the principle, that, to teach or to demonstrate an industry is not enough; you must first learn how to practise it profitably, then teach it as it is to be practised; this applies to the weaving as much as to rearing.

10. I had hoped that Indore might have solved one problem, how can silkworms be grown here in the rains and what is the outturn per ounce. While silkworms have been grown, this has been done very badly and there are no definite returns. It is clear that the sericultural station will not in any way help to develop an industry, and its chief merit, from this point of view, is that it has enabled the Superintendent to learn a great deal as to the methods of making cloth and to get some experience of local demand. If ever this tract became a producing area, and there was a question of local utilisation of the product, this experience would be of some value and the sericultural station would become profitable.

11. The first essential in Indore is to ascertain exactly the best way to grow silkworms and what the profits are, if any. This can be done at the existing station or at a village. It will be necessary in the first case to set apart mulberry sufficient, to build a rearing house such as a cultivator would use and to employ a family to rear worms; they should do it entirely themselves using nothing that they cannot themselves get ordinarily. I think they would do best to grow Miss Cleghorn's hybrid or the Madagascar race from June onwards and if stopped in the winter by cold or want of leaf, they could grow univoltine French or Italian in the spring. The total cost of trays, etc., must be kept rigidly and deducted from sale proceeds. If this cannot be done at the station, it will be necessary to find a village where say five families will do it and to start them, planting 10 acres of mulberry for them and guaranteeing them a return or monthly pay. The cocoons must be taken over by the State at the market price, not more.

If this shows that a rearer can make a good living, doing nothing else, it will be possible to establish it; it may show that it is better only to rear one crop in spring as a subsidiary industry, in that case the methods of the Punjab or Kashmir can be applied.

12. There is one circumstance in Indore of which advantage can be taken; the rearer will plant any plant, will grow any race, can be taught good methods and can be taught to feed properly; he will have no inherited prejudices. Before this scheme can be carried out, proper rearing methods must be adopted; the present Superintendent is more skilled in dyeing than in rearing and Indore will require a proper fieldman to conduct this work. In starting sericulture, one cannot afford to make mistakes and the present methods of rearing are not at all satisfactory. I see no use in considering reeling, dyeing, twisting, weaving at present; there is no harm in carrying on the present station, as silk rearing may develop and the question of utilisation may come up: but it must be at least three years before there are cocoons to reel in sufficient quantities to make it worth while thinking about it. A reeler constantly employed will reel two pounds of good dried cocoons a day, he will want say 5 seers a week or 6 maunds a year, *i.e.*, 24 maunds of green cocoons. A rearer doing 1 spring brood and three rains crops will not produce at first more than 5 maunds green cocoons a year. So that 65 rearers will supply one reeler, and it is not good for a reeler to be at work at intervals only, as he loses his touch.

13. The cocoons produced should be bought by the State and either sold or stored. If the existing weaving station is maintained the cocoons can be reeled there and the silk sold or used. A cocoon rearer in Bengal, who does well makes in the year Rs. 200 to Rs. 250. A rearer in Indore, who takes a crop of cocoons in spring, and three from June to December, should get 5 maunds of cocoons worth Rs. 200. When he gets experience he should be able

to get double that amount, and if Madagascar variety is reared, these should be worth Rs. 50 per maund.

From this must be deducted cost of trays, nets, etc., cost of seed, rent of land; I assume that as a rule he cultivates his own land and has sufficient mulberry of his own. The conditions of Indore generally are very suitable to the industry so far as climate, mulberry and markets are concerned, but whether the religion factor will prevent any development must be ascertained by experiment. If there are a sufficient number of Mohammadans or of other people, who will not object, and if the returns are high enough to attract them, as they probably are, then there seems no reason why, on proper lines, the industry should not develop, either as a full-time one or as a subsidiary one to cultivation. If this is done, then the Silk Institute should seriously grapple with this problem, how can a weaving industry be developed to utilise the silk, and the Institute should be in a position to lay down the exact lines on which a master-weaver could establish a small hand-loom factory to use the silk, making fabrics for local demand or for sale elsewhere in the State and nearby markets. This is not easy for an Institute that has Rs. 7,000 to fall back on, but it should be possible if the Superintendent will keep rigidly to this one point. Quiet possibly the best plan would be to run the Institute as a model factory on strict business lines, not experimenting, but making money, in which case others could be established by master-weavers on its model as the silk production expanded.

GWALIOR.

14. From 1910 onwards, sericulture has been tried, on a scheme recommended by Fakir Chand and to some extent revised by the Agricultural Expert Mr. Dongre. Three methods have been tested, the growing of univoltine silk in February-March, the growing of the Mysore race in the rains and eri cultivation.

The first has shown that univoltine silk can be grown as a single brood, but that it is difficult to get leaf then unless irrigation is resorted to. Rai Har Swarup Bahadur, Conservator of Forests, who has had charge of the work, tells me, an average of 10 seers dry cocoons per ounce has been obtained. The cocoons are small but otherwise good.

The second method is still on trial, the first lot of cocoons are not very good.

The third method has given very good cocoons but there are difficulties about castor, as it cannot be sown till the monsoon begins and leaf is wanted then. The cocoons have been sold, have been spun and woven locally.

15. These trials have been made at three places in the State; at each the rearing has been done and a trained man provided to introduce the industry. Seed is provided, plants are given free, and help is given with trays, rearing houses, etc. The cocoons are purchased by the State. In spite of this, in spite of pamphlets and an exhibition, the district officers are, in the main, opposed to it and no one has taken it up. A considerable amount of money has been spent, the budget allotment for one year was Rs. 35,000, the rearing house is good, the mulberry plant is well grown, good eri is produced, but the result is *nil*.

16. Technical improvements can obviously be made, but do not affect the result, the plant grown has been Kashmir (which is a late variety) and a local fruiting variety, the Philippine or the Cleghorn might be earlier. Then the Mysore race is not so good as Madagascar or the Cleghorn hybrid.

Both the eri seed and the univoltine mulberry seed supply, have been uncertain, no reliable renewal of Mysore seed is possible every year.

These are technical difficulties, which can be overcome, but they hardly affect the present issue, which is the difference of the people. I think it is clear that this method of procedure will affect very little; it is not enough to have a central rearing house, which costs a good deal, and grow silkworms; you want to do it as the cultivator must do it, in multiple perhaps, and

actually show profits. A hut should be made or rented, such as he would use; a cultivator should be paid to rear his ounce of seed, with leaf from a local plantation or local trees; his crop should be taken over: the cost of the hut, the seed, etc., should be deducted, and the rearer given the balance. Is he willing to repeat it minus the payment? If so he thinks it pays; if not it does not: and if it does not in his opinion, why try further?

17. The trial made in Gwalior is one of the best yet made in India, probably, in the thoroughness and efficiency of the details; the original scheme was not perfect, but it has been improved: but it has failed to succeed because (1) it was not done as any rearer could do it (2) there was no evidence as to profits.

The only way to demonstrate such an industry is to do it, by cultivators as cultivators can do it, and then see what there is in it. If these men are making money without any subsidies, then others will do the same. I think the Gwalior trials are good and helpful; technically they could have been improved: actually they fail because the people, who have to do the industry cannot copy the methods of the State and so cannot see whether it will pay or not. Local knowledge has been at fault and there has been the usual result.

TRAVANCORE.

18. For five years, experiments have been in progress at Trivandrum to determine if sericulture can be profitably practised there. The leading idea of the Director of Agriculture is that silkworm rearing will be a profitable subsidiary industry to the lower classes, as an adjunct to cultivation, where there is land unsuitable to paddy or to cocoanut. A small cultivation of mulberry has been established at the cattle farm and silkworm rearing carried on there. The Salvation Army are also carrying on silkworm rearing and reeling at their settlement and a number of boys are being trained there: these boys are from the class, which will possibly take to the industry, and they are to commence rearing in their villages at the close of the training; mulberry has been distributed to these villages and planted there so that they can commence rearing on their return. The Salvation Army settlement receives a grant from the State; it is the only Salvation Army institution I have seen where mulberry was properly cultivated and where silkworm rearing was taught on a proper method, and the sole disadvantage that I noted was that there was insufficient leaf to allow of each boy rearing a sufficient amount of worms; it is a mistake to teach boys by letting them rear one tray of worms, all the trays together in one building; each rearer should be taught as he will have to do it when he starts on his own account. In other respects the Salvation Army Settlement work struck me as being extremely good and practical.

The above shortly summarises the position in this State; only one rearer actually grows silkworms outside the farm or school, but when the first batch of students finish, they will presumably commence rearing themselves. The intention is to purchase their cocoons and to reel them at the Salvation Army Settlement, and the chief reason for utilising the Salvation Army is that they have an organisation that works among the depressed classes and can exert influence among them throughout Travancore State. The results of the past five years' work give a basis on which to estimate the prospects of the future. Mulberry grows well on the poor land, which is unsuited to paddy, and not well suited to cocoanut: irrigation is not ordinarily required provided no leaf is wanted in the dry hot season, and there is probably no difficulty in growing abundant bush or tree mulberry where there is land of this description. The present mulberry is from Mysore and is probably *Morus alba*, not the Indian mulberry. Quite possibly another variety will do better, but that is easily ascertained. The present mulberry looks excellent.

19. The climate is on the whole suitable for a good part of the year, but not the whole; the general figures are discussed elsewhere (see paragraph 20, page 71), but the actual rearing done at Trivandrum gives data on this point, and the experience gained is useful. The following figures of rearings at the farm at Trivandrum; the figures are difficult to follow because the amount of seed used to start with is so obscure: assuming a laying to be 300 eggs, the actual

number reared is as a rule very small indeed and the fraction at the end represents the theoretical proportion reared :—

Kind.	Month.	Seed.	days.	Yield of cocoons (dried) Weight.	No. to 1 lb.	Proportion reared.
Mysore	II III	225 layings	40	7 lbs.	1,650	1/5
"	V .VI	50 "	25	5 "	800	1/4
"	VI VII	500 "	51	22 "	900	1/7
"	VII VIII	380 "	42	flacherie.		
"	X XI	18 "	23	1 lb.	800	1/7
"	IV V	200 "	33	9 lbs.	1,000	1/7
"	VIII IX	100 "	38	3 "	1,050	1/10
"	XII I	20 "	34	5 "	1,000	5/6
"	I II	75 "	30	8 "	900	1/3
"	VII VIII	50 "	31	15 "	1,500	2/3
"	VI VII	30 "	32	6 "	1,100	2/3
Pusa yellow	XII I	25 "	27	1½ "	1,200	1/4
Nistari	II III	40 "	28	flacherie		
Yellow	V VI		28	6 lbs.	1,000	
"	VI VII			failed		
Pusa, Yellow	IX X	68 "	26	3 lbs.	960	1/3
" "	X XI		28	1 lb.	1,000	
" "	VI VII	200 "	31	15 lbs.	1,500	1/3
" "	XI XII	75 "	30	12 "	1,000	1/2
" "	XII I	100 "	40	2 "	No leaves	
" "	VI VII	40 "	30	14 "	2,000	
French, Pusa	II III	50 "	28	2 "	1,000	1/7
" "	V VI		27	1 lb.	500	
Univoltine Pusa	XI	40 "	28	2 lbs.	1,000	1/6
" Simla	I II	2 oz.	35	died		
" Pusa	VIII IX	100 layings	38	3 lbs.	1,050	1/10
" "	XI XII	1,000 eggs	21	1 lb.	400	2/5
" Simla		12 oz.		did not hatch.		

The cocoon weights vary a good deal, but on the whole suitable months seem to be June, July, August, October to January. The Mysore race gives the best results on the whole, but it is practically certain that the right breed for Travancore has yet to be found. The Madagascar and the hybrid races need to be tried. There has been difficulty with leaf supply and probably too much has been attempted on an insufficient amount of plant. The cocoons I have seen are promising but better results can be got.

Assuming the climate to be suitable in those months and the plant to grow well, it is necessary to have seed twice a year, in May-June, in October: this adds to the difficulty and has been one of the troubles in the past, but this can be overcome and if the Central Silk Station proposed in Chapter XXVIII is created, Travancore should get its seed there: If Mysore or Madras start seed supply from a hill station, they also could supply Travancore.

20. Assuming this to be overcome, there is the question of the rearers : I am told that the people, who will welcome the industry are low caste people, who can grow mulberry, who will have no scruples about killing cocoons, who will welcome an extra industry. If there are such people in large numbers, then the industry should establish itself and do well : it is not proposed to teach reeling to these people, but to buy cocoons and reel them at the Salvation Army Settlement. At the start this is a wise course : if the rearing succeeds and extends, then the reeling question can be gone into : but with the efficient management there is now, the system of reeling at the Settlement will be the best.

21. The future seems to me to turn on the progress made by the 12 students trained at the School, and I would concentrate on them before extending further : each should have one acre of proper mulberry cultivation : each should grow a proper brood of worms from say 120 layings of seed and get at least 40 lbs. green cocoons : and they should be able to do this at least four times a year. If this succeeds then the farm should be properly run to test the best varieties and the best plant : it should do rearing properly, getting a full return from a definite amount of seed : and the further training of students should be properly provided for, each having his own trays and leaf enough for at least 50 layings of seed at a time. The training of students should not include reeling, weaving and the like and if in the settlement these are done, the students should not have anything to do with it. The mistake made elsewhere of teaching, rearing, reeling, dyeing, twisting and weaving should not be repeated here. If there is scope for silk weaving other people should be taught and the first aim is to develop silk rearing alone as a cottage industry.

The wise policy seems to me to concentrate on the existing students first. If they succeed extend the farm as a trial place, extend the Salvation Army settlement as a training place : both will require money to be spent, the former in better rearing accommodation and in training the Manager, the latter in more mulberry and more rearing accommodation. It would be money well spent to send the farm manager to Berhampur (Bengal), Pusa, Srinagar. It will be necessary to test the available hybrid and pure races and get the best for Travancore.

22. The possibilities of the State are worth testing properly : at present the outcome is uncertain but seeing that 12 students will shortly be ready I would use them to ascertain what can really be done and for the rest await their results. It will be a case of either spending more money and developing largely or of abandoning the attempt altogether. The present efforts are too small to be successful and yet they cost some money. I am hopeful of ultimate success, but not on the present scale.

CHAPTER IX.—CONCLUSIONS.

NATURAL DIVISIONS.

Lower Burma.

The climate is on the whole adverse owing to its extreme humidity and temperature. Sericulture is practised in Prome, Toungoo and Magwe. The population is very predominantly Buddhist but the number of rearers (2,658 in 1891) is very small. There are areas where the climate is quite suitable but the population factor is against sericulture, otherwise there might be a considerable production of univoltine silk in the winter months. Another adverse factor is the value of rice, and the suitability of this area for rice cultivation. One would not expect this to be a promising area.

Upper Burma.

2. Suitable months in the winter are four or five and the climate offers scope for at least two broods of very good silk if other factors were favourable.

But the population is predominantly Buddhist and though much silk is used, little is produced and there is a very great import from China.

It would be interesting to see the effect of better races giving a high yield of the Chinese quality of silk which is in demand locally.

Assam.

3. The Assam Valley is a producing area fully discussed in Chapter VI (Assam). A single small new area has definite promise and it is probable that a silk industry of some size could be developed there; this is the Khasi Hills, an area lying at some elevation with a population of 192,000 Animists, 31,000 Christians, 1,500 Mohammadans and 9,000 Hindus; experiments made there show great promise.

Bengal.

4. A silk-producing area fully discussed in Chapter II. The natural contraction of the silk area is partly due to economic causes such as jute; there will be no extension to new areas under present circumstances; the interesting localities are Hill Tipperah, the Chittagong Hill Tracts and similar areas of higher elevation. A definite limiting factor in the plains districts is the great value of rice, cane and jute.

Orissa and Madras Coast North.

5. The available figures of climate show a long and suitable period from November to March. There is a very large population of Animists, all districts are tasar producers, though the industry is small, and all are hilly and with some range of climate. Experiments made in Cuttack, Mayurbhanj, Dhenkanal and Keonjhar are of little use. There is probably no area of India in which the prospects of sericulture are more deserving of trial and enquiry, particularly in the North. The country is little developed and it is quite possible that sericulture would be an industry well suited to the people as a subsidiary livelihood. Until its possibilities have been investigated, it cannot be definitely placed.

Bihar and United Provinces East.

6. The climate factor is quite definite, offering great possibilities from October to March. The religion factor is a strong adverse one but there is a high Mussalman proportion. Experiments are very enlightening and it is well shown that sericulture is possible. The work of Pusa over eight years shows exactly what is possible; and there is probably a very great prospect of sericulture being profitable if run on proper lines.

What those lines are is fully discussed on page 114 under Tirhut and there the unique factor of the European planter complicates the position. The "pressure of population" appears to me to be a factor of very high importance.

United Provinces West, Punjab, East.

7. The outstanding factors are good climate for a single brood fed on tree-leaf in February and March in the submontane tracts, where there is "pressure of population." The ultimate limit of this cannot be estimated but on the analogy of Jammu and Kashmir, the industry could well be a bigger one than the whole of the existing Indian industry.

There is also the uncertain factor of the hill districts especially Kulu and Kangra and the Garhwal division. Against these is a peculiar climate factor, the continual rainfall tending to disease in the worms owing to the feeding with wet leaf. Light-hearted enthusiasts forget this practical difficulty and think the Simla Hill States should be large silk producers. But it is a very real difficulty.

North-West Dry Area.

8. There is one limiting climatic factor. It is there a long enough period between the cold winter and the extreme dry heat to allow for one brood of univoltine worms on tree mulberry; where there is, then economic factors come into play; the population is predominantly Mussalman; and experiments show that the best silk can be very well grown at very small cost where trees are available. Considering the amount of silk produced further North and West, there should be a good deal produced in parts of the North-West Frontier, with a good market at hand. The rest of the area is climatically impossible.

Baluchistan.

9. The factors are much as in the last section, with very marked economic factors depending upon population. Good silk has been grown and there is no difficulty on the technical side.

Mulberry grows well in restricted areas as in the Harnai Valley in Sibi and is valued for its fruit. 'Silkworm' mulberries grow well and the extension of sericulture is probably solely a question of population and organisation.

Rajputana, East and Central India, West.

10. The climate records give too cold a winter, too hot a dry weather; the rains are the best time. Apart from experiments in Indore, Gwalior and Bhopal, which have not given much promise, there is no direct evidence of the possibility of sericulture and the method of getting several broods during the rainy months has not been fully tried yet. The population factor is distinctly adverse but variable and there are areas where sericulture should be tried, using the new hybrid or an improved multivoltine race.

Trials have been commenced in Indore with a view to testing the possibility of getting three broods of silkworms during the rains. Irrigation is a difficulty and possibly the system of growing one brood of univoltine worms in the spring on tree leaf will be the best. In that case expansion is purely a matter of planting trees, which grow very well when once established.

Gujarat.

11. All the factors are against the area as a whole while one can easily find places where the climate factor is very good. The Jain and Hindu are a feature of the population and the irrigation difficulty is against mulberry cultivation. Experiments have been made in Baroda but not on sound lines and there is little to be learnt from them. It is possible that Kathiawar has suitable conditions for at least six months but the population factors are not known.

Central India, East, Central Provinces, Chota Nagpur.

12. Should a system of growing good silkworms during the rains be perfected, as could possibly be done this area offers very great possibilities. It is the tasar-area of India, extremely diversified in climate and conditions, with a very large population of Animists and of tasar rearers inclined to silk rearing. There is the short dry hot weather that is unsuitable and, in many places, irrigation being required for mulberry prevents its being grown. It will not be taken up on black cotton soil areas but might be at higher levels, in Chota Nagpur, in tasar districts, if the population factor does not forbid it. It is a promising experimental area.

The rainfall in the cooler monsoon months will be a bar, on the experience of Kashmir and this will probably be the deciding factor.

The Deccan.

13. The factor that at its southern limit there is the largest area of mulberry in India leads one to think there are greater possibilities in the Deccan; but the limiting factors are the necessity of irrigation in all but the Mysore area, the very dry heat of the hot weather months and the shortness of the suitable moist cool period from July to October.

The sharp delineation of the Mysore area is noteworthy and is due wholly to climatic conditions; and it is extremely doubtful if under any circumstances the mulberry plant and its risky host will flourish in the Deccan. Experiments have been made, mulberry grows well; but if irrigation is needed, cane pays very well and is less risky. Mulberry silk culture has existed in Dharwar and there is no doubt it can be practised; in some respects the Dharwar and Belgaum districts are climatically as nearly ideal as any in India, yet sericulture has never established itself there.

Malabar and the Konkan.

14. The population is mainly Hindu, with a large Christian element in the South. The climate is excessively moist and rather hot. The mean minimum is high, the humidity high, the rainfall great. Over a great part there is no question of an industry, as much is forest land; and the experiments in the South are not yet very definite or decisive. It is an area in which a small industry might develop in the South but no more.

Madras South-East.

15. The climate factor is adverse; the crop factor is usually adverse as the crops are good, the rainfall secure and there is little need for another industry. This area is a silk-using and silk-buying area rather than a producing area.

POSSIBLE NEW AREAS.

16. Apart from single districts and small areas, which may be found almost anywhere in India where local conditions call for a subsidiary industry, there are large areas in which there is a reasonable exception that sericulture could be developed.

17. The first is the extension of the Punjab submontane area naturally along the submontane districts to the East. The second is the development of an entirely new industry in Tirhut joining to the Punjab area if the United Provinces submontane districts take up the cultivation and stretching east till the jute areas of the Bengal districts limit sericultural development. The main features of this development are very fully discussed under the Punjab and Tirhut (Bihar and Orissa). The third is the Chota Nagpur area, but its development depends on the working out of the best race of worms to grow during the cool wet season. When this is done and a supply of seed is available of the proper variety of worm, it is probable that the Chota Nagpur area can become a large silk-producing tract. The fourth area with prospects but which has as yet been almost entirely untouched is the Orissa area. The economic factors will need to be worked out with the technical question of the best races of worms to use.

18. Other possible areas are less promising, and it is probable that development can only take the form of the finding of places where a subsidiary industry is required, where the conditions are good and where sericulture can be developed on an upland stretch, in a sheltered valley or in a small well-defined area within a single district. The valleys of the North-West Frontier and of Baluchistan are typical examples. The Khasi Hill plateau is another. Such places can also be found for instance in the Central Provinces. If economic factors were promising, such places as Chhindwara and Chikalda would be suitable. The Central Indian uplands offer many promising areas if the economic conditions are suitable. The experiments made at Indore should have given better results but the proper race and the proper method

of doing sericulture in the cool rainy months in Central India and Chota Nagpur has yet to be worked out. The same applies to the South Western Hills, and Travancore, to Coorg, to Almorah, Kumaon, Kangra and Kulu. Neither the univoltine spring brood system of the Punjab nor the multivoltine continuous system of Bengal is the right one for these wet areas and the promise of these districts is yet an unknown quantity. It needs to be worked out in detail and the experience of Kashmir is not favourable to rearing successfully in rainy months.

19. From the sericultural point of view India consists of four uniform tracts where sericulture is practised and can be extended with limiting economic factors, these areas being Mysore, Bengal, Kashmir, Assam; there is then one very large uniform tract, in which sericulture can be immensely developed by commencing at the two ends, these being the Punjab submontane and the Tirhut areas. There are then two large areas, of unknown possibilities, but fit for development, the Chota Nagpur and Orissa areas. There follow three large tracts in which the conditions are right at many selected spots but not uniformly over the whole tract, these tracts being the Central Provinces and the Central Indian uplands and the valleys of Baluchistan and the North West Frontier. There is a small area of very definite promise in the Khasi Hill district of Assam. There is finally a series of places characterised by excessive rainfall in which sericulture may develop but only on very definite lines which have yet to be worked out. Included in this series is Travancore, Malabar, the South West Hills, Kangra and Kulu, Kumaon and Almorah.

For the rest of India the possibility of sericulture under present conditions seems small.

20. It is a reasonable policy that where factors are not absolutely forbidding, sericulture should be tried under the cultivators' conditions till definitely shown to fail for good reasons, such as economic ones. But until this has been done, the prospects of sericulture are not assessable: the Tirhut people took up eri culture to a considerable extent till they saw they had no market, but had they had a market, it would have flourished now. This looks as if Tirhut might be a good area but it has not been tried. If a real trial is made, under their conditions, and it then fails, I would strike off Tirhut as a possible area. But one cannot do so till it has been tried. So for other areas where sericulture has never been seen or tried: I would try any place at which climate, water, economic factors promised success: and having really tried it, either go hard for development or cease wasting money.

PART III.—TECHNICAL.

CHAPTER X.

In this section of the report, the technical details of silk-rearing are discussed so far as they are necessary in considering how the industry can be improved. It is not necessary to go into questions of detail as regards cutting the leaf, number of times to feed, amount of leaf and the like: but there are questions such as the seed supply, its hibernation or cold storage, its production in India, the races and hybrids, the rearing methods, the spinning methods, the problems of disease and plants, which are best dealt with in a separate section.

MULBERRY.

There is a considerable amount of confusion as to the existing species and varieties of mulberry in India and this is not lessened by the confusion in the nomenclature of the species of *Morus* in the world. This need not concern us further than is necessary to get clear ideas as to the available mulberry plant varieties for sericulture. There are wild indigenous species, there are introduced species or varieties. Introductions have been made from Europe, from China and possibly from Japan or the Philippines and there is a difficult problem for the botanist to clear up. The following is a summary that is without any botanical authority whatever:—

1. *Morus serrata* Roxb.—Giant Hill Mulberry. Hooker, Flora British India, 4,000—9,000 feet in the Himalayas, Kashmir eastwards. (Probably one of the common Kashmir varieties).
2. *Morus laevigata* Wall.—Wild and Cultivated—Hooker, Tropical and subtropical Himalayas to 4,000 feet. Assam, Khasi Hills, Burma.
3. *Morus indica* Linn.—Hooker—China. Japan. Temperate and subtropical Himalaya. Cultivated in Bengal.
4. *Morus atro-purpurea* Roxb.—Hooker—China—Introduced to India for fruit, cultivated. Probably the "Shah-toot."
5. *Morus alba* Linn.—Hooker—North and West Asia. In India, cultivated to 10,000 feet. (Possibly in Kashmir but not certain).
6. *Morus multicāulis*-*Morus alba* var *latifolia*—Introduced to India from China or the Philippines about 1840; the so-called Philippine Mulberry.
7. *Morus alba* var *rosea*.
8. *Morus alba* var *moretti*.—

These were obtained as seed from France. The names are those used by the French Seedsman. The former is growing at Pusa.

9. *Morus nigra* Linn.
10. *Morus nigra* var *laciniata*.—

Two varieties from France. The former is said to be cultivated in Baluchistan. (D. Brandis.)

11. *Morus alba* var *sinensis*.—A variety from China. Possibly the variety in the Srinagar nursery.
12. *Morus japonica*.—A broad leaved variety, stated by l'Arbousset to have originated as a sprout among a lot of Japanese seedlings, in France.

The above are referred to in books, papers and silk literature. Numbers 7 to 11 are of little value, and probably are not distinct.

From the silk point of view, there are the following:—

1. Indian or Deshi Bush Mulberry. *Morus indica*—No. 3 above.
2. "Bombay" Bush Mulberry of Bengal, *Morus*?—A distinct bush mulberry to which two sources are ascribed; it may be the European variety brought to Bombay via St. Helena in 1832. It may be any of the European varieties brought to Bengal more recently through the European filatures.

3. Philippine Mulberry No. 6 above. An early variety that grows well from cuttings.
4. Kashmir Mulberry—a tree, growing freely in Kashmir. This seems to be a distinct plant, with much indented leaf and a small black fruit: but what it is botanically is not clear. In Kashmir there is a white fruited plant, a black fruited, the Shahtoont, a fruitless and a large leaved supposed Chinese race.
5. Japanese Mulberry. No. 12 above—A tree or bush with very large leaves.
6. Italian, French, Hungarian Mulberries. Grown as trees usually.
Probably varieties of *Morus alba*. A distinct form is Cleghorn's variety, which bears no fruit and is a male plant, from a tree found in Ballyganj. See Appendix XII.
7. Mysore bush Mulberry.—?
8. Purple fruited Mulberry.—No. 4 above and perhaps also No. 9 and 10. "Shah-toont."
The fruiting mulberry of Indian gardens, usually regarded as useless for silk worm cultivation. Possibly the indigenous variety of Indore and Gwalior.
9. "Toont" or Fruiting Mulberry. Referred to by N. G. Mukerji as the best for fruit and called *Morus alba* var *lævigata*. Probably No. 2 above.
10. "Kajli" or "Chini Toont."—Referred to by Mukherji as *Morus alba* var *sinensis* and probably No. 11 above.
11. 12. At Jeolikot, Mr. Gill has an unclassified variety that makes very good bushes and he refers to another variety as *Morus alba* var *serrata-teste* Bur. His new variety was the best for chota-polo and nistari worms.

Mulberry occurs in the Punjab in plantations of sissoo on islands in the Jhelum and in such irrigated plantations as Changa Manga, probably from seed carried down by the water or dropped by birds. Brandis refers to the Changa Manga species as *Morus alba*, Gamble refers to it as *Morus indica*. The mulberry gradually takes the place of sissoo and in Changa Manga, the mulberry trees are extremely fine. These plantations are irrigated.

3. A question of the greatest importance from the silk point of view is the behaviour of each variety as regards early budding. Mulberry becomes leafless in winter and as it buds and the leaves develop, the eggs are brought on to higher temperatures so that as the trees come to leaf the worms hatch and find tender leaf for them. In India this is a matter of enormous importance in some tracts as the earlier the trees will bud the earlier the worms can be hatched and the greater the chance of escaping the hot winds. Notably early varieties are the Philippine, the European known as *Morus alba vulgaris tenuifolia* and the unnamed variety of Jeolikot. The Indian bush (*Morus indica*) and the Himalayan *Morus lævigata* are late varieties.

4. Mulberry is grown in India as either a small bush or a tree; elsewhere it is grown on a variety of systems. Bush mulberry is got by taking cuttings, and putting them in the ground in a bunch of six to eight, each one of the bunch separate but the whole forming a compact bush: each roots and buds and you get a shrubby growth of shoots to about three feet high. These can be plucked, cut down to the ground and a fresh growth of shoots starts. In this way you can get several crops a year: but it requires good soil, good water and good manuring. This is the system of Bengal and Mysore. Shoots are planted as close as eighteen inches apart in the row and the rows two feet apart.

The other existing system is to grow trees: the best are grown from seedlings which are carefully handled from the start and are planted out in permanent positions up to five years old.

It is not necessary here to describe the details of the production of trees which are well known in India. Trees are not planted as field cultivation but along boundaries, headlands, water courses, railway embankments and roadsides. In

Kashmir blocks of trees are grown on land near villages, the trees put out from nurseries when three or four years old and planted 18 feet apart. Each tree should have room to develop and the roadside tree, which gets covered with dust, is the least satisfactory; at the same time the mulberry, so grown, is a good compact shade tree, useful for roadsides and growing well in almost all parts of India. If mulberry existed over India as a roadside tree it would be much easier to test sericulture. As it is it will be necessary to plant it in such areas as are likely to be suitable for sericulture.

5. A point of great importance lies in the difference between the leaf of bush mulberry and tree mulberry. The former matures quickly, contains more moisture, contains less resin and secondary products, and is used chiefly for multivoltine races. The latter matures more slowly, is produced from a tree and so contains more secondary products and is generally used for the univoltine silk such as the European breeds. It is usually stated that the Bengal breeds will not feed on tree-leaf, the European will not take bush leaf without getting disease.

As a practice, tree leaf is associated with univoltines, bush leaf with multivoltines; it is to be noted that multivoltines must have bush as from a tree you cannot get leaf four times a year.

6. There are intermediates between trees and bushes. It is possible to plant single cuttings five feet apart and develop large shrubs eight to ten feet high. It is possible to let one single shoot of a bush shoot up to say 6 feet high, and let it bud off all the way up: you get a bush that you pluck leaf from several times a year, but in which eventually the single stem becomes thick and grows a great deal of short twiggy stuff that is not very good.

In this matter the advice of the horticulturist does not seem to have been taken and I was very much impressed by the beautiful clean bushes produced by Mr. Norman Gill at Jeolikot. I think that in his method we have the ideal cultivation that will give leaf suited to all varieties several times a year if necessary. Fortunately the question has been taken up by Dr. Hope and Mr. Andrews of the Indian Tea Association. Their experience of leaf production should help with a very similar problem; and guidance will certainly come from these trials.

7. It will be easily understood how vital this point is and how necessary it is to first determine clearly whether you need trees, or bushes, how you are going to get leaf when you want it, whether it is the right kind of leaf and how much you can get per tree or per acre. Where, as in Jammu, trees are common, the matter resolves itself into the question of whether you can use these, where you want to start and you have to plant, what are you going to plant and on what system?

These questions have never been properly tried. N. G. Mukherji laid down the law about tree growing in Bengal without effecting anything or really quite understanding the problem; and a great deal of experimental work has to be done on this point before we can quite decide how far sericulture is possible in any new area. I have referred elsewhere (see page 72) to another aspect of this, namely the irrigation and watering problem. Even in Bengal the plant must be irrigated in the dry hot weather if it is to yield leaf, though it will survive without it. The same holds in Mysore, and the cost of irrigation is a considerable item.

Where irrigation is required for bush mulberry, trees may yet do if they are watered during the first few years, provided the soil conditions are right; and trees can be established in some parts of India if looked after the first two or three dry hot weathers, when bush mulberry would be impossible owing to wanting irrigation every year.

There is one objection to trees and that is that leaf is produced anew only once a year. How far trees can be used for giving leaf in the rains or in October is an unsettled point; and where leaf is required in the rains, or in October, the large shrub method of cultivation will probably be the best. Here again the variety of mulberry varies immensely. At Pusa some varieties hold their leaf through the cold weather while others lose it all in November; and these problems have all to be worked out and solved.

8. The yield of leaf per acre of mulberry varies according to soil, water supply manure and number of pluckings. In Bengal 200 maunds of leaf per acre in five pluckings is near the average but 300 might be got with irrigation in March

and good manuring. Less will be got from the big shrub system and less still from trees. The last will probably not give more than 100 maunds per acre at 10 years old in one plucking if planted 15 feet apart or allowing for 200 trees in a line. It is easy to overestimate this matter and there is little reliable information on this point for this country. The Pusa yields are put at 300 maunds per acre for bush, 240 for tall shrub and 200 for trees, the last being in two pluckings, the others in 4 or 5.

Maillot and Lambert give the yield of a 7 year tree in France as 5 maunds; the trees grown 20-30 feet apart give from 250 to 360 maunds per acre in one plucking over the two months rearing season. The yield of a Kashmir tree, with full room to develop is probably quite three maunds, and after it has yielded this amount it renews its leaf quite well: but Kashmir suits mulberry as no part of India except the North-West Frontier Province and Baluchistan does.

As a rule the Indian varieties of silk worm require 20 maunds of leaf per maund of green cocoons but in the higher temperatures of India leaf dries or ferments quickly. In Europe 12 to 15 kilos, of leaf yield a kilo of green cocoons.

9. It is evident that in this fundamental point India has yet to get the facts. There are many kinds of mulberry, which can be grown on several systems, and, under very varying conditions. The preliminary to any sericulture is knowledge of the best way to produce a leaf supply at the proper season; and except where sericulture is actually being practised as in Bengal and Mysore little is known about it; even there the best leaf-producing plant and the best way to grow it is still unknown.

REARING.

10. An essential to much univoltine rearing is a system that dispenses with the trays altogether after the second moult.

The Persian system should be thoroughly tested. So should variations of it such as net and wood frames, pierced pulp trays, folding wood and cloth trays.

11. As the cocoons are all to be killed, none kept for seed, the production of the very healthiest worms is not necessary; so long as all spin properly it does not much matter if they are healthy and one wants to find the compromise between the use of trays which is costly but essential to a certain point and the death of the worms before spinning due to bad rearing. Where this compromise is has to be found for each climate.

12. It may be possible to get wood-pulp trays, perforated.

The cost of temporary shelter for rearing is very excessive and one should be able to do something with portable huts or shelters.

At Moradabad, the semi-underground place cost Rs. 200; it reared at most 5 oz., i.e., 6 maunds green cocoons worth Rs. 300. To use it again next year will cost another Rs. 100 probably.

If one could get light roofs with light sides, all tied together, it would do. There is as a rule no rain when this univoltine rearing is done and the huts could be packed away again for another season; it may be possible to combine huts with trays so as to cheapen the whole thing. What is wanted is shelter from wind, dust and sun, for a short time only, as cheaply as possible.

A different problem arises when it is a case of several broods or when the rearing has to be done in a climate so moist that trays are essential. This is a factor that is of importance in estimating the chances of success in a new area, for the cost of trays for only a single brood is a serious item. As a rule trays are of split bamboo and palm leaf strips; their cost may be as much as Rs. 8 for a crop of cocoons worth only Rs. 32 and this cost needs to be spread over a series of broods before it is a negligible item. Such trays when not in use deteriorate rapidly and cannot be kept from one year to another.

There is clearly scope for ingenuity in this matter and one imagines that quite workable trays would be possible from cheaper and more durable material: also that such trays could be so made as to be really disinfected after use.

13. The following table shows the results of trials of rearing in the Persian system without litter removal carried out at the Agricultural Research Institute, Pusa, by M. N. De in 1915. I am not as sanguine as to the merits of the system

for multivoltine races as M. N. De is, though these trials look as if the system was possible in the rains: but things are done at Pusa in a way the rearer could not do them.

RACE.	Date of hatching.	Date of spinning.	WEIGHING 10 GRAMMES.				Mortality.
			Mature worms.	Raw cocoons.	Pierced cocoons.	Empty cocoons.	
1. French (on trays)	3rd March 1915	1st April 1915	8	6	30	84	4 per cent.
1a. French (without changing beds)	11th March 1915	9th April 1915	4	8	38	40	6 "
2. Multivoltine x Univoltine (on trays)	16th August 1915	3rd September 1915.	6	9	60	75	Very little.
2a. Multivoltine x Univoltine (without changing beds).	17th August 1915	4th September 1915.	6	10	60	70	10 per cent.
3. [(Nistari F x French M) M x Mysore F] M x Mysore F (on trays).	5th June 1915	26th June 1915	8	12	75	90	Very little.
3a. [(Nistari F x French M) M x Mysore F] M x Mysore F (without changing beds).	4th June 1915	25th June 1915	7	12	68	95	Do.
4. Multivoltine x Univoltine (on trays)	10th July 1915	1st August 1915	7	11	75	80	5 per cent.
4a. Multivoltine x Univoltine (without changing beds.)	Do.	Do.	7	11	70	80	9 "
5. Nistari (as usual)	7th November 1915.	10th December 1915.	6	12	85	110	7 "
5a. Nistari (without changing beds)	7th November 1915.	9th December 1915.	8	13	95	120	10 "

14. If it were possible to supply ameliorated seed to all the rearers, then any system of rearing would be possible and when, in a new area, seed is to be supplied, almost any method of rearing will do: but where continuous broods are to be taken and the rearers keep these for seed, trays are absolutely essential. The same applies to the nets used in rearing. The very good rearer in Bengal uses nets for the small worms, in Japan perforated paper is used and in Mysore this system is being introduced.

15. *Spinning* is done on spinning trays (chandrakis) of the Bengal kind where multivoltine broods are grown; where the univoltine is grown, the worms spin on twigs, dry grass, linseed stalks, etc., piled over them. There is a great need of a good simple system such as Italian hurdles for the univoltine breed but the chandraki does not seem likely to be improved upon. The curious hiring system of Mysore is worth note and it would be an advantage to be able to abolish it.

SEED SUPPLY.

16. The details of seed supply of the Bengal races is very fully discussed for that Province. The seed supply of the Punjab and all areas that rear univoltine worms is a very different matter since the eggs are hibernated or exposed to cold and are brought down for rearing in spring. At the present time, the seed required for the Punjab is brought to Simla and hibernated there, that for Jammu and Kashmir is imported from Europe and hibernated there. This seed is mainly 'industrial' seed, that is from moths of which a proportion are examined for pebrine: the Kashmir locally produced seed is "cellular," that is, from moths each of which is examined separately for pebrine and flacherie. The imported seed comes from several firms in France and Italy, who make a business of seed supply, and have rearing establishments at places in the hills. The supply of this disease-free seed was the factor which changed the crop in Kashmir from a small precarious one to a large regular one; and it is at present essential that the supply should continue. The only features about it which require investigation are the uneven hatching of the eggs and the mixed character of the worms. The hatching of the seed is spread over too long a time and it looks as if more care is required in putting in one box only seed from moths that have all laid at the same time. The second point is the mixed colouring of the worms; they are white, zebra and clouded; the Punjab rearer cares little at present but every other rearer in India is most particular about his worms and it would be an advantage to get seed that gave all white, all zebra or all clouded worms. This is a matter that needs to be looked into in Europe if the Indian seed supply is to come from there.

17. Seed is hibernated at Simla and some of the seed imported by the Salvation Army is usually for sale in the spring. There is no difficulty in hibernating the seed. At a proper elevation with a suitable building any quantity of seed can be kept, properly wintered and brought out to hatch at the proper time. With the use of water and ice, the hibernation can be prolonged a little to supply a late demand. Such hibernation is possible in many parts of the hills and by selecting proper sites, a short or long hibernation is easily arranged for. It is suggested that in some parts of India a second crop of worms should be got in October from seed produced from the spring moths and artificially hibernated in cold storage during rains.

So also artificial cold storage may be needed to produce univoltine races for hybridising purposes at any time of the year. Up to the present, artificial cold storage of this sort has not been a success, probably chiefly because it is not specially arranged for and the ordinary ice company cannot give the necessary facilities. Natural cold storage in the hills is very different to an ice factory storage. The Japanese make great use of certain caves at high elevation for their cold storage and it seems likely that a similar arrangement could be made in India if bivoltine crops are possible. The cold storage problem needs to be tackled, as artificially hibernated seed has been a source of failure and trouble.

18. It would seem as if India should not have to import seed from France and Italy, since there are areas at all elevations where similar climatic conditions to the Pyrenees can be found. Why should not India produce good univoltine seed from imported stock?

There are two reasons probably why it is not done now: the first is that the univoltine breeds grown in India are reared on a system quite good for cocoons but not good for reproduction purposes, and no one has seriously taken up seed production from worms grown say as Miss Cleghorn grows hers. The second is that the problems of pebrine in India are as yet untouched and there is not the control over disease that there is in Europe. It is quite likely that a really first-class establishment at a place like Shillong, with not too much rain, would give excellent results if worked with rigorous care and supervision. The result obtained in Shillong from their own seed was good (see Experiments Appendix XI) and quite likely this could be done on a large scale. As yet it has not been done and the question is another that needs investigation. The disease problem, as it affects this, is discussed below. This question is further discussed under Kashmir.

19. Another seed problem, of another kind, is the hill rearing station for producing "ameliorated" seed, notably of the multivoltine breeds. The only one existing is the small one at Kurseong, used for producing ameliorated nistari or hybrid males for crossing with nistari females to produce the seed for the November crop. Every multivoltine race could be improved by this form of amelioration and it is a question that might profitably interest commercial enterprise, if there were any, in Bengal say. The value of ameliorated seed is discussed on page 100 for Bengal, Assam and Mysore and there is considerable scope for the production of hill-ameliorated stock.

RACES AND HYBRIDS.

20. There are a number of races of silkworms in existence, and it is impossible to tell exactly what had been their origin or whether they have developed from a single stock or a single species. As they hybridise freely, as there are practically no differences in the moths and only small ones in the cocoons, we may treat them as races or strains of a single species.

21. There are the three main characters in the races, the number of broods, the physical characters of the worm, the physical characters of the cocoon and silk.

In India, one can distinguish the following races:—

Kashmir.—One brooded large yellow or white cocoon. Now no longer grown.

European.—One brooded buff cocoon of mixed ancestry, worms of uncertain characters. The imported worm of Kashmir, and the Punjab.

Boro-polo.—The Bengal and Assam one-brooded, originally probably the old European prior to the Japanese stock reaching Europe; white cocoon.

Burma.—The many brooded race of Burma; cocoon yellow and very flimsy.

Mysore.—The many brooded race of Mysore, said to have reached India from China about 1795. Cocoon greenish-yellow.

Nistari.—The many brooded race of Bengal, probably a Chinese race, grown chiefly in the rains. Cocoon yellow.

Chotapolo.—The inferior many brooded race of Bengal, probably the original race brought in before Europeans reached India. Cocoon yellow, flimsy.

Midnapur.—(China polu) a many brooded race. Cocoon greenish yellow, that may be the same as Mysore and Assam.

Bulu.—A white variety of the last.

Assam.—Horupolu a greeny-yellow many brooded cocoon, grown there in winter months. Cocoon very poor. Possibly the same as Midnapur and Mysore.

There is now another remarkable race, the Madagascar, which is a many brooded race with the characters of the European and which is the European race become many brooded. It was produced by Grangeon in Madagascar and sent to India.

Elsewhere there are hundreds of races varying specially in cocoon characters but also in the question of broods. There are in Japan races giving two broods a year and when after the pebrine outbreak, the world was scoured for seed, eggs were obtained from all silk areas and hundreds of kinds are figured by *Duseigneur Kleber* (*Les Soies* 1883). None of these are known in India now. There have been introductions of white and yellow Chinese and Japanese races, which are no longer to be found in India and there are hybrids from Chinese and Japanese races still to be found. A Japanese race is said to exist still in the Gurdaspur district.

22. If one looks at a series of cocoons and long series bred from them, one realises that the colour, shape, size, thread characters, amount of silk, fluffiness, etc., are perfectly fixed definite characters inherent in these races. Another fixed character is the number of broods; but one finds too that climate has a great influence on size, amount of silk, fluffiness. Cocoons produced in August in Bengal with excessive moisture and temperature are similar in colour, shape, thread characters but not in size, amount of silk or fluffiness, to cocoons produced in November, with a lower temperature but a similar humidity factor; and in India in every race the size, amount of silk and fluffiness vary at different seasons of the year.

23. If now you take hybrids, crossing two races, you get at once very great effects produced, and by selfing and then separating, by further hybridising, you can produce races which differ very much from the originals, in all characters. If on the other hand you work on the pure race, with alteration of climatic conditions, you will never produce alteration in more than size, amount of silk and fluffiness.

If you work on the pure race with selection continually, picking out and breeding from cocoons with special characters, you can to some extent affect size, shape, amount of silk and fluffiness. It is clear that there are three definite ways of influencing any breed, each with fairly definite limits. The most drastic is hybridising, the slowest is selecting, the quickest but most limited is climate-amelioration. In India, a limited amount has been done with all three methods but their limitations and value are not fully recognised. The full account of the hybridisation work done in India in recent years will be found in the following publications :—

1. "Experiments in the inheritance of visible and invisible characters in Silkworm" by Maude L. Cleghorn. (Pp. 1—9, Bengal Secretariat Press, 1913.)

2. "Report on the Results obtained in the Experiments for Improving Sericulture in Bengal" by F. D. Lafont. (Bengal Secretariat Book Depot, 1915, pp. 1—35.)

3. Report of the Agricultural Department, Bengal, for 1913-1914.

4. Report of the Scientific Officers of the Agricultural Department, Bengal, for the year ending June 30th, 1915.

5. First Report on the Experiments carried out at Pusa to improve the Mulberry Silk Industry. Bulletin 48. Agricultural Research Institute, Pusa (1915).

24. The earliest experiments recorded are those of Mr. Bashford in Surdah who in 1854 crossed French and Bengal moths : he found the cross with French female was univoltine, with Bengal female the eggs hatched, the worm spun in 34 days, but on pairing *inter se* (selfing) the eggs were univoltine. The cocoons were fluffy but good. He crossed with China also.

The second year he recrossed the French male-*Deshi* female that had become annual, with *Deshi* female but eventually all seem to have become annuals.

In the autumn of 1856 he had some cross that had not become annual for he issued much seed and got six bales of raw silk (*i.e.*, 6 × 150 lbs.) ; a large quantity was sold for seed and spread over the district but the rearers were unused to the large worms, fed them insufficiently and the race deteriorated. Only bush mulberry leaf was used. (Geoghegan.)

25. There are two main objects in hybridisation in India ; the one is to take a multivoltine race indigenous in India which is in favour with rearers, and by hybridising with a superior race, produce a race which is so like the original indigenous one that the rearer will take it : its cocoon must resemble the indigenous ; its worm must not be very different in appearance and the worm must not eat too much more. The other object in hybridising is to produce from any races available a superior race which will give several broods a year.

In both these the question of degeneration comes in. A further point is the proportion of eggs from the hybrid parents which will hatch at once, *i.e.*, be multivoltine, and which will hatch only after wintering, *i.e.*, be univoltine if the parents are from multivoltine and univoltine characters respectively.

26. Among the many races in the world, there are speaking broadly (1) the single brooded ones, whose cocoons may be white, buff or yellow, whose worms usually are fed on tree leaf, in which the worms are large, and in which the eggs must be hibernated before they hatch. As a rule these give good quality cocoons, easy to reel, of which from 5 to 8 kahans green cocoons give 1 seer raw silk.

(2) The double brooded races, of white or yellow cocoons, with small or large worms feeding on tree leaf or bush leaf, the eggs of the second brood requiring hibernation. The cocoons are good but probably 8 to 12 kahans are required per seer of silk.

(3) The many brooded races, of yellow or white cocoons, of small worms, feeding on bush leaf, the eggs hatching without hibernation. The cocoons are small, flimsy, with a high proportion of floss ; the thread of the cocoons is weak, breaks frequently, is troublesome to reel but usually has a peculiar lustre. As much as 15 to 20 kahans of cocoons are needed for a seer of silk.

27. The first or univoltine are the races of Europe, Japan, China, Central Asia and typical of cold countries ; the second are best known from Japan and China where the climate allows of two broods ; the third are characteristic of India, Siam, Tonkin, Annam, South China and other places with a continuous warm moist climate.

Whether these are from one original stock or not is not known but it is a sound working hypothesis that they are ; and it is probably true that the cocoon characters, *i.e.*, the amount of silk and floss, the length and characters of the thread, are functions purely of climate. As evidence of that, the same race of worms grown in November and in July will give cocoons similar in shape and colour, but the July ones are inferior in amount of silk, in quality of thread, in amount of floss. As further evidence, the Madagascar race is a univoltine European that has become multivoltine ; that is, when grown in a warm climate a race normally one brooded has become many brooded, the eggs hatching without cold. This race brought to the warm moist climate of Bengal, "degenerates" *i.e.*, the cocoons get smaller, flimsier, with less silk, with more floss and the thread of poorer quality.

28. Equally if a poor race grown in Bengal is grown also at an elevation of say 5,000 feet, the latter race will give better cocoons at once. Why this should occur is probably a matter of physiology ; and it is to be noted that temperature is less a factor than humidity. Silk worms will live well between a wide range of tempe-

perature if the humidity is what suits them : but that range of temperature becomes much more limited if the humidity is excessive. This has to do with several factors ; one is the elimination of moisture from the body. The excess moisture is lost through the spiracles, the size of which is fixed, and the amount of water lost by evaporation may be insufficient when the worm is feeding actively at a high temperature with a high humidity. Worms do better at a temperature of 90 with 60° humidity than at 85 maximum \times 85 humidity ; still more is this so when the worm spins a cocoon. At that time it is building a cocoon from wet material that needs to dry ; and its own body needs to lose a great proportion of its weight as water owing to the rapid changes taking place as the metamorphosis commences. At a high temperature, cocoon making and metamorphosis go fast ; if then there is a high humidity, the cocoon formation and the metamorphosis may be seriously impaired by the fact that the excess of water cannot evaporate sufficiently fast.

If this is correct, then any variety will tend to " degenerate," that is, to adapt itself to the climatic conditions, till it is small enough and secretes a sufficiently open cocoon to be able to eliminate its moisture. The fundamental fact then must be faced that continual cultivation in a climate in which there is a high humidity and temperature will tend to bring down to one level any race however good.

• The object of the hybridiser in India is then to produce a race that will stand adverse conditions for a few generations and that he can ameliorate by recrossing at intervals with a better strain.

29. The most successful hybrid race produced at present is that of Miss Cleghorn. She mated an Italian Japanese male with a Nistari female and selfed these. After nine generations, the eggs were entirely multivoltine and from parent cocoons of 1 to 1.6 grains in the Nistari and 2.5 to 4.6 grains in the Italian Japanese, the cocoons weighed on the average over 4 grains. This race was carried on to F. 36, and was then recrossed with an Italian-Japanese race, which was an accidental multivoltine, these were then carried on to F. 43 and a trial on an industrial scale was arranged for. Results obtained with a few cocoons are of little value and it was necessary to form some definite idea of its value to rearers.

A trial was made at the Rose Filatures Concern, Ramnugger, and Mr. de Minvielle reported as follows :—

" I received 1 kahan seed cocoons, which had spun on 26th February, from Miss Cleghorn. The cocoons cut out as follows :—

	Layings.
3rd March	3
4th "	11
5th "	29
6th "	120
7th "	136
8th "	115
9th "	60
10th "	36

The layings of 3rd, 4th and 10th March were discarded and half the worms of the layings of 9th March were thrown away for want of space. From start to finish the worms gave no trouble in spite of very hot weather and were healthy throughout the brood.

We obtained 73 kahans of cocoons from the 430 layings. There were a few univoltine layings.

Miss Cleghorn's went 12 kahans and 12 puns to the seer of silk.

Nistaris went 17 kahans and 14 puns to the seer of silk.

Chotopolus went 18 kahans and 10 puns to the seer of silk.

The weather throughout the brood was very hot and against the worms and with better weather there is no doubt the cocoons would have been superior in quality but this would have applied equally to the Nistari and Chotopolu worms."

These are the figures of cocoons per seer. What the sericulturist wants to know is how many cocoons give a seer of silk, and in Bengal this is expressed in so many kahans (of 1,280 cocoons each) per seer of silk produce.

Lafont gives this for some breeds :—

	K.	p.	g.
Japan × Italian—March	8	12	0
Japan, white, univoltine—March	8	0	0
Chinese golden univoltine—March	11	3	4
Chotapolo—March	17	9	12
Nistari—March	20	9	0
„ selected—March	18	15	6
Univoltine × Nistari Rearers—April	16	12	0
„ „ Lafont „	7	8	0
„ „ Rearers „	8	15	0
„ „ „ „	7	14	0

The figures are the number of kahans (1,280) puns (80) gondas (16) of cocoons required to give a seer of raw silk at Banjetia factory.

It will be seen how difficult it is to compare in any way the figures of the various hybridisers and so how useless most of these figures are. All that is learnt is that a cross of univoltine male × multivoltine female will be univoltine in the second generation and thereafter largely multivoltine, and that by a combination of selection, hybridising and good breeding improved multivoltine races can be got. How long they will last industrially is to be seen. The total result of hybridising in India is encouraging but not conclusive and there has been a good deal of wasted effort. The cross of Madagascar and multivoltine is on a very different footing as regards percentage polyvoltine as both parents are polyvoltine. We as yet know little of its behaviour as regards cocoons, etc.

Some results have been obtained at Berhampur with crosses of Madagascar and Nistari. The direct cross gives a worm larger than Nistari giving cocoons of which 5 kahans 3 puns gave a seer of raw silk and 9 tolas of floss. A rearer obtained cocoons of which 6 kahans 8 puns gave a seer of Khungru silk. Taking a further race, (Madagascar male × Nistari female), male crossed with Nistari, a cocoon was got of which 7 kahans gave one seer of raw silk and 23 tolas of floss. Rearers obtained 100 kahans of cocoons per kahan of seed cocoons. These results are promising but not yet conclusive.

33. A similar problem to that of India is found in French Indo-China and has been solved by hybridisation. A hybrid between the Annam and Japanese was bred, and was subsequently crossed with univoltine French and a stable multivoltine was produced. Mons. P. Vieil writes :—“ Except during the hot months one can rear the Japanese-Annam crosses with the best results. Yellow and white cocoons are got but by constant selection pure multivoltine races are maintained. These tend to revert but by recrossing with Japanese can be revived ” (Bull. Economique Indo-Chine, November 1911).

At that time Tonkin filature silk, 15/16 denier was selling there for Frs. 35 per kilo, very nearly Rs. 22 per seer, so its quality was high.

Selection.

34. As a general rule in cocoon selection it is best to breed from good average cocoons allowing for the disparity in weight in the sexes ; little is accurately known of this in India, and nothing from an industrial scale. A result in Tonkin is expressed as follows :—

Original stock	1,555 cocoons to 1 kilo.
1st brood	1,248 „ „
2nd „	1,230 „ „
3rd „	1,100 „ „

From then on the cocoons remained at approximately that figure. They were selected on weight, strength and whether the female laid eggs in a continuous circle or not. (Bull. Econ. 1911, page 263.)

E. Delonca (*Considerations Generales sur le role de la Selection en Sericiculture* (1912)) gives data of crossing and selection, preferring selection : but their problem is to improve what we should regard as a very good breed with nothing better to cross it with.

Disease.

35. Mulberry silkworms in India suffer from the usual diseases, including pebrine, grasserie, flacherie, muscardine and the fly. These are discussed under Bengal : the really serious diseases are pebrine and the fly pest : the former is known definitely in Bengal and in Mysore : the latter is at present confined to Burma, Assam and Bengal : the remaining diseases are presumed to be similar to the diseases passing under these names in Europe but very little is known about them in India. They should be investigated fully and a method of dealing with the fly should be worked out : as this is a purely entomological problem, it might well occupy the attention of the entomological section at Pusa.

Pebrine.

36. This disease appeared in Bengal about 1895, and probably in Mysore between 1890 and 1900. Its effects in Bengal have been fully discussed and it is only necessary to point out here that Rs. 2,65,000 have been expended in Bengal since 1910 in the production of so called "disease-free" seed, which still contains from 2 to 5 per cent. of disease, and that pebrine is probably as serious in its effects as it was thirty years ago. It is quite evident that the mere application in India of methods suited to the univoltine race of Europe has failed and it is necessary to know more about the behaviour of pebrine under Indian conditions : this is important not only for Bengal and Mysore but for Kashmir, which imports seed worth Rs. 2,00,000 and is now producing about 15 per cent. of its seed requirements in the State : the question has been taken up this year by Mr. C. M. Hutchinson, Imperial Agricultural Bacteriologist, at Pusa, and his inquiry has shown that the Bengal method of examination is faulty and that there is hope of being able to issue really disease-free seed if a better method of examination is adopted. The following note by Mr. Hutchinson summarises progress to date : it is to be hoped this inquiry will be carried on to a definite conclusion.

37. "No original work on Pebrine in India appears to have been carried out ; Pasteur's recommendations have been adopted wholesale without reference to the differences necessarily existing between European and Indian conditions. This being the case it is not surprising that the standard method adopted in Europe should have been found only partially successful in India ; on the other hand it may be considered most surprising that pebrine has not played a more important part in the decline of the Indian Silk Industry than it has done so far and it may be said with some confidence that as things are at present, so far as the methods in vogue for procuring disease-free seed are concerned, at any moment this disease might spread and threaten the existence of the industry as it did in France and Italy before Pasteur's investigations were carried out. I agree with Mr. Maxwell-Lefroy as to the serious menace of this disease to the welfare of the industry in this country and I should be inclined to go still further and to say that in all probability the comparatively small part which pebrine has played in depressing the successful rearing of silkworms in India up to the present is merely due to the comparatively short time which has elapsed since the introduction of infection, and that in the absence of effective measures for dealing with it, its future spread and expansion to dimensions similar to those attained in France in the middle of last century is only a matter of time.

In the comparatively short space of six months' time, which I have been able to give to this enquiry, it has been naturally impossible to deal with more than a few of the many important points which it is necessary to investigate in order to arrive at any definite conclusions as to the causes underlying the incidence of this disease in India and the preventive or remedial measures necessary to deal with it successfully. It has been possible, however, to discover some important facts bearing on the problem, especially with regard to the differences existing between the European and Indian conditions.

1. *Life history of the parasite.*—This part of the work, although essential for a complete understanding of the relations between parasite and host, is necessarily

so prolonged and difficult that it is a matter for satisfaction that progress on the practical side has not depended upon any complete working out of the life cycle. So far as my observations have gone I have no reason to suppose that there is any difference between the organism as described in the standard works of European authors and the organism as observed by me in Indian specimens; the life cycle as described by Stempel and others appears to be the same so far as I have observed it, although there are important gaps in my observations as compared with those of this author on *Nosema bombycis* and of Fantham and Porter on *Nosema apis*; the relations between parasite and host so far as I have been able to determine them, limit the method of infection to ingestion of the "pebrine body" and the passage of the latter into the alimentary canal of the worm, where the motile amoeboid form of the parasite emerges from the spore case (the pebrine corpuscle) and penetrating the lining membrane of the gut enters the epithelial tissue and there multiplies. Subsequently this multiplication continuing indefinitely results in penetration of practically every part of the body of the worm, which eventually succumbs to exhaustion. The final stage in the life cycle of the parasite consists in the formation in the body of the worm of the resting stage or spore form of the parasite; this is the familiar pebrine corpuscle which is large enough and is possessed of a sufficiently characteristic appearance (high refrangibility) to be readily recognized under a comparatively low power of the microscope, thus making it possible for unskilled workers to detect its presence with ease and certainty. This resting spore form plays an important part in the propagation and perpetuation of the disease as it is resistant to drought and extremes of temperature which would be fatal to the active dividing forms. In this spore form it not only passes out unharmed with the faeces of the diseased worm but even survives the decay of the body of the host, whose death it has brought about, and remains as a source of infection for later generations. The importance of a complete understanding and knowledge of the life cycle and inter-relationships of parasite and host lies especially in its intimate connection with the elucidation of the vital problem of comparative immunity. One most important conclusion, fully confirmed not only by controlled experiment at Pusa, but by the experience of expert breeders,* is that the silk-worm in India is practically immune to pebrine infection, whether derived by heredity or environment, provided the conditions under which it is reared are suitable for its healthy growth and development. So far as my observations have gone, I should be inclined to suggest that the explanation of this most important point lies in the fact that infection can only take place through the lining membrane of the alimentary canal and that in healthy worms receiving proper food the necessary conditions for the penetration by the amoeboid form of the parasite do not generally occur. This may come about in more than one way, either the conditions are not favourable for the emergence of the amoeba from the spore form of the parasite, or the lining membrane of the well nourished worm is sufficiently resistant to penetration; a third possibility, which appears a highly probable one, is that the peristaltic movements of the gut in the healthy worm are of such a vigorous nature as to prevent the adhesion of the amoeba to the gut wall for a sufficient length of time to allow of penetration. It may be remarked here that the amoeba on emerging from the spore case or shell is furnished with an exceedingly long flagellum or tail, the function of which is generally supposed to be, not to produce motility, but to secure adhesion to the gut wall and so allow of penetration into the epithelial cells which line the latter. Vigorous muscular movements of the intestine producing correspondingly rapid passage of the food along the gut would tend to prevent adhesion of the parasite to the lining membrane and so inhibit penetration and infection. It has been established by experiment that emergence of the amoeba from the spore only takes place under certain stimuli, such as those afforded by an acid medium. It is supposed that the chemical action of the digestive fluids in the alimentary canal of the host provide such a stimulus, but it appears possible in the light of work which I carried out on the causes of flacherie in the Eri worm at the instance of Mr. Maxwell-Lefroy some five years since, that this acid reaction and its resulting stimulus to the emergence of the parasite, result from abnormal conditions in the gut due to improper feeding, and that this may be a contributory cause of loss of immunity to the pebrine infection.

* Miss Cloghorn's experience with pebrinised seed.

Enough has been said on this subject to illustrate the importance of complete investigation of the relationships between parasite and host from this point of view; it will be sufficient to state here that controlled experiments carried out at Pusa during the past six months (April-October 1916) have demonstrated the possibility of rearing under proper conditions a high percentage of healthy worms producing normal cocoons and moths giving disease-free eggs either starting with pebrinized seed or with healthy seed exposed to infection during the rearing period, either by contact with diseased worms, or feeding with infective leaf.

It must not be inferred from the above record of observations that all worms can avoid pebrine infection if kept under otherwise suitable conditions of life. The question is by no means so simple as might appear from the conclusions drawn above. In the first place it is generally impossible in practice to start with a lot of equally healthy worms or to ensure optimal conditions for all of them in rearing. Hence it is necessary to endeavour to avoid infection by heredity or environment in order to allow not only of the maturation of the weaker individuals but also to avoid the condition well-known to medical science of heavy infection which will overcome natural resistance by its repeated attacks. A slightly weak individual worm may exhibit sufficient resistance to allow of its continued life up to the spinning stage, when failure to produce a cocoon means the loss of the time, leaf and labour expended on feeding it up to that point, and it is this feature of the incidence of pebrine, which has contributed so largely to the decline of the industry, by introducing so considerable an element of uncertainty into the rearing of the worms.

One point deserves careful consideration in connection with the subject of immunity. It is practically certain from analogy that comparative immunity must be a character of certain varieties, and hybridization could probably produce and establish races possessing this highly important character.

Experiment at Pusa has clearly shown the relative susceptibility to infection, by feeding on leaf contaminated with pebrine parasites, of worms in the earlier stage of rearing; thus almost entire lack of resistance to infection was exhibited during the first two and sometimes three stages, i.e., after the first and second moults, whereas during the later stages comparative immunity was exhibited. This suggests the necessity for the greatest care in avoiding possible sources of infection during the earlier stages and useful modifications of actual methods of rearing and feeding might be introduced with this in view. One of the difficulties of dealing with the native rearer is that of presenting to his mind any clear conception of the nature of infection, but a strong effort should be made to impress upon him the necessity for extreme care and cleanliness in the earlier stages of rearing, when the comparatively small space occupied by the young worms which should make this easier to attain, in actual practice is liable to result in overcrowding and contamination.

2. *Selection of disease-free seed by the Pasteur method.*—The Pasteur method consists in microscopic examination of moths which have laid eggs, and the rejection of such of the latter as have come from parents found to contain pebrine corpuscles. In Europe the method depends for its reliability upon the fact that it is possible and customary to keep the eggs and the parent moth, for so long a period of time, possibly several months, after laying, that multiplication of the pebrine parasite, which goes on in the dead body of the moth, has proceeded to such an extent that examination of practically any part of the body of the moth will serve to determine the presence of the disease. This long period is possible because of the use in Europe only of univoltine varieties of worm the eggs of which will not hatch out until the following season, but in the case of the multivoltine varieties common in Bengal, examination of the moth must be carried out within eight days from deposition of the eggs, this being the average period of time before hatching out. It has been clearly shown at Pusa that examination of moths by the standard Pasteur method may entirely fail to detect pebrine even though present in the moth, owing to the short period of time necessarily elapsing between deposition and examination. Further, eggs deposited by moths passed as disease-free by the ordinary routine, but condemned by the more strict method of examination, gave rise to a high percentage of pebrinized worms thus explaining fully the failure of this method in India to eliminate pebrine by selection. It may be stated here that the stricter method of examination referred to above is well with-

in the capabilities of the ordinary rearer trained to the use of the microscope for the ordinary routine one; the only practical difference resulting from its use would be in the reduction of the number of moths examined in the same time; this, however, in my opinion would not constitute a serious objection to its introduction, but on the other hand might result in the use of rather more care in carrying out the operation. It will appear from the above instance that the wholesale importation of European methods into India without scientific investigation of their suitability to their new environment, is as illogical in the case of the silk industry as it has proved in other instances. It is remarkable, however, that the point involved in the difference between the univoltine races of Europe and the multivoltine of India should have escaped the notice of responsible workers in this country over the long period of time during which the Pasteur method has been blindly misapplied.

It will appear from the above that much remains to be done towards the scientific elucidation of the incidence of pebrine in India. I have not yet, for instance, had time to ascertain the length of time or the conditions under which the pebrine body retains its infective power in this country, nor the best method of sterilizing the surroundings of the silkworm such as the floor, walls and roof of the rearing house or the trays and supports. Counsels of perfection are of no value to the native rearer and of very little even to the Government nursery; what is required is the cheapest effective method and material. This has to be determined, but the basis of determination must be a scientific one and not guess work or even imitation of European methods, however sound the latter may have proved in France or Italy. Then the local prejudices of the native rearer must be considered sympathetically, however difficult this may be, as for instance in the case of those districts in Bengal where the rearer will not buy seed eggs although certified as disease-free by Government establishments, but must have seed cocoons with the attendant risk of re-infection between the egg and pupa stages. The greatest difficulty of all appears to be the prevention of cumulative infection of the rearing house owing to the numerous porous or rough surfaces of the walls, floor, and roof, in the necessary absence of other building materials than bamboo, thatch and cowdung. I should be inclined to experiment with paper lined houses, but during the present scarcity of this material it is perhaps unwise to suggest its adoption, although if suitably treated it would appear a hopeful alternative to the present ones.

The lines of enquiry upon which I am at present engaged and upon which further work will be carried out, are as follows:—

1. *Retention of infective power* by pebrine parasite under Indian conditions. This involves the whole question of cumulative infection, i.e. does a rearing house (and consequently a rearing district) become more and more heavily infected every season, failing proper disinfection, or is the vitality of the pebrine parasite in its resting condition or spore stage outside the body of the silkworm, insufficient under Indian conditions to carry it over as a source of infection from one brood to the next. This would have to be worked out separately for the Multivoltine races in India and the Univoltine in Kashmir.

2. *Disinfection*.—Do standard methods of disinfection as at present practised in India have any effect upon infection? Nothing is known about this point in India, all present methods are blind imitations of European practice. It is also to be determined whether disinfection is necessary or merely a precautionary measure, and its efficiency as regards the incidence of other diseases such as flâcherie should be taken into account. The most efficient method should be determined.

3. *Injection of seed eggs*.—The infection of eggs by contagion during examination, as distinguished from infection by hereditary transmission is probably of much greater importance than has been generally recognized in India. This point will be examined together with the possibility of sterilizing eggs before issue for rearing without affecting their vitality under Indian conditions. The whole technique of selection by microscopic examination requires revision in the light of recent investigation, but more remain to be carried out in order to make such revision complete and effective.

Intimately connected with the question of infection is the persistence and multiplication of the pebrine parasite in the body of the moth after death; this requires careful investigation to determine the possibilities not only of contagion

passing from pebrinized moths during examination to healthy seed eggs, but of the correct technique of examination in the case of Univoltine the race such as that reared in Kashmir.

The design of nurseries, rearing houses, examination houses and seed storage houses requires examination and revision in India, more especially with reference to the production and issue of disease-free seed."

Mulberry Disease.

38. Apart from the diseases of mulberry in Kashmir, due to *Coryneum Mori* Nomuru [E. J. Butler, Memoirs of the Department of Agriculture, India, Vol. II, No. 8, (1909)] and to undetermined Longicorn beetles, the only disease of mulberry that is serious is that known as Tukra in Bengal : there are fortunately no fungoid diseases of any moment ; and Dr. Butler, Imperial Mycologist, regards the determining factor of the Kashmir disease as climatic : little is on record regarding tukra and a note in Appendix XII deals with the most recent investigation.

HILL AMELIORATION.

39. Everything points conclusively to the benefit silkworms derive from growing in areas where, even if the humidity is high, the temperature is lower and they can live : but accurate data are not forthcoming. I am convinced that if the nistari stock was kept in the hills, where the temperature factor can be reduced, or in artificial dry rooms, where the humidity could be reduced, the stock available for industrial purposes would be greatly improved and the nistari breeders would get better results. Still more is this the case with the Assam races, which are very poor now and I think improvement is possible in the Mysore stock. Whether Miss Cleghorn's stock would improve is not known but it probably would. It has been grown entirely in Calcutta and has had extremely good care and attention : but it has throughout had an excessive humidity to contend with.

PART IV.—THE DEVELOPMENT OF SERICULTURE.

Introductory.—In this section I deal with the broad aspects of the development of the cocoon-producing industry: assuming that it is desirable that the industry should be developed what are the lines on which to proceed? I omit here all the technical methods discussed for Bengal, Mysore, Kashmir and the other existing areas: the factors of development, the influences to be employed, the broad lines of development of new areas are discussed.

As in other parts of this report, the section is rather patchwork, put together in the intervals of touring: most of it was written on the underlying assumption that the silk industry should be developed and extended to the full extent: but this assumption is not accepted or to be assumed as underlying the whole section. Rather the conclusion is that at present the development of sericulture in India should not extend to new areas but only to areas already producing silk and for these areas the technical measures required are discussed for each area separately.

This section is chiefly a discussion of the factors of development, of the means of development and of the desirability of attempting it.

CHAPTER XI.—INFLUENCES.

THE ZEMINDARS AND GENTRY.

There are few instances known to me of influential people in this country stimulating the development of sericulture or actually testing its possibilities: the few I have knowledge of have been interesting and, in one notable case, valuable. In the Punjab report, reference is made to the work of Khan Bahadur Ghulam Sadiq of Amritsar and the development in the Punjab has been very largely his work; others are referred to under Experiments in Appendix XI. Why are there not more? There are many places in India where it would be a public-spirited action to test the possibilities of sericulture and if successful to extend it amongst the people: it seems to me really more laudable to do that than to give funds for a new statue, for the statue really makes no one any happier or more contented, while I imagine the extra fifteen rupees is a very solid benefit to the Punjab rearer.

It cannot be doubted that if the influential landowners and wealthy people in India did think in this way, sericulture would develop, as nothing else could make it develop: perhaps the time will come when public-spirited action of this sort will appeal to those who have the influence and the means: when it does, the possibilities of developing sericulture, which are really an unknown quantity for very large areas, can be tested in a way impossible at present: and if it fails we shall know for each place that a proper trial has been made and that place is useless. It is worth a good deal to know that and to be able to restrict future efforts to directly profitable areas.

Apart from developing sericulture as a means of "acquiring merit" it is reasonable to expect that people should do it as a means of acquiring wealth: it is perhaps unnecessary to refer further to this since the prosecution of a new industry involving capital is foreign to the nature of the ordinary land-owner and zemindar. This applies to the planter almost as much as to the zemindar: and it is not likely that the natural development of sericulture that one might expect in suitable tracts will take place on the initiative of this class.

THE DISTRICT OFFICER.

2. Whatever is to be done to develop sericulture in new localities or to extend it where it now exists, is to be done through the district officer and his subordinates and the key to much development will lie in their hands. When the time comes that there is a district agricultural officer with the district administrative officer, as there will be, the development of sericulture or of mulberry planting will be easy: but it is difficult now since the development of sericulture, valuable as it may be, is but one of hundreds of things of equal importance and it is only here

and there that the district officer can give any attention to it. I think that every district officer needs to have the plain facts before him; they are the climatic conditions that are required, the length of time it takes to get a crop of cocoons, the kind of cocoons that can be grown and their value, the probable cost of doing sericulture and the probable cost of testing it in the district: he can then with his own knowledge decide if there is in his district any class of people, who would benefit by such an industry, if they are the kind of people, who would take it up: if there is such a class of people, if he thinks that the conditions are favourable, then he should be able to get expert advice as to how to test the matter by an actual trial done by people of the class who need such an industry, what such a trial would cost and exactly how it should be conducted.

No single expert can have expert knowledge of the industry and the local knowledge of the people possessed by the settlement officer and district officer: and the extent to which silk will develop will depend very much upon whether, in likely areas, the district officer can give time to considering whether in his charge are people to whom the industry would be a help. As district officers may, here and there, read this, it may be as well to say that the rearer, who grows a single crop of cocoons from imported seed, gets probably R15 to R20 in actual cash in the Punjab or Kashmir: and that the rearer who rears four or five crops as in Mysore or Bengal gets actually some three hundred rupees on an expenditure somewhere near to R100. So that it is not difficult to compare this with the earnings of other crops or industries.

I have explained below that the development of sericulture is a question of patient work spread over large areas and that no administrative or legislative measures on a large scale will effect anything: so that its development rests much with the district officer, who can decide whether it is needed, whether it is possible, and can have the question tested in his own district at a quite small expense.

AGRICULTURAL DEPARTMENTS.

3. The Agricultural Departments in India are not sufficiently staffed in the entomological or sericultural side to be able to do very much; but they will be a valuable influence in developing sericulture and have been of great value in this enquiry from the knowledge the Deputy Director of Agriculture has of the conditions of the people and of the chances of their taking to sericulture or growing mulberry. In every province the departments have experimented with eri silk, on the lines suggested by Pusa, and in some the departments have experimented with mulberry or tasar silk. In Bengal the Director of Agriculture is Chairman of the Silk Committee and the Department control the nurseries, etc., the Committee being really advisory. In Burma the entomological assistant has investigated the industry; in Madras, the Kollegal industry has been helped; in Mysore, the department are investigating the best methods of growing mulberry; in the Punjab the Department issue seed, look after the rearers and manage the annual exhibition. The development of sericulture is in their hands. When there is a Deputy Director of Agriculture, or an equivalent officer, in every division, the development of sericulture will be easier and the industry will reach its full limit; at present the department is too understaffed to be able to give the requisite time to the demands of the sericulture organiser. The Agricultural Department can of course only influence mulberry cultivation and silk production: it is essential that the development of silk production shall be associated with the commercial organisation of silk utilisation and the two branches must be in the same hands.

4. *Pusa*.—The cultivation of eri silk was taken up at Pusa in 1907 under circumstances explained in the section dealing with eri (Chapter XV); this led to developments in eri silk, the cocoons being spun, dyed and woven in Pusa in order to get practical experience of the industry. As this developed, both tasar and mulberry silk were taken up; the former was given up but the latter was very much developed. The industry was carried on in every stage; the worms were reared and every operation was carried out to the weaving of coloured cloth. The Pusa Spinning Machine is in use in many places. The possibilities of eri were exploited to the fullest and firms in Bhagalpur and Benares are still making cloths to Pusa designs and with Pusa methods. The correspondence files in Pusa show

the extent of the influence exerted in India and the need of practical advice ; it is necessary to remember that silk was only one small part of the section, that it cost only Rs. 2,000 a year besides Rs. 2,160 for staff. Yet the influence exerted was out of all proportion to the cost, and it is mainly on that experience that the recommendations in some sections of this report depend.

It is impossible here to give figures showing the operations of Pusa ; three bulletins have been published between 1913 and 1915. Since 1912, the work has been practically in the hands of the Sericultural Assistant, M. N. De, who has written these three bulletins. Pusa is in a good situation for eri, a bad one for mulberry, a hopeless one for tasar or muga ; it has enjoyed the advantages of help from the Chemist, the Bacteriologist, the Mycologist and the Agriculturist. At every stage expert advice was obtained ; and the influence of the section in India owed much to this expert help ; but the experience of work at Pusa was chiefly that it was too big a subject to be tackled as a subsidiary one, that it required too much attention and that the results of this work were out of all proportion to its cost and too onerous for the staff. The whole energies of the section could have been devoted to silk with good results ; but silk was an item to which only a proportion of the energies of the staff could be devoted. The Inspector-General of Agriculture, Mr. Mollison, wished to reproduce at Pusa the Tata Silk Institute of Bangalore ; the climate was unfavourable and this was dropped. Mulberry silk could never be developed from Pusa with its excessive wet-bulb temperatures and the mulberry silk industry was studied there but not adequately assisted ; it is impossible to develop mulberry silk from a place that can only get a good crop once a year.

A trial was made at Pusa of teaching sericulture, courses were given there in eri-silk cultivation, mulberry silk cultivation, and in reeling, spinning, twisting, dyeing and weaving. There was no theoretical instruction, no lectures, no books ; all was done in the way it would be done if the industry was being practised as a handicraft on whose profits the worker lived. The lesson learned was that such instruction is useless ; it is probable that there is not now a single man earning a living at any branch of sericulture who was trained at Pusa. The influence of Pusa as regards methods, dyes, designs, markets, remains, but I doubt if any of the men trained under my direction have been able to earn a living at their subject. Some may have done so as instructors, none as actual workers in their craft. Possibly the experience gained has been worth the cost ; certainly no institution in India had the same prestige, the same facilities, the same teaching methods as Pusa ; yet the teaching failed, because the method is one not adapted to the Indian mind.

It is impossible here to attempt to summarise the results of the Pusa experiments ; the eri work has been published as a memoir, recent work in three bulletins has been published with, I think, absolutely no effect whatever on the industry. A bulletin has been published entitled "How to improve Silk Reeling in Bengal" ; a Bengali translation has been issued. This will not even influence silk reeling in Bengal in any degree whatever ; the same applies to two publications issued from the Allahabad Exhibition. They explained how to grow eri silk and mulberry silk in the United Provinces ; they were supplemented by an exhibit at the exhibition at which every stage from rearing to weaving was shown. Their influence was nil, though thousands of zemindars came to the Exhibition, saw the work and took away the pamphlet in their own language.

The publication of these bulletins affects no one but the staff of the Department who could get it better by other means ; and this branch of activity is useless except to the officials of the Department and of Government. The chief use of the Pusa experiments was to give us experience of silk, of its possibilities, of its needs ; practical experience was obtained of the difficulties, of the methods, of the commercial aspect. Some silk was sold and experience was obtained of demand, of markets, of values ; such an institution is a necessity if an official is to gain experience and be able to get down to the real issues. He has to sell his own products ; he has to produce new designs, to meet needs, to get ahead of the prevailing demand. He may create a demand by a striking design ; and in no other way can he get in touch with trade necessities which should be the main-spring of his work. Pusa in a small way was what is required in a large way, a place where new things could be worked out, new ideas tried, new designs created ;

yet the commercial aspect had to be considered, each new piece had to be sold and the trade demand had to be considered.

It is vital to the industry that such a place should exist and the prosperity of silk will depend very much on whether such an institution can be created on a scale so big that it will really impress the craftsmen in silk; its functions are discussed in Chapter XXVIII. Pusa was the beginning and germ of this idea and would have been very successful had it been situated in the proper place. It was unsuited to silk rearing, it was not a weaving centre; it was an isolated place, hard to come to, and its remarkable influence was certainly not aided by its position or its climatic facilities. In the main it demonstrates what could be done by a sericultural institute in a proper place with full facilities and the same means of influencing public opinion.

MISSIONS.

5. The many Missions and Mission settlements in India have not probably realised the possibilities of silk, either in production of cocoons, in reeling or weaving. Where Missions are situated in favourable areas, as in the Khasi Hills or Chota Nagpur, there is scope for them to take up a profitable industry; their difficulty is in getting advice as to how to commence and what will pay: but with this there should be a development in Mission settlements.

As explained under the heading Salvation Army below, development in Missions will not affect the people: because silk rearing or weaving is undertaken in a Mission, the cultivators or weavers in the neighbourhood will not do the same: and so the amount of extension from Missions will be small. In areas like the Khasi Hills where the Missions have influence and many adherents, the development can be large but such areas are limited. I think the aid of the Missions should be enlisted where the conditions are climatically suitable, as they usually are in the areas in which Animists are numerous and in which Missions are successful, and it is desirable that some encouragement, notably expert advice, should be offered to them. I hope the distinction between the direct working of the Missions as silk workers and their efforts to teach sericulture will be realised and remembered: Mission activities take curious forms in India and I would emphasise the fact that the mere teaching of sericulture is simply a waste of time: it is perhaps also necessary here to point out that, before embarking on silk cultivation, cocoon reeling or silk weaving, the exact lines to be followed need to be ascertained with expert advice and that only within rigid lines can any profitable industry be carried on. In the absence of expert advice, it is best to leave sericulture or any silk work alone.

It has not been possible, in this inquiry, to devote attention to the possible extent of development through the Missions: this would have entailed more investigation than there has been time for: but there is some scope for development and the Missions should be utilised as far as possible.

THE SALVATION ARMY

6. In the public press, at public meetings and in direct communications to Government, Commissioner Booth-Tucker, head of the Salvation Army in India, has urged the immense possibilities of silk as an Indian industry and has repeatedly stated that India is neglecting a great potential source of wealth. Furthermore he has asked and obtained financial assistance for the institutions under his charge and has obtained other forms of support from the Imperial and Provincial Governments. Recently the Simla Silk School has been opened: the Tata Silk Farm at Bangalore has been in the hands of the Salvation Army for some years: a large brood of silk worms was reared at Changa Manga in 1916; and at a number of institutions in India the rearing of silk worms, the reeling of raw silk, and the weaving of cloth is carried on. The report of the work of these institutions for 1913-14, corrected up to August 1915, refers to a staff of 6 experts, 12 European Managers, 12 Silk Masters; there are 350 basins for reeling, 30 looms. Five "silk schools" then existed and two more were to be formed: and there is a total list of 25 places at which the Salvation Army maintained an institution of some description, ranging from the Simla Silk School to the smallest branch criminal tribe institution. Such an organisation, which puts forward the development of sericulture in India as one of its objects should be an influence of some weight and it is necessary to determine the part it is playing in the development of the industry.

There are four distinct classes of institution, the criminal and industrial settlements, the Tata Silk Farm, the Changa Manga Camp, the Simla Silk School. A typical criminal settlement such as Bareilly or Moradabad is a building or set of buildings, surrounded by cultivation, with quarters for the criminals: the men are employed on cultivation on the farm: a certain area is devoted to mulberry, usually grown as large bushes or small trees; in the building there are chiefly women and children, employed on weaving, silk-reeling, re-reeling, twisting, dhurrie-weaving, mat-making and similar industries. The reeling is done on a variety of machines, usually the Salvation Army pattern, by children; the cocoons are either those grown there or more usually cocoons supplied by the headquarters at Simla, which are reeled at a rate of Re. 1 to Rs. 1-4 per lb. of raw silk produced, the silk and waste sent to the headquarters for sale or sold by them. At the above rate, the reeling is just paid for and there would appear to be no profit to the local institution. Re-reeling is also done, and the silk is in some cases twisted, warped and woven into cloth, which is sold. Weaving is done on the Salvation Army loom; the method of twisting is not good, the warping is done on a variety of systems, some good, some bad.

At suitable times in the year, rearing is done; seed is supplied from Simla, and the worms are reared on trays, on the floor or on the semi-underground system. The manager does this in the best way he can, with the assistance of a "Silk Master," who supervises the reeling, and with a visit perhaps from an "expert." As a rule a brood of worms is reared in the spring from French or Italian seed and some eri may be reared in the rains.

All the children learn reeling and so long as there is a cocoon supply, the regular reelers are kept to that; at other times they weave or do other work.

The workers at these institutions are criminal tribes, for whose control the Salvation Army receive grants from Government; they are paid wages, are taught occupations; in order that the institutions may attain their objects the occupations must be profitable. The business part is attended to by Salvation Army employes at Simla; reeling and weaving are profitable and are easily taught; and there is a definite and cheap labour supply, with some financial support in the way of grants. The management is extraordinarily cheap, being in the hands of members of the Salvation Army who are paid very low wages. As a rule they have very little knowledge of any branch of sericulture, but some know weaving.

7. These institutions do not influence the silk industry in any way that is at present apparent. There is no outside demand for reelers and apart from the work in the institution, the reeler cannot apply his craft. These boys also learn silk-rearing but equally have no scope for their knowledge. The cultivation of mulberry is extremely bad at every institution I visited; the rearing is usually bad, the reeling is good; but the net result is simply a paid occupation; it does not enable any one to start silk-rearing for himself or to earn an independent living at reeling. These institutions simply have no effect on the industry. The same is true of the Ludhiana school and other industrial institutes at which reeling is done; there is no demand for reelers and the only object for practising it is that it is profitable.

8. The Tata Silk Farm was originally founded to introduce into Mysore improved Japanese methods, and particularly reeling. At present, mulberry is grown, as large bushes, on an extremely bad system; the Mysore race of silk-worm is reared. The cocoons are reeled on the Japanese machinery and the raw silk is re-reeled, and either woven, sold in India or exported. The silk is of good quality and the greater quantity is from cocoons purchased locally, as their own rearing cannot supply their needs.

This institution exerts no influence in Mysore that is perceptible; it employs boys from the Salvation Army settlement in Nagercoil and local boys who are paid wages. It produces a quality of silk not in local demand; the local reeler cannot adopt this system of reeling and the method has never been taken up. The only merit that I could see in the institute was that visitors could see every stage in manufacture from the live worm to the finished cloth and that boys employed there could do the same; but there does not seem to be any real advantage in this.

9. At all these institutions, silk-worms are reared, and a great feature of the Salvation Army propaganda is that silk-worms can be grown everywhere in India, as witness these institutions. It is unfortunate that this statement is so continually reiterated because it misleads the public who think that it pays to grow silk-worms everywhere. Silk-worms can be grown in a *pukka* building, with immense care, anywhere in India at any time, provided expense is no consideration, and the rearer has unlimited time to give to it but it cannot be done profitably unless the conditions are exactly right. Silk-worms have been grown at Pusa continually for years, but no one would advocate sericulture there as an industry except during a very small part of the year. The public propaganda of the Salvation Army do not refer to the fact that their institutions rear small quantities of silk-worms under special conditions and could not possibly do so profitably.

10. The third feature of the Salvation Army's activities is the Changa Manga Camp. At this place there is a very large forest of irrigated mulberry and sissou trees: the Salvation Army took there a large number of boys from their institutions, a large part of their staff: they lived in tents, etc., and reared a single brood of silk-worms in February-March from seed imported from France and Italy. In these houses immense quantities of worms were reared together, half a million (15 oz.) in some cases. The rearing was done on several systems, on trays, on mats, on the floors, in temporary houses of bamboos and grass erected for the purpose. There is abundant leaf for the picking and the climate then is very suitable, unless the dry hot winds commence blowing early. Assuming the high average yield of 1 md. of green cocoons per ounce of seed, the net value of the crop was Rs. 4,000 at Rs. 50 per maund. The total expenses were stated to be between Rs. 4,000 and Rs. 5,000 but it is not certain what this includes. Every year the same expenditure must be incurred therefore the rearing cannot be considered financially profitable.

No organisation but the Salvation Army could have carried out such a scheme and it was not commercially profitable even to them. It is impossible to utilise large forest areas for sericulture when the workers have to be brought there, housed and fed, and only a single brood of worms, grown in temporary houses; as a final result, the returns are not financially satisfactory. As a demonstration, the Changa Manga venture is not good because it demonstrates the worst system of sericulture, a system abandoned everywhere in the world; small rearing houses, large filatures (*petites magnaneries grandes filatures* is the French motto) and in India the failure of the Lister Company's efforts in the Punjab and Dehra Dun began from the year they started large rearing houses. Sericulture can never be successfully carried on if large rearing houses are employed in this way, and it is a mistake to demonstrate and advertise a system that is in itself thoroughly bad.

11. The last and newest part of the Salvation Army's scheme is the Simla Silk Farm and Institute. Its objects are to provide a Library and Sericultural Museum, to give courses in sericulture, and to provide a demonstration centre from which the industry will spread. In themselves, a Sericultural Library and Museum can interest no one but the Salvation Army's staff at Simla; there is very good reason to believe that sericulture as an industry will never spread in the Simla Hills, and the main object of the institutions is presumably to teach. The prospectus lays down a one year's course for class A, Inspectors, a one year's course for class B, Foremen, Rearers, Artisans. There are short courses—three months for rearing, six months for grainage, six months for filature, six months for weaving.

Correspondence classes are arranged for and certificates of proficiency will be given on examinations.

An extract from the prospectus will be found in Appendix XIII.

12. The Institute receives grants from Government and in return admits 10 students to Class A or 20 to Class B. It is abundantly clear that this Institute will not affect the industry in any way whatever. When a student has taken either class and has been instructed in everything from "Indian and Foreign Silkworms" to "Silk Literature," what use can he possibly make of his knowledge? He could perhaps earn a living by teaching it if any one wanted teaching. He cannot earn a living by growing silk worms, by reeling or by weaving; he cannot even become an employer of labour and start a filature or a weavery. He has a superficial theoretical knowledge gained under abnormal conditions from teachers

who do not themselves earn a livelihood at any branch of the subject. The best will be employed in the institutions of the Salvation Army ; a few will be employed as in the past, by Native States, to develop sericulture until it is clear they are incapable of doing so ; and the school would simply add to the present number of partly-trained sericulturists unable to find employment.

The institute has no connection of any kind with the real silk industry of India, will not affect it and certainly will not be able to do anything towards helping to develop sericulture or to assist the weaver.

13. It is unnecessary to criticise from the technical point of view, though the syllabus lends itself to abundant criticism. The question of the value of schools and teaching in the development of sericulture is fully dealt with on pages 110-112. The Salvation Army is a considerable organisation which identifies itself with various projects. Sericulture is one of the subjects on which they seek to influence public opinion, and if they did so on good lines, they would be a useful organisation ; so far as one can see their efforts are directed to—

- 1.—Improving weaving processes.
- 2.—Selling looms and appliances.
- 3.—Teaching students sent to their schools, when Government gives grants.
- 4.—Reeling silk.
- 5.—Selling machines.
- 6.—Training students in reeling.
- 7.—Taking care of criminal tribes in settlements, in return for grants, teaching them trades, etc.
- 8.—Growing silk-worms on a small scale, for instruction or use.
- 9.—Selling seed from France.

Their organisation provides cheap supervision and motives of philanthropy impel them to form settlements for orphans and to take over criminals in the endeavour to reclaim them.

They thus have cheap labour available in settlements for whom paying work must be found. As financial aid is small, they must make enough money to pay their way.

They have found weaving profitable, have had a real expert who has improved looms and processes ; in order to get grants, they appeal to Governments to aid them in improving looms, etc.

As cotton pays little, they have tried silk ; they have found rearing an industry suited to children, still more is reeling ; but for the reeling they cannot themselves rear all they need. A boy will reel 1 lb. dry cocoons a day, or a maund in 3 months, he will want a maund of good cocoons (green) every 20 days, or 15 maunds in a year. At present reeling is far ahead of rearing, apart from Bengal and Mysore cocoons ; there may be 300 maunds cocoons produced in the Punjab but that only supplies 20 boys, so their need is obviously more and more cocoons that they can buy.

So they start "Silk Schools," for training people, asking and getting grants for this purpose and hoping to get a large production of cocoons for their criminals, orphans and settlements.

14. The weak point is that—

- (1) no school is any good, as reelers are not in demand ;
- (2) they do not take into account the limited profits of cocoon rearing ;
- (3) they shut their eyes to the inherent difference of Kashmir, its being a State monopoly, and expect India to develop similarly ;
- (4) they entirely mistake the position regarding the possibilities of sericulture in India.

15. In this report I am concerned solely with the activities of the Salvation Army as regards silk and am interested chiefly owing to their public influence and to their demanding public money to spend on their institutions. If they neither attempt to influence the public nor ask for grants it is immaterial to me what they do ; but genuine efforts to develop sericulture are very seriously prejudiced by the ill-advised advocacy of the Salvation Army. Native States are wasting

money on sericulture, partly from the fair prospects held out by the Salvation Army, partly owing to their taking badly-trained "experts" from the Salvation Army. (See Section on Indore under "Experiments. Chapter VIII and Appendix XI.") Natives of India are going to Japan to get trained and returning to find no opening for their training; and lastly the Army are maintaining a Silk Farm and Institute with a grant from Government and receive grants from Provincial Governments for similar institutions.

16. I do not think that any part of the Salvation Army's activities will benefit sericulture. If silk cultivation is to increase, if it is a profitable industry that should be developed, it will be done only by other methods than those of the Salvation Army; and every failure, every misdirected venture is an impediment, is a strong influence against sericulture ever being tried on proper lines in the same place again. If sericulture is to be developed in India it will be by appeal to the people themselves, not by any system of publications, schools or teaching. The rearing of silk-worms will need to be taught to them by a man of their own kind and not by any outside agency—that is the real limiting factor in the case of the Salvation Army. They can teach sericulture to their own people, to criminal tribes they have control of; but they can never spread it outside the limits of their settlements. Their settlements exert no influence outside and the people round will not be influenced by what they do. You could not put a Hindu to persuade Mohammadans to try sericulture. You would need to employ a Mohamadan; and this factor explains why the influence of the Salvation Army never extends to the districts they have settlements in and why their work is so completely limited to their own folk.

17. The above was written before the copy of the Annual Report on the Silk Centres of the Salvation Army for 1915-16 was received. The following occurs on page 3:—"Our progress would probably have been far greater had we not been crippled at every turn for lack of funds."

Page 5:—"We have completed arrangements for cold storage of European seed in Simla and for its distribution from this centre at the proper season all over India. This in itself makes a new and necessary departure of great importance." Seed hibernated at Simla has been available for several years past, certainly since 1907.

Page 6:—"It will be necessary for us for some time to come to import cocoons." Comment is needless in view of what is written on page 107 above. The report states that 4 tons of cocoons per month are required; but India certainly can never develop a silk industry by importing cocoons. No wonder the Salvation Army require grants and the first extract above is explained.

In regard to Kashmir, the report comments on the profit of Rs. 9 lakhs made by the State. It omits to notice that the State buys cocoons at Rs. 14 and annas 6 per maund, which are worth three times that amount in the open market.

In regard to Mysore, page 8:—"We have ourselves suffered heavily in our efforts to organize the industry by both the smallness and uncertainty of the grant-in-aid." Here if anywhere the Salvation Army should be able to make a large profit from the industry; if the Salvation Army with cheap labour and supervision cannot make the Mysore Silk Farm a success, no one can do it commercially.

Bombay Presidency:—"We have had a severe and prolonged struggle with the old enemy, unbelief. Some four years ago we urged that the industry should be taken up. The question was referred to the usual Departmental channels with the result that a strongly adverse opinion was given. We were soon after able to send excellent specimens of French, Mysore and Bengal silkworms and reeled silk from Ahmednagar"; yet the Salvation Army are asking for a grant from the Bombay Government. (See page 83.)

Bengal.—The report advocates planting trees, regardless of the fact that it means a reorganisation of the whole industry, changing from growing multivoltine all the year to univoltine in the spring, or growing two distinct races, yielding different qualities of silk.

Madras.—The report advocates silk growing and refers the previous failures to the growth of trees for feeding the worms; the climate factor is against silk in all but Kollegal and the hills in the greater part of Madras, to say nothing of economic and population factors. "The industry cannot however be expected to flourish till

Government is prepared to do its part in a liberal manner by ordering the planting of mulberries on an extensive scale and by encouraging and subsidising silk schools." See pages 72 and 83 of this report.

On page 19 of the Annual Report an estimate is given of the profits of starting sericulture : 1,000 trees per acre are to be planted ; 1,000 " fully grown " trees will supply leaves for from 50 to 60 ounces of eggs, which should produce 50 or 60 maunds of green cocoons, say 20 maunds of dry cocoons. These are the basal figures for the estimate ; they appear to be incorrect. One acre containing 1,000 trees yields actually in one plucking at the most 160 maunds of leaf sufficient for 10 ounces of seed. One tree with full room to grow will yield 2 maunds of leaf but you will not get 1,000 to the acre ; not more than 100. In considering the estimate then it is well to divide everything as to yields, etc., thereafter by 5 or 6.

(I deal with this because it is a typical example of the exaggerated statements of the Salvation Army ; presumably these are included in the teaching of the Simla Silk School.) The income to Government from this scheme is to be as follows :—

100 villages each with 1 acre of 1,000 trees are to use 5,000 ounces seed, producing 130,000 lbs. dry cocoons costing Government to buy Rs. 75,000, and giving a profit of Rs. 1,60,000, *i.e.*, Government pays the rearer Rs. 46 per maund dry cocoons (=Rs. 15-6-0 per green maund) and sells those cocoons for Rs. 146 per maund.

This assumes 1 maund green cocoons per ounce of seed as an average. The actual average in the Punjab is 36 lbs. and in Jammu is 55 lbs. You can never in practice (outside Kashmir) on a large scale realise 80 lbs. of green cocoons per ounce ; half that would be an excellent return.

" It should however be noted that in Kashmir a considerable proportion of the cocoons are reeled and the raw silk and waste sold, thereby further increasing the profits to the State." This is incorrect, the reeling diminishes the profit possible by the sale of cocoons.

The report however continues : *" I have avoided any such calculations as I assume that Government would not want to go into this part of the business but would prefer leaving it to private enterprise."*

The report would be valuable and the efforts of the Salvation Army would carry conviction if there was a single financially profitable venture to record ; every effort must have grants to support it and none can work at a profit. If so, why should Government stimulate a financially unsound industry ? It would be illuminating to have from the Salvation Army an account of a single case where silk rearing had paid. I imagine there is not a single case under the management of the Salvation Army ; and yet this is to be an industry that is to be developed by Government, paying the rearer one third of the value of the cocoons ! If the Salvation Army getting the full value of cocoons cannot work at a profit, even at Changa Manga, how is the silk rearer to do it, getting one third of the value.

CHAPTER XII.—THE METHODS OF DEVELOPMENT OF SERICULTURE.

Two broad lines of development have been pursued in India in recent years in the development of sericulture, the isolated effort with a foreign-trained expert, the ' Silk-School ' method.

2. For the first, a Native State will decide that sericulture is an industry that should be tried ; a trained sericulturist is obtained, and put in charge. This ' expert ' may be a man who has been to Japan or France, a man who has been in one of the Salvation Army institutions, or a man who has had experience in some branch of sericulture somewhere in India. To decide very difficult questions, both technical and economic, a man is taken whose qualifications, judging by his pay, are small ; the result has been failure. India has suffered heavily from entrusting sericultural development to men of inadequate training and insufficient experience. The most striking case is perhaps Bengal, which entrusted the desti-

nies of an industry in which a quarter of a million people were interested to a man whose sole qualification was six months' travel in European silk districts. Not only was his influence supreme for some twenty years but the influence of his work persists yet in the Bengal Silk Industry.

It is possible to quote many cases since then, where quite genuine efforts to promote sericulture have been spoilt by entrusting the development to an underpaid inexperienced "expert" with some foreign training.

This may sound harsh but if the industry is to develop it will be only if it is taken seriously, and men of real training and experience employed. This is particularly necessary when the lines on which sericulture is to be developed are to be decided, as in a new locality.

It is a noteworthy commentary on this position that every assistant in sericulture who left Pusa because he did not come up to the standard required was at once employed as an 'expert' to develop sericulture either by the Salvation Army or by a Native State in India. No progress is possible under such conditions.

3. The second line of development is the "School" It is believed that a teaching institution, properly staffed, can develop sericulture by teaching it; if sufficient men will pass through a full course of training in sericulture, the industry will, by the effort of these men, develop. What it really means is that if you could take a thousand young men and teach them sericulture, those thousand would at once start it as a business and so the industry would develop.

This policy will fail in India. It has failed continually at the Agricultural Research Institute, Pusa, where a short course of training in practical sericulture was given; and the view expressed six years ago in the following article applies equally at this time:—

TRAINING SCHOOLS.

We have already suggested that the silk industry might offer an outlet to the energies of educated young men, who are otherwise unemployed and who could be trained in sericultural schools. There are some considerations in regard to such schools generally, which are frequently neglected and which are of fundamental importance if any success is to be attained. There are already Institutes in India at which young men are taught arts, trades, industries, etc., and the tendency is to multiply them. These are usually staffed with experts from England, who are often tied to their institutes and never can or do know any part of India. All they can do is to impress their (English) methods on the men who come to them in their peculiarly English way, without regard to the fact that what they learn they have to apply in India and not in England. The expert with his technical training acquired in English should have several years in which to master the ways of the country and the conditions of the industry before he is fit to teach in India. We have in mind several technical schools, weaving schools and similar institutes and we will illustrate our meaning by a definite concrete instance. We may contrast two existing weaving institutes, designed for the improvement of weaving. In the one a three years' course is given including the theory of weaving, the construction of looms, the theory of design, design drawing, freehand drawing, machine drawing, the theory of textiles, etc. *It takes three years:* the student, aided by a scholarship, learns weaving on an expensive iron loom, preparing a few inches of each class of fabric in one continuous length, these fabrics having no reference to the fabrics of the country and being unsaleable. But when he leaves, he is not able to earn a living as a weaver; he knows theoretically all about it, but he does not know what fabrics are in demand, what the local trade customs are, where to buy his raw material, what to make, where to sell it or how to apply his skill, and he is useless except as a teacher.

In the other, the learner provides himself with a "country" loom as a sort of guarantee, then he sits down and works at it; having learnt plain weaving, he takes twills, etc. Of each fabric he must do one whole piece which is sold. He does only fabrics for which there is a local demand; he sells his pieces at the local market: when he leaves after six or nine months, he only knows how to make the locally required fabrics (which he can at once sell) by the most economical method and if the institute finds a demand for a new thing they tell their

trained men and show them how to do it. They teach them no theory, no drawing, no fundamental education, but simply teach them how to weave, what they can sell, and so put them in the way of earning a living.

The latter we regard as a proper institute: a poor man or a poor weaver can go there and be taught to earn Rs. 20 to 30 a month in his own house, with a very small capital for his loom and raw material. He is not demoralised with a scholarship, he does not get anything given him but he learns how to practise a definite trade in a definite manner, and when he starts in business, he can of himself earn a fair living. Now this is an instance of considerable rarity in India, due to the fact that it is the creation of a practical man, who has been many years in the country, who knows the requirements of his district, and who has got competent local men to develop a *definite paying industrial line*. Why cannot other institutes work on similar lines? Because they all start with the English idea of giving a thorough education and leaving the educated man to find an application for his skill, as is done in England. This requires a high order of intelligence and requires also that the educated man shall have opportunities of applying his knowledge. But there are not, in India, the means of finding the opportunities nor can the trained man go about the country till he gets work. Take the case of your highly-trained weaver; what can he do or where can he start; he cannot advertise, he cannot find out where there are weaving centres. He is averse to leaving his district, and if he does, he will not easily get a place to live in unless he falls among his caste-fellows.

So it is also in India's greatest industry, agriculture; you can give a man three years' training in improved agriculture, but at the end he cannot apply his knowledge to his own land; *he has not that kind of mind*: if you teach him ten definite improvements, which are suited to his particular land and conditions, and train him thoroughly in them, he will apply them; but it is the teacher and not he who has to find the application of the knowledge and teach only that.

We may go further and consider the young men, who have been and are being sent abroad to learn industries of all sorts: do any come back to start these industries successfully? Have any been able to apply their knowledge? Very, very few indeed; and quite recently an association that has sent away many such had regretfully to admit that only one was earning a living at the industry he had been taught in Europe, and that the rest had not been able to do so. Why? Because they were taught tanning or dyeing or textile or glass manufacture generally, and had not been taken by an expert in India and taught say silk dyeing, as required at Murshidabad, or how to work a tannery at Bombay or any one definite thing whereby they could earn a living.

It has become the fashion to believe that by sending young men to England, Japan or elsewhere to be industrially trained, industries are going to spring up; they are not, and the sooner the folly of the present method is recognised the better. It is one thing to have technical knowledge; it is another to apply it, to be able to work an industry on profitable lines and to build up a business; the class of man now being sent away will never do this, and unless the industry is started for them, so that they can apply their skill as employes, they will be worse off than if they had never been sent out of India. We know of several, for instance, who have been trained in sericulture in Japan and France, but we are not aware that they have been able as yet to do more than attempt to get into Government service, and they are not likely to take up sericulture as a business of their own.*

The silk industry in Kashmir was not developed by means of a Silk School, nor that in Jammu. The industry in the Punjab will not develop if sericulture is taught nor does the School of Sericulture in Bengal in any way influence the industry there. (To develop sericulture you must go to the people themselves, not expect the people to come to schools; and there is in India no scope whatever for any school system at the present time.)

THE MONOPOLY QUESTION.

4. It has been suggested that as in Kashmir the sericultural industry has been developed as a State monopoly so in India the same can be done and the industry worked just as salt and opium are.

If the section on Jammu is read, one can see how the presence of mulberry trees on the land was a powerful inducement to the owner to take up sericulture ; and if trees existed over any large stretch of country as they do in Jammu, by declaring mulberry State property and silk a State monopoly one could proceed exactly as in Jammu. But mulberry trees do not exist, they do not grow with the same facility as in Kashmir and any that were planted would need to be on land that was taken up by the District Board or other local authority. This could be done and any quantity of mulberry could be planted but that would not be a guarantee that people would take to the industry nor could they be compelled to.

The circumstances of the development of sericulture in Kashmir have been very carefully considered and they are obviously different to those of India ; and there would be insuperable difficulties in making a State monopoly of silk in any part of India. The boundary difficulties in Jammu illustrate the point very well and it is clearly impossible to develop silk on these lines.

PRIMARY SCHOOLS.

5. Another method of developing sericulture is the use of primary and other schools to familiarise the people with the industry.

Hungary is believed to have made use of this method and it is used in the Punjab on a small scale now. In other parts of India, it has been tried with eri silk and the rearing of silk worms may have some definite educational value. As a means of developing the silk industry in India, the use of the primary or any other school does not appear to offer much hope of progress. I have little personal knowledge of schools or school masters except in Tirhut but until the standard of education and the ability of the masters rises to a higher level, the schools cannot be used to spread the industry. They may spread a knowledge of it that has an educational value but that knowledge may be a bar to further extension by the parents determining that they will never get any good from such an industry.

To convince a cultivator or weaver that sericulture pays, you want to show him the business properly done, as he can do it, to do it well throughout, to get a definite return in money for definite expenses in appliances, plant, seed, etc. No school can do this. The school grows a couple of trays of silk worms, gets its leaf from the village trees, has all the scholars to look after the worms and bring leaf, and at the end has a small crop of cocoons that gives each boy a few annas. It would be much more practical to have a single proper rearing house with worms at every railway station in India and let all the passengers actually see it being done and tell them the selling value of the cocoons.

BOUNTIES.

6. It is reasonable that a man who starts sericulture in a new area should receive assistance in the form of a bounty, such bounty being calculated as a sum sufficient to cover actual loss if the venture totally fails and being paid only if the crop does wholly or partially fail.

The cost of doing sericulture through an indigo concern in Tirhut is calculated in Chapter XX and if no cocoons were got at all, a sum of Rs. 85 per acre covers the expenses incurred. In this case the full bounty could be offered up to say 20 acres, thereafter a half up to 100 acres, thereafter a bounty fixed upon the green maund of cocoons produced. Once the industry has been started and its difficulties met, it would be possible to know exactly how far it would succeed in that area and the bounty could be discontinued. This system has this advantage that it provides for control of the experimental operations and so gives a reasonable chance of their being properly done ; and this is essential to success.

The French bounty amounts to Rs. 15 per maund of cocoons produced, the Brazil bounty is Rs. 42-8-0 per maund of cocoons (probably dry), the Turkish bounty is Rs. 30 per acre of mulberry cultivation and from Rs. 13-8-0 to Rs. 70 for 30 to 600 square yards of trays used in rearing. These are not experimental bounties but are actually paid for all cocoons produced, and even on the full crop.

In very few parts of India are the conditions such that a direct permanent bounty would effect much and it is an open question if these bounties are a sound way of establishing an industry unless the industry is to be permanently supported

by such bounties or by some protective tariff. The experimental bounty has a very definite value as a means of testing possibilities.

OTHER METHODS.

7. A difficulty which has to be faced in the development of silk in India is the immense number of races, castes, tribes and kinds of people, each one difficult to approach except through a member of the same race or caste. If I wanted to develop silk rearing among the Mohammadans of a district, I would select a Mohammadan of that district, pay him to do silk rearing in the best possible way, see that he found a market for his crop and employ him to persuade other Mohammadans to take it up ; there would then be direct access to one class of people who might take up the industry. The Director of Sericulture in Kashmir lays stress on the importance of this point and states that their experience fully endorses it. It is in this way that Khan Bahadur Ghulam Sadiq in Amritsar has developed sericulture among the Mohammadans of Gurdaspur. It will be the same everywhere if a new industry is to be created and it is an essential point in the development of sericulture in any part of India. It is the limiting factor with regard to the Salvation Army, whose activities must be confined to criminal tribes, orphans and the like.

8. In starting sericulture in a new locality or in testing its possibilities the procedure is a very definite one. The climatic conditions are studied and the favourable months determined. The best kind of mulberry to plant, the method, the details of cultivation, are settled after regard to the race of silk worms that will suit the conditions best. If tree mulberry is required, time has to pass before it will be available and meanwhile the standard or large bush system of cultivation is adopted. The seed supply has to be arranged for, a small hut erected similar to those that would be used in the neighbourhood, and at the proper time a rearer is sent to rear the brood of worms. The crop is then sold for reeling, or reeled and the silk sold. The results are then gone into with District Officers and the chances of the industry growing are fairly easily ascertained ; if they look good, it is a question of getting a small number of cultivators locally to try it, giving them seed, supervision and plants, buying their crop and guaranteeing them a definite fixed amount, probably half the value of the normal crop, if total failure results. With success in this small way the industry will start, expand if profitable and eventually become established. As it grows, an agency must be provided to issue seed, to buy cocoons, to register fresh rearers and so on. In Kashmir this agency is the State, in the Punjab it is chiefly a private agency aided and supplemented by the Agricultural Department.

If there is reason to think that a district or a locality is suitable for silk, and that economic factors are favourable, then the question can be easily and cheaply tested in this way ; but it is essential that it shall be done as nearly as possible in the way the people themselves will do it if they take it up and there must, at the start, be an organisation behind it.

9. It is possible that eventually the development of sericulture may be taken up by zemindars as it would be in England for instance, and in such cases a different procedure will be necessary. One can imagine a large land-owner having a son or relative taught how to start sericulture ; in England he might go to an Agricultural College, take a three years course and if he was exceptionally sensible, be able to go back and develop agriculture on his property ; but we cannot expect this in India and that man will have to be deliberately taught exactly how to *develop sericulture under his own conditions* on his own property. There is at present little sign of this happening as it is easier to employ a paid 'expert' on small pay who soon fails.

But it must be kept in view and there is no doubt that if ever the well-to-do and well educated land-owner and people of influence take up sericulture as an industry beneficial both to their tenants and themselves, it will develop more rapidly than it can under any other system. The one essential will be that no effort is made to start till every detail has been thought out, till the exact lines have been rigidly laid down, by really competent persons ; and there must be this expert guidance behind it throughout. Given that, given sensible practical

methods of developing it, and sericulture could be rapidly established wherever the conditions are right.

It is probable that a great deal can be done to develop it by utilising the influence of the zemindars or influential people in suitable districts, by having silk cultivation done on their land or under their influence wherever the prospects are good ; and if the experimental losses are made up to them, the question can be easily and cheaply decided. If every large land-owner knew that he could get really practical advice and would not be encouraged to do sericulture unless success was fairly certain, it would not be difficult to get as many to try it as could be advised and helped at one time. District Boards and District Officers may be utilised, as they are in the Punjab and elsewhere ; but the key to all is the provision of advice.

10. In this respect the experience gained at Pusa with eri silk was extremely valuable and it has shown pretty clearly some mistakes to avoid. One certainly is the indiscriminate distribution of seed to any who require it. I would not send seed to any one whatsoever unless I was satisfied he knew how to proceed ; every failure from ignorance is interpreted as a failure due to the unsuitability of the industry, and I would supply seed to no one unless I could have it followed up, the rearing properly done, the produce sold for its full value.

11. Another mistake has been referred to, the belief that after training in rearing silkworms a man can go back to his own place and practise it. If you want to help a man to do sericulture in a particular place, it is of no use to take him to Pusa and train him, unless he is a Tirhut man. You want to send a man to his place to find out how to do it and then to show him. A further lesson is the utter uselessness of any kind of printed matter ; it is a waste of time to write or print anything meant to reach any one in India outside the officials of the department ; and all efforts in the education line are of no use. The Allahabad Exhibition contained a good working exhibit of eri and mulberry silk, two pamphlets in two vernaculars, sold very cheaply, leaflets given away free, and intelligent people to answer all enquiries ; but the effect was *nil*.

The experience of Kashmir is the same, the rearers had to pay shopkeepers or literate people to read the leaflets to them and the method was abandoned.

12. This inquiry is directed chiefly to determining whether the silk industry can be increased and the broad lines of the methods. It is perhaps unnecessary here to consider detailed procedure but for the fact that it illustrates method better than anything else can do.

13. I am assuming that it is determined to develop sericulture as an industry in all possible new areas ; and the lines of procedure are somewhat as follows :—

- (a) *Tirhut*.—Arrange with one indigo concern to plant twenty acres of mulberry at 5 suitable villages ; guarantee all losses provided the instructions were exactly followed, grow one crop of univoltine breed in February-March, another crop of nistari hybrid or Madagascar in October-November. If it succeeded, extend on that concern. The rearing would be done in small mat-huts on the lines discussed in Chapter X under "Rearing." If successful, extend indefinitely, providing a trained field man to show rearers to carry out the work. That would absorb one field man for some four months.
- (b) *Khasi Hills*.—With the help of the district officers or one of the Missions find a village where Khasis would do silk rearing ; plant bush mulberry or trees, if necessary pay for small huts ; rear one crop of univoltine or Madagascar, paying wages to villagers if necessary and having one field man to carry it out. If that succeeds, extend there, issue cuttings or trees and never take in more new villages than can be looked after properly. The number depends on the available staff chiefly. I think that in the Khasi Hills or at least in part of them two or three crops could be got, in which case the Madagascar or an improved multivoltine would be used.
- (c) Find a suitable area in the Central India uplands and experiment with the growth of the Madagascar or a very good multivoltine in the rains and till the cold or heat stopped it. Do nothing else there

whatever, no reeling or weaving, etc. Definitely ascertain if and how sericulture there will pay and what class of people will take to it. (This has been commenced at Indore : see Appendix XI.)

- (d) Do the same in a suitable place in the Central Provinces if one can be found where the population factor is right.
- (e) Do the same in Chota Nagpur if a proper place can be found.
- (f) Find a site in the Orissa area if one can be found and try silk rearing there, at one place, using a good multivoltine race or Madagascar ; quite possibly the conditions would suit a univoltine race.
- (g) If (c), (d), (e) showed that sericulture could be developed during these months, apply the method in Belgaum or Dharwar if there was reason to think that any community would take it up.
- (h) Ascertain the position in Baluchistan and if possible develop the univoltine race there, on the Punjab lines.
- (i) Pay grants to individuals or any organisation, a Mission for instance, prepared to take up sericulture under fixed conditions, where the climate factor was right and where there was a community that would be large enough eventually to be able to produce a reasonable amount of cocoons for reeling.

The exact details of the whole procedure would have to be rigidly laid down and adhered to ; a market would be guaranteed for cocoons and the grant would include any loss made.

- (j) Wherever possible, put the present efforts on right lines or advise their cessation ; this refers to Native States which are experimenting.
- (k) Ascertain the available mulberry in the whole area from Ambala to Purneah and start an experiment where climate \times population \times mulberry agree as favourable.

This is a large seeming programme but it would not all be done at once ; it indicates the points at which I think progress will be made most rapidly.

14. It is necessary to refer to a difficulty which will be fairly obvious ; this kind of scheme depends a great deal on the expert who lays down the exact details for each place, it depends a great deal on his initiative in pushing it, on his knowledge of the country and the people, on his relations with local authorities ; it is not a plain straightforward administrative post. It is not the control, or improvement, of an existing industry as for instance in Jammu or Bengal. There is nothing going on, the " show will not run itself " and routine work is not part of it ; so that it may well be that, in practice, it will not be possible and its practicability is not made to appear more likely if one reads the recommendations of foreign experts for Mysore or Bengal. But to me the development of sericulture depends more on the man than on any administrative or financial measures. The only alternative that suggests itself is the blind money one ; spend money, offer bonuses and grants, finance every experiment liberally, and deliberately devote a large sum of money to the development of sericulture blindly. If Missions know that they will not lose, they will try sericulture probably ; if liberal grants are given and a really big bonus is put on every tree, every acre of mulberry, every square yard of trays, or every maund of cocoons produced, every reeling basin, the industry will certainly get a full trial and if a thousand trials are made every year, some few will succeed and eventually get established as local industries, especially if the bonus is kept on.

POLICY.

15. Silk has been developed in Kashmir and Jammu against the will of the people and not with it. The same can take place in suitable areas in India, but without a measure of persuasion, and enthusiastic help from the officials, it will not succeed. If the view is to be that the Government is to force the industry on the people against their will, but for their good, then the Government must take the necessary steps, but if the view is that it must not be forced but must be left to native enterprise assisted by Government, then nothing will be done.

My personal feeling is that it is a mistake to foist on the people a new industry they do not want. When the representatives of the country ask for it, then it can be given, but I do not see how under the freedom that obtains in British India, we can adopt the methods used by a more autocratic Government in a Native State. There is undoubtedly no demand for the development of the industry from native sources. In Jammu the industry has been developed against the will of the people and not with their consent, and there is, as far as I am aware, no demand from native sources for the development of sericulture in any part of India.

It is not my business to do more than show how sericulture can be developed, if it can be, but it is my business to state that any development must take place in opposition to the feelings of the Indians and not with their active help. The duty of Government ends with the provision of the means of developing the industry, if it is needed ; in the absence of a demand, the means of development are not called for.

There is, I think, no doubt that a big industry can be created, if the autocratic methods of Native States are adopted : but I think that it is repugnant to Government to do this.

If the methods of Kashmir and Jammu are followed in Bengal, in the Punjab, in Assam, in the Mysore area, including Kollegal, in parts of the Central Provinces and Central India, in the submontane and northern districts of the United Provinces, Bihar and Bengal, a very large silk industry can be created ; but there is no evidence that it is wanted, that it can be established except against opposition or that it will be acceptable to the people, if it is done.

Looking at the matter from the point of view of the Indian Government as now constituted, I am not sanguine that proposals for the development of sericulture will be acceptable to the country, will be welcomed by the Indian members of the Imperial and Provincial Councils, will be successful without a measure of autocratic Government, that will be incompatible with our methods of Government.

16. Success can be achieved probably far more quickly by the encouragement and active help of the influential Indian than in any other way. In suitable tracts, it is open to the zemindar, the rajah, the member of council, to exert his influence, to employ capital, to use the persuasive methods of the Jammu authorities. It is an industry that offers scope to such persons if they are seriously in earnest as to the welfare of their people. It offers scope to all influential persons and it is open to them to ask for the technical expert help that can be provided by Government, if they are willing to use their influence and to persuade their people to try it. Without this, and without the Government using the methods of the Jammu and Kashmir State, I see no chance of the industry developing to any extent nor would I recommend it to be tried.

I should therefore be inclined to point out the possibilities of the industry, the means of development, the part that can be played by existing native agency ; and leave it to that agency, well represented in Councils and in Governments, to press for it and to use their influence to develop it.

That there is not a larger sericultural industry, is due mainly to industrial apathy, to want of business enterprise, to the apathy of the people, and their leaders ; there is no reason why an industry should not be developed : but for Government to force it on the people will be a costly and difficult task.

PART V.—WILD SILKS.

Introductory.—In India at present, the only silks that are of economic importance are the tasar, the muga, the eri.

2. Tasar is regarded and treated as one species, which is one brooded, two brooded or three brooded, according to the race used. As described under tasar below, the cocoons used for breeding are both wild ones and semi-domesticated ones; the tasar of the United Provinces is probably a distinct species, if the cocoon characters are any guide, and it is probably this species which comes to females of the Chota Nagpur race when moths emerge from cocoons brought for instance to Pusa.

It is at least probable that the tasar in Chota Nagpur is not really all one species but several; the practice of exposing females to fertilisation by wild males offers inducement to hybridising between various species, if there are such, and accounts probably for the uneven hatching and irregular brood characters that are a difficulty there.

3. Muga, as grown in Assam, is stated by Watson to be three species; this is quite probable and as no scientific investigation has been made in Assam, we cannot tell how far muga is influenced by the hybridising if there is any. Eri again appears not to be a pure species but probably a hybrid; whether this fact is of economic importance is uncertain except so far as the cocoon colour is concerned.

4. In his note Mr. Watson expresses views as to the possible utility of other races; he refers to oak-feeding species, not realising that there are difficulties about growing oak-feeding worms in India owing to the lack of population at suitable elevations in the hills. Appendix XIV.

His remarks however help us in estimating the value of the experiments made with China tasar at Chakrata.

5. There is no doubt that the whole problem of the utilisation of muga and tasar is bound up in this purely entomological question of pure races; and a full investigation of this point is an essential preliminary to any efforts to improve, revive or extend the industries dependent on the cultivation of these silk-worms.

This investigation will be difficult, will take several years to carry through and will require considerable expenditure both in providing suitable places for experiment and in travelling facilities in India, in the Andamans, in Japan, China, Borneo and other parts of the East. Mr. Watson who has prepared this note (Appendix XIV) at my suggestion has for years specialised in the wild silk-worms, both from the purely entomological aspect of getting rare species and new hybrids, and from the industrial aspect and the commercial utilisation of the cocoons. Were he able to devote his whole time to this subject and have full facilities in India for the experimental culture of all the likely races, it is uncertain what results might be attained. They might be results of very considerable economic value. They might lead to no useful result except as far as muga and tasars were concerned.

6. While I am interested in the purely scientific problem of the classification of all the wild silk moths as they occur in India, I am not prepared to advise that it should be taken up in connection with the present problem; it is a matter that falls within the scope of the activities of the Indian Museum. But a part of the enquiry is of very definite importance especially with regard to muga and I think that an enquiry should be made into the following questions:—

- (1) The species comprised within the "muga" as grown in Assam,
- (2) their isolation as pure races, if possible, and the determination of the economic value of each,
- (3) the question of distributing seed of one to muga rearers and the determination of the amount of hybridising that then occurs,
- (4) the races of tasar as found in all parts of India,
- (5) their isolation as pure species and the determination of their economic value,

- (6) the improvement of the existing industry by these pure races, and
 (7) the investigation, in India, of any races of wild silks, which seem likely to have any commercial value, whether they are drawn from Indian or foreign sources.

If developments showed that there was any real advantage to be gained by seeking other species in Borneo, China or elsewhere, this could be considered but at the start, the work might well be limited to the above points solely.

CHAPTER XIII.—TASAR.

This is a wild silk insect, never successfully domesticated, which lives in forest areas chiefly and which feeds on a variety of trees. In nature, the moths hatch out in June, fly and pair at nights; the female lays eggs on trees, which hatch to caterpillars which feed on the leaves of the tree. When full-fed and very large, they spin cocoons on the tree, either spinning a stalk to the cocoon round a branch or spinning the cocoon among a few leaves. In due time the moth emerges and the cycle starts again. The normal cycle is a brood from June to August, then another which remains in the cocoon from October to June.

FOODPLANTS.

Asan.—*Terminalia tomentosa*.— }
 Arjan.—*Terminalia arjuna*.— } The two chief varieties in Chota Nagpur.

Remarks on the development of sericulture in India.

Ber.—*Zizyphus jujuba*.—The food plant outside tasar hill areas. The cocoon is without a stalk and light-coloured.

Lagerstrœmia indica.— }
Lagerstrœmia parviflora.— } Can be reared on these.

Other recorded food plants are as below, but it is not at all clear on what authority they are called food plants.

Mahua.—*Bassia latifolia*.

Simul.—*Bombax malabaricum*.

Jamūn.—*Eugenia jambolana*.

Pipal.—*Ficus religiosa*.

F. retusa.

F. benamina.

Sal.—*Shorea robusta*.

Teak.—*Tectona grandis*.

Desi-badam.—*Terminalia belerica*.

Terminalia catappa.

Castor.—*Ricinus communis*.

Dodonœa viscosa.

Chloroxylon swietenia.

Celastrus paniculata.

Carissa Carundas.

Careya arborœa.

Anogeissus latifolia.

Bauhinia variegata.

2. The most successful investigator of tasar has been Captain Coussmaker, who bred it successfully in semi-domestication in Poona. This race was quite regularly two brooded and he got moths to pair in baskets, so that he was able to control the breeding. He quotes the following figures for cocoon weight:—

“Cocoon, 150 grains, chrysalis 130, shell and pedicel 20, reelable silk 12; about 800 yards of thread is reelable, the thread flat, coarse, and self coloured in shades of brown.”

3. Rearing in captivity has been successfully done at Pusa of the race which feeds on ber (*Zizyphus jujuba*), but the rearing so done could not be commercially profitable, nor could Captain Coussmaker's system be profitable unless the price of cocoons was extraordinarily high.

AREAS.

4. Tasar occurs as a wild insect over a great part of India : its northern limit is the outer slopes of the Himalayas bordering the Punjab and including Kangra and Kulu. It is found in the Hoshiarpur and Sialkot districts in the Salt Range and along the submontane districts, in Dehra Dun, Almora, most of the districts in the United Provinces to Mirzapur and Benares ; further east it occurs north of the Ganges through Tirhut as far as Purneah, and along the Himalayas into the Assam hills. Its occurrence in Burma is not certain, though it is stated to occur in Amherst and Akyab.

From the United Provinces it occurs westwards over Central India to the jungles between Surat and Thanā ; it is found in the Western Ghats as far south as Malabar, and is known from Pondicherry : it occurs through Mysore, Hyderabad and the Central Provinces. The great area of hills forming Chota Nagpur is the centre of the industry and it is found in Orissa, and in most of the Bengal districts, including the Sunderbans.

The fact that the insect occurs wild does not mean that in that district it has any economic value necessarily ; only where it is so abundant that large quantities can be easily and cheaply collected, does the wild form have any value ; these localities are chiefly forest areas, where the conditions may be such that collection is impossible. When in 1875, attention was devoted to the possibility of developing tasar in all provinces, cocoons were collected from many places in which no industry exists, but at a cost which would leave no profit to the collectors. More recently, it was believed that a possible tasar industry was being neglected in the forests of the Bombay Presidency and cocoons were collected there ; but there is no possibility of any industry there under the present conditions.

The principal districts in which tasar is produced are the Chota Nagpur districts, Hazaribagh, Ranchi, Palamau, Manbhum and Singhbhum,—the Santhal Pergannahs, the Sambalpur district, the Chota Nagpur and Orissa States, and the Chanda and Bilaspur districts of the Central Provinces. A small amount is collected in Mirzapur district and in Balasore, Angul, Midnapur, Bankura, Gya, Bhandara, Balaghat, Seoni and Raipur. In Ganjam, the Panos rear a small amount, selling the thread or cocoons to Sambalpur : of the Orissa States, Sonpur, Bamra, Bonai, Mayurbhanj are reported to produce cocoons or to collect them. Tasar could be obtained over a very much wider area if it was worth while collecting and there are probably areas in Hyderabad, in the Orissa and Chota Nagpur States, where much more is produced than is recorded.

PRODUCTION.

5. Tasar cocoons come into trade from two sources, wild cocoons collected from the trees and brought in alive, semi-domesticated cocoons reared upon selected trees from seed obtained from female moths in captivity. The proportion of each is a wholly unknown figure : the cocoons are collected or produced in jungle and forest tracts by hill peoples such as the Santhals, and Kols, and accurate figures of production are not available. As a rule the wild cocoons are needed for stock from which to rear the semi-domesticated worms but are not always used, the rearers preferring to use their own stock. There is a very great difference in value in the different classes of cocoons and prices range from Rs. 3 per kahan for poor cocoons to Rs. 12 per kahan for the best. There is a very extensive literature on tasar, which can be found in Watt's Dictionary of Economic Products, in Geoghegan's "Silk in India" ; it is unnecessary to reproduce any account of the methods of rearing, etc. A very great deal of descriptive matter can be found and it is only necessary here to discuss the present position of tasar and the factors that have to be considered.

EXTENT OF THE INDUSTRY.

6. It is difficult to get any idea of the extent of the industry in India, or of the amount of production.

In 1912-13, 4,498,000 cocoons were produced in the forest areas of Bihar and Orissa, under the administration of the Forest Department, yielding revenue of Rs. 1,462. Singhbhum alone produces 40,000 kahans (51,200,000) in all, according to the figures of Mr. H. H. Haines, Conservator of Forests, Ranchi. Mr. Walker quoted in the Annual Report, Chaibassa Silk Farm, 1908, computes that in 1907-08, 12,500 kahans went to the Central Provinces, 12,000 to Louis Payen & Co., and 8,000 kahans were bought by *mahajans*; that gives a total production for Singhbhum of 32,500 kahans (41,600,000).

The remaining Chota Nagpur districts must produce at least twice this amount. Chanda produced in 1875, 22,000 seers of thread, so apart from cocoon export, there must have been 22,000 kahans of cocoons produced there. Sambalpur used to produce 6,000 kahans of cocoons. Assuming a total production of 250,000 kahans of cocoons, and allowing $2\frac{1}{2}$ kahans per rearer, allows for 100,000 rearers and collectors, apart from families, with whom it is a partial means of living. As each weaving family uses $30 \times 800 = 24,000$ cocoons = 20 kahans, there are 12,000 families of weavers or 50,000 persons engaged in tasar weaving.

These figures are based on the returns available in 1904 and there is no real means of checking them for the present. The census figures of 1911 are reproduced below: but they are of practically no use because so many rearers are returned otherwise, so many twisters are returned simply as silk twisters and weavers, and most weavers weave cotton also and so come under that head. The total people concerned are—

Collectors and rearers	100,000
Twisters	20,000
Weavers	50,000
	TOTAL . 170,000

UTILISATION.

7. *Tasar* cocoons come to the markets at fixed places (where revenue can be paid on them in some cases) and are sold to dealers, who export them to the weaving centres. The dry cocoons are reeled, by a very simple hand process, a kahan of cocoons yielding from $1\frac{1}{2}$ to 4 lbs. of thread: the unreelable part of the cocoon becomes "tasar waste" as also do cocoons from which the moths have emerged. *Tasar* waste is spun by hand into coarse thread, or is sold for export. Some has been used by mills in Cawnpore, who spin it and weave tasar twill puttees and similar fabrics. *Tasar* cocoons vary from Rs. 3 to Rs. 12 per kahan, thread sells at Rs. 8 to Rs. 16 per seer, and waste fetches from Rs. 18 to Rs. 35 per maund according to demand. Louis Payen & Co. used to buy cocoons and reel thread for export to France; they have now ceased their operations in India and no European firm exports reeled tasar. The whole reeling is in the hands of the weavers and tasar reelers, and there is no filature reeling at present.

Tasar silk is essentially different to all other silks except the Assam Muga, the Chinese Shantung and the Japanese Oak Silk; it is a coarse flat fibre, self-coloured throughout in delicate shades of buff and brown; dyeing is not easy except in dark shades and it is chiefly used in its natural colour. It is a very durable, rather harsh fibre and is used in India for weaving pure or for weaving with cotton into "bafta," a cloth much used by Mohammadans to whom pure silk is forbidden. In India, much is woven into cloth entirely worn by natives, either pure or bafta. Outside India, tasar cloth competes with Shantung, the waste competes with Shantung waste. A great deal of Shantung waste or cocoons is exported to Europe for spinning or for manufacture into plush, imitation seal-skin, carpets or other fabrics. *Tasar* is used for this purpose but the price is determined by the price of the much greater supply of Chinese Shantung. So the cloth is also in competition with Shantung silk, which is incredibly cheap. A large London firm sell Shantung cloth at a little over a rupee a yard; they buy it in China at 9 and 10 annas a yard. A complete lady's costume of Shantung made ready to wear, sells for five shillings and six pence in London. India simply cannot compete with the extraordinary cheapness of Shantung silk cloth from China. In India, tasar and bafta cloths are cheap, as silks go, but not as cheap as Chinese tasar. The weaving centres for tasar will be found on pages 124-125 and

present conditions discussed. The industry very seriously needs organisation, exploitation and advertisement. The weavers need to be told the class of fabrics required, to be organised in societies and helped to manufacture what is in demand. If exorbitant demands are made as to price, the industry will die but with good craftsmanship, labour-saving appliances, knowledge of what to produce and help as to sales, the tasar weaver could hold his own in India. Eventually the China product will rise in price, as communications and civilisation put up the price of living and the cost of food, then the Indian craftsmen will prosper and the tasar weaver will compete on equal terms, to his advantage.

A considerable amount of effort has been expended on enquiry into tasar. The Resolution of the Government of India No. 5156-165, dated the 23rd November 1875, and the attached papers brought together as "Collection of papers regarding tasar silk" give a great deal of information as to the industry and the efforts made to revive it: Agricultural Ledger No. 9 of 1893 discusses efforts made in the Central Provinces: "The Report on an Enquiry into the state of the Tasar Silk Industry" by N. G. Mukherji gives a detailed account of his enquiry, made during 1904: as a result of his enquiry farms were opened at Chaibassa and Chanda, for the supply of seed and the investigation of disease. The investigation there made will be found in the Reports of the Agricultural Departments of Bengal and the Central Provinces; with the abandonment of these farms no further investigation has been made.

In all this enquiry, the one salient point that has been wholly omitted and neglected has been the investigation of the insect from the purely biological aspect: the decline of tasar has been put down to (1) Restriction of the use of trees in forests, to prevent excessive or injurious pollarding; (2) Increasing value of crops such as rice with no corresponding increases in tasar values; (3) Disease, due to over-collecting or to too prolonged breeding from domesticated stock; (4) Low prices, due to less demand for tasar cloth and yarn.

These points are important but are not all; and in no single enquiry has a competent entomologist investigated the insect from the biological point of view.

It is certain that tasar is more than one species; that these species exist side by side in Chota Nagpur and neighbouring areas and may have to some extent hybridised; that the rearers have difficulty with their crops because when they get wild stock or when they buy semi-domesticated stock they buy either of the species and the disease may be due to the wrong species being reared on the trees used by the rearer. In considering this, it is necessary to remember that tasar is an extremely wild insect, very little amenable to control. The mating is effected by fastening the female in the open and wild males come to her at night: the cultivator does not attempt to control this and a male of any race comes; if there are distinct races, with distinct kinds of cocoons, distinct breeding periods and separate food plants, one can understand the irregularity in these matters if the progeny are hybrid. In Chota Nagpur, the rearers say that their own produced males never mate with their females. This was the case at Pusa with Chota Nagpur stock, which attracted local males, though till then no tasar was known to exist there at all.

The whole of the difficulties of the rearers in Chota Nagpur, the irregular emergence of the moths, the irregular behaviour as regards food-plants, is explainable at once if two or more species have been confused as one; so too the failure of the farms at Chaibassa and Chanda is understandable. The present position is that, until the races or species of tasar are investigated and understood, no further amelioration is possible from the scientific point of view; and it is extremely doubtful if any other method of assistance is possible at present. N. G. Mukerji's Report deals with the industry from the economic aspect and his main recommendation, the issue of good stock for breeding from, has been found to be impossible because the fundamental distinction in behaviour between the strains and races has never been understood.

This is no new consideration and was pointed out in 1909, when the work of the Chaibassa farm was under discussion. It is necessary to emphasise it as it explains the failure of all efforts to improve and safeguard the industry, from the seed-supply side.

THE IMPROVEMENT OF THE INDUSTRY.

8. The most careful enquiry yet made into tasar is that of N. G. Mukerji, and action was taken on his recommendations both in Bengal (now Bihar and Orissa) and the Central Provinces, without any effect.

N. G. Mukerji's conclusions were:—

- (1) *The main decline is due to grasserie.* No investigation of the diseases of tasar has yet been made. He concluded this on his inquiry and on analogy with the diseases of mulberry silkworms.
- (2) *Grasserie is partly caused by unavoidable weather conditions.* Grasserie is not really known in tasar.
- (3) *Degeneracy of the worms is due to selection for seed of thin cocoons, used for seed of home grown cocoons instead of wild ones.* This is correct, and its importance is emphasised if we treat the thin cocoons as being possibly of a hybrid or separate race.
- (4) *Exchange of seed is beneficial.*
- (5) *There is difficulty in getting wild cocoons for seed, and fraud in selling as wild cocoons those produced in semi-domestication and so inferior.* The most illuminating comment on this is provided by the failure of the nurseries established to provide seed.

9. In considering the tasar industry, it must be looked at from three points of view, the rearer or cocoon producer, the trader, twister and thread producer, the weaver and the trader in cloth. For the first, all the efforts made on the lines of Mukerji's recommendations fail. They must fail, until it is clearly understood what the races are, they are got pure and under control, and until we know just how far it is possible to issue good stock. This would in any event affect only those who rear the worms and will not affect the cocoon collector. There is then the question of the position of the rearer. He is not favourably looked on by the Forest Department. His methods are injurious to the trees, his industry is a precarious one and is a subsidiary occupation from which he derives little. There is no evidence that the degeneration of the tasar has produced distress; from the rearer and collector's point of view, the industry is not in urgent need of help or regeneration.

10. The second class affected is the dealer, twister and thread producer. The diminution in the production of cocoons, due largely to purely economic causes and poor prices, affects particularly the twistors or reelers whose occupation is partly that of preparing thread. There is no doubt that a plentiful supply of cocoons and a good demand for thread would benefit them, but in the districts in which these are most numerous, there is little evidence of distress. The tasar twister has other means of living and there is little evidence of there being any need to assist them.

11. The third class affected are the weavers and cloth dealers. These are situated in places outside the producing areas, and their condition is hard to estimate. Some reports are reproduced in Appendix XIV, obtained from the districts concerned; from personal enquiry, my opinion is that on the whole, the short supply and high prices of cocoons are affecting the weavers, that the continual rise in the price of food, with the stagnation in the demand for the price of cloth, has affected the weaver who will not work for very low wages if he can get employment in any other capacity on higher ones; and that the demand for tasar cloth could be much increased by good organisation and that the price would increase to a reasonable extent. In India tasar and bafta has been a cheap cloth. In the towns and outside India it competes with Chinese Shantung and then must be cheap. And it is impossible by any reasonable method to make tasar very cheap and yet pay the weaver well. However much there is, however the rearer is helped, he will not produce cocoons at the old prices while paying for rice at the new, and the weaver will not work for the old prices if he has to pay for rice at the new. So many people are concerned, in so many ways, in so many places, that one could come to fifty different conclusions in this matter. My own may be entirely wrong, but the data are presented and those with experience of the industry will form their own.

12. If the scientific problems of tasar breeding were investigated, if forest areas were given for breeding, if all cess were removed, more tasar might be produced and the price might fall; if so the twister and weaver would benefit, the cloth would be cheaper, the demand would increase if properly organised. But behind all is the increase in the value of food grains and the increased cost of living, (both tending to make cocoons dear and weaving dear), and the persistent supply of extraordinarily cheap Shantung silk. If there were a twenty per cent. duty on Shantung, Indian tasar would be in demand; without that it seems that whatever was done, the industry would not be really affected.

13. I have tried to eliminate all effects due to the war, which I assume to be temporary and I have tried to be uninfluenced by the peculiar conditions it produced. A significant factor, which I have laid little stress on, is that the mills buy tasar waste for spinning when they can get it at Rs. 20 per maund but cannot do so when it goes to Rs. 40. Tasar must be cheap or it is cheaper to buy Shantung and at present tasar is not and cannot be cheap.

If nothing is done, if the demand remains as it is and the prices as they are, what will happen? Tasar is a wild insect, naturally indigenous; to entirely cease cultivation will be no harm. If the prices go down, less collecting will be done and the wild stock will increase; if prices go up very much more will be collected and some will be cultivated. If the prices went up, because the demand for cloth was greater, and if better prices were paid for cloth, then it would react backwards right through to the producer, and if tasar was really to be in demand, cocoons could be got from larger areas. But this must come from the demand for cloth, and the point at which to start is to organise and stimulate the selling of tasar cloth.

Until the demand for cloth stimulates the price for cloth, giving the weaver good wages, the reeler a good price for yarn, the cocoon producer a good price for cocoons, no good can be done by increasing the supply of cocoons, and it is necessary to start at the proper end. To ultimately benefit the tasar industry it is necessary to organise and help the sale of cloth; there should be a survey of production, the qualities produced; the amounts, sizes, etc., should be ascertained; the demand should be investigated, the merits of tasar advertised; the sale of Shantung, of tasar substitutes should be investigated and so far as possible the real tasar put in its place. The tradesmen selling tasar should be put in touch with the master weaver producing it; and the whole business should be intelligently organised and stimulated.

14. If this leads to no results, then it is useless to attempt to improve tasar. But I anticipate that it will lead to a very greatly increased demand, and ultimately a good demand for cocoons at a better price. Whether this will occur while Shantung remains at its present level is uncertain. Ultimately Shantung will rise in price but it seems worth while making a single effort with tasar on the lines indicated.

Such an effort can be easily made, the number of tasar weaving centres is few; the people are keen to be helped and probably only Government can help; and the industry will probably benefit most if this particular form of assistance can be given.

TASAR FABRICS.

15. Tasar is used to weave mainly saris, dhotis, chadars, pagris, and similar pieces of fixed size; they are nearly always woven plain, rarely twilled; coloured stripes or checks are put in, and narrow coloured borders, usually crimson. There is a limited amount made of tasar *thans* and these can be got for instance in Bhagalpur; but there is much more made of tasar cotton mixtures, called *bafta* or *garbha suti*. In a few places a very coarse cloth is made of spun waste tasar, called *kethe*. It is a harsh coarse cloth of a dark brown colour, but exceedingly durable.

Tasar is a comparatively cheap silk in that the prices vary from twelve annas to one rupee eight annas per yard, of a yard wide. Mixtures are of course cheaper still if made with cotton and good *bafta* is sold at about twelve annas a yard. The fibre is a harsh one, and pure tasar fabrics are very stiff. The lustre is good but the colour varies very much according to the class of cocoons used in spinning. Tasar has not the delightful "old gold" tint of muga or the very light buff tint of 'Shantung' silk; it is usually rather a dark fibre. Full use has never been

made of tasar in regard to mixtures and the commercial possibilities of tasar have never been thoroughly worked out. Tasar mixes well with spun eri or spun mulberry. It can be used in alternate warp threads or doubled in the weft to give stiffness and to modify the colour. From the fabric designer's point of view, the possibilities of tasar are very interesting and if there were a fabric designing institute, the use of tasar should be studied and new ideas tried.

SPINNING.

16. The cocoons are softened by soaking or boiling with water containing plant ashes and when soft are removed from the water, the outer floss taken off and the thread found. The threads from three, four, six or eight cocoons may be taken together and the joined threads are run off on a *latai* or spindle; the thread gets a twist and is consolidated by the spinner, rubbing it along the thigh, the thread passing from the cocoons on the left side to the spindle in the spinner's right hand. It is a very simple primitive process, and very slow. The outer floss and the inside of the cocoon are waste and either spun into thread or sold as waste.

A kahan of cocoons (1,280) is ordinarily supposed to yield a seer of thread and it takes ten to fifteen days to spin it. The wages paid are near to Re. 1 per seer. The work is done almost entirely by women, usually relatives of the weavers who make the cloth. There is great variation in the yield of the different qualities of cocoons and the prices paid for the best yielding cocoons, such as *dabas*, are twice or three times that paid for poor cocoons.

The reeled thread is wound off and twisted or doubled together, using either the spinning wheel or charkha or simply running the thread from one spindle to the other and in the passage twisting it a little by means of the left hand. Dewar describes a machine used in Chanda which is practically the multiple belt machine used in Nagpur, Belgaum, etc., but the use of this is certainly not general.

17. Dyeing tasar is not easy unless heavy shades are wanted and the dyeing is usually done with lac, cochineal, kamela, indigo and other plant dyes. In Bhagalpur aniline dyes are used and the use of aniline dyes is spreading.

18. Warping and sizing, brushing, and drawing in to the loom are done as with ordinary silk or with cotton. The details of the looms vary but there is nothing essential in these details. The looms are of the ordinary type, the shuttle thrown by hand. Mr. Cumming notes that the fly-shuttle has not been applied to tasar and that it requires some adaptation to do this.

19. The improvement in the details of handling tasar may not influence the industry to any material extent, as the weaving and spinning is the occupation of so many scattered people in villages in remote parts of so many districts. At least it is impossible to mention any detailed improvement that could be of much use, without very careful study of the material and of the conditions of the people. Better reeling may be possible but if it entails any reeling machine, then it will be better left alone probably. What is wanted is a study of the tasar spinner and weaver, in his own surroundings with a view to finding means of improving his craft in a way satisfactory to him, and I do not think this has ever been done. Better weaving may be possible with the fly-shuttle slay or some other modification but the thread is so unlike other thread that only experience can show this. It would be valuable to have a tasar weaving experiment for a short time and to really work out the possibilities of improvement and utilisation.

The following is a summary of districts in which tasar reeling, spinning and weaving was formerly carried on; an enquiry was addressed to district officers and the replies received will be found in Appendix XIV, which show the present state of the industry.

Bihar and Orissa.

Patna.—Bihar subdivision, 200 looms doing *batta* or tasar, Barh sub-division, 1,000 looms.

Cocoons imported from Hazaribagh and Singhbhum.

Gya.—Gya, Kadurgunj, Akharpur, Daudnagar, 100 families. Cocoons from Ranchi, Hazaribagh and Singhbhum.

Manbhum.—Raghunathpur, Singh Bazar, Lobagarh, 150 families; cocoons from Singhbhum.

Singhbhum.—Seraikella State, 30 families.

Santhal Pergannahs.—Malbhagaya, 40 families.

Bhagalpur.—Champanagar, Nathnagar, Rumpur, Kelabari, Kutubganj, Khangarpur, Lodpur, Poorami, Mustafarpur, Radhanagar, Dariapur, 2,000 families. Cocoons from Chaibassa.

Balasore.—Purusanda, 40 families. Patpur and Raibanda, 50 families. Cocoons from Keonjhar.

Puri.—Khurda, 40 families.

Cuttack.—Gopalpur, 200 families.

Mayurbhanj.—Bamanghati and Ulmara, 200 families.

Sambalpur.—Rengali, Sambalpur, Reminda and Chandrapur. Weaving.

Angul.—Dhenkanal State, 50 families.

Bengal.

Birbhum.—Kalipur, Koddia, Tantipara, Birsingpur, Illanbazar, 500 families employed. Cocoons got from Singhbhum and the Santhal Pergannahs.

Bankura.—Gopinathpur, Bankura, Rajgram, Swamuki, Vishnupur, Rajhat-Birsingpur, 3,000 families of rearers, who weave tasar and cotton.

Cocoons sold at Rajagram, locally produced, and also imported from Singhbhum.

Hooghly.—Shambazar, Badanganj, and villages in Goghat thana, 100 families. Imported cocoons from Singhbhum and Bankura.

Burdwan.—Bagtikri, Katwa, Mankar, Memari, Radhakantapur, Tantigantar, Khanpara, Uttarpara, Halbazar, Jagatpur, Kota, etc., 1,000 families. Cocoons from Bankura and Singhbhum.

Midnapur.—Anandapur, Kesiari, 200 families. Cocoons from local jungles.

Central Provinces.

Bilaspur.—Tasar weaving.

Chanda.—Tasar spinning.

Umrer.—Saoli, Chamursi, Garchiruli, Armoori, Nagbhir, 200 families.

Bhandara.—Tasar spinning. Sakoli, Pauni, Taroda.

CHAPTER XIV.—MUGA.

This silk is derived from a semi-domesticated insect, whose origin is not very clear. Unlike tasar, wild muga is not known in the places where muga is grown; there are stories of wild muga but they are not reliable. All the muga in cultivation is derived from cultivated sources; but it is not clear that the matter has ever been investigated by a competent entomologist. In Upper Assam, Nagas are said to bring in wild cocoons for sale. The seed supply of Assam is said to come from an area where the Kamrup and Goalpara districts join with the Khasi and Garo hills (Luki, Bangaon, Boga and Pargana Habraghat). There may be wild muga there, but it has not been established for certain. Many rearers go for stock to Darrang; it is possible there is wild stock there.

FOOD PLANTS.

Lauraceae.

1. Soom.—*Machilus bombycina* King, usually called *Machilus odoratissima* Assam,—West Duars, Chittagong.

M. Kurzii from Sikkim, 6--9,000 feet, Upper Burma and Martaban.

M. Gamblei, Sub-himalayan tract and outer hills from the Jumna eastwards to 7,000 feet.

May be the same species (D. Brandis).

2. Hualu.—*Litsaea polyantha* Juss, usually *Litsaea monopetala*. Sub-himalayan tract from the Ravi eastwards, to 3,000 feet. Punjab, Salt Range. Assam-Khasi and Naga Hills, Cachar, Bengal plains, Chittagong, Satpura, North Circars, Burma. (D. Brandis).

3. Digloti.—*Litsaea salicifolia* Roxb. usually *Litsaea glauca*. Sub-himalayan tract from Nepal eastwards, to 6,000 feet.

Oudh forests. Assam.—Garo, Khasi and Naga Hills. Bengal plains.—Sundarbans, Chittagong. Burma (D. Brandis).

4. Pati konda.—*Cinnamomum obtusifolium* Nees. Outer Eastern Himalaya to 7,000 feet. Khasis. Chittagong, Andamans, Burma (D. Brandis).

5. Mezankuri.—*Litsaea citrata*, Blum. Adakuri, Sub-himalayan tract from Nepal eastwards, ascending to 9,000 feet. West Duars, Assam Valley, Khasi Hills, Cachar. Upper Burma. (D. Brandis).

Magnoliaceae.

6. Champa.—*Michelia oblonga*. Wall.
Assam, Sylhet. (D. Brandis).

Styracaceae.

7. Bomrati.—*Symplocos grandiflora*. Wall. Assam, Khasi Hills.

These are the recorded food plants. The first two are those used on a large scale. Champa and Mezankuri were used to feed special varieties of silk and it is by no means certain these were the same species as muga, *Antheraea Assama*. Basu gives figures of *soom* trees for ten years, showing a total of 20,000 acres in 1903-04, that increased to 24,334 in 1912-13. These figures are for the area assessed, not that used for rearing. He also gives details of the method of utilisation of the trees, the *soom* being planted, the *hualu* being commonly used wild. A tree is, as a rule, used only once a year, and should be at least three years old and not more than twenty years.

3. Rearing is entirely done in the open on trees, usually on *hualu* and *soom*, sometimes on both in this order. The moths that emerge and couple are put to lay eggs on *korikas*, each consisting of a number of grass stems tied together with a crook at the end; these are hung up on a frame in the house; when they hatch they are hung on the tree and the worms crawl up on to the branches. When the tree is stripped the worms are collected on triangular mats attached to crooked sticks, and the mat is taken to another tree and hung on it. In this way the worms are handled without being touched. When they are full grown they crawl down the trunk and are collected, placed on trays and over them a bunch of leaves in which they spin. The cocoons are picked out and placed in a basket formed by turning in the corners of a square piece of matting, in this the moths emerge and couple. Cocoons not wanted for reproduction are steamed and dried.

4. A tree will carry 1,000 to 1,500 worms. There are usually five broods a year, harvested in November, March, May, July and September, and the biggest is the autumn one when a family will do a brood of 4,000—5,000. The return is small; a brood from 100 females (25,000 eggs) on ten trees, estimated at 10,000 when half grown was expected to give 3,000 cocoons. In another case, the return from 40 couples was actually 800 cocoons. An increase of 20 fold on the number of seed cocoons is a fair yield and is very small.

Cocoons for seed sell at 70 to 100 per rupee and are very carefully selected; for reeling the prices are Rs. 3 to Rs. 3-8 per 1,000. Land with *hualu* and *soom* pays assessment of Re. 1 per bigha and a local tax of say anna one per bigha. Such land is not under the Forest Department, but under the Agricultural Department. The average size of plantation held by a family is five bighas; to the assessment must be added seed cocoons costing from three to five rupees but no other expenses in money. A family produces in a good year some 15,000 cocoons worth perhaps Rs. 50 as cocoons, worth probably Rs. 100 as raw muga silk and waste.

5. The great enemy of the muga is disease; the worm is said to suffer from "flacherie" and Mr. Basu's report refers to examination of worms. All silk,

worms suffer from "flacherie," meaning nothing more than bacterial fermentation of undigested food. These diseases have been very serious in eri, tasar and muga; they are not understood, have not been thoroughly studied and the muga disease should be studied on the spot. An identical problem affects tasar silk and no control of this disease has been feasible as yet. Grasserie is also reported as occurring in muga worms, and pebrine. The whole question of disease in muga, as in tasar, requires investigation.

Muga has many other enemies, such as birds, bats, monkeys, wasps, ants, which feed on the worms. The parasitic fly also attacks it. Most of these can be guarded against and the trees are carefully watched. At night the bats and owls are scared off by empty tins or bamboo clappers pulled from below by a string.

6. Basu refers to degeneration taking place in the stock in Assam and new seed having to be obtained. He says that rearing can only go on continually in a small tract of hilly and jungle country lying near the southern junction of the Kamrup and Goalpara districts. The same problem occurs in tasar, and is met by the use of good wild stock for breeding from.

Here we find the same difficulty as in tasar and it is significant that two kinds of muga are known in Assam by the rearers and that Mr. Watson refers to two species as being collected as muga.

The muga insect has never been biologically investigated by an entomologist. Basu has to quote Mr. Stack's figures of the length of the life history even and no study of muga has ever been made from the biological aspect.

It is noteworthy that, when the worms crawl down the trunks to spin cocoons, some escape and spin in the ground, etc. What happens to these? Is there a wild stock and do these moths breed successfully in the open? Do wild males come to the females if they are exposed as tasar is? Basu states that surplus females are tied to *khorikas* and placed out of doors and are mated by wild males that come to them. This is extremely probable if there are wild males there. He also says that eggs so obtained "hatch imperfectly and give an indifferent result." If there are separate strains, then they need to be obtained separate and pure strains used; if there are not but if only hill seed can be used, then a hill station is required to supply seed.

These questions lie at the root of the whole matter and improvement will be possible only when they are investigated.

7. Visiting the muga rearings and seeing the methods gives one a strong impression that the industry could be benefited by better methods. The rearer has extremely ingenious appliances, follows very carefully a strict routine and is not hampered by the strict observances enjoined on the tasar rearers; but his methods are those of the aboriginal dweller in the primeval jungle and his treatment of the tree is remarkably bad. It is an obvious disadvantage to have worms at the tops of tall trees. Whether this is really avoidable is not certain but it certainly should be tested: the question of food plants is worth investigation: the seed supply question is a very interesting one and the question of races: and lastly the disease is a serious and difficult problem.

No improvement will be possible without very careful investigation and this investigation must commence with the growth of the food-plants. When these have been grown in several different ways, and there is a supply of food-plant available for feeding worms, the cultivation should be taken up and the behaviour of the worms studied. This would allow of solving the wild race question and throw light on the occurrence of wild stock; possibly this could be supplemented by inquiry in different hill tracts of Assam and wild stock could be collected.

8. Muga cocoons are reeled by a very simple process, distinctly better than tasar reeling and apparently well suited to the cocoons.

Reeling.

Five or six cocoons are placed in a pot over a fire and the cocoons warmed for some time in water containing alkali derived from ash. They are then teased out slightly and a thread got from each. This passes over a bar in front of the reeler to the winder who takes the thread over his forearm and winds it on a horizontal bar suspended on two bamboos placed in the ground: on the bar is fixed a heavy piece of wood acting as a fly wheel to keep the bar spinning. In the

worst reeling the reeler puts in as much floss as possible and while reeling the cocoons is also teasing out another to put in the floss. In the better reeling, the cocoons are first cleaned of floss and then boiled. The thread also passes between two smooth canes tied together which tends to prevent lumps passing through and makes the thread consolidate better, also the winding bar has a fly wheel on it of solid wood which makes the winding quicker and the thread is wound on a bamboo slipped on the bar which can be detached when full and replaced by another. The thread is run over the forearm to smooth and twist it, the winder rubbing it along her forearm just as in tasar reeling the reeler rubs the thread along her thigh. The thread is reeled off the bar and formed into skeins. One thousand cocoons give 25 tolas silk and 50 tolas waste : (According to Basu only 20 tolas silk and 8 tolas waste.)

	Rs. A. P.
1,000 cocoons cost	3 0 0
reeling	3 4 0
	6 4 0
25 tolas good thread	6 4 0
50 tolas waste	0 12 0
	7 0 0

Waste muga is spun on the taku or charkha just as eri is and produces a coarse thread like spun tasar which is utilised for weaving or is sold.

Good muga thread is bought by dealers at the fairs and sold at prices now near to Rs. 20 a seer, usually Rs. 7 to Rs. 16 a seer. Reeled and waste muga are used for weaving at home and muga owes its chief value to its colour. The thread has a tint best described as "old gold" which is not superficial and which is quite fast. The thread mixes beautifully with white silk in weaving, and can be mixed well with eri or pat silk. It is very lustrous when woven pure and cloths of pure muga are very attractive.

There is no export of muga cocoons from Assam : but there is an export chiefly of inferior reeled muga thread and according to the statistics this amounted to an average of 542 maunds from 1886 to 1911-12.

Deducting cocoons from exports, the following are the figures of raw silk exported :—

Maunds.	Maunds.
1886 258	1899 2
1887 886	1900 0
1888 684	1901 5
1889 758	1902 384
1890 1,437	1903 559
1891 374	1904 213
1892 438	1905 789
1893 973	1906-07 635
1894 1,155	1907-08 644
1895 923	1908-09 453
1896 497	1909-10 429
1897 95	1910-11 474
1898 448	1911-12 915
1912-13	51

The figures vary from 1,437 maunds to *nil* and there has probably been confusion between raw mulberry, muga and eri silk. These figures are obtained from the returns published in Appendix II of B. C. Basu's Report on the Assam Silk Industry.

Basu considers that there is really a much larger export and that the figures are of little value on account of the amount of silk exported by post which is not recorded. The silk is sent to Calcutta, Dacca, Madras, Hyderabad, Bhagalpur, Benares, Murshidabad and other weaving centres where it is used for embroidery and for ornamental borders. Its natural sheen and colour account for the demand; and probably with better reeling and larger supplies the demand would be much increased, at the same prices.

The production of muga in Assam is put at 2,25,000 kahans of cocoons, valued at Rs. 6,25,000. The export is put at an average of 542 maunds of thread, worth Rs. 2,16,800. The total production of raw silk and thread from 2,25,000 kahans of cocoons may be put at 1,750 maunds of raw silk and 3,000 maunds waste silk or spun thread. The industry is estimated to concern 15,000 families who rear and 10,000 persons who are concerned in reeling, spinning and weaving muga with other silks. It is with all a subsidiary occupation but an important one.

My estimate above fails to agree with Basu's which is:—

Total outturn of cocoons 2,25,000 kahans.

Reeled thread : 20 tolas per 1,000 = 1,400 maunds.

	Rs.
Thread exported in 1911-12, 592 maunds	2,37,000
Thread woven in Assam—	
808 maunds at 600 per maund, Rs. 4,85,000.	
Value of cloth woven	9,70,000
Muga waste 560 maunds = 480 maunds thread, Rs. 98,000.	
Value of cloth	1,96,000
TOTAL	14,03,000

The figures in both cases are not likely to be more than extremely approximate and they are only quoted to give an idea of what the muga industry is.

The prospects of the industry are difficult to assess. There is not likely to be any export trade in muga waste. The waste is valued in the villages at Rs. 1-4-0 a seer, equivalent to Rs. 50 a maund and this could not be used for spinning. Nor is there likely to be any export trade in muga cocoons unless a filature was set up to reel muga cocoons: and since Payen and Co.'s filature was stopped, it seems unlikely a muga filature would be profitable unless on a small scale in Assam.

The export of raw silk is astonishing and I am unable to agree with Basu that it is likely to be over 500 maunds at present: but if it is, I still believe it would be very much greater if muga was better known. I have visited weaving centres in India where muga was wholly unknown and weavers would certainly use it if they ever saw it: but the use of muga reeled silk, as an ornamental silk for borders, stripes and ornamentation, is not generally known in India.

The question of weaving is discussed in chapter XVIII and if the sale of muga cloth expands as it should do, the demand for muga thread would also grow. It is quite unlikely that muga will ever be grown outside Assam. The industry is a considerable one, of peculiar character and concerned with a class of silk not known from any other area. It is probably well worth while making an effort to put the industry on a good footing and to develop it.

CHAPTER XV.—ERI.

There are in India two species, which are recorded as *Attacus ricini* and *Attacus cynthia*. The moths differ slightly in markings and in the amount of white scales on the abdomen. The cocoon of the former is a loose white one, that of the latter a smooth compact brown one, usually spun in a leaf; the former is the species cultivated in Assam as eri silk, the latter is a wild insect, found also in China, acclimatised and now wild in North America, and once grown in Europe, where it lives in the open. The two hybridise freely, not only with each other

but with other species of the genus *Attacus* and there is a very large series of *Attacus* hybrids described. The Indian eri silk is probably not a pure species and it is not known with certainty that it occurs wild. It is also probable that the Assam eri is recrossed with *cynthia* by the rearers in Assam from wild cocoons. This assumption is chiefly based on the fact that in Assam the cocoons are often white and red. This condition can be obtained by crossing white *ricini* and brown *cynthia*, when the red cocoon is obtained. A very full account of eri silk as an industry occurs in Basu's Monograph of Silk in Assam. A detailed account of the rearing and utilisation is to be found in Memoirs of the Department of Agriculture in India IV No. 1 (1912). There is some other literature on eri but these two, with the section in Watt's Dictionary of Economic Products give a full account.

2. Eri is cultivated in their houses by the Animistic tribes who live on the outskirts of the Assam Valley and to some extent by people living in the Valley itself. It

Eri in Assam.

is cultivated for use at home, the women spinning and weaving it, and it is also brought in to the fairs and dealers' shops for sale by those who cannot live wholly on their cultivation. The latter supply the amount that is exported as they grow more than they can spin or weave; and there is a trade in eri cocoons, in spun eri thread, and in handwoven cloth. Many women spin and weave eri who do not grow it; and the spinning and weaving of eri, usually for wear, sometimes for sale, is a common practice in the houses in the Assam valley villages.

3. The big crops are reared from September to November and in February and March because the climatic conditions

Rearing.

are best then. December and January are cold, the rainy months are too steamy; and rearers want seed in September and again probably in February. Seed cocoons and eggs are sold in the fairs or are obtained from a rearer in the village who has kept a small quantity of worms going to supply seed.

It is probable that in the hilly areas, wild cocoons can be got and are used to some extent to provide seed in September.

The rearing is done on trays, as usual, or is done, when the worms are in the last stage on bunches of leaves tied up on a frame. As one bunch is stripped another is put beside it. Very little care is taken, the worms are not all of one age, there is no separate rearing house; it does not matter very much if a full crop is got or not; cocoons are wanted for the girls to spin into thread and by the end of the two big broods there should be enough cocoons to supply the family needs. All the moths are allowed to emerge if more seed is needed and the cocoons are not harmed, so that very great care is not necessary.

Two food plants are used, the castor which grows about the villages and the *keseru* (*Heteropanax fragrans*), a wild or cultivated tree found near the villages. There is no field cultivation of either plant for the purpose of feeding silk-worms. They are grown on headlands, on embankments and round the houses, no family requiring a great number to feed their crop. If leaf is scarce, the rearer may buy leaf by the load or buy the leaf he can pluck from a patch of castor or a group of *keseru* trees.

Eri suffers from several diseases, the two worst being the fly pest and what is called "flacherie." For the former, only such precautions as wire gauze would be of any avail; for the latter, nothing is yet known and it is a more serious problem outside Assam than in it.

In spite of very careful rearing at Pusa, the onset of the disease has never been connected with any definite climatic, food or other factor. Many worms will die in unsuitable conditions but this is not "flacherie"; and there are so many variable factors in the rearing of any silk-worm that it is not easy to connect any with the production of disease. Like the similar diseases of muga and tasar, it needs investigation.

4. A greater part of the eri is used in home weaving but a certain amount is exported to Calcutta, whence it is sent to silk spinners in England or the Continent.

Export.

The cocoons for export are said by Basu to come from the hilly country along the south bank of the Brahmaputra, the hill men bringing them to fairs when the

Marwaris buy them, pack them and send them to Gauhati. The following are the figures of export of cocoons from Gauhati as recorded :—

Maunds.		Maunds.	
1886	1,290	1900	0
1887	62	1901	0
1888	1,498	1902	0
1889	3,544	1903	0
1890	920	1904	578
1891	1,120	1905	0
1892	1,342	1906-07	8
1893	603	1907-08	0
1894	196	1908-09	0
1895	278	1909-10	0
1896	33	1910-11	483
1897	21	1911-12	323
1898	0	1912-13	1,081
1899	5		

Figures for prices are not available. In 1889, the price is said by Basu to have gone to Rs. 140 per maund, normally it is Rs. 50—60 for cocoons containing the skins: i.e., 80 per cent silk. In February 1916, it was Rs. 70 per maund and in June 1914 was Rs. 110. The highest known was Rs. 250 and for some years (1909-1912) the Choi Mills bought at Rs. 80. A dealer in Gauhati gave his annual export normally as 600 to 700 maunds. His limit should be 1,000 maunds unless prices were very high.

The dealers' accounts and the export figures do not agree at all; and too much reliance cannot be placed on either.

The eri cocoon is exported as a "pierced cocoon" from which the moth has emerged. Such a cocoon contains 18-22 per cent of dry chrysalis skin and last caterpillar skin, i.e., 78-82 per cent silk shell. The cocoons are valued in Calcutta on that basis and should be about 80 per cent. silk. In Assam the Animistic rearers eat the chrysalis which they extract by slitting the cocoon, and they leave the cocoon clean, removing also the caterpillars moult. Such cocoons are 100 per cent. silk.

If the cocoon contains the dead chrysalis, the percentage of silk is much less. It is so also if the moth has died inside without emergence, if the caterpillar has died inside without becoming chrysalis, if the chrysalis has been killed in the cocoon by heat. The percentage of silk to waste is still greater if stones or mud are put into the cocoons. The condition of the cocoons therefore is really important if any export is to be done and unfortunately when prices are high the tendency is to find cocoons in which the silk proportion is low. The silk spinner then suffers, if he gets these cocoons at all, since his machinery gets fouled with extraneous non-fibrous matter for which he has paid at the silk rate.

This is one reason why eri cocoons are not favourably looked on in Calcutta or elsewhere and if the high prices were kept up and there was a real demand for eri, which would undoubtedly benefit the Assam Valley, some precautions would be necessary.

The Coryton Cocoon Reverser would probably be the solution as this turns the cocoons inside out, throwing off all dirt, etc., and giving a cocoon that must be clean and is quite different to any other cocoon.

This machine was invented in two forms, a small hand one and a large automatic machine one. As a full description of the mechanism exists, it need not be further referred to. There is at present no question of eri export: but if there ever is, the question of exporting clean cocoons, not slit up one side, will be important and if a means can be found of exporting guaranteed clean cocoons the production would increase with good demand.

The position of Eri in Assam.

5. The following is Basu's estimate of the eri industry in Assam :—

	Ra.
Total outturn of cocoons, 5,325 maunds.	
Cocoons exported in 1912-13, 1,080 maunds valued @ Rs. 100 per maund	1,08,000
Cocoons spun in Assam, 4,245 maunds.	
Thread 3,180 maunds.	
Imported eri thread 150 maunds.	
Thread exported to Bhutan, 1,096 maunds	2,09,000
Thread woven in Assam, 2,234 maunds	
@ Rs. 240 per maund . . . = (5,36,000)	
Value of cloth woven	10,72,000
	<hr/>
TOTAL VALUE	13,89,000
	<hr/>

6. A trial was made of eri silk at Cawnpore as it was thought that it would afford a cottage industry for the wives and families of the mill workers. The worms were found to die every year in April and the entomological section of the Agricultural Research Institute, Pusa, investigated this. Eri silk was taken up there and the cocoons sold in Calcutta. It was then decided to try using the cocoons and as the local method of spinning was poor, a new machine for spinning was invented. As yarn accumulated it was decided to try weaving and finally the whole series of operations was started. Ultimately this led to a long series of dyeing and weaving trials and the possibilities of the fibre were fully worked out; the Choi Silk Mills in Bombay took up the spinning of yarn from the cocoons, turning out very fine yarn of 160-2, 180-2, 220-2 and 280-2 count.

Eri outside Assam.

An account of this was published and help was given to those wishing to start the industry, either for the production of cocoons or of home spun and woven cloth. Eri silk is still produced, spun and woven at Pusa and elsewhere in India: eri cocoons were grown in practically all provinces of India where the climate allowed it: but the industry has not succeeded anywhere and it is now again almost confined to Assam. The reasons for failure were:—

(1) *Seed Supply*.—No part of India can keep eri going all the year: each has to start afresh every year at some time and wants then a new supply: in spite of the seed exchange arranged by Pusa, the seed supply failed.

(2) *Market*.—No fixed market exists for cocoons. The Choi Mills bought lots of 100 lbs. and over but could not buy small lots all over India. Pusa could buy nothing except for its own use; and no organisation existed which had capital to buy cocoons in small lots and sell in large lots to the mills.

(3) *Disease*.—Eri silk-worms suffer from a disease due to bacteria. Up to now no method of dealing with it is known and careless rearers lost their crop; as most Indian rearers are careless, the industry suffered heavily. Even at Pusa with very careful rearing the worms died from disease at times.

7. Eri silk was tried by a number of rearers in the Central Provinces who finally abandoned it chiefly owing to the want of a seed supply in July when the climatic conditions become suitable.

8. In Bombay Presidency, in 1909-10, many cultivators tried it and eventually abandoned it owing to disease and to the want of buyers for small lots of cocoons. In the United Provinces, the biggest trial was that at Shahjahanpur made by Munshi Akhtar Mahommed Khan, who was put on special duty in 1911 and was allowed to demonstrate how to grow eri at a profit on a large scale. There was a total loss on the working in 1912 of Rs. 915; in 1913, the total expenditure on rearing was Rs. 2,790, the income Rs. 984; on weaving and spinning the expenditure was Rs. 1,772, the cloth sold and in hand Rs. 1,801. Cultivators working in connection with the farm produced 9 maunds of cocoons in three years. The farm is closed now and the experiment is not regarded as showing anything definite.

Other experiments show that big rearings, in large houses, will never pay and the only possible way to do it is as a cottage industry.

9. Elsewhere many rearers took up eri silk culture and the lesson learnt was that without an organisation that will continually buy cocoons as produced, and finally sell in large lots to the mills, nothing will be done. Such an organisation exists only in Assam where there are regular dealers and the cocoons come to the fairs held at fixed places. A certain number of rearers took up eri with a view to using the cocoons themselves and getting cloth made from the yarn spun by their women folk. This is in progress still in some parts of the country and is likely to continue unless there is no source of fresh seed supply.

10. Eri as an industry was very carefully investigated and its utilisation thoroughly studied. The Pusa spinning machine and the Coryton reversing machine are still used in India. The mill spun yarn from Bombay is woven in Benares, Bhagalpur, etc., often to the designs devised at Pusa, and dyed with the very fast dyes, whose use was developed there. Eri silk rearing and spinning can be learnt at Pusa now and the industry is carried on there. The whole method of working eri was shown at the Allahabad Exhibition and has since been shown at exhibitions, etc., but the industry has nowhere taken hold definitely, for want of an organisation with capital to buy up cocoons. It will possibly be taken up eventually as an adjunct to mulberry silk cultivation but this will only be if there is a proper seed supply from a station in the hills and if the disease can be controlled. Given these two, and some buying organisation, and the eri industry would succeed in many parts of India.

11. There is a demand for eri cocoons outside India and there is a small export from Calcutta. This could be much larger if large quantities of cocoons could be got. Enquiries have been received at Pusa for quantities of 300,000 kilos and similar large amounts. Without large and constant supplies spinning machinery cannot work but no one in India can offer such large quantities and the demand from Europe cannot be met. The cocoons are in demand for spinning, and their white colour is an advantage. At the present time there is a small export but no eri is now spun in mills in India.

12. The war has of course interfered with trade and it is uncertain whether the high prices that prevailed shortly before the war will be current again. The use of waste silk of all sorts for spinning was increasing enormously in Europe, resulting in high prices for eri cocoons, but the future is wholly uncertain.

13. Eri will persist as an industry in Assam and can always be revived again. It may be an adjunct to mulberry silk cultivation but probably not. If a seed supply can be found from a hill source and if prices rule high it may be worth trying the industry again in places where it has now failed.

PART VI.—SILK PROCESSES.

CHAPTER XVI.

Reeling.

The first process that takes place after the cocoon is sold is the unwinding of the cocoon. There are three systems followed in India :—

- (1) *Indian*.—The cocoons are placed in a pot of water, heated by fire, and the reeler has beside him a pot of cold water. The cocoons are beaten with a bundle of twigs, to remove the floss, and after a little the ends of the fibre are found and some eight to 20 ends put together. The thread is put through a hole in an iron plate, and taken up through a guide to the reel, passing through a guide on the "oscillating bar"; a second thread is passed the same way and crossed over the first thread. The reel is turned by a small boy usually.

The reeler's object here is quantity, not fineness, evenness or quality: the thread is not examined but is removed from the reel and dried: if the thread breaks it is joined but not knotted.

Such is the reeling of Bengal and Mysore. It yields 14 or 15 chittacks of reeled silk per day.

The reeling of Burma and Assam is still simpler but essentially the same: it can scarcely be called reeling at all.

- (2) *Chambon or Bengal Filature*.—Here the essential differences are (1) steam heating of basins (2) porcelain buttons for the thread to pass through (3) a crossing of 20 or more turns of the two threads. The thread is also examined on the reel, the skeins are examined, the silk is tested for denier, for breaks and is classed into qualities (see under Bengal page 17). It yields perhaps 8 or 9 chittacks per day.

- (3) *Tavelette or Kashmir filature*.—In this system each thread is twisted round itself, twenty or more times by passing it over two pulleys after it has left the button. It yields 6 or 7 chittacks per day.

In all these systems, the yield varies according to the worker. With Bengal cocoons, no reeler does more than two threads at once: with Mysore, some reelers do four threads. With Kashmir cocoons and the tavelette, boys are classed as 2, 3, 4, 5 and even 6 skeiners: naturally this depends very much on the quality of the cocoons and only the best cocoons can be used by 4, 5 or 6 skeiners. In all the above the winder or reel-turner is a separate person from the reeler; but there are systems in which the reeler turns the reel by a pedal. These are simply adaptations of one of the above systems whereby the reeler has mechanism to enable him to turn the reel. In European and in the new Kashmir filatures, the reels are turned by power and each reeler can disconnect his own: at Bangalore and Ludhiana, the Salvation Army have all the reels turned by a separate man or woman, as there are only a few. Whether it is an advantage or not to have the reel turned by power or hand depends on circumstances: the winder learns his work, can adjust his speed to suit the reeler, can knot breaks, examine the thread. He may be an old man or a child, unable to reel but quite able to wind. In Jammu as in Bengal, separate winders are employed.

Re-reeling.

2. After the silk is taken off the reel, and examined, it should be re-reeled, or could be re-reeled direct from the original reel: re-reeling is simply this, that the thread is run off from the original skein over a bar, to another reel: every break becomes obvious by the original reel stopping: by simple mechanical adjustments, the thread can be put under tension so that weak spots break, and so that joins can be knotted or the silk can be mechanically tested for thickness and the reel stopped at thick places: or the silk can be examined by the eye. The re-reeled silk should have no breaks, or defects: and selling it as such lessens the manu-

facture thereafter by one whole stage. Re-reeling is not practised in India and it is significant that the biggest filature in Bengal after erecting the machinery for Tavelette reeling and re-reeling, deliberately went back to the Chambon and no re-reeling.

There has been a certain amount of inquiry into reeling and in 1906 N. G. Mukherji published "Suggestions on the Improvement of Silk Reeling in Bengal" : in 1914 a Bulletin on "How to Improve Silk Reeling in Bengal" by M. N. De was published from Pusa : the Salvation Army produced and sell a reeling machine that uses the Tavelette system and only requires one person. The filatures in Kashmir are organised on improved systems and the Department of Sericulture there have given great attention to the reeling question. It is unnecessary here to discuss the publications : no printed matter, in English or Bengali, has the smallest effect so far as the reeler is concerned. As a record of experiments these bulletins are interesting reading to the expert but that is all. I have discussed the question of reeling for Mysore and Bengal in Chapters II and III. The question of reeling in Kashmir is thoroughly understood and it is significant to remember that they find cocoon-selling pays better than reeling. The difficulty with reeling will be the system to introduce if silk is grown in new areas where reeling is not known : and in this connection it is necessary to remember that good cocoons from univoltine seed give a quality of silk that reels well at low denier but for which demand is uncertain in India at present and that multivoltine cocoons reel well on a simple system giving *khungru* silk for which there is a demand in India. The reeling system adopted must be suited to the class of cocoon.

I do not think that any improvements in reeling will affect the industry except in Burma : the problem is the same everywhere and the methods have been so thoroughly worked out that India will not be likely to improve them : but whether these improved systems are to be adopted and which of them, is a matter purely of local conditions. Bengal and Mysore would both sell more silk if they re-reeled : whether they would get an improved price sufficient to compensate them is probably a matter for organisation, which does not at present exist. If there were to be a greatly increased supply of cocoons in India, this question would become important locally.

The most important point in connection with reeling and re-reeling is the formation of model reeling sheds, which will be economical and yet not require too much capital expenditure. Re-reeling should be more general, even of imported silk, and there is scope for the small factory with say 10 machines for re-reeling all the silk used locally and for doing economically what has to be done slowly by each person separately a skein at a time. This is referred to below. The same applies to reeling : there is scope in Mysore and Bengal for small reeling houses, employing say 20 reelers, worked economically and turning out good silk for the Indian demand. The details of these have to be worked out and this is badly needed.

Winding off and Sorting.

3. The first process in the utilisation of raw silk is the winding off or sorting. The skein of silk is opened out and placed on a swift free to revolve : the details of this vary : in the Punjab the skein is placed over two reels, one on the floor, one overhead : in Western India the skein is placed over three or four upright rods and the thread passes through a glass bangle hung overhead and back to the winder. The silk is run off on to small hand reels, usually made of bamboo, which are held in one hand and twisted by the stalk : the Burmese hand reel is a very neat one and is used in all the processes there : it is revolved by a wheel and belt and works very rapidly. In winding off Chinese silk, the thread is sorted into qualities by feel : there are usually four qualities, of which the worst is used for embroidery or sold as "winding waste," the finest is twisted for warp, the second used for weft. In estimating the comparative value of qualities of silk, it is necessary to take into account what proportion is fit for use : Chinese silk at Rs. 14 a seer is not so good as Bengal filature silk at Rs. 18 because of the waste in the former. (See under Chapter XXVII.)

Twisting.

4. After sorting, the silk is usually twisted if for warp. The best warp is made by putting twist into single threads at say six turns to the inch from right to left

and then twisting two or more threads together with the same amount of twist from left to right. This is by no means always done : much warp is simply thread twisted once.

In the best method the following five processes are done : the silk is wound on to reeds or small bobbins : these are placed on the twisting machine and each revolved while the thread is slowly run off on to a large reel : if for instance the reel has a circumference of 30 inches and the reeds revolve 180 times to one revolution of the reel, the twist is 6 to one inch. The silk is run off the big reel on to reeds, two threads at a time side by side : these are placed again on the machine and twisted in pairs the reverse way : the thread is again run off the big reel on to small reels for warping.

The machines used for twisting vary in detail : the simplest is a plain spinning wheel in which a big wheel with a belt turns a spindle on which the reed is placed : the silk is drawn off slowly on to the axle of the wheel : if the diameter of the axle is six inches, of the spindle one inch, of the big wheel thirty six, the twist will be six to the inch. If instead, you place a number of spindles between two sloping uprights and drive them by a number of thread belts from one big wheel, you can twist many threads at once : and if from the axle of the big wheel you drive a large receiving reel slowly and reel the threads on it, the twisted threads can be reeled off at one time. This is the system of Nagpur, Belgaum, Poona, etc. : it varies only in detail. In the Punjab it is perfected : a single big wheel drives a number of spindles by a single belt passing successively round opposite sides of them : and the silk is received on baby reels each turned by another single belt driven off the axle. It is a very great improvement on the Nagpur system. The best Burma machine is pedal driven, and has an oscillating bar to lay the silk criss-cross on the big reel. In Kumbakonam the receiving reel is vertical and is made to move up and down so that the thread is laid criss-cross on the reel, thereby avoiding the next stage of criss-cross reeling off.

The Surat machine is still more perfect and is a hand-machine perfected from the power machine : the spindles are vertical and each separately belt driven from a drum : the silk is received on baby reels at the top. This is the most mechanically perfect machine. In all these the silk is received on reels and must be again wound off on bobbins for the next twisting.

A machine was made in 1910 to my design which twisted each thread singly and in the same operation twisted them in pairs the opposite way : it has never been developed and its usefulness is uncertain : but it did in one operation what now requires five.

Another process is in use in Benares, Bengal and Assam : the twister erects two vertical bamboos 6 feet apart and across them two horizontal slips at say 7 and 6 feet from the ground : a number of these are erected down a straight stretch of road for say 60 yards. The rectangle formed by the four is divided into 10 compartments with vertical slips of bamboo. The threads are then passed down No. 1, 3, 5, 7, 9 compartments from one end to the other and back along No. 2, 4, 6, 8, 10 : the thread is broken so that each pair of ends hangs say one foot from the ground and the ends have attached to them little reed spindles weighted. The weighted spindles are then kept spinning till the twist of the thread has raised each spindle about 3 feet : a fresh thread is then joined to the end in No. 1 and the end in No. 2 is joined to the thread on a reel and is run off, pulling in the fresh thread to No. 1 ; when the knot is reached in No. 2, the thread is broken and the spindles put on the new thread : so for all the threads, which are separately wound off after twisting. This is a very clumsy, laborious and tedious method, and almost any mechanical system is better.

I cannot pretend to give clear descriptions without pictures or to expect the reader to be able to follow : the point is that there are at least five machine systems of varying complexity and one primitive one : and that a promising improvement waits development. There is no single process in which improvement will be so valuable or so labour-saving as in twisting : but the introduction of better methods without an increased demand for twisted silk for weaving would simply throw a number of people out of work without any real advantage. But where there is increased weaving and labour saving is a gain, there the introduction of better methods will be a benefit

Cross reeling is done from the skein, usually by winding the silk off the receiving reel over two upright pegs: in Madura there is a very neat little cross-reeling machine which lays the thread criss-cross on a reel: this machine is described under Madras. Cross reeling facilitates later operations.

Weft preparation.

5. As a rule weft is not twisted to the same extent as warp, as the weft is intended to cover the warp and a looser thread is needed. Weft is commonly prepared by running off two or three threads side by side on the shuttle-reed by means of a wheel and this is used as it is. The improved method of loosely winding one thread round three or more parallel ones, is unknown in India and would be a useful introduction. The Indian weaver does not as a rule know how to make the most of his material through ignorance of these methods and some classes of fabric are at present beyond his scope on that account.

Boiling off.

6. After twisting, the silk is boiled off, usually with soap of an inferior kind or with plant ashes. The process is done quite simply in a pot over a fire and the finishing is estimated by rule of thumb usually. It is doubtful if any improvement can be effected except perhaps in the supply of better soap: the dyer is usually careful with the water, choosing the best he can get: clean rain water is the best as the purity of the water as regards lime is very important.

Dyeing.

7. The question of dyeing is a very important one in the silk industry, since the best fabrics are made very largely of dyed yarn and there is a far smaller proportion of undyed cloth prepared than in cotton for instance. Many branches of silk weaving are now feeling the shortage of dyes acutely and it is not possible to replace artificial dyes at short notice. This is a matter that need not be too closely considered since this inquiry is not directed to determining the effects of the war but to the general question of silk.

In the dyeing problem, there are two separate questions, the use of good, "indigenous" or plant dyes, including imported cochineal: the use of aniline, alizarine and other dyes, distinguishing fugitive from fast ones.

The use of indigenous dyes has decreased very much during the last twenty years, chiefly owing to the introduction of aniline dyes by German firms. Certain centres were famous for dyeing, such as Amritsar, Benares, Belgaum, Nagpur: in Madras dyeing is done at most weaving centres, as it is in most provinces. Cochineal, with or without kamela, indigo, lac-dye, madder, kusum, sapan wood, jackwood, and turmeric are used for colours, and cutch or myrobalans with iron for black. Cochineal and kamela are the commonest since this gives a very fast red for turbans and other fabrics exposed to light. At the present time, it is difficult to find people who know how to get good shades with any colour but red or blue, except where dyeing persists among hill tribes as in Assam and Burma: and it is as a rule not easy to obtain any but light shades with most of the indigenous dyes. If the use of plant dyes was to return, there would be difficulty in obtaining supplies of the materials: in Madras, Turkey red (madder) dyeing is practised on cotton and the question of indigenous dyes is being investigated; now if ever is the moment to re-establish the use of the best indigenous dyes but it is impossible to believe that their use will remain. Their range is limited, their use difficult, their supply difficult to organise.

Aniline dyes were widely used in India and the German firms had a large organisation for selling them: one company maintained a laboratory at Bombay and dyers could get advice, sample cards, etc., freely. As a rule, fugitive basic dyes were used for silk, since they were simple and very cheap. This question has been investigated at Pusa very carefully and the result of much trial there is that the best method is to use mordanted alizarin dyes, using alizarin in the wide sense to include coerulein, gallein, etc. Good results can be got also with a carefully selected range of acid dyes, which are as simple to use as basic dyes but which require the use of acids not usually available to the dyer.

If conditions were normal, I would endeavour to get the faster acid dyes used in place of basic ones, and to introduce alizarine at dyeing centres where there were professional dyers likely to adopt it if properly taught. The Bhagalpur and Benares weaving masters and dealers were much interested in the Pusa dyed silks: the Amritsar dyers, for wool as for cotton, are much concerned at present in the question of fast dyes: owing to the shortage of anilines, an attempt is being made to find dyers and raw materials for the use of indigenous dyes but it will be a difficult matter.

The question of silk dyes is actually a smaller one probably than the dyeing of cotton, and the matter will presumably settle itself by the supply of dyes from Japan, America or elsewhere. If alizarines became available, I would endeavour to get their use more general for all yarns in which fastness is essential. This question cannot be settled without further inquiry: it is one which should engage the attention of a silk institute if such is created and with real technical advice from such a centre the matter could be solved.

Winding off.

8. After dyeing, the skeins are dried, spread out on a swift and wound off on small reels for warping or on reeds for the shuttle. The efficiency of the methods used varies very much and the rapidity with which it can be done say in Bengal and Burma differs over wide limits. It is in these details that the Indian craftsman is so slack as compared with his fellow worker elsewhere: the Indian *charkha* is a poor clumsy tool beside the neat English or Burmese wheel and it will pay to introduce better methods where increased demand is stimulating labour-saving devices.

At various stages in its progress, thread has to be run off on to reeds or bobbins, either for twisting, warping or the shuttle and this process is very variously effected. Only in Burma is the compound winder in use: in this the big wheel turns by a belt an axle on which is another wheel which drives the spindle by another belt: whereas one turn of the simple wheel will give say 50 turns of the spindle, one turn of the compound will give say 50×10 turns of the spindle. In these little details the efficiency of the weaver is shown and generally speaking there is scope for much improvement in India in this way.

Warping.

9. The simplest system of warping is to erect posts in a row, to the length of the required warp, and to wind off two threads at a time one on each side, crossing at the posts so as to give the leases: a warp 50 yards long of 400 threads means walking say 6 miles in all but it requires little intelligence and occupies time. The next improvement is to place the posts in a rectangle and save the walking: the next is to carry a frame on which are several or many bobbins of yarn and to lay out several threads at once: the next is to fix a creel of bobbins, to take threads from them in a hand frame and to lay the warp round a series of pegs on a board. From this it is not a long way to the revolving warping mill on which the warp threads are laid in a spiral on a revolving vertical frame: and one ends with the horizontal revolving frame on which the warp is laid out in a spiral and cut in sections.

All of these systems obtain in India, some indigenous, some introduced from mill practice, some introduced by textile experts. Which is the best depends upon the fabric, the loom, the thread, the length of warp and the weaver's circumstances. There is an increasing use of prepared warps of spun silk imported from Japan. Warping is a process in which the weaver's peculiarities have to be considered and in which the worker himself is more to be consulted than in other processes. No very great improvement is to be effected in warping probably: the simple method of the single weaver suits his circumstances while the hand-loom factory needs a quick labour-saving one.

At the same time, where co-operation is introduced among weavers, it will pay to adopt mill warping as a special process, as in Burma: the practice whereby each weaving family does its own warping is not a cheap one but suits where work is slack: if by organisation and advertisement a demand can be created and business increased, then better warping methods will be needed.

Weaving.

10. The Indian loom is a simple affair, consisting of a plain wood slay holding a bamboo reed, two shafts with healds knitted round the warp threads, a simple beam for taking up, held in position by a cross bar and another for the warp, which can be let out by a cord fixed at the weaver's side, and a pair of pedals usually placed in a hole in the ground, the weaver sitting on the ground. In Assam the loom is carried about and hung from four up-right bamboos: in Burma it is a frame loom and the warp comes back to the top of the frame over the weaver's head so that tension is easily regulated.

An improvement is the fly-shuttle slay in which the shuttle is thrown by a cord attached to a picker: the weaving of widths of over forty inches is then easy. Another improvement is the automatic beating slay in which the shuttle is thrown by the simple beating motion of the slay: in Assam, fly-shuttle slays and brass reeds have been introduced: in Burma the automatic beating slay is popular and the fly-shuttle loom of no account. Better made healds have been introduced in some cases and metal reeds are an advantage. There are then the automatic looms worked by pedals: the Hattersley loom is one, the Japanese another, the Churchill loom another: the last is an extremely remarkable invention and it is a great pity its development has been checked by the war.

It is a far cry from the simple village loom to the Hattersley automatic loom and the usefulness of one is quite distinct from that of the other. From the simple two shaft loom in which only plain cloth can be woven, we come to the four shaft loom capable of doing twills and simple patterns: from this one development has proceeded, as in Burma, to eight and twelve shaft looms, giving a great variety of designs by simple adjustment of the pedals and shafts: a rather similar loom, with the shafts only controlling the border healds and worked by hand is typical of Orissa and Ganjam: another development has proceeded in the direction of the automatic Dobbie loom with its mechanical production of pattern, or of the Dobbie border attachment solely for the production of quite simple patterns in silk borders on silk or cotton cloths. The last development is the hand Jacquard loom, in which figured designs are woven by a mechanical selection of healds controlled by cards stamped out for each design: given the Jacquard attachment and the cards practically any design can be woven by hand. The most complex form of Indian weaving was the "kamkhwab" loom, in which every pair of healds was connected separately to threads from above and in which every possible successive combination of threads could be got by loops enclosing a particular selection of heald threads: each successive loop pulled a different set of healds up; and by pulling the whole series of loops in succession, the pattern was worked out and was reversed in complement by reversing the series and working back again. Combining this with double and treble warps, with border warps and loops, with ornamentation put in with small embroidery shuttles separately, you get the beautiful and elaborate kamkhwabs of Benares and Surat.

In this weaving as in the Jacquard, all depends on the loop setting or card setting: but the most elaborate and beautiful designs are possible on this system. Separate weaving systems exist in Burma and Kashmir, where all the weft is put in by small shuttles, giving thus what is practically a carpet or tapestry design: this admits of any complication of pattern within the mental grasp of the weaver and the Burma *Acheiks* used up to 250 distinct shuttles in 22 inches of warp.

In the two matters of the design of loom and of method of forming designs on patterns with thread selecting mechanisms, there is clearly scope for improvement and a great deal has been done in different areas of India, notably in Madras. There is still much scope not only for experimental improvement but for teaching improved methods in areas where the weaver still practises a slow method. The four most notable lines of improvement lie in the development of the eight shaft loom, the Dobbie, the hand-Jacquard, and the Churchill mechanical loom. The simplest development is the use of the fly-shuttle loom. For every class of fabric there is the appropriate loom and the possibilities of each need to be worked out: there are looms, not referred to above, which need testing: and a promising mechanical loom such as that of Mr. Churchill should be developed with funds from the Department if it offers promise of successful development.

Fabrics.

11. Over a great part of India no other weaving but plain weaving is done on a two shaft loom : pattern can be effected only by the use of coloured warp threads and weft threads, as in the Burma checks, etc. In some parts, twill weaving on four shaft looms is known and the variations possible on four shafts are woven. A development in some places is the border Dobbie attachment which is probably copied from mill practice : in a very few instances a Dobbie attachment for the body is used or a similar result is arrived at by means of heald combinations brought into use by cords which the weaver pulls and fixes with a wedge or a ring. Beyond this is the brocade loom worked by the loop-puller or draw-boy, which gives any combination it is set to, as the Jacquard does.

In this series, which almost covers all the modifications found in India, there has been no development of the many-shaft loom or the loom with the double harness, giving pattern effects simply on the combinations of pedals and shafts : nor has there been any development in the satin and damask direction except the plain satins woven at Azamgarh, Ayyampet, Surat and Benares.

Pattern and colour effects are got by other methods : one is the dyeing of warps tied every inch or so, and arranging the warps in pattern : another is the tying and dyeing of the actual fabric : a third is printing on the fabric : a fourth is embroidering on the fabric.

Finishing.

12. When a fabric is woven, it is taken off the loom, folded and sold. In the mills it is examined, loose threads picked, knots taken out, dirty spots cleaned ; the fabric is calendered between hot rollers, and is pressed between smooth sheets of card-board. It is then folded carefully, packed in a card-board box and is sold. In this case it looks clean, polished and well put up : its appearance is attractive and the best has been made of it.

This is one of the great faults of Indian weaving as a whole and there is scope for really good finishing processes : the best way to secure good finishing will be through co-operative societies or through small finishing factories capable of dealing with the whole output of a weaving centre or group of villages. This is referred to in Chapter XXVII under industrial development : it is one of the most important points on which investigation is required : in Burma finishing is properly done at Rangoon and Mandalay : it should be more general and in any organisation of weaving the question of co-operative finishing establishments will be very important.

Fraud in Weaving.

13. There are two forms of fraud practised : in one the dents in the reed are closer at the margin, so that the cloth feels more compact when the edge is tested by the buyer or more threads are put in the dents at the edge than in the middle ; in the other the number of picks to the inch in weaving is greater at the ends, giving a cloth which looks compact but is really not so. Both frauds are as undesirable as is the adulteration of silk with mercerised cotton : the former is deliberately secured by using a special reed : the latter is done for each individual piece by the weaver beating up more closely at the ends and putting in more threads to the inch.

Gold Thread.

14. In much of the best weaving, gold or silver thread is used and this is either imported ready for use or is made. In the latter case, the process is shortly as follows : a bar of silver is coated heavily with gold leaf and the leaf fixed on by hammering : it is then drawn through holes in steel plates, at first by means of a winch : each hole is a trace smaller than the last : at each drawing the bar elongates : always the gold overlays the silver : a bar an inch across becomes hundreds of feet of fine thread wound on spools : when it is fine enough, the thread is passed between fine steel rollers and becomes flat. It is then wound spirally round a thick orange thread of Chinese silk ; the silk thread is drawn through the axis of a steel flyer and the flat thread laid on it so as to cover it. This is a separate branch of the industry and it uses very neat and efficient methods and machinery.

Embroidery and Miscellaneous Industries.

15. An account of the embroidery industry in Kashmir will be found under that State and no enquiry has been made into it elsewhere : it is an industry that occurs in the Punjab and the North-West Frontier, in Gilgit and Bokhara. The silk used is very coarse raw silk which yields a very thick flossy thread : there is a demand for silk embroidered goods in India and much is sold in shops and bazaars, by travelling box-wallahs. Other minor industries employing silk are those connected with the making of silk huqa-tubes, of buttons, of silk braid and plaited fringes, of silk armlets and ornaments : these minor industries exist widely in North India, on a small scale, occupying the attention of women chiefly as a minor occupation. No figures are available of the numbers engaged or of the amount of silk used : they are probably inconsiderable.

Organisation.

16. Weaving in India is run on four systems, each with its own characteristics :—

- (1) The single weaver or family who sells his product locally to a dealer.
- (2) Master-weavers who employ weavers in their own houses but who advance materials, pay wages and sell the product.
- (3) Hand-loom factories, in which the owner erects the buildings, buys machinery and pays wages for labour solely.
- (4) Mills, employing power, and paying wages to weavers. To this must be added
- (5) The Co-operative Credit Society of weavers.

17. The single weaver or family is probably the commonest unit in India, especially where the industry is not highly organised and does not occupy a large number of people in a town : most of the *tasar* weaving appears to be done in this way and it is the usual system in Burma. It grades into the system where a master-weaver or dealer employs the weavers, giving them the dyed thread and paying for the actual weaving : this is to be seen in Benares, Nagpur, Surat, Murshidabad, and other large centres : it is apt to lead to much sweating, to a system of slavery of the actual worker to the benefit of the employer : where the system exists, this point deserves further investigation which is not always easy to make as an outsider can learn little of relations between employer and employed. Hand-loom factories exist, where the various operations are done in one place and the weavers work in a building, being paid wages or by piece work. The drawback to them is that the weaver has to leave his house and work for stated hours at a factory : one advantage lies in the economy possible in minor processes, such as twisting, filling, dyeing, etc. : another lies in the employer's command of resources, enabling him to make what is in demand : whether they succeed or not depends very much on the people themselves : what succeeds in Madras fails in Bihar and on the whole it is not certain as yet that the hand-loom factory is to be encouraged.

18. Mills exist at Calcutta (1) and Bombay (2) where silk is woven on power looms : there was one working at Poona but it is closed. The Ariff Silk Mill at Calcutta was established to weave Bengal silk with power looms and has been in working for over 30 years. It is equipped with winding, twisting, warping and weaving machinery, with a dye house and with finishing plant. It used also to print designs in up to 12 colours on silk cloth. Its present activities are hampered by want of dyes and it weaves chiefly for the local market. The Sassoon Alliance and the Choi Silk Mills in Bombay weave on Jacquard looms, for the Indian market now, formerly for the Burma market chiefly. They are equipped with machinery for winding, twisting, doubling, dyeing, warping, weaving, finishing : they both spin waste silk into yarn, which they use in their weaving with raw silk. Both have suffered in competition with Japan in the Burma market and they have little trade in Burma at present. An inquiry into the circumstances of these mills has not been made as the enquiry into the Japanese weaving industry was not possible : the point to determine is why the Japanese product has cut out the Indian mill product in Burma and India and this cannot be determined in India. If the Indian silk mill is to be a feature of development of the industry, then this inquiry should be made : but the present circumstances of the mill development

do not call for any special investigation at the moment. The mills have a large field if they can work it : they have the proper equipment and technical knowledge : and it is not possible for me to discuss their condition or their prospects.

On general grounds of social economy, hygiene and the like, I am not in favour of any mill development as a solution of the problem : the weaving industry seems to me to be eminently suited to the Indian craftsman working in his own village if his circumstances can be bettered : and if I am correctly informed the success achieved by Japan has been due largely to a splendid organisation of cottage weaving centred round factories which only collect and ' finish ' the fabrics. Whether we achieve a similar result by the individual weaver, the group of weavers or the hand loom factory is a matter of local circumstances purely : but it cannot ordinarily be by any development of mills.

19. The Co-operative Credit Society is probably the best solution and the development of weaving on this system urgently requires organising. An account of the Conjeeveram Society will be found under Madras in Volume II and a short statement of the Amarapura system under Burma on page 147 of this volume : the applications of co-operative credit to all branches of the weaving industry could be very extensive and though my practical knowledge of the subject is very small, I am convinced that a great deal can be done on these lines. Want of available technical advice limits the development at present but once this is available, there should be a notable development : through the societies the weavers could be informed of new demands, of new methods, of cheap raw materials : through them, special fabrics could be made to test new markets : and any attempt at the industrial development sketched in Chapter XXVII must clearly depend much on the development of Co-operative Credit Societies. It is not always easy to develop such societies or to conduct them satisfactorily : in some parts of India it is almost impossible to get the weavers to combine or to work together : they have been slaves of the dealer so long that they cannot work on their own account or understand how to work together : it will be as difficult to organise combination among these people as it is to induce them to use a new method : and it will be very slow work developing in this way.

It is the root of the whole matter if the weaver's condition is to be bettered ; if I am correctly informed the organisation of the cottage weaver is the secret of the success of Japan : and unless it can be done in India it will be wholly impossible to improve the industry or to enable it to compete successfully with the Japanese product.

PART VII.—THE SILK INDUSTRY.

Introductory.—In this section, the industry is very shortly discussed for each large administrative area and the main features of the weaving are summarised. The intention is not to minutely describe the industry but to discuss the technical methods, the fabrics, the features of the industry and the prospects of its extension. As this is the only section in which administrative areas are dealt with, the prospects of silk growing are also summarised.

CHAPTER XVII.—BURMA.

Burma.—The following summary of localities is prepared from Hardiman-Silk in Burma, (1901); E. L.—“Capital” 13th November 1913 and Imperial and District Gazetteers of Burma:—

Rangoon.—There was weaving in Hanthawaddy district prior to 1891, which appears now to have ceased: the number of weavers reported in 1889 was 2,882, in the 1891 Census 359, in the 1911 Census was 17.

Prome.—At Shwedaung and Kyithe specially, silk is woven, from silk derived from Paukkaung, Tbungoo and Thayetmyo or imported, and the cloth is sold in Burma by traders. The report of 1899 refers to the want of prosperity of the industry.

Henzada.—The District Gazetteer of 1915 refers to weaving at Henzada and Kyangin, with silk from Prome and Tharrawaddy, the cloth sold to Rangoon and Mandalay.

Tavoy.—There is much weaving with imported silk. The 1,107 weavers returned in 1891 are 1,282 in 1901: the Gazetteer gives the following figures:—

A viss of silk costs Rs. 24, spinning costs Rs. 3-12-0, dyeing Rs. 4-4-0, weaving Rs. 5-0-0, totalling Rs. 37, and the produce is four longyis worth Rs. 40.

Toungoo.—The Gazetteer refers to silk weaving as a declining industry. There were 327 silk spinners and weavers in 1901, 39 in 1911. Weaving is still carried on as a house-hold industry.

Mandalay.—Amarapura is the largest weaving centre in Burma, using over half the silk imported.

Patheingyi also is a centre.

The 1899 report refers to the increase of the industry.

In 1826, Mr. H. Gouger resident as a merchant, estimated the Chinese import of silk at 27,000 bundles worth each 30 ticals: (Embassy to Court of Ava, J. Crawford, published 1834).

Sagaing.—Weaving in elaborate patterns with imported or Burmese silk. The 1899 report gives the price of imported silk as Rs. 9-5 per lb. of Burmese as Rs. 7-3 per lb.

Kyaukse.—In 1899, 569 people were weavers of silk but the number was referred to as a large decrease.

Shwebo.—Weaving was done at Shwebo town, Chiba and Seitkun. “The profit, nine or ten rupees per year per worker, would not seem to encourage a feverish development of the industry.” (1899 report).

Lower Chindwin.—At Kothan an industry developed between 1887 and 1899 but was apparently declining as fashion changed.

Pakokku.—It is referred to in 1899 as not having any industry: but the Gazetteer refers to the Gangaw subdivision where the famous Yaw waist cloths were produced. The writer in “Capital” refers to the workers as Taungthas and Chins.

Thaton.—A special quality of cloth is woven in Thaton for pasos and longyis.

Magwe.—There were 50 or 60 looms in Taungwingyi but in 1899 only 20.

Yamethin.—There was a little weaving formerly.

Upper Chindwin.—In Kabaw, there is a very limited amount of silk weaving for home use.

Thayetmyo.—Tanyin-hmaw and a few villages wove silk.

Sandoway.—Silk weaving is reported from villages, for local use. The cloth made in Sandoway is reported to sell for its weight in silver.

S. Shan States.—In Yawng Hwe States, there is weaving, and the dyeing is reported to be particularly good.

Akyab.—The Arakanese weave silk with thin cotton or pure as a home occupation for their wear.

Pakokku.—There is at present an industry in Pakokku town and neighbouring villages: the weavers are women, who weave on two and four shaft looms, with silk or silk and cotton, for employers: the looms are of the usual simple type and the warps used are some 20 yards long. Twisted China silk is obtained from Mandalay: for raw silk untwisted Rs. 23 per viss is paid, for the same slightly twisted Rs. 27. The silk is boiled off and dyed and then given to the women, who warp it and weave it: four threads are laid together for the weft, wound off from reels by a spinning wheel. The patterns are of the usual check type, done with alternating colours, or of a better check done with four shafts. A weaver makes about a yard a day and earns about Rs. 7 to Rs. 10 a month: three workers together earn Rs. 20 to 25 as the payment for the cloth woven has to cover filling spools and warping.

The industry in Pakokku town is there said to be increasing: formerly cotton was woven: the recent fire destroyed many looms and assistance is given in providing new ones from the relief fund. The employers collect the cloths and sell them locally or supply traders who come in for them: they also buy all the yarn, boil it off, dye it and arrange for the pattern to be woven. The weavers are skilful and can do a number of patterns. The shortage of dyes, high price of silk and want of demand are causing difficulty but I could not find that there was any lessening of production.

General.

2. As in Assam, there is a certain amount of weaving done as a spare-time occupation by women in their homes, the cloths being for home use or for local sale. In Toungoo such weaving is done, the return to the weaver being some six or eight rupees a month, she doing perhaps two feet of cloth a day. These persons are not returned in the census: they are members of cultivators' families and would be returned as such: they weave in slack times to earn a little extra and there is probably a large number of such weavers in Burma. They are not dependent on weaving, and cannot easily be reached or helped: nor do they need any help probably and their home industry is not one which is much affected by any depression.

The bulk of the weaving is done by professional weavers (many women), whose main source of livelihood it is and who weave wholly for the local market. So far as can be seen they are well-to-do and the increasing imports of raw silk point to increased demand for Burma silks: the pessimistic views of Mr. Hardiman have not been realised: the Burmese weaver is doing fairly well, there is a steady demand for his products and the weaving industry is on the whole flourishing; but I think it is clear that the industry has declined in the outlying areas and increased in places like Amarapura, Sagaing, Prome: the small communities of weavers in scattered places are no longer weavers: if they are, they weave for home use and not for the markets and something must be attributed to the general increase of prosperity in the country as a whole. With the increase in the import of raw silk has gone an increase in the import of piece goods. Burma is buying more silk, whether its own fabrics or imported ones: and this is probably an index of increasing prosperity. Whether it is due to any internal conditions or to the increase in the money value of the rice crop I have no means of knowing: but whatever it is, it is a definite process.

It would be interesting to know what the fluctuations have been in the nature of the demand: the decline between 1890 and 1910 was by many put down to the competition of cheaper showy goods: but the demand now is for good articles of good silk, which will last and wash well. This is the view of Mr. English, Registrar

of Co-operative Credit Societies, who has long experience of the industry in Burma. If the fashion has changed and if the day of the cheap showy silk is over, then the position of the Burman weaver may be a very sound one if his originality is equal to competing with the Japan craftsman's skill. In Rangoon, Mandalay, Toungoo, Prome, etc., longyis of the full width of dyed Japanese and Chinese figured silks, in one colour, were selling largely and were quite new: the beautiful Bangkok fabrics sell well and are not widely made in Burma: but Mandalay longyis of full width of new designs in basket-pattern weaving were selling and these are in good demand. All these are good cloths but only one class out of these was produced in Burma. The new fabrics are from abroad: and it is a question whether the fashion will go over to new fabrics not made on the hand loom or will remain with fabrics possible to the Burman weaver. Here again the utter lack of patriotism in dealer and buyer is fairly apparent: the former must live of course and sell what he can: but the latter might well help his countrymen by buying Burma made goods. It is typical of India that wealthy Hindu dealers in Burma should send the cloths in demand to Japan as patterns for the Japanese to copy, getting thus a cheap article resembling the hand-loom fabric then in demand. This is the practice at the present time and the Japanese producer is naturally much helped by this assistance.

Organisation.

3. The industry in Burma is mainly in the hands of independent weavers, usually women, who either buy silk and weave for sale or who get silk and are paid for the weaving. At Amarapura, there was formerly a system almost of slavery, in which the weavers were so indebted to dealers that they worked for a starvation wage: but this has been altered by the Co-operative Credit development: doubtless there are still many employed on silk who are badly paid labourers and who are in the hands of employers to whom they are in debt: but on the whole the weaver is not in this condition: at Shwedaung, Pakokku, Toungoo, the weavers seemed to be in good circumstances and earning a proper wage. Many worked for employers but were paid reasonable wages and could earn from six to ten rupees per month. In the main the weaving in this province is a woman's employment and they are not so wholly dependent upon it as are the weavers elsewhere. The remark in the Shwebo Gazetteer may be referred to above, and there is probably a large variety of condition among the weavers.

Raw Material.

4. The silk used by the weaver is largely white or yellow China or Bangkok silk imported through Rangoon or from Yunnan *via* Bhamo: some of it is slightly twisted, suitable for warp, some untwisted and used for weft. The silk produced in Burma is used for local weaving in smaller centres where coarse longyis are produced. The prices of imported silk are at present high, Rs. 18 to 25 for raw silk, Rs. 36 to 40 per viss for boiled silk: locally produced raw silk fetches Rs. 15 to 16 per viss. The figures for import and export are discussed in Appendix XV. The silk imported is largely of very poor quality and is first sorted into grades, with a great deal of waste, especially in the Bangkok qualities. Why this poor grade of silk should be used is not clear: it is certainly not cheap when it has been sorted and while it is good for coarse longyis it is not good for anything else.

Methods.

5. The industry has been dealt with in Hardiman's volume and illustrations of the methods used in Amarapura will be found in Shroff's article in the *Agricultural Journal of India*, volume IX, p. 254 (1914). The silk when received is opened out and the skeins joined: it is then run off on to small reels and sorted into four qualities: the medium even silk is used for warp, the very thin or thick for weft, the very thick rejected. The little reels used are well made and polished: in Shwedaung a particularly large pattern is used and the sorting is done very well and quickly. If local silk is used the warp thread is twisted, the machine used being a modification of the Nagpur and Bombay one: the silk is run off on to reeds by a very well made compound spinning wheel: the reeds are placed on spindles which are twisted by thread belts from a single large wheel: the thread from each reed passes through a loop in a wire fixed on a board and then to another

loop on the frame and so up to a large reel : the reel is turned by a belt from a small pulley on the axle of the driving wheel and so the proper relation in speed is obtained.

The illustration in the Agricultural Journal explains the machine. It is a very neat machine and works up to sixteen threads : a larger machine is used in Shwedaung which is worked by a pedal, and in which the thread is laid on reels criss-cross (compare Madras), with a very neat cam driven by a belt from a wheel : this is a very effective machine and is well constructed. In some cases, a neater machine still is used for two threads : in this case the twisted thread is received on the shaft of the driving wheel and there is no slow-turning reel : the simplicity of this is admirable and it is well suited to the household where only a little weaving is done.

The silk is then boiled off in soap and washed : the washed silk is dyed with aniline dye and run off on to reeds for warping or for the shuttle. The dyes formerly used were lac, saffron, safflower, indigo, anatto and jackwood : cutch was used for black : the use of cochineal seems to be unknown and the bright reds were obtained from lac and anatto combined. Before warping the thread is stretched between posts and is sized and polished with rice-glue. Warping is done in several ways, the most interesting being the use of the revolving warp frame such as is used in mills. Warping on the mill is done by women, who are paid four annas per warp and usually do two per day. But it is also done on a rectangle of up-right sticks as in India. The healds are knitted on the warp threads by special workers usually women. The loom is an upright frame loom, with two shafts, the reed of bamboo slips, the warp carried over the beam and over the top back to the weaver where it is stretched to the frame by cords : the cloth is taken up by hand in the usual way. Most weaving is done 22 inches wide and the longyi is of two pieces sewn together lengthways and it would be an advantage if it were woven the full width. The fabric is then washed and sold : finishing is crude in the extreme except in Rangoon itself and there is scope for better methods. The three noticeable points in the methods are the very neat polished reels used for handling the silk ; (equivalent to the *latai* of India), the neat twisting machine and the very excellent warping method. The Burmese weaver is neater in his methods, more careful and more efficient than the Indian craftsman as a whole. He is also interested in better methods and has experimented with Hattersley looms, Dobbie looms and eight shaft looms. There will be little difficulty in having improvements adopted.

Fabrics.

6. Two classes of fabric are made, the single whole garment such as the longyi, the piece for cutting. A longyi is one and three quarters of a yard or two yards long, of two pieces stitched together lengthwise, each 20 to 22 inches wide : a paso is double this length. Originally they were made in stripes, checks, and plain "shot silk" with blending of colours for the checks, giving very beautiful colour effects. Figured effects *Acheik* were obtained by a more complicated weaving method, involving the use of many small shuttles and giving real tapestry cloth : very complicated designs were worked out in this way, usually of such small conventional patterns as are easily worked in with a number of separate shuttles on a plain or striped warp. A peculiar class of fabric was woven in stripes of colour, with twill weaving : the Yaw cloth is of black and dark blue check with white patterns put in with embroidery shuttles. The designs are quite different to anything Indian : the colouring, the patterns, the complicated checks and tartans are of a distinct character and the Burma fabric is in a class by itself. Other fabrics were imported, notably from Surat and from China ; the former were hand-loom fabrics, woven to the Burma style but without their special characteristics.

Now the imported power loom fabric has altered the character of what is worn and the expensive figured cloths are scarcely made : for the last thirty years there has been a growing demand for figured cloths, woven on Jacquard looms or printed on a check or line design. The mills in Bombay and Calcutta specialised in this trade : there was an import also from France, from England, from China and now from Japan : and the Burman is buying cloths of totally distinct character, many of them not suited to the hand-loom of the weaver.

7. The Amarapura Silk Institute will probably be the factor in saving the indigenous industry from decline : if the indigenous weaver does not learn new methods and new designs, if his variety of fabric cannot keep pace with the imported one, it is probable that gradually the imported fabric will prevail. The excellent work of the Institute will, I think, save the situation : the method of work there is wholly admirable : the weaver comes, works at producing new classes of fabrics, which he sells : he learns no theory, only how to weave profitably goods for which there is a steady demand ; and the result is an increasing variety of product which is competing with the imported fabric. The Institute is new, and is already very successful ; every loom is occupied and the new designs of the Principal, Mr. Hurst are very attractive. When it is possible the scope of the Institute needs to be enlarged : it is not enough to teach how to weave new cloths on an eight-shaft loom : there should be a section devoted to the production of a far greater variety of fabrics, in which skilled weavers are retained permanently solely for working out the new ideas of the Principal. At present the best student stays only six months and there is no permanent weaver who can go on from the stage reached during that time. Eventually the Institute will doubtless go in for better methods of dyeing : but that is not immediately necessary. The future of weaving in Burma depends on the progress made at the Institute and on the variety of design that can be produced : the hand Jacquard may enable the weaver to produce figured cloths at a price that will compare with the product of the power-loom or the Japanese hand-loom : that is uncertain but needs to be ascertained. If this proves to be possible, then the industry should extend and prosper ; the competition of the imported fabric will be fully met and I think that the Burman will prefer the well-made hand-loom fabric, once its range is equal to that of the foreign product. Should the commercial organisation that is sketched in Chapter XXVII ever be created in India, Burma should benefit from it and there is a field for the sale of Burma fabrics if an organisation is formed to make these more widely known. Similarly if enquiry shows that certain classes of silk goods are likely to be in demand which are within the scope of the hand-loom, the Burma craftsman, through the Amarapura Institute, will probably readily produce them : there is no part of the Indian industry that will benefit more from trade organisation than this and there is probably none that will respond more readily or give more effective help to the organisers. The immediate necessity is to extend the scope of the Institute in the experimental direction, without altering in any way its excellent methods in teaching weavers.

8. The principle of co-operative credit has been applied in Amarapura : small societies are formed of weavers, and these are united in one union with societies of cultivators and of cultivator-weavers. The members of each society are each liable for the whole indebtedness of the society : each society is liable only for its total indebtedness ; periodically the society meets, receives payments from its members, decides on its needs : the total required is scrutinised by the Union, which if satisfied, passes it on to the Registrar : it is again scrutinised and the bank is authorised to advance the total or such proportion as is available. In this way weavers who had got into the hands of dealers have been enabled to pay off debts, to buy silk or looms and to carry on business under good conditions. Had the war not crippled the trade the position of these societies and of the weavers would probably be very satisfactory : but the Registrar is satisfied that with normal conditions the weavers and the societies will prosper.

The essentials to success are an extension of the Institute's activities, some expert help in methods of dyeing, twisting and the like, an increase in co-operative credit societies and the assistance of trade organisation outside Burma. The industry would benefit very definitely from the technical advice and trade organisation proposed in Chapters XXVIII & XXVII respectively ; given this assistance, there is probably a good future for the weaving industry.

9. At the present time, the Burman imports one longyi for every one he makes : the total value of raw silk imported in 1915-16 is Rs. 22,88,304. Assuming that it is worth double as cloth, its value is Rs. 45 lakhs : and the value of imported piece-goods of silk in this year is Rs. 38,63,286. This gives a rough measure of the importance of the indigenous product and one must remember that while imported piece-goods sell especially in the towns, the indigenous sell better in the country districts. For the Burman weavers to meet the town competition, quite new

weaving with new qualities of silk will be required : it is not enough to go on weaving inferior China and Bangkok silk into longyis but it will be necessary to weave satins, waved cloths, crapes, brocades, pongee silks, which means new methods, new qualities of yarn.

10. I would introduce to Burma the products of Bengal, Mysore, Kashmir in coarse and fine raw silk : I would pick intelligent weavers and get them on to weaving twills, satins, pongees ; I would try weaving the suiting silk so largely imported : and I think that with commercial organisation in India generally and with technical organisation in Burma, the Rs. 38 lakhs worth of cloths now imported could be made in Burma or India. The policy in this case will be not to interfere with the existing production but to pick intelligent weavers and put them on gradually to other fabrics : the preliminary to this is to extend the Amarapura Institute so that these fabrics can be made there : and then as each new fabric is made, to get weavers in there to learn how to make it and where to sell it.

Whether this is possible or not depends as much on co-operation from India as in development in Burma but under the scheme proposed elsewhere (see Chapter XXVIII) this should be possible.

Printing.

11. A feature of the industry in Rangoon is the many establishments where satin or pongee silk is printed, or dyed, and finished.

The printing is done with wood blocks applied by hand : these are cut by carpenters from pencil tracings : these tracings are from designs produced by artists in colour, the designs suggested or planned by the printers. A design may take four or more colours, each separately applied by hand with many separate blocks : they are largely copies of chintzes or other figured cloths and are crude conventional flower designs as a rule. The beauty of design that characterises the Srinagar embroidered silk is lacking : but a considerable amount of skill and taste is expended on the designs and processes.

The advantage of the method is that it is cheap, and that a longyi or shawl can be printed again when the wearer is tired and wants a change. The printing is not fast to washing : a well executed longyi and shawl on good Japanese white silk costs some Rs. 10 to 12 in all and judging by the number of printers engaged, the business is profitable. It sorely needs help : a little assistance with designs, a little originality, would help them very much : and it is a branch of the industry that is extremely interesting.

Finishing.

12. In Rangoon there are many establishments where cloths are cleaned, ironed and finished. It is a pity there are not more of these in other places : but only in Mandalay apparently is there an establishment where the silk cloths are properly cleaned, picked, and ironed. There is scope in Burma as in India for the Silk finisher : and the Burman fabric would get a better sale probably if properly finished.

Trade.

13. Burma is separated from the rest of India, so far as trade is concerned, and is a distinct unit with its own trade channels ; it is not dealt with in detail in Mr. Anson's report (Volume II) and this section is added to cover the figures of the silk trade. Chiefly the figures are of interest as indicating the main features of the industry, and also as illustrating the effect of the war, marked as regards the importation of fabrics, small as regards raw silk importation. See Appendix XV.

Raw silk.

14. The figures of importance are reproduced in Appendix XV and it is necessary to include also the figures of importation by land. Raw silk imported is chiefly Shanghai, Yellow, (S.C.) Meyong, (Mein-Yang), No. 2, or Canton, S.W.C. ; there is also importation of Shanghai re-reeled : silk comes also from Siam, Cochin-China and Tonkin. The bulk is Shanghai, which is imported in large quantities, by firms in Rangoon, whose brokers sell it in bales (130—140 lbs.) to up-country dealers, who sell it again in bundles of 12

skeins, a bundle being about 10 lbs. The silk is all coarse, not reeled to denier; irregular and of quality inferior to Bengal *Khungru* silk probably. As in Assam, all has to be sorted into grades: the price is low, Rs. 19 to 23 per viss for ordinary, Rs. 27 for re-reeled. This is equivalent to Rs. 6 per lb., Rs. 12 per seer: when sorting is allowed for, the weaver is probably paying Rs. 9 per lb. for the good silk at which price Bengal or Mysore silk of similar quality will compete. So long as silk of this quality is imported and used, the Burma fabric will be poor: there was an import of Bengal silk to the extent of 22,000 lbs. in 1912-13, but this has ceased: there was an all round increase in raw silk importation in that year, and even Japan raw silk was imported: but China and Siam practically export the whole of the silk used at present.

The Trade.—Piece-goods.

15. It is extremely interesting to visit the bazaars in places like Mandalay, Rangoon, Prome, etc., and see what is actually selling there. The dealers, as well as the importing firms, find that the Burman demand fluctuates and varies over a considerable range and that the amount of trade depends on the season. A good rice crop means a large demand and a sale for a wide range of goods. Speaking very broadly the demand is for these fabrics;

Brocades of pure silk or silk and cotton, woven in one or two colours and selling at about Rs. 5 to Rs. 6 a yard. These are of good quality and must stand wearing. They are from Japan and China now, formerly from India or France.

Bangkok waved cloths, of pure silk with the peculiar pattern in two colours. These have been woven also in Surat but unsuccessfully and the Surat fabric is not so good.

Crepe.—Woven in Japan chiefly.

Plain, twill and stripe silk, from China and Japan.

Pongee silk, plain and printed in colours, which sell in pieces for head dresses for men, scarves and the like for women's use.

Light figure silks (*Habutœ*) for handkerchiefs and head-cloths from Japan.

Satin, plain and printed, or dyed in "bandanna" patterns: the last are from Surat.

Tasars and *Suitings* in Shantung and Mulberry silk from China entirely.

Yaw cloths, formerly woven for the Burmese royal family only, said to be still popular on that account: they are black, of silk and cotton mixed and the limited supply fetches a high price.

Mandalay and *Tavoy* cloths, in the stripes, checks, tartans, 'basket' patterns, etc., already described above.

Surat—longyis in checks and basket patterns.

The above are the principal things sold quite extensively: there are small quantities of fancy cloths, embroidered silks, etc., but the above cover the articles in large demand. Between figured cloths, printed cloths, 'bandanna' cloths and the Burmese designs there is a very large available variety. Up to quite recently there was a trade in English printed silks woven and printed in Macclesfield and the last importation was apparently in 1915. Twenty years ago there was a very large trade in these goods, but the Japanese have ousted them entirely.

16. From all the importers, brokers and dealers, I met in Rangoon, the same story was to be heard, that the Japanese fabrics cut out the French and English fabrics wholly on price and quality: some say that the quality is now not so high: but there is no import from England of printed goods, and of French goods, only silk voile or muslin not produced elsewhere. English artificial silk goods are selling in the market at annas 10—13 per yard 22 inches wide: the demand is for bright variegated goods, and the dealers complain of lack of variety of design. Apparently this fabric fills the demand of the Burman who likes a change: his wrap does not wear for ever but it is cheap

and he can renew it in a new design frequently. The cotton cloth dealers sell the artificial silk fabric and not the silk dealers.

17. Piece-goods are handled by a dozen English firms and twice as many native firms in Rangoon, who import direct from Japan and Bangkok, or buy from dealers in Burma. The Japanese dealer pushes his goods in Burma and the larger firms buy from English or Japanese firms in Japan and China. Formerly this trade was with France and England: now it is practically all with Japan: the figures in Appendix XV illustrate this: and it will be seen how very little Indian piece-goods come to Burma now. There are dealers who specialise in Surat silks, having their headquarters in Surat and branches in Rangoon. An average value of five lakhs of piece-goods from India, with a foreign import of from Rs. 43 to Rs. 64 lakhs, was the approximate position before the war and the Indian piece-goods were from Surat, Madras, the Bombay mills, chiefly. The import from England now is chiefly 'suitings' (*i.e.* cloths made to look like tasar or Assam silk) of spun-silk chiefly. There is an import from France of silk muslin. The Ariff Mill in Calcutta used to supply Burma with printed silks but has ceased to do so: and the two Bombay mills used to weave figured silks, etc., for the Burma trade but do so very little now: dealers in Rangoon who formerly dealt in Calcutta and Bombay mill fabrics do so no longer, and say that the Japanese article, made on a hand loom, but cleaned, polished and finished in a factory, competes with the mill product in durability, design and variety. That seems to be the reason why Japan has nearly the whole of the trade: and until India can supply a similar article, in wide variety, at a similar price, Japan will keep this trade.

CHAPTER XVIII.—ASSAM.

The districts of the Assam Valley are the home of a silk industry of a peculiar kind in that it is a subsidiary industry, mainly carried on by cultivators, but partly the occupation of the leisure hours of the women folk of the well-to-do Assamese, and which embraces three kinds of silk-worm, the mulberry or *pat* silk grown indoors, the castor or *eri* silk grown indoors and the laurel or *muga* silk grown outside on trees.

It is not easy to form an idea of the number of persons interested: according to Basu's figures, there are actually 4,250 families who rear mulberry silk; the out-turn of *eri* is put at 5,325 maunds, which probably means 20,000 families, who grow some *eri*: the outturn of *muga* is put at 225,000 kahans which would be the production of some 15,000 families or rearers: there are probably some 40,000 persons interested directly in silk rearing in Assam, all doing it as an adjunct to cultivation. The total value of the silk products of the province is estimated by Basu as Rs. 31,00,000 of which perhaps a quarter is exported, the remainder used in the country. The silk is grown practically entirely in the Assam Valley, none in the Surma Valley districts except a little in Sylhet. *Eri* is found in Sylhet, Sibsagar, Nowgong, Lakhimpur, Upper Cachar, Darrang, Kamrup, the Garo Hills, Goalpara and it used to extend into the Bogra and Dinajpur districts of Bengal, and some *eri* cultivation and spinning is still done in Bogra.

Muga is found in areas in Sibsagar, Lakhimpur, Darrang, Nowgong, Kamrup.

Pat is grown in Sibsagar, Darrang, Nowgong, Kamrup and a little in Lakhimpur. Manipur also produces some.

Weaving is done in Cachar, Sylhet, Goalpara, Kamrup, Darrang, Nowgong, Sibsagar, and Lakhimpur.

The *pat* silk industry has been discussed under Mulberry silk. The *eri* silk industry and the *muga* are discussed under wild silks and in this section it is proposed only to discuss the utilisation of silk and the requirements of Assam as a separate unit with the best means of developing its industry.

The Utilisation of Silk.

2. The methods of reeling *muga* and *pat* and of spinning *eri* have been referred to under wild silks. The methods of preparing and weaving *pat* silk are here discussed. Chinese *pat* silk is imported by post in 10 lb. parcels and sells at Rs.

12 to Rs. 16 a seer : it is obtained from Bombay agents. *Eri* hand spun yarn sells for Rs. 5 to Rs. 7 per seer ; *muga* reeled sells for Rs. 10 to Rs. 30 per seer : indigenous *pat* silk, if sold, fetches Rs. 16 a seer as a rule.

Eri silk is not usually twisted or doubled but is used in the single thread and the first operation is warping. *Muga* silk is frequently used as it is, after re-reeling but for some fabrics is doubled. *Pat* silk is doubled and twisted for warp, doubled for weft : but this depends on whether it is imported Chinese silk or thick locally-produced silk. The Chinese silk is doubled and twisted usually. The sequence of operations may be followed in *pat* silk.

The Chinese *pat* silk is opened up and the skein put on a swift : the end is found and the thread is run off on to a series of "*latais*", each for a separate thickness : at each break, the thread is knotted and at each change of thickness the thread must be broken and reknotted. The result is a series of two to four qualities of thread and some unusable waste : the skeins vary very much in quality and there may be little more than half of the best quality.

The threads are then doubled together, by removing them from swifts on to a *latai*, the requisite number being taken and run off side by side. They are then twisted either by the method described on page 136 by laying out the threads and spinning them with spindle-weights, or by using the *charkha* or spinning wheel. The thread for weft may be twisted as is done in Bengal for *tasar*, by taking the doubled thread and running it over the left forearm on to two short uprights in a figure of eight.

3. *Boiling off*.—*Pat* silk has to be degummed and this is done usually before weaving : the thread is dipped in a hot solution of plantain ash until the gum is removed. *Muga* and *eri* are boiled off before or in reeling.

4. *Dyeing*.—There is not much dyeing of silk : *muga* is used in its beautiful natural colour : *eri* is used mainly in its natural tint but coarse cloths in checks are made for sale to the Khasis, etc. and the yarn is dyed. Mr. Basu refers to dyeing among the hill tribes, usually with vegetable dyes and lac. In Gauhati, the dyes used are aniline. There is a demand for really fast dyes for dhoti and sari borders and for a few fabrics in *pat* silk.

5. *Sizing*.—*Eri* yarn must be sized if for use in the warp and this is done, before warping, with rice-starch. Basu describes an additional sizing applied to the fabric to make it appear smooth as the best quality *eri* cloth is smooth.

6. *Warping and Weaving* are done for silk as for cotton, the warp laid out in the open and the threads put down from *latais* held by the warper who walks up and down : as a rule several men each with a pair of *latais* walk up and down together till the proper number of threads is laid. The loom in use in Assam is usually a simple frame loom, fixed to four upright bamboos outside : the better quality fabrics are woven indoors. The loom is a simple one, with two or four sets of healds, and the shuttle thrown by hand. Big widths up to 54 inches are woven for some fabrics of *eri* yarn. At Gauhati, R. K. Saraswati has introduced metal reeds and fly-shuttle slays. Fly-shuttle looms are being introduced in the districts. The fabrics are usually plain woven, sometimes twill. I was not able to see the very beautiful weaving done by the well-to-do Assamese in their homes but the fabrics show the weaving must be similar to the best Benares or Murshidabad brocade and damask weaving. At Sualkuchi, the weavers make *pat* silk with borders in four colours, the border pattern formed by a series of 25 loops attached to sets of healds, the pattern reversing by taking the loops in the reverse order and so completing the pattern : this is similar to the Benares method. They also make a damask with a pattern over the whole fabric. As a rule, the weaving is much simpler and plain or twill is made.

7. *Fabrics*.—Most of the cloths made are for home wearing or for sale to the hill people or to Bhutan. B. C. Allen's Monograph of Assam Silk Cloths (1899) lists a great number of fabrics, mostly for wear or local sale. The only exported cloth is plain *eri* cloth or plain *muga*, woven either as dhotis or chadars or in pieces to cut. There was formerly a considerable trade in "Assam silk" that is plain *eri* cloth woven up to 54 inches wide and used for hot-weather suits in India, in Australia and elsewhere. This trade is rapidly lessening and even the enterprising Gauhati firms with branches in Calcutta are doing small business. The reason is that firms in Calcutta or Australia could not obtain a continuous supply of one

quality and one size : the quality varies and the cloths were not quite uniform. Another reason is that Indian firms certainly prefer to stock and sell imitation silks and mercerised cotton, under fancy names suggesting that they are silk. This is discussed on page 208.

The other fabric exported is *muga* or *muga* mixed with *pat*, *eri* or *jute*. Neither *eri* nor *muga* are cheap ; an *eri* cloth 50 inches wide costs from 2 to 5 rupees a yard depending on closeness of weaving, evenness of yarn, etc. A *muga* cloth 36 inches wide would sell for Rs. 1-8 to Rs. 3 per yard. *Pat* cloth 36 inches wide sells for Rs. 2 to Rs. 2-8 a yard. There are many mixtures of *pat* and *muga*, *pat* and *eri*, *muga* and *eri*, or either silk with cotton : at Gauhati, the weavers have used mill-spun *eri* silk and the weaver in Assam is much interested in it.

For home use, cloths are made of spun *muga* or of spun *muga* mixed with *eri*.

The Position of the Industry.

8. In the main the weaving is done at home for home use or for cloth to sell at the nearest *hât*. In Gauhati, there are dealers who buy cloth or who employ weavers to make pieces to their order. These dealers have agents who buy at the fairs and they also deal in China silk, reeled *muga* thread and the like. So far as the internal trade is concerned, the position is probably normal : the export trade is decreasing and has gone down very much.

At Sualkuchi the weavers are combined into associations or companies which attempt to develop trade with other places. These issue printed catalogues of cloth as the Gauhati dealers do and they are striving to develop on more up-to-date lines. One dealer told me he could get 500 pieces (7 yards \times 36 inches) of *muga* of all one quality woven in three months, this cloth selling there at Rs. 2 to Rs. 2-4 per yard. Some of the cloths at Sualkuchi are well adapted to European use if better known but they are made in a far corner of India and have little chance of being known. So far as development is concerned, an increased trade in cloth from Gauhati would be an advantage if it could be achieved : and if there was increased demand, it would be well to go carefully into the question of better reeling, better twisting, better warping. Basu suggests that Sualkuchi reelers would welcome a reeling machine : still more they would benefit by a twisting machine if there was increased demand for cloth.

9. Mr. Basu refers to the trial of co-operative societies among cloth producers at Sualkuchi and Palasbari. Without some assistance outside Assam, it seems unlikely that the trade will expand : if Assam fabrics could be seen and introduced to the trade at the big cities, if the societies of weavers would rise to the occasion and produce what was wanted, I think they could be helped. Assam weavers have one asset, the reeled *muga* silk, and they should develop it. This is a case where commercial organisation and expert advice would help the industry very considerably. Mr. Basu sums up the position of the whole industry in Assam and the following is quoted from his report :—

The rearing of the *muga* silkworm is in a stationary condition, and does not seem capable of much development. There is some demand for *muga* silk from other parts of India principally as material for embroidery, but the demand is limited and is not likely to expand much. Practically, there is no demand for this silk from outside India : it is far too costly to suit the European market. The cultivation of this silk is attended by constant losses from disease. If some means could be discovered for preventing disease, it might help to put a new life into the industry, and *muga* silk may become cheap enough again to hold its ground against other kinds of silk. The present high price of this silk has caused many to give it up and use imported mulberry silk instead ; and I fear that unless it becomes cheap again, it may before long succumb to the competition of imported silk.

The rearing of the mulberry silkworm (*pat*), has long been in a state of decadence and is of little importance at the present day. It is in danger of further decay from the social movement which I have mentioned in paragraph 55. We may perhaps be able to give it a new lease of life by introducing improved races of the silkworm, by

teaching the rearers how to combat disease and by introducing its culture among such people as have no social or religious prejudice against the industry. But I admit that the task will be an uphill one and the chances of success, considering the nature of the people concerned, somewhat doubtful. The Agricultural Department made a beginning in these directions some years ago at Shillong, but their efforts to popularise sericulture among the Khasis have not as yet met with visible success. The work is now being carried on by the Roman Catholic Missionaries of Shillong. I have some hope that with due co-operation and financial assistance from Government, the efforts of the Mission to spread sericulture in the Khasi and Jaintia Hills will prove successful.

Lastly, as to the rearing of eri silk. The prospects of this branch of the silk industry seem hopeful. There is a demand for eri cocoon from silk spinners of Europe and Bombay. Eri silk is probably in greater favour for power spinning than any other class of waste silk. The export of eri cocoons is showing a marked tendency to increase, but there is a danger ahead which must be removed to enable the trade to expand. I refer to the adulteration of cocoons with insects (paragraph 26). The export trade in eri cloth and thread is also in a flourishing condition. The export of eri silk to Bhutan has enormously increased within the past three years, and there is a brisk demand for eri cloth from Bengal and other parts of India.

Sericulture has to face the competition of other occupations just as much as any other form of employment. It is said that the rearing of silk worms does not cost much, and being a cottage industry and principally the occupation of females, it causes no interference with agricultural work or other kinds of rural labour. This is not exactly true; silk growing may not cost much in money, but it costs labour and is more risky than any other occupation. It often clashes with other kinds of employment. In most parts of Assam the women take an active part in the cultivation of crops which are more profitable than the rearing of silk worms and are becoming more remunerative every year with the steady rise in the price of agricultural staples. Then again, the attention of the people is being diverted to many occupations which did not exist before. All this must tell on the popularity of silk rearing. It is not possible to forecast the effect of this growing factor on the future of the sericultural industry in Assam. In the open thickly populated parts of the Brahmaputra Valley, the rearing of silkworms is losing favour with the people; away in the hills and in the backward parts of the Valley, the people have got nothing to attend to beyond their hereditary callings of which silk growing is one, and it is in these parts that sericulture still retains its former importance, and has at least in some places, gained in importance in comparison with former times.

Recommendations.

10. 1. *Eri*.—Grow Eri at Shillong or at some place with an elevation of 3,000 feet where castor will grow well. Issue seed from this every year in September-October for the cold weather crops. If necessary get the seed to start with from the best centre in the hills.

2. Go into the question of cocoon reversing or cleaning and ensure clean cocoons. Do this through the trade, finding out the exporting agents in Calcutta or the buying firms in England, France, etc. If necessary sell guaranteed cocoons under seal as clean.

3. *Muga*.—Start a small plantation of *soom* and *hualu*, *champa* and *mezankuri*, and on this grow *muga*. First master the rearing in all details trying new methods: then study the disease with the co-operation of a bacteriologist. Study the best means of growing the food-plants under control. If possible issue pure disease-free seed.

4. Ascertain the wild centres of *muga*, and if possible get wild stock.

5. Grow mulberry at an elevation of 3,000 feet at least and there grow the horu-polo, the boro-polo, the nistari, chota-polo, bulu, Mysore, Madagascar, and hybrid races: select rearers in the plains and to each issue seed as an experiment guaranteeing them against loss. If no other worm does, then give them their own from the hills. Grow the important kinds of mulberry and test them with selected rearers in the plains.

6. Grow the race that does best at Shillong under industrial conditions, each lot in charge of a Khasi in a hut similar to what he would use.

7. Extend the Gauhati Weaving School, not as a school but to experiment—
Get better reeling, twisting, spinning.

As soon as a good simple method is found, for either, extend it through the peripatetic agency of the demonstrators. Similarly extend the use of brass reeds, of fly-shuttle slays, of warping machines.

8. Get samples of all cloths available, and organise the trade, either direct or through the all-India organisation if there is one. Use this to stimulate the use only of fast dyes, plant dyes if possible. Introduce to the weavers better kinds of raw silk, *e.g.*, Mysore, and organise the supply of this from Indian sources.

11. To carry this out entails—

1. A station at an elevation where *eri*, mulberry, and if possible *muga* can be grown: probably the latter must be separate and the two former could be grown on an extension of the Fruit garden at Shillong. There should be 5 acres of castor, 10 acres of mulberry.

2. A separate *muga* station, at the upper level limit of *soom* and *hualu* growing preferably on the Gauhati-Shillong road but possibly near the Sibsagar district, or in connection with a tea garden. The first essential is to test growing all the food plants. Site will be a matter of careful survey.

3. Funds for purchase and making of machines for reeling, etc., for purchase of cloth samples, for paying losses on rearers' experimental crops.

4. *Staff*.—A trained native (of Assam) not one who has been to Japan, but one trained in India, and if possible selected with the assistance of the Silk Expert whom I assume will be appointed. His pay should be at least Rs. 200—300. Under him, an assistant for the *eri* and *pat* station, another for the *muga* station, and more than one demonstrator or fieldman to tour the district.

5. *General*.—It should be recognised that it is essential—

- (1) to have continued expert advice and guidance,
- (2) to budget liberally,
- (3) to guarantee at least five years permanency without financial stringency,
- (4) to do the whole scheme and not parts of it.

Until the whole can be done, including 1, I would do nothing more than extend the activities of the weaving master on pure weaving questions.

CHAPTER XIX.—BENGAL.

Weaving.

The districts in Bengal in which silk weaving is most important are Murshidabad, Malda, Rajshahi, Bankura, Birbhum and Burdwan. The table in appendix X gives census figures for 1891, 1901 and 1911 for cocoon rearers and for silk spinners and weavers: too much reliance should not be placed upon the figures of cocoon rearers. The fabrics produced are made from filature silk, *khungru* silk, reeled and spun tasar, reeled *muga*, spun mulberry waste (*matka*), and spun *eri*. The filature silk is derived from the filatures in Malda and Murshidabad through native dealers: the *khungru* is obtained from dealers who buy it from the native reelers: tasar is obtained from districts chiefly in the Chota Nagpur division and in the Orissa area. A little reeled *muga* is used, obtained from

Assam, *matka* is spun in the districts producing *khungru* silk from the waste cocoons, and the *eri* is obtained from Bogra, Rangpur and Dinajpur, or from Assam. There is a very great variety of fabrics but the main classes are the following :—

Thans.

- (1) *Corahs*.—These are the silk that formed the basis of the export trade which is now nearly extinct. They are plain *khungru* silk, woven of untwisted thread and boiled off after weaving. The price of cloth 36 inches wide is from Rs. 1-8-0 to Rs. 2 per yard. They are made in lengths of from 7 to 50 yards and are the class of plain white or cream silk cloth used for making dresses, etc., and which every draper's shop in England stocks : only now they are not made in Bengal but elsewhere. They were exported originally to be boiled, printed and finished in England.
- (2) *Thans*.—Made of *khungru* silk, in plain or twill and either uncoloured, coloured or in stripes, checks, etc. The thread is twisted and is properly boiled off and perhaps dyed. These cloths are better quality, heavier, better woven. Some are of very good quality, though these are rare. The Japanese and the French power loom has superseded them to a large extent : what the box-wallah, or bazaar or European shop now sells as Japanese or Chinese used to be from Bengal.
- (3) *Mustins, chiffon and fine fabrics (mal-mals)*.—Made from filature silk of good quality, sometimes with gold thread : these silks are now superseded by Benares products or foreign fabrics.
- (4) *Matka Thans*.—Matka is woven in plain or twill, sometimes with a stripe or check and used for making suits and frocks or for making coarse cloths that are exported to Orissa and North India. Its use is entirely limited to India and there has never been any foreign trade : it is used to some extent to imitate eri silk cloths and is a peculiar product of Bengal. It is a cheap fabric and being made of hand spun thread is rough like "Assam silk."
- (5) *Tasar Thans*.—Tasar is woven into plain fabrics, like Shantung silk, this is done in Bankura and Birbhum chiefly : the thread used is that reeled from the cocoons. The waste tasar is spun like matka and used to make a coarse cloth (*kete*) which is very cheap and durable.
- (6) *Eri Thans*.—These are made for suits chiefly and there was formerly a considerable trade in these. Dinajpur, Rangpur and Bogra make these for local use and Murshidabad also makes them for export.

Whole pieces.

Chaddars.—Usually 3 yards by 50 inches.

Dhoties.—Five yards by 44 inches.

Saries.—Five yards by 40 inches.

Jores.—Eight yards by 44 inches.

These are made of *khungru* silk for the heavy qualities, of filature silk only for very fine fabrics : they are made in plain or twill, with coloured borders, with gold borders : they are also made of tasar silk and of matka. There is great variety in these, especially in the degree of ornamentation of the borders.

Flowered silk.—Brocades, tapestries, damasks, etc., woven on special looms are made as shawls, saries, table covers, etc., the ornamentation may be exceedingly complex and the weaving very slow. A sari of this sort may cost a very large sum of money. These have been largely superseded by Benares products, and still more by hand-loom products from Japan : Murshidabad and Bankura fabrics still have a reputation.

Printed silks.—Silk printed in patterns was formerly made and the art is still practised to a small extent. *Bandana* silk is silk dyed in a pattern made by tying knots in the fabric with strings and then dyeing the fabric. The bandana

handkerchief of past times was so made or was a printed handkerchief. Lord Carmichael's search for "bandana" and the discovery of their origin as Murshidabad has led to a demand for these.

Mixed Fabrics.—Thans, chadars, dhoties, saris are made of silk and cotton mixed: when tasar is used, the fabric is called bafta: this is produced chiefly in Bihar and Orissa. There are various mixtures and recently mill spun eri has been used to some extent. Mercerised cotton is being increasingly used and spun silk.

Handkerchiefs.—These are of white silk, 18 to 24 inches square, sometimes with borders or checks: they sell at Rs. 4 to Rs. 12 per dozen.

The preparation of silk.

2. The Bengal weaver uses his silk in every form from plain *khungru* silk to twisted doubles. The first procedure is to wind it off from the skein: if using *khungru* silk, this first winding must be carefully done and the thread sorted: at every break, at every thick piece, the thread is knotted and the thick thread is taken out. As a rule the sorting is done into three qualities or thicknesses.

Filature silk is of one quality and simply requires winding off. If the silk is to be used raw, the wound thread is used at once for warping: if not, the silk is either twisted or is doubled: for twisting the single thread the tedious and elaborate method is used of laying out the threads on long frames, each thread spun with a small weight (see page 136). As each thread is twisted it is wound off again upon a *latai*: two or three of these threads are then run off side by side from the *latais* and this double or treble is used direct or is twisted on a spinning wheel or *charkha*. This thread is then ready for the warp if it is to be used raw, or is boiled off and dyed.

Where the regular silk-twister is not known, as in small weaving communities the twisting of threads is done by hanging up the thread on a swift so that it can turn easily and then the thread is carried over the twister's left forearm, twisted with the right hand (as in tasar reeling) and the thread put over two upright sticks in a figure-of-eight skein. Boiling off is done in the skein as a rule but in the piece with raw silk fabrics such as corahs. The silk is boiled in carbonate of soda or potash, derived from the ashes of plantain, or purchased. The method is probably satisfactory where care is taken in the preparation of the dye: the silk is afterwards washed in clean water. The quality of the water is of great importance in boiling off. Dyeing is done by professional dyers or by the weavers themselves. Formerly plant dyes such as indigo, cochineal, lac, kamela, anatto, were used and skilled dyers were able to obtain almost any shade. Anilines have replaced these to a very large extent and not always the best or fastest anilines. Some aniline dyes are satisfactory: still more so are alizarines but they require mordanting.

There is an industry in silk dyeing by the bandana method, the threads being tied at regular intervals and this is also applied to cloth: with this is combined printing on silk with blocks and there used to be a large trade in bandanas for the European trade.

3. Warping is done on the crude method with upright sticks fixed in a rectangle, the weaver walking round laying two threads at a time. The warp is then laid out, brushed, sized if necessary and drawn in to the reed which is usually of bamboo: the healds are then knitted on. Quills are filled with the *charkha* and the weaving is done on a pit loom of a very simple kind with usually two or four shafts. In Murshidabad there is still weaving on the complicated loom in which the pattern is developed by loops controlling different combination of healds, the loops manipulated by a 'draw-boy' and the weaver having to put in wedges to hold the cords up. This is similar to the Benares method, and to the Madras method: but in details it is inferior to the best Madras looms.

This class of weaving is diminishing, the demand for this expensive cloth is small and uncertain and the industry is never likely to develop in this province. It is to be seen if the Jacquard succeeds in Madras and Burma: if it does, then the Bengal industry may revive again.

4. The Bengal Silk Industry is concerned with three different outlets: the Indian demand for saris, chadars, dhoties and Indian fabrics: the demand for

thans, chiffons, muslins, suitings, blouse lengths, dress lengths, etc., in European shops in India: the demand abroad for corahs, thans, chiffons, muslins, etc. Thirty years ago, Bengal exported a class of cloth used for dress goods, especially for linings and for printing; that demand has ceased practically entirely and there is now no export. The Bengal weaver, isolated and in ignorance of development abroad, failed to keep up with the change in demand or to meet competition: his methods did not change, he could not produce so quickly or cheaply, his fabrics were supplanted by others, produced by workers directed by men in close touch with the markets. The power-loom helped to cheapen these fabrics and the superior commercial organisation of the mills gave their products the advantage. For the second, the Bengal trader has failed equally: the European trade no longer buy Bengal silks, they buy Japanese, Chinese, French or Italian: and they do so because they get the quality they want, in uniform thickness, weave and size, in guaranteed dyes, qualities and weights. If you want plain white or coloured silk now, you get Japanese but Bengal produces that silk, only they market it badly and the trader prefers Japanese. The question of finish comes in, the method of packing, the way it is put to the trade. Given the same business capacity and enterprise, Bengal silk could probably hold its own.

The trade persists chiefly on the demand for chaddars, dhoties, saris and thans sold in Bengal and exported to other provinces. It is handled largely by dealers or their agents who come round and buy pieces, who buy in centres where there are weavers, or who advance thread or money and buy the silk when made. In some cases weavers are able to buy their own yarn and take their cloths into the towns and sell direct, and in Murshidabad and Mirzapur weavers are employed on wages by dealers who trade on a large scale and sell a great variety of cloths. These cloths are sold locally, for the very large demand in Bengal itself or go to dealers in North India, in Madras, in Burma: the outside demand is usually for a peculiar quality or style of cloth which has a definite local sale in that place and the trade has persisted from former times.

When large quantities of a single class of fabric are wanted, as used to be the case, they are obtained from weavers through silk dealers or *mahajans*, who spread the order among the necessary number of weavers: but there is less of this now that the export trade is practically dead. It is not at all easy to get large quantities of any uniform quality or pattern now in piece-goods.

In Murshidabad, Benares, Bhagalpur, and other centres, there are produced silk fabrics which have only a local sale because they are not known. The producers find no use in advertising, are not in touch with markets and have only a local outlet. Yet their silks are very good, would sell well if known and with steady demand, cost of supply would go down.

The condition of the actual weaver in general is not a good one: he is often very much indebted, is in the hands of a *mahajan* and cannot easily get a real living wage: the industry has very much declined, many weavers have turned to other occupations and there is a great need of organisation on proper lines.

It is impossible to obtain accurate figures at the present time and this view does not hold in all weaving centres: but it is the general truth for the Bengal industry as a whole.

In 1903, N. G. Mukherji estimated the value of silks produced at fifty lakhs, his very detailed figures can be found in the Monograph of Silk Fabrics of Bengal: it has not been possible to minutely investigate the Bengal weaving industry and its present position is not properly known.

5. At present the silk weaver is assisted by the peripatetic Weaving Expert, who is attempting to improve weaving generally, and by the Commercial Museum in Calcutta which stocks silk goods and exhibits them. The present organisation is wholly insufficient and Bengal stands in urgent need of proper organisation for the industry: the employment of one weaving expert from Madras is not sufficient to give any real help to the weaver: the Commercial Museum is of very little use as yet. The Serampur Weaving Institute is concerned with cotton and has not attempted to develop or help the silk weaver. The Bengal industry wants first a proper survey: secondly the application of the reorganisation discussed elsewhere (see Chapter XXVII) in this report: thirdly the development of co-operative credit to put the weaver in a position to get proper earnings indepen-

dent of the *mahajan* and dealer. There is considerable scope for the development of small finishing factories as centres from which the weavers can obtain materials and to which they can sell their fabrics, and there is considerable scope for the development of the co-operative credit society for weavers. There is also scope for the development of better methods of twisting and the like : the weaving is skilful but the weaver's condition is usually a very bad one and his methods are poor.

CHAPTER XX.—BIHAR AND ORISSA.

The silk industry in Bihar and Orissa is concerned mainly with tasar silk twisting and weaving : the only important weaving centre is Bhagalpur : the figures for all districts are given in Appendix X for 1891, 1901 and 1911 ; they are of little value : a great deal of tasar twisting is done by persons with whom it is a minor occupation and who are otherwise returned and this accounts for the fluctuations in each decade. The increase in weavers, etc., in Bhagalpur is curious and the large number of twistors and weavers in the Orissa States, who work chiefly in tasar.

2. The tasar industry has been fully dealt with under Wild Silks and the production of tasar is limited to the Chota Nagpur Division, the Sonthal Perganahs and Orissa. The fate of the industry depends upon the policy followed in regard to tasar and thousands of weavers, twistors and spinners in Bengal and the Central Provinces depend upon Chota Nagpur for their cocoon supplies and so for their livelihood.

Tirhut.

3. An attempt has been made to calculate the costs and profits of growing univoltine silk worms in Tirhut. Assuming that the indigo concern planted mulberry, paid for seed, and a rearing house, etc., and paid Rs. 20 a maund for cocoons, how would they stand ?

An acre of land planted in June as bush gives 100 maunds of leaf per acre in the next spring : this supplies 6 families who each get two ounces of seed : they produce each 1 maund of green cocoons from the seed, which the factory buys. The expenses are—

	Rs.	A.	P.
12 oz. of seed at Rs. 3 ounce	36	0	0
4 temporary chitai houses 12' × 9'	20	0	0
Split bamboo machans	12	0	0
Cocoons 6 maunds at Rs. 20	120	0	0
Bags and freight	6	0	0
Drying and carting	1	0	0
Land	30	0	0
TOTAL	225	0	0

The seed is assumed to be got from Simla : the houses are temporary shelters of chitai, assumed to cost Rs. 7 to Rs. 10, and to cost Rs. 2-8 a year to keep up : so Rs. 5 each is allowed. The cost of split bamboo machans for cocoons allowing for three machans above the other is put at Re. 1 per machan per house : the cost of wire netting would be from Rs. 1-8 to Rs. 3 and the cost of chitai would be Rs. 1-8 per machan : probably split bamboo with cloth over would be used. The cost of land is put at Rs. 30 per acre as covering management expenses.

Assuming 6 maunds of cocoons are produced, selling them at Rs. 35 covers expenses : and good quality cocoons from European seed are worth Rs. 45 to Rs. 50 as a rule. I have assumed the cocoons are sold to Bengal for reeling until the production in Tirhut is big enough to justify a filature. It is impossible to calculate costs of reeling in any way accurately : in Bengal, labour costs Re. 1 per seer of raw silk, other expenses Re. 1 per seer.

Allowing 100 acres of mulberry, producing 600 maunds green cocoons at Rs. 35 a maund :—

	Rs.
Cocoons cost	21,000
Reeling costs	4,000
Expenses are	4,000
TOTAL .	29,000

600 maunds green cocoons

	Rs.
4,000 lbs. raw silk =	40,000
6,000 lbs. waste „ =	4,800
TOTAL .	44,800

This estimate has been prepared after very careful discussion with Mr. Francis Coventry, the Manager of the Dalsing Serai Concern in Tirhut. This division is peculiar in that it is covered with indigo concerns, which have great local influence and which would form an admirable medium for the introduction of sericulture : it may also be pointed out that the whole cost of an acre of mulberry is put against a single brood in the spring : but this acre will yield leaf for the rains crop or an October crop, if such is possible.

The figures given above have been calculated on a yield of 40 lbs. of cocoons to one ounce of seed. Supposing conditions are bad and only half is got ? then—

	Rs.	A.	P.
12 oz. seed	36	0	0
4 houses	20	0	0
Machans	12	0	0
Cocoons 3 maunds	60	0	0
Bags and freight	3	0	0
Drying and carting	0	8	0
Land	30	0	0
TOTAL .	161	8	0

To cover this half yield of 3 maunds, Rs. 54 per maund must be got, which is equivalent to Rs. 162-11 per dry maund. Such prices would be realised now and probably for some years : but if such low yields were got, it would not pay eventually. The average yield in Kashmir is 80 lbs., in Jammu is over 50 lbs. and in the Punjab is about 40 lbs. I think that Tirhut offers very good hope, as the pressure of population is high, the indigo concerns, European or Native managed, offer a means of organising it and a very complete experiment can be made at quite small expense. I would guarantee to make up losses up to Rs. 100 an acre to a concern for 5 years subject to 20 acres being done the first year, and the experiment being under the supervision of a competent fieldman. If one concern made a success of it, others would take it up and a nucleus would be formed : possibly large land owners such as the Maharajah of Darbhanga would be interested. It is perhaps well to point out at once that no silk industry will be profitable if large rearing houses at the factories are used : the eri failures have confirmed that fully.

4. I have discussed on pages 83 & 84 the possibilities of Chota Nagpur and Orissa as areas for mulberry silk and I would experiment carefully after very full enquiry. Experiments have been made in three Orissa States but I do not think the possibilities have been properly tested. This is referred to here simply to bring together the possibilities of this administrative area, which are very large.

Weaving.

5. The following districts are concerned in the industry :—

Patna Division.

Patna.—Is reported to have once produced mulberry silk. In the Bihar subdivision, 200 looms used to work on tasar and bafta : in the Barh subdivision, 1,000 looms were estimated to work, with silk from tasar cocoons imported from Hazaribagh and Singhbhum.

Gya.—In Gya, Kadirganj, Akbarpur, Daudnagar, weaving of bafta occupied many looms, probably nearly 1,000. The reports say that the chief demand is to supply shrouds and the demand is from pilgrims.

Shahabad is not reported to weave.

Tirhut Division.

Saran has a curious return of 258 persons engaged in bee keeping, bird and cocoon rearing in the 1911 census : these are probably shikaris and have no relation to silk. A crop of univoltine cocoons of very good quality was grown at Hathwa by Mr. M. Mackenzie in 1909.

Champaran.—Should be a splendid silk producing area but produces only the handful of cocoons grown at the Salvation Army Criminal tribe settlement at Bettiah.

Muzaffarpur.—The only silk production are the eri products, now nearly extinct.

Darbhanga.—Apart from Pusa, there is no silk production. This district contains the very skilled weavers who produced kokti cloths from cotton : the Madhubani subdivision should have a large silk weaving and producing industry, containing as it does very skilled weavers.

Bhagalpur Division.

Monghyr.—There is neither silk production nor silk weaving.

Bhagalpur.—Is reported to have produced mulberry silk. The villages round Bhagalpur city contain many weavers of tasar and bafta. The cocoons are bought from Chota Nagpur, very largely from Chaibassa. There are probably from 1,500 to 2,000 weavers' families in the district. There are also very enterprising firms who employ weavers to produce a great variety of fabrics : a good handloom factory exists there, in which weavers can get work. It is characteristic of the industry that at Champanagar, the weavers were having slack times, in Bhagalpur, the hand-loom weaving factory could not get workers. The enterprising Bhagalpur firms took up many ideas from Pusa and have used much eri silk.

This is probably the only place that will respond readily to advice and technical assistance. Hattersly looms can be seen working there and good pirn-winding machines : but the firms want expert advice and help, which they cannot get.

Purneah.—This district is on record as having produced mulberry silk : it might produce some now.

Sonthal Pergannahs.—This is a hilly district cut off from the Chota Nagpur block, in which a certain amount of tasar is produced, the cocoons going to Birbhum. Formerly a colony of weavers existed at Malbhagaya, who wove tasar. Probably mulberry silk could be produced successfully.

Chota Nagpur.

Hazaribagh has a production of tasar cocoons, exported for use to other districts.

Rancht is similar to the last district : it is an exporting area for tasar.

Palamau as the last.

Manbhum produces tasar and also weaves it : three villages produced tasar cloth.

Singbhum produces tasar cocoons, and formerly contained a filature for tasar cocoons, the thread being exported : in 1911 this employed 90 people according to the census. A small amount of weaving was done in Seraikella State.

Orissa.

Cuttack.—Gopalpur contained 200 families of weavers who used cocoons from the Keonjhar State and produced tasar fabrics. In regard to this district Mr. Anson writes—“ There is an interesting little silk industry in a single village Olsing, about 16 miles from Khurda. Some 80 families are employed and all branches of the industry are carried on. Pure tasar, pure mulberry-silk, and a cloth composed of a tasar warp and a mulberry weft, are manufactured. The mulberry-silk is all Bengal, and is bought in Cuttack at Rs. 20 a standard seer (80 tolas). It is said to lose 20 tolas in cleaning, and no use appears to be made of the waste. If this is true the silk ready for use costs nearly Rs. 27 per seer. This price is absurd. Malda and Mysore cost Rs. 13-8 for 72 tolas in Kumbakonam and obviously by better organisation the Olsing weavers could get their raw material for much less than they now pay.”

“ The tasar cocoons are fetched from Angul, Chaibassa, etc., or bought in local *hâts*. They are spun in the usual way across the thigh by old women, 8 cocoons at a time, two bobbins being used, one for *Kantia* (coarse thread) and the other for the *tasar*. Both are used for weaving. *Misri* and *tasar* cloth are both plastered with *lia* (fried paddy and water), while still on the loom, for strengthening the fabric.”

“ The tasar cloth sells for Rs. 9, *misri* for Rs. 16 and mulberry for Rs. 24 to Rs. 28 for 15 cubits. The dyes used are German, and also magenta and lac from Cuttack. Kamela was formerly obtained from Banpur (forest tract in this subdivision) but for some reason is not now used. All the cloth is sold locally.”

“ I noted (1) bad communications. The village is practically isolated by paddy fields in the rains. I am told that it is ready to provide half the cost of a 2-mile feeder road, and I shall see if this cannot be arranged. (2) The fly-shuttle is apparently unknown—still more the Churchill loom. If these could be introduced I imagine the output could be enormously increased. (3) As already mentioned the price paid for raw material is much too high. (4) The weavers appear to be mostly independent and not merely servants of petty employers. (5) The industry is probably not economically run, winding-waste being apparently thrown away. It could be sold to the Bombay mills.”

“ I think there is good scope for co-operation here. By joint buying and selling, and joint funds for purchasing improved looms, etc., on the same plan as the big Conjeevaram Weavers Union, I do not see why the industry should not improve very considerably.”

Balasore.—A small tasar weaving industry existed, estimated at 40 families in Purusanda and 50 in Patpur and Raibania using cocoons from Keonjhar.

Angul.—The Dhenkanal State : 50 families wove locally produced tasar cocoons. A mulberry silk experiment has been recently in progress.

Sambalpur.—This district is a great tasar using district ; for details the Central Provinces Monograph is to be consulted : a report on the tasar industry will be found under ‘Tasar’ in Chapter XIII.

Puri.—In the Khurda subdivision, 40 milies of weavers existed who used local cocoons.

Orissa States.—According to the census of 1911, there is a great production of tasar and a considerable use. In Mayurbhanj, 200 families in Bamanghati and Ulmara wove tasar. The State has also experimented in mulberry silk production. Not very much information is available but these States should be able to develop sericulture probably, if they worked it on proper lines.

DEVELOPMENT.

It has not been possible to investigate in detail the silk industry and its possibilities in these districts and in many States. The only large centre is Bhagalpur and that mainly uses silk derived from other districts; the industry elsewhere is very scattered and it will be a very difficult matter to help the weaver in these scattered villages. The trade is a difficult one to understand or to know: and the isolation of most of the weavers in this area adds to the difficulties. If they could be helped, this class would probably respond very readily but the number of small communities concerned makes it difficult: on the other hand, these communities respond very readily and do offer very good hope of development. At Olsing for instance, the weavers make excellent cloth that would probably have a wide sale: but in the first place they get their raw silk from a *mahajan* who comes from Madras and they pay an extravagant price: in the second place they sell their cloth only in the local market. They would probably co-operate and get their raw silk direct from Calcutta a bale at a time: they would also buy their tasar supplies for the whole year and not as they want them: and they could execute an order say for 100 *thans* of their cloth for an outside demand.

7. All this would be easy to do if there was the organisation: and it would only need an assistant to visit all such places, investigate their circumstances, start the co-operation, give a big order for cloth, and then visit them say twice a year: if there were a demand, the assistant could see that it reached them and was being executed: and slight improvements in their processes could be introduced. There are hundreds of places like Olsing in this province, largely in feudatory states: and the need obviously is for organisation and co-operation.

8. The main interest is tasar and the enquiry made into the tasar industry this year shows that while the tasar cocoon rearer and collector is not in need of any assistance, having other means of livelihood to fall back on, the tasar weaver is very definitely in need of help which can be easily applied. Moreover the tasar weaver is largely outside Behar and Orissa and this province is not less concerned in this problem than is Bengal or the Central Provinces. Apart from the organisation of the trade, the real interest in Bihar and Orissa lies in its possibility of developing a mulberry silk producing industry, both in Tirhut and in suitable areas in the Chota Nagpur and Orissa tracts: the possibilities are very large indeed and have not been tested as yet: but it would not require a very great expenditure to commence experimental silk rearing on sound lines in suitable places and this expenditure would be fully justified. As a centre (Pusa) already exists in the province from which the production could be organised, it requires only the provision of the small necessary staff under the general control of the silk expert if such an officer is appointed: failing that, the appointment of a properly qualified silk expert for a short term, say three or five years.

CHAPTER XXI.—THE UNITED PROVINCES.

There is no mulberry silk rearing in the Province at present: the trials at Kalakankar and Dehra Dun were interesting (see Experiments, Appendix XI) and the eri trial at Shahjahanpur (page 132). In Mirzapur, tasar is collected to a considerable extent. Mulberry grows well and has been planted in most districts at some time: trees are available in quantity in submontane districts particularly. The population is predominantly Hindu and with strong prejudices against taking life: the rearing industry, if introduced, will be done by Mohammadans, by low castes and by paharis and the like in hill districts. The climate is well suited to growing a single crop of univoltine worms in the spring; whether another crop can be taken in the autumn remains to be seen.

2. Eri has been grown by numbers of cultivators who got seed from Shahjahanpur or Pusa : it has ceased for want of a market for the cocoons and for want of a certain seed supply in July. If there were a demand for cocoons, large quantities of seed could be supplied from Jeolikot, as has been done recently and a big crop of cocoons could be obtained if markets were organised. The best policy for the United Provinces will be to ascertain where mulberry exists, and if in those places there are people who will rear silkworms, to start them at it directly, doing eri in the rains and mulberry in the spring. The futility of schools, bulletins, demonstrations, school-teaching, and exhibitions has been well shown and nothing but direct starting by the cultivator will achieve anything. Mission settlements who have land could start it but their example will not be followed outside their own limits, so they have no effect in actually increasing the industry. The Province could have a large industry as almost the whole of it is climatically favourable in February-March : but its development will be difficult and is not worth undertaking except in specially favourable places.

3. The United Provinces are more directly interested in silk weaving and a considerable population (15,000—20,000) are concerned in the industry which is centred at Benares. Weaving used to be practised at Agra, Azamgarh, Farukhabad, and Jhansi ; at Meerut, silk embroidery was an industry, at Budaun there was silk dyeing and weaving : Fatehpur had an industry in printing silk, Lucknow was famous for dyeing, for chikan work and the making of ribands, lace, etc., in silk and gold or silver thread. Aligarh, Muttra, Jalaun, Allahabad, and Manipur have small industries in silk embroidery, buttons and *huga* tube making, etc., in which silk is used. Bara Banki is now a silk weaving district, the industry having been developed by the Hewett Weaving School there : there are silk-weavers now at Shahjahanpur. The census figures for 1911 are to be found in Appendix X.

4. The industry is centred in the towns and is not a village industry except in Bara Banki : Benares is the chief town concerned and is in its workmanship and fabrics one of the leading weaving centres for all India. The details of the methods used in Benares are described fully in A. Yusuf Ali's Monograph of Silk Fabrics (1900) and need not be repeated here. The twisting and doubling of the thread is still done on the slow and tedious process of laying the thread out and twisting each one individually by a weighted spindle : warping is done in the open, by laying out the threads round uprights in the usual way : if the wavy pattern is required, the warp is tied up at intervals in such a way that when placed in dye, the threads are dyed between the knots only and the warp can then be arranged so that the dyed and undyed parts make a pattern. The weaving is on pit-looms, some of them with the complicated harness required for weaving brocades and flowered fabrics : the heald strings of complicated patterns are manipulated by loops pulled by a separate worker : in gold ornamented cloth the gold stars on patterns are put in separately from small bobbins and a single loom may require four workers. In the United Provinces the *kundigar* or polisher is a feature, the finished fabric being washed, then smoothed and polished with a mallet and a flat block or with a smooth block of stone.

5. Benares was famous for its very elaborate brocades and these require the very complicated looms, worked wholly by hand, whose setting is so difficult : a single loom may have as many as five separate sets of loop combinations to form the border, the corners, the solid body, the end block and the end border : one cannot use fly-shuttle slays and rapid weaving for such fabrics and it is not easy to see how, apart from dyes and twisting methods, much improvement can be made : also the demand is lessening and the production of the very finest quality fabrics is diminishing. In the last fifteen years Benares has developed a new industry in 'Kashi' silk, plain cloths of artificial silk, spun silk and mercerised cotton, sold for suits, frocks and general use : the trade has been partly with European firms and with box-wallahs and traders who supply Europeans and Anglo-Indians, partly with the usual bazaar channels for the supply of suiting silk for wear by Indians,

a custom which is rapidly growing. There is little doubt that had it been better organised and had only good spun silk been used, the production in Benares would have reached much larger dimensions: the reputation of Kashi silk is now not good and yet the amount of the demand showed what the possibilities have been and what an opportunity has been lost. Such silks are now being made elsewhere and Kashi no longer has the monopoly of the supply.

Fabrics.

6. Brocades (*Kamkhwabs*) are produced in great variety of design on hand-loom: silk alone or silk and cotton is used, with gold and silver thread. The cost reaches Rs. 100 and more a yard for pure silk and heavy gold thread: the *than* is usually 30 inches wide and 3 or 4 yards long. Without gold or silver thread, the fabrics (called *amru*) are proportionately cheaper.

Sangi is a plain fabric with waved effects produced by dyeing the weft thread with regular knotting: it is usually silk and cotton mixed: two warp threads of different colours are put together.

Gulbadan is another fabric with waved effects: *mashru* has the wave produced by dyeing knotted warp threads and is also silk and cotton, like the *bafta* of Bhagalpur.

Satinette is cotton back satin, so woven that the smooth silk is one side, the cotton warp on the other. It is a feature of Azamgarh. Real satin is made in Benares.

Checks, stripes, daryai, nainsooks, gauzes are produced in great variety of colours and designs, some of the finest with gold threads in them. In recent years there has been an attempt to make these for the European trade in India and Benares firms are represented in Simla, Calcutta, etc.

Pieces. The best weaving is employed on making pieces ready for wear. *Saris* are made with one end plain, the other very elaborate, and with one border ornamented.

Dhoties are simpler, *pitambar* dhoties of pure silk, others of silk and cotton; *Dupattas* are wraps of over fifty inches wide, made in silk or mixtures.

Borders and end pieces are separately woven and stitched on in some cases: they are very elaborate, with much gold and sell by weight. Turbans are woven in simple line designs of various widths and lengths. *Rumals* are small wraps or handkerchiefs, woven in single squares up to 60 inches wide: they grade into wraps and shawls of various kinds and sizes.

Other pieces include petticoats, bodices, veils, *kamarbands, rizzai* pieces, and *chaddars*, woven for special order or for special places: there is a great variety of these in silk and silk-cotton; there is a separate production of hand spun mulberry waste (*matka*) and of tasar, the former in pieces ready to wear such as dhoties or in lengths to cut. The Monograph dated 1900 makes no reference to the fabrics of spun silk, noil silk, artificial silk, mercerised cotton, already referred to, which is now such a feature of Benares, so presumably it has developed since that time. So too the silk fabrics of Bara Banki, usually piece goods in stripes, made of spun silk and cotton, are not referred to: these are now largely produced and sold in Lucknow, Bara Banki and neighbouring districts.

7. A bad feature of the Benares industry is its poor dyeing: aniline dyes are used giving the delicate shades so much in demand but the best aniline dyes are not used: acid dyes are sometimes employed, with the juice of limes to provide the acids; most of the very best fabrics will scarcely be exposed to light or washed, being worn on high occasions by women: but there is scope for really good dyes and the Weaving Masters were much interested in the alizarine dyes that Pusa employed. The use of first rate fast dyes would be an advantage especially in regard to fabrics for the European trade.

8. The silk used in the United Provinces is from various sources: much is Bengal *khungru* silk, some is filature silk from Berhampur, China silk from

Bombay is used as well as dyed silk from the Bombay dyeing centres. From the North, Bokhara silk comes down *via* Peshawar: *matka* or spun mulberry thread, and tasar thread is imported from Bengal and Mirzapur: a limited amount of handspun eri is used but not much is available as a rule. There is now a large import of spun silk and noil silk from Bombay, which is mostly imported from Italy, England and Japan, the latter now predominating. There is an import also of spun tasar silk from England: and one mill at Cawnpore imports tasar waste, spins it and weaves the yarn into serge, puttees, etc. The figures of trade, etc., will be found in Mr. Ansorge's report, Volume II.

9. An investigation of industries was made by A. C. Chatterjee, I.C.S., and published in 1903 (Notes on the Industries of the United Provinces). He deals with the silk and gold thread industries and makes suggestions for their improvement. He classes the Benares weavers (*jolahas*) as—

- (1) workers for dealers, who are not themselves weavers,
- (2) independent workers who sell in the bazaar,
- (3) employés of Mohammadan factory owners:

"the first class are almost entirely within the power of the middleman dealer, who advances the yarn and takes the manufactured product either as a purchase or on commission sale. It was for the benefit of this class mainly that the Benares Silk Weavers Co-operative Association was started and the results have so far been eminently successful."

10. In Benares as elsewhere the weaver who is in the hands of the employer makes a bare livelihood working at a very skilled craft and his condition is a very unsatisfactory one.

11. The development of the silk industry in the United Provinces has received some attention and the opening of the village industry shops in places like Cawnpore is an interesting development. But there are so many industries to deal with that silk is not receiving much attention as yet. The most noteworthy developments are the Benares Central Weaving Institute, the Bara Banki Weaving School. The former is intended to undertake experimental work for the weaving industry, to afford assistance in technical operations and to provide instruction. A course is given which occupies three years: twenty students a year are admitted and in 1913 there were 61 of whom 3 were weavers: there are now 90, mainly of non-weaver castes. Materials and appliances are supplied free and some students get scholarships. The Institute is equipped with many kinds of looms costing from Rs. 200 downwards and with warping and winding machines. The Superintendent informs me that 80 per cent. of the students have taken up weaving or hosiery after leaving. As a rule the weavers are the ones who benefit least and it is among non-weavers most success is gained; at the present time hosiery is the popular industry. Socks are being made of silk and the eri silk socks made should have a future, if the yarn supply can be arranged for.

A supply of eri cloth was made for sale in London, partly through my suggestion when I was in London, and this has now been disposed of at good prices: it looks as if eri was worth paying attention to and it is certain that if it had been pushed in connection with the war in Mesopotamia, the Benares weaver could have added a new production to his present selection. This work is done experimentally at the school and then tried outside: and the Superintendent is starting a model factory in Benares and is in touch with master-weavers who want to do the same. The fabrics and hosiery made at the school are sold or are made to order: this is an excellent practice and works especially well on the hosiery side. The school experience with looms is against the Jacquard and the automatic beating loom, but is for the fly-shuttle and the Dobbie: it is an illustration of how each province varies in this respect and shows how each area must be separately developed.

I do not think that this Institute will effect much as regards silk and I question if Benares will benefit very much from it. It is impossible for

such an Institute to teach and to improve weaving: the head of it cannot possibly master and improve all processes from winding to weaving including dyeing, understand the trade, develop hosiery and teach 90 students on a three years' course. Nor can I see any good in teaching 90 students of whom only a few are weavers.

12. Bara Banki was an example of the proper weaving school and the original idea was excellent: it was the most practical and commonsense Institute for silk that I ever saw and its policy was extremely sound. It is the one referred to in the extract from the "Indian Textile Journal" quoted on page 110.

The following are extracts from its prospectus:—

* * * * *

The primary object of the school has been to give a thoroughly practical training in weaving on improved hand-loom.

* * * * *

In the men's section the school has 87 students on the roll, out of which 55 work on hand-loom, 14 on hand *karghas* and 4 on carpet work, with 35 Salvation Army looms, 6 Salvation Army slays and 2 Chatterton looms. This school has during three years instructed 325 pupils of whom 26 have gone out as teachers to various districts on pay of Rs. 25 or more, while others exercise their profession in this district either at various branch factories or at their homes.

The weaving section is divided into two parts (1) those who buy their own looms, (2) those who are being instructed to become teachers.

* * * * *

There are in the district eight branch factories employing between them 50 looms of the Salvation Army large type. The school assists these branches in every way by giving continuous instruction even after the weavers have left the school and also putting their manufactured cloth on the market. During the three years the Hewett School has sold Rs. 5,100 worth of cloth for these branches. The Elgin Mills have given us an order for 800 yards of cloth and have promised to give us further orders.

* * * * *

In the dyeing section not only is all the yarn required for the school dyed but lessons are given in dyeing fast and beautiful colours to all the students in the weaving and hosiery sections. The dyes used are aniline dyes and the dyed product is dipped in boiling water to prove that it is fast.

We have ourselves sold 88 Salvation Army looms, 38 Salvation Army slays, 20 Serampur slays, 21 Benares slays, and 53 knitting machines and 14 Singer's Sewing machines.

Apart from the above, students have purchased from Bombay, Lucknow and Lahore to the value of some thousands of rupees. Cloth we have prepared to the value of about Rs. 24,500 and we have sold from the beginning up to the present to the value of Rs. 22,900 out of which Rs. 8,282 worth of cloth we have sold from 1st April to date; from 1st April to date we have sold cloth of other factories to the value of about Rs. 600. During the same period we have received donations to the amount of Rs. 4,185, we have purchased yarns from the beginning to the value of Rs. 20,000 or from 1st April to date to the value of Rs. 8,000 and we have sold yarns to students and other factories from 1st April to date of about Rs. 1,906-6-6. A further very satisfactory fact is that we have during the last two months sold 74 looms on the *takkavi* system and expect to sell a large number more shortly. These are our own school adaptation and cost only Rs. 7 each.

The following are extracts from the notes I took on a visit to the school in 1910 :—

The men who come, buy looms and take them off. They may not be weavers and often are not but they take it up. They buy the upright loom or the school's own slay and adapt that to their loom. The men are genuine and are really learning the most important thing, that is, to make a few cloths for which there is a definite demand. There is a ready sale in Bara Banki and the school itself also sells afar as at Lucknow, etc. I dislike the loom they sell and dislike the dyeing: the rest I consider admirable and thoroughly practical.

The whole Institute is practical; they make every man do work he can sell; there is no theoretical instruction; the weavers have to buy their materials, looms, etc., all cloth is sold; there is no class for design or machine drawing; the weavers actually learn how best to make definite cloths for which there is a demand and the school pays as much attention to that as to the teaching.

13. The Director of Industries regards the peripatetic weaving school as the most valuable means of developing and improving weaving generally: there are nearly 500,000 cotton weavers in the province as opposed to some 14,000 silk weavers so that the development and improvement of cotton naturally comes first: and it is to be noted that while the object in cotton is to do coarse weaving quickly, the object in silk is usually to make a better product: so that methods applied to cotton do not necessarily suit silk. Another method of helping the weaver is the supply of materials and appliances at wholesale prices direct to the worker: this method is giving very good results and the weaver is taking advantage of the facilities: this is mainly for cotton and at present not much for silk: but the method seems to be a sound one.

14. The silk industry in the United Provinces is small as compared with some other provinces but has great possibilities on account of the large number of cotton weavers, who might weave silk: and there might very probably be a very large development of the suiting silk weaving, if it were organised on proper lines. There is a probability that the small finishing factory, serving as an organising centre, might be a success and it would certainly be worth trying: I am not sanguine as to the small hand-loom factory since here as elsewhere the weaver works better at home: but the finishing factory is a very different thing, serving chiefly as a centre and putting the finished article on the market in large quantities, properly prepared for sale.

15. In Chapter XXVIII the formation of a Central Silk Institute has been discussed and the natural place for it, in some ways, would be Benares, on account of its existing industry, fine methods and accessible situation. Furthermore the industry in the United Provinces is nearly all in Benares and the Institute could carry on its work for the whole of India without being called upon for any local development work outside Benares: the present Institute would become a district weaving school and its work would not be in any way overlapped by the activities of the Institute as I have sketched it. I think further that the development of model finishing factories and the like could be worked up there and that the small factory method of dyeing, twisting, warping could be taken up with good chances of trial.

16. The development of the silk industry in the Province depends upon these points :—

1. *Survey of production.*—A real study needs to be made of what is being produced, of the capacity of the weavers, of the organisation of the industry. It will be possible then to see what branches can be developed and where a demand can be stimulated for local products as is certainly possible.
2. *Facilities for cheap supplies.*—This is now being done and could be extended, if the industry was well understood. The demand for eri silk cloth for instance cannot be met for want of yarn.

3. *Better dyes.*—This has been carefully investigated before with the master-weavers of Benares and the really fast dyes of Pusa could have been adopted here. For certain classes of new fabrics this will be essential if there is to be a development.
4. *Better designs.*—The demand for the well known Benares *kum-khwabs* is lessening and there is no production taking its place: but there is scope for new designs, new ideas, new productions to meet other demands. The Benares fine silks are the only Indian productions selling in big cities where they compete with foreign silks and this could be very much developed, if the producers got help with new designs and new ideas. I have discussed, on page 187 how ideas would be got from Paris, London, etc., in regard to new fashions and I would expect to produce many of these at Benares, if the trade was organised.
5. *Model Finishing Factory.*—The development of weaving in new places or in existing centres (*e.g.*, Azamgarh) by means of the small finishing factory deserves a trial and may be a very valuable means of development. The details require to be worked out experimentally, a trial factory made on a small scale and the whole question to be carefully gone into on the spot. If this is done it must be done on the results of the survey and finishing tried for the special classes of fabric likely to be most easily developed.

CHAPTER XXII.—THE PUNJAB.

The province has a small silk rearing industry, which is discussed in Chapter V: it has a much larger silk weaving industry centred at Amritsar, Multan, Jullundur and Lahore. The kinds of silk used are very varied, including China, Bokhara, Yarkand, Bengal raw silk, and spun silk from Japan, Italy and England. This is fully discussed in Mr. Ansorge's section of this report (volume II).

2. Raw silk is opened out and wound off on to small hand reels: in Lahore, the skein is spread out on two small swifts one of which is placed on the floor, the other on the wall or on an upright: the silk is sorted into four qualities, there being as much as a chittack of waste in a seer on the average. The silk is then twisted on a very excellent machine, which is a modification of the one used in Bombay, Nagpur, etc. The silk wound off on reeds, is placed on spindles which are fixed in a vertical frame: these are driven by a leather belt from a big wheel, the belt passing round the first spindle, then round the near side of the second, the far side of the third and so on: actually two belts drive the whole series of twenty spindles: the silk is received on baby reels which are turned by two belts driven from the axle of the driving wheels. The twisted threads are not again twisted together but used as they are. The machine is most efficient, does a large amount of silk at one time and is well constructed. The day's output is two pounds. It is referred to by Hailey in 1899 as then new. The twisted silk is then boiled off in soap, or soda: dyeing is done with aniline dyes mainly: formerly Amritsar was famous for dyeing in indigenous dyes and silk was sent there from distant parts of India: but anilines are now used. The dyed yarn is then wound off, warped in the usual way on upright sticks or on a revolving warping mill direct from the baby reels, the warp stretched and sized, and put into the loom.

3. Weaving is done on pit looms, with two shafts, usually to a width of not more than 31 inches: the use of any better loom seems to be unknown and there are great numbers of these looms at work in the weaving centres.

The fabrics woven are almost wholly plain coloured silk (*daryai*) or striped and shot (*gulbadan*), or checks (*charkhana*): some are finer than others but there is otherwise little variety. In Multan there is a large production of cotton and silk cloth. Cotton cloths with silk borders are also woven largely and some pure silk is woven to stitch on to cotton cloth as a border.

There is an increasing use now of artificial silk as weft with spun silk or even mercerised cotton as warp: and the Punjab silk, formerly of pure China or Bokhara yarn fast-dyed with cochineal or kamela, is now losing its quality and its reputation.

Weaving in the Punjab is largely in the hands of dealers and employers, who are shortsighted, who go in for the cheap showy fabric and think more of the immediate profit than of the maintenance of an industry. All forms of adulteration are practised and the weaver is skilled in making cloth thick at the edge, thin inside (an extra thread in the outer dents) and in putting more picks to the inch at the ends of the cloth than inside. The weavers can make plain silk piece-goods very rapidly and cheaply: they are not organised, are in the hands of traders and are unable to keep up their fabrics to a proper standard. There is very great scope for organisation on co-operative lines with better methods and making a wider variety of cloth: and this is made easy by the concentration of weavers in large cities such as Lahore, Amritsar, Multan, etc. There are a considerable number of people affected: the census total of 1911 is 13,584. Hailey's Monograph in 1899, gives a total of 12,740 silk twistlers, weavers, etc., in Amritsar, Multan Jullundur, Lahore: and the following very interesting figures are from Cope (Journal Agri-Horticultural Society in India, X; part II, 1858).

	Lahore.	Amritsar.	Multan.	Jullundur.
Dealers	52	133	101	..
Dalals	20	32	..	..
Winders	300	735	218	39
Twistlers	87	249	89	306
Dyers	19	156	32	43
Weavers	447	900	371	169
TOTAL	925	2,205	811	557

These are the only figures known to me in which the proportion of persons employed and trading in silk are given: thus for 1,718 weavers, there are 1,885 preparers (1253 winders, 425 twistlers, 207 dyers), and 338 dealers in raw materials, and piece-goods. That is seventeen weavers require 2 dyers, 4 twistlers, 12 winders and 3 dealers.

4. There is a considerable industry of a minor kind in silk embroidery, making silk braid, buttons, armlets, ornaments, etc. Two branches of this are described in Hailey's "Monograph on the Silk Industry in the Punjab (1899)", quoted from Baden Powell's "Punjab Manufactures": the workers (*patolis*) are to be found throughout the Punjab towns and carry on a small industry that requires a certain amount of coarser kinds of silk.

NORTH-WEST FRONTIER PROVINCE.

5. There is an industry in weaving and silk work in Kohat and Peshawar: no silk is produced now: an account of experiments will be found in Appendix XI. There is no reason why silk should not be produced extensively and profitably. In Baluchistan there is also silk embroidery and some weaving. The industry is a small one and apparently growing smaller: Hailey in 1899 records 976 persons engaged in Peshawar, 450 in Kohat: the number now in Peshawar is reported as 40 weavers and 50 on twisting, dyeing etc.: the cloths made are of pure silk or of cotton and silk and are similar to those made in the Punjab.

6. The embroidery of silk on cotton (*phulkaris*) is probably a more extended industry of which figures are not available: it is reported to be carried on in Hazara, Zhob, Loralai, Sibi, Bolan, Chagai, Quetta, Kachi, Jhalawan, Mekran and Kharan: the work is done by women in their homes and much finds its way down country through dealers and wandering traders (box-wallahs). It is an industry similar to that of Kashmir: and the only notable point about it from our point of view is that it has suffered to some extent from the use of aniline dyed yarn, and that to persist now the use of the old indigenous plant dyes will need to be gone back to.

It has not been possible to make local inquiry into this industry but it would be extremely interesting to do so: and its possibilities may be investigated later on.

CHAPTER XXIII.—KASHMIR.

Weaving.—During 1904-05, 12 looms were obtained from England and as results appeared satisfactory, 200 more were ordered.

During 1905-06, 11 looms worked and 70 more were brought into working, 109 pieces were made and 87 sent to London for sale. Sale proceeds Rs. 2,349-8-9; working expenses Rs. 18,828-0-5, capital Rs. 64,150.

1906-07. 200 looms were fixed, 123 worked, 58 made "perfect cloth." During the year 538 pieces were made. Total sale receipts Rs. 7,455, expenditure Rs. 62,779—of which 36,316 working expenses.

In 1907 the weavers were working as follows :—

40	doing	5	yards	daily
15	"	6	"	"
13	"	7	"	"
6	"	8	"	"
2	"	9	"	"
1	"	10	"	"

The 200 looms were fixed and 114 were making "perfect cloth." Cloth was sold in London (Rs. 7,702) and locally (Rs. 11,103); working expenses including cost of silk were Rs. 1,36,211. On the average there were 186 weavers doing 601 yards per day.

The results were not very hopeful, but the reasons were (1) excessive price charged for raw silk, (2) weavers not staying, and (3) want of dyeing and finishing plant. It is illuminating to remember that the cloth made was of 24 and 28 denier, not degummed nor thrown, as no throwing plant existed.

In 1908, the loss was Rs. 44,109 and 3,034 pieces were made.

In 1909-10, the loss was 21,447 of which Rs. 10,026 for depreciation. The labour difficulty was acute. 3,407 pieces were made. Spun silk was used in part. The drawback of the inability to dye and finish was realised and the industry was clearly failing for want of demand for this quality of light white silk.

In September 1910 weaving was handed over to Sericulture Department again "since which time a good deal of the finished cloth of thicker quality has been sold on a profitable basis" (Report 1911).

In 1910 the weaving was closed.

2. It is difficult to comment on the weaving because it seems so amazing that a factory with 200 looms capable of doing say 1,200 yards a day should have turned out cloth in the gum, undyed, without doubling or twisting, and expect to continue to do so profitably. It was apparently meant to be sent to Macclesfield for finishing and printing: and the cloth was practically the corah than whose export from Bengal was then ceasing. A large sum has been spent, but had a little more been spent, had throwing plant and a dye house been erected; had the weaving master been allowed to visit India and see what he could make which was in demand, the project would have been a success as big as the cocoon production.

It is of no use to comment on this failure. Difficulties with labour were small compared to the difficulty of finding a market for pieces made of 24-28 denier untwisted silk in the gum!

At present the looms lie idle. There is no throwing plant, no dyeing, no finishing, the few pieces made by private enterprise have to be sent to Bombay to be degummed, and there is no prospect of doing anything unless a better policy is adopted.

3. Apart from the necessary expenditure on throwing machinery and a dye house, there is no extra expenditure to be incurred to make the weaving plant fit to turn out large quantities of the fabrics in demand in India. I think that this organisation might be a very valuable help in the competition with imported fabrics. It is probable that with the 200 looms available, the very efficient assistance of Mr. Worsley, the supply of raw silk of any required denier, that the Kashmir weaving could supply at once any fabric found to be in demand.

4. To fully understand this, the section of this report on the Development of the Silk Industry must be read. Above all we want to be able to make, on an

industrial scale, every fabric that is in demand, and the Kashmir organisation with its production of raw silk of any denier, its available waste, its efficient organisation, is in a unique position to help. The weaving factory at Srinagar with proper throwing, dyeing and finishing could turn out thousands of pieces of any grade, made to pattern, to meet any demand; and if I had the control of the commercial organisation proposed in Chapter XXVII of this report, I would regard this organisation as one of my chief assets. I could pass large orders on to it which I would know would be carried out, and it would be a help of the most useful kind in meeting foreign competition.

I think that if one reads the section on the Development of the Silk Industry and then realises the possibilities of the Kashmir weaving factory, able to turn out any fabric, to meet the demand found to exist, that one can realise the immense opportunity that lies before the development of this industry.

The Silk Embroidery Industry.

5. Kashmir has an industry in the embroidery of silk upon cloth, and in the weaving of silk and wool (*pashmina*). For the former, coarse thread is made with waste cocoons and *dupost* and this is sold from the filature. The silk is boiled off first with some 6 chittacks of locally made soap per seer of silk, it is then dyed, the dyers formerly using plant dyes, now using all sorts. There is a separate class of dyers, and they claim to have secret processes: dyes are tested by washing but not for fastness to light and there is scope for improvement here.

The dyed silk is in a tangle and the skein is put over two upright rods and run off on to a *latai*. In that form it is used by the embroiderer. It is untwisted, the fibres parallel, soft and very glossy; and the beautiful designs are stitched on with this soft material. There is another use for this material. The loose dyed thread is run off on to a spindle and a short length run round from the spindle to a peg and back. The worker smooths and polishes this with his hands and a long smooth iron needle, which he runs along the stretched threads to and fro till all the irregularities are taken out. He then takes the smooth thread, attaches it to a weighted spindle as in spinning and takes a short length, runs the thread back again to the spindle and then to the end of the first length. He has then three threads parallel, with the spindle he twists them together and makes a thick even thread that he winds off on the spindle, so he goes on with successive lengths. This thread is used for the peculiar knotted work done on wool coats.

The same dyed thread is used to make braid. The thread is carried from the hand of the worker to a peg in front of him three times, giving 6 threads in loops; these are then plaited together in sequence and the plaited portion tightly held by the toe of the worker. It is impossible to describe the process further. The result is a stout round braid of six plaited threads and it is sewn to the lower hem of coats, etc.

6. There is another industry which is of great interest. There is a large production of wool shawls for Bengal, these are made up with coloured borders, which are very curiously made. Silk of 18-20 denier is obtained and is twisted exactly as described for Assam and Benares by laying out the threads and twisting with a weight. Then these are warped on a four shaft loom as for twill weaving. Then a small pattern is put in with a great number of little wood "quills" and the white back ground is also so put in from quills. There are two or three men at each loom; one calls the pattern, 10 white ground, 3 green, 4 white ground, 5 red, etc., each puts it in, in order from the left. When one line is done the healds are lifted in the next-twill combination and the weaving resumes, and you get strips of figured cloth; but these are then embroidered over with the needle and are sewn on to the edge of the wool shawls. There are said to be between two and three hundred looms engaged on this work, with over 500 workers. It is more like carpet making than weaving as a single cross thread is never put in right across but the whole weft is put in in small lots with hundreds of quills. The industry is a very limited one that depends wholly upon the demand from Bengal and other parts of India. (Compare *acheik* weaving in Burma.)

7. The great interest of the Kashmir industry lies in its artistic beauty. Where in India you find conventional designs, very old, and no new ones, you find in Srinagar, the most beautiful designs based on local flowers such as the

lotus, the rose, or on the peacock, the chinar leaf, etc. The designing is still flexible, the dyeing is good, the spirit is progressive, and the firms concerned sell to English people and even have agents in London.

8. The possibilities of this industry are very great and I think they would justify study, the improvement of detail, the extension of design, the development of demand. I believe there will be an enormous reaction in Europe in taste, and that the hideous shoddy product of the modern mill will give place to what no mill can make, a really beautiful article, made by man's effort, and completely satisfying. I think that the products of Kashmir, aided by expert advice in dyeing, in designing, in details, would, if properly exploited, be in such demand that all the workers flourished.

The following extract from "Hand-Loom Weaving" by Luther Hooper is of interest in this connection:—

"Notwithstanding the competition of its formidable rival the power-loom, the hand-loom still survives, and seems likely to continue in use for the weaving of the best webs, in several branches of textile manufacture.

In various districts of Great Britain, as well as in France, Germany, Italy, and other European countries, hand-loom weaving continues to be, though much decayed, an important industry. In the East—in India, China, and Japan—the hand-loom weavers outnumber by several millions the workers employed in attending to the textile machinery of Europe and America.

The fact that hand-loom weaving has so long survived gives hope, that, now that there is a growing demand for the best in all departments of workmanship, the future may see an extensive revival of this beautiful and ingenious art."

The process of weaving the Cashmere Shawls has been instructively described by a traveller in India :

"The loom differs not in principle from that of Europe, but is inferior in workmanship, and the factories contain from three to three hundred of them, crowded together into very small spaces. About three weavers work at each loom. When the warp is fixed in the loom the pattern-drawer makes a design in black and white. He shows it to the colourist and the scribe, and they confer together. The colourist, having well considered it, points out the proportion of the colours, and, beginning at the foot of the pattern, he calls out the colour and number of threads to which each is to extend, that by which it is to be followed, and so on in succession until the whole pattern has been described. From his dictation the scribe writes down the particulars in a kind of shorthand, and delivers a copy of the document to the weavers.

"The workmen then prepare the needles by winding on each, coloured yarn of about four grains weight. These needles without eyes are made of smooth wood, and have both their sharp ends slightly charred to prevent their becoming rough through use. Under the Superintendence of the colourmaster, the weavers next knot the yarn of the needles in their proper places to the warp.

"The face or right side of the cloth is placed next to the ground, the work being carried on at the back, where the needles all hang in a row, making from four to fifteen hundred according to the lightness or heaviness of the ornament. As soon as the designer is satisfied that the work in one line is completed the reed is brought down upon it, with a vigour and repetition apparently very disproportionate to the delicacy of the material."

"It is a grievous fact that this beautiful handicraft of shawl-weaving has almost died out in India, owing to the competition of the cheap, meretricious, European, machine made imitations of the Cashmere weaving and design, with which the markets of both the East and West were flooded in the last century."

9. Three things would help the industry, the first is really fast dyeing, that was absolutely above reproach. If alizarine and indigo dyes were used exclusively, every shade could be obtained and the dyes would be as absolutely fast as any can be, far better than the existing ones. The second is design; it is impossible for me to suggest improvement in design say for the Bengal trade, but I can see the value of better design for the European demand, and I imagine that a really

good artist, with the flexibility of the Kashmir worker to aid him, could turn out the most beautiful fabrics. There are some but there should be more, and I think that it would not be difficult to turn out new designs, work them out and turn them over to the present dealers. The third is trade organisation; given absolutely fast dyes, given an artistic designer, the beautiful fabrics of Kashmir should find a large and ready sale in London, in Paris, in New York, etc. It requires a centre, where designs are worked out, it requires artists to design, it requires a fund that pays for designs, and it requires a selling centre in London, Paris, etc., to which the dealers send their goods. I believe that this organisation would benefit the Kashmir worker very greatly, it would be very successful if sympathetically worked, its development would be an important part of the work of the Silk Institute proposed in Chapter XXVIII and I can imagine nothing more attractive to the organiser or more beneficial to the craftsmen, than development on the lines I have briefly outlined.

In Chapter XXVII I have dealt with trade organisation; to nowhere could this be so well applied as to Kashmir; the promise of development is enormous, the artistic scope is unlimited, and the industry would respond readily to this kind of organisation.

Silk Carpets.

10. At one factory in Srinagar, carpets of silk are produced for the American market chiefly. The silk used is "dopost" or thick uneven thread made from double cocoons: the thread is twisted by hand on the *charkha*, then boiled off with soap and dyed: acid dyes of German origin are used with acetic acid. The carpets are extremely beautiful, usually the 15-18 stitch, on a cotton yarn foundation.

Development.

11. The State is losing a great asset in not developing the weaving industry and the fact that failure followed an attempt to make silk cloth before should not be allowed to prevent development in this direction. I believe the possibilities in this direction are very great, not in making cloth for export so much as in weaving for the Indian market. I think that the lines of development are perfectly clear; they are fully discussed in Chapter XXVII of this report. If the kind of trade organisation there sketched is ever provided for India as a whole, it would be an immense help to the Department to be able to fall back on the State and the State would benefit by the help of the Department. Failing that, it is a case only of sending the weaving expert on a tour of the weaving and trading centres and giving him a free hand. Of course the necessary plant must be provided for throwing, dyeing and finishing the cloth. I am very strongly convinced that a great opportunity is being lost and that a flourishing industry can be created if development is pushed on sound lines, and I believe the lines on which to develop are very clear.

It will require expenditure but it will also make profitable the machinery and buildings now lying idle in Srinagar.

I think that probably the development of this would eventually lead to the erection of a spinning mill capable of making spun silk from the available waste silk, and of warping these ready for sale or for local use in the weaving mill. There is a very large import of spun silk yarn and warps into India at present and with the supply of waste and the demand for yarn both at hand, this development would probably succeed well.

The immediate need is the development of the weaving blocked at present by the want of throwing machinery, a dye house and the plant for finishing. The position strikes one as a little absurd and it is to be hoped that the State will reconsider the matter.

CHAPTER XXIV.—THE CENTRAL PROVINCES.

There is no production of mulberry silk in the Central Provinces and the experiments made are referred in Appendix XI. Tasar silk is a large industry, both in weaving, twisting and production: eri silk has been produced experiment-

ally but there is no industry. The chief industry in silk is the weaving of Nagpur, Nimar and Bhandara, where silk, silk and cotton, or silk-bordered cotton cloths are extensively produced. This industry is described in Dewar's "Monograph of the Silk Fabrics of the Central Provinces (1901)" it is stated to concern 6,000 workers in Nagpur, 1,700 weavers and probably another 1,500 twistors, etc., in Nimar (Burhanpur), and some 4,000 workers in Bhandara. The silk used is very largely Bengal silk imported by rail and there is a smaller import of China silk *via* Bombay. The figures are given in Appendix XVI and are extremely misleading, the large import of Indian raw silk from Bihar and Orissa to the Chhattisgarh block is Bengal silk for Nagpur, Bhandara and Nimar : while a large part of the import from Bombay of China silk is probably not shown as it comes in passenger train or post parcels. There is a recorded import of some 4,000 maunds of silk of the value of twenty odd lakhs of rupees : so that there is a production of silk goods in the Province to the value of nearly forty lakhs. The import of piece-goods is small, the export nothing, and the silk woven is for local use.

2. The methods used in Nagpur may be shortly described. The raw silk from Malda is opened out and run off into qualities in the usual way ; the warp threads are then twisted singly and three twisted threads twisted again together to make one warp thread : twisting is done on spindles turned by thread belts from a wheel, there are as many as 21 spindles turned and the thread is received on a large reel turned slowly by a belt from the axle of the driving wheel. The machine is crude, heavy to work and not well made but it does the work. Twisted thread is cross wound over two upright pegs and is boiled off and dyed : dyes are cochineal, kamela, indigo, lac, kusum, etc., and anilines, the cost of the operations are as follows :—

28 tolas thread—8 annas sorting,	
12 „ twisting,	
4 „ warping,	
10-12 „ dyeing,	

undyed boiled thread and dyed thread sell for the same price by weight : *i.e.*, the dyer pays say Rs. 20 a seer for boiled thread and sells it for the same price per seer : but his seer has become nearly a chittack heavier, which is his profit.

3. Warping is done on a warping board or on uprights fixed in the open : and the warp is then laid out, brushed, sized and drawn in to the loom. Colour, effects are obtained by tying the warp, dyeing and then arranging the warp threads.

4. Weaving is done on pit-looms usually with two shafts, and to a standard width of 45 inches, on a warp 20 to 60 yards long. The number of dents to the inch is greater at the edges of the reed than in the middle. For borders a separate set of healds are used and for figures the usual loops for making the ground.

Cloths are of silk pure, silk and cotton, cotton with silk borders, cotton with silk and gold borders and ends. Practically all are saris, dhoties and scarves, made almost wholly in a few conventional designs and patterns, with a greater or less amount of gold thread woven into the border. The colours are varied but the designs limited to those conventional ones in local demand.

Weaving is done by isolated workers who sell to the dealers or by workers paid wages or employed by traders. The sorters, twistors, dyers, warpers and weavers are distinct and the industry is subdivided. There is one interesting feature : in Nagpur the cloths are stamped as properly dyed by a man who tests each piece before stamping ; the stamper gets one pice per cloth and unstamped cloth does not fetch the same price from the dealers ; the stamper is appointed by a committee of merchants and the system appears to work well.

5. The records of import of raw silk and the census figures tend to support the belief that the industry is as a whole prosperous and increasing ; its prosperity depends mainly on the steady demand for this class of fabric in the province and though dealers sell Chinese and Japanese silk cloth it is to a very small extent only. The disquieting symptoms are the increasing use of mercerised cotton as a silk substitute and the bad organisation of the industry as regards the actual workers.

6. The war affected the industry so seriously that Government intervened : the feature of the industry is that the demand is for silk cloths in the marriage season

only and that in the summer demand is small, the demand for cloths fell off at once in the winter of 1914-15 and dealers could buy no more; the weaver never has any capital and would have simply starved: and Government bought up three lakhs worth of saris, etc., and stored them for sale when normal times came again.

The fluctuation of demand puts the weaver at the mercy of the trader, who buys cheap when there is no demand and the weaver, unless he can buy raw materials and live from June to November, must take any price he can get. I have not the local knowledge to decide if the dealer does sweat the worker but it is clearly possible and it was bitterly complained of to me.

7. The industry is fit for development on wider lines; the weaving is skilful and good, better reeds, fly-shuttle slays, better twisting, faster dyes would all improve it: but above all, the weaver should be helped to make other cloths. In the bazaar, hand-loom Japanese cloth, 27 inches wide, was selling at Rs. 2 per yard: Chinese satin was selling at Rs. 3-4: the first was stamped as passed by a Japanese Guild: the second was stamped as "Guaranteed fast dyed," I can see no real reason why Nagpur weavers should not be shown how to weave plain silk cloth or satin to compete with these and it would be possible for the weavers to make other cloths also in demand. Probably organisation on co-operative credit lines is needed or the dealer will make an exorbitant profit while he sweats the weaver: but this could be organised probably on the lines of Amrapura.

Failing that, the production of new fabrics could be organised on the model factory system, putting up a small finishing factory and collecting the cloths made: this method of organisation seem to me the best for Nagpur but I have not the local knowledge necessary to decide this. Nagpur certainly is a favourable place in which to develop the production of new fabrics and I believe the weaver would respond readily to this form of stimulus.

CHAPTER XXV.—BOMBAY.

There is no production of silk in the Presidency at present and not any likelihood of production being developed: nor is there any tasar industry: a production of eri silk was developed and now persists only in Kathiawar.

2. The silk weaving industry is a large one, employing some 39,000 people: it is centred chiefly at Surat, Ahmedabad, Poona, Nasik, and is found also at Belgaum, Dharwar, Bijapur, Sholapur, Ahmednagar, Bombay, and Hyderabad in Sind. Three silk mills were formerly working, two at Bombay, one at Poona; the last is now closed.

The raw material used is imported China silk, of several qualities, the Bengal *khungru* silk, some Bengal filature silk, and silk from Mysore used in Belgaum and Dharwar; formerly silk from Persia came down from the Gulf and a small amount of Bokhara silk from North India. Formerly only raw silk was woven: now there is a large use of spun silk from Italy, England or Japan, and of mercerised cotton to mix with silk.

The trade in silk and the qualities used are fully discussed by Mr. Anson in Volume II of this report. A short summary of the industry from the technical point of view is necessary and a summary of the fabrics.

3. The processes used in weaving silk in Bombay centres are superior to those of Bengal for instance but distinctly inferior to those of Burma. The raw silk when purchased is opened out, placed on a swift and run off into four or five distinct qualities on to hand reels twisted in the fingers: from these the thread for twisting is run off on to reeds, with the aid of the simple wheel; the reeds are placed on the spindles of the twisting machine, which is of the large driving wheel type, in which many belts from a large wheel turn a row of spindles on which the reeds are placed and the thread passes on to a slowly moving reel driven from the axle of the big wheel. The machine is clumsy, with a large driving wheel and twisting as many as 16 to 20 spindles at once: as a rule the twisted threads are run off in pairs on to the big reel and then twisted together again or two pairs are twisted together giving a four-fold thread used for warp.

In Surat, a very efficient machine is used which has been adapted from mill practice: in it the spindles are vertical, are each driven separately from a drum,

and the silk is wound off on to baby reels at the top of the frame : the machine is driven with iron gear wheels, is constructed on a vertical frame and is by far the most efficient machine used in India. Edwards writing in 1900, refers to another process used in Surat but this is apparently no longer in use.

After twisting, or without it in the case of weft, the yarn is boiled off with soda and soap, or soda alone, and is then dyed. Dyeing is partly with cochineal kamela, indigo, turmeric, partly with aniline dyes : the very fast bright red is cochineal and kamela together : indigo is dyed by a separate class of dyer as a rule. Dyeing is practised at Belgaum (Shahapoor), Gokak, Yeola, Nasik specially and much yarn is sent for dyeing. The dyed yarn is sometimes sized with starch paste, and is weighted to a slight extent with sugar or oil. The yarn is then warped : the usual method is an improvement on the simple Indian process and is done on a vertical warping frame, the thread taken round a series of pegs till all is laid : in some places a single thread is laid at a time, in others a series of 10 to 20 threads are laid from a creel of bobbins with a warping stick and the process is a rapid one. The warp is then drawn in through the reed (usually bamboo), and through the healds : as a rule healds are not knitted round the threads but eyeletted healds are used as in mill practice.

4. Weaving is commonly done on the pit loom and there are three types of weaving : the plain weaving with two shafts, in which checks, etc., are made by laying striped warp and weaving with various colours : the ornamented border done either with a Dobbie or with border healds connected to eight or more shafts worked by cords fixed to pegs in front of the weaver : the brocade loom in which there are three sets of harness, the two shaft for the ground, the eight lever for the border (worked by cords), the loop-controlled figure harness for working in the figures in the body of the cloth. The last is extremely complex and the figure weaving of the body is controlled by loops, arranged in order by the loom setter and manipulated by a separate operator : with this loom, there may be workers who put in figures or stars with small embroidery bobbins, as in Benares weaving, and some fabrics are made almost wholly of embroidery put in by this means.

5. The woven fabric is not finished as a rule : very high class *kamkhuabs* are carefully picked over, smoothed delicately and properly packed : but as a rule the pieces are folded, tied with silk and sold as they are.

Fabrics.

6. The fabrics of the Bombay Presidency include the following principal kinds :

Saris, of cotton with silk borders are commonly woven in the Deccan and are frequently produced with a simple border pattern with a Dobbie loom or a separate set of border healds and levers. Pure silk saris are also produced but less commonly : Surat, Ahmedabad and Poona produce these. Silk and gold thread saris are woven in the same places and on these the most elaborate and intricate weaving is done. A really good silk sari in *kamkhuab* weaving with heavy gold borders and ends may cost three hundred rupees : the designs are conventional ones as a rule : one Poona dealer stated that he paid Rs. 1,000 to a designer and loom setter for the setting of a loom to weave a "jungli" (forest) pattern.

Dhotis are woven of cotton with a narrow silk border, just as saris are : in some cases gold thread, i.e., gold or silk, is woven in as a line edging or end. Dhoties of pure silk (*pitambars*) are made to a small extent and are expensive : they are produced and sold in Gujarat, the Deccani buyer being too poor to afford them.

Scarves and the cloth that the Hindu throws over his shoulder are made of silk, or of cotton with silk borders.

Bodice cloth of cotton and silk or silk is a peculiarity of the Bombay Presidency and is specially woven : some are silk, some silk and cotton : the best have an ornamented border of silk : they are woven to make the garment that covers the shoulders and bust of the women.

Piece-goods are woven to some extent and this heading may cover any quality of cloth : but it includes really various qualities of cloth from plain silk-cotton

mixed to very elaborate *kamkhwabs*, woven in lengths and meant for cutting into bodices, shawls, pyjamas, coats, cushion-covers, etc. There are not many definite fabrics except the plain silk and cotton woven in stripes or plain colours, silk chiffon and fine cloths, the simple satins, and the very elaborate brocades woven with colours and gold thread: Surat produces such fabrics, in some variety, but their production is lessening.

Turbans.—There is a production of narrow cloth for turbans, either dyed, or with gold thread borders or ends: the fast red dye of the best turban is the cochineal-kamela colour.

Longyis for Burma are still woven in check patterns in Surat and sent to Burma: the waved cloth of Bangkok has also been imitated in Surat, with not much success: there was once a large trade, which still persists.

Spot satins are woven in Surat and are plain cotton-backed satins, the fabric knotted and dyed, producing a pattern and this pattern is added to by printing another colour in the undyed knotted portion. These go to Rangoon: they are nearly all in one pattern, but in different colours.

Kamkhwabs.—These have been referred to under Saris but there was a production of these for export to Siam and there is still a demand for the beautiful gold and brocaded fabric of Surat, Ahmednagar and Poona. The demand lessens, unfortunately, but it would grow if the fabric was better known in Europe and (specially) America.

Mashru or silk and cotton mixed is woven very largely as it makes a fabric permitted to Mohammadans.

Suiting cloth is a new fabric, of spun silk, woven to sell to compete with "Kashi" cloth. It is also made of mercerised cotton, very cheaply.

In the above, a complete summary of the production is not attempted but the general features are obvious: mainly the silk is for local sale, the best for the rich man of Gujarat, the poorer for the Deccani: there is a special production for Burma which is lessening, for Siam which is nearly dead: there is practically nothing for any other export trade at all.

Mercerised Cotton.

7. During the last twenty years, there has been an increasing use of mercerised cotton and spun silk and the Surat weaver particularly has mixed in both yarns with his silk to an extent that has certainly done harm to the reputation of Surat goods. Fabrics reputed to be pure silk have been woven with spun silk or mercerised cotton warps and the resemblance is close enough to deceive the buyer till he has washed the cloth. Mercerised cotton in itself makes an excellent fabric: but when it is used to adulterate silk and the cloth is sold as silk, harm is done and the buyer in the end gets his silk from another place. This is true to some extent of spun silk but spun silk retains its lustre and can be used in the warp without real detriment to the fabric.

Gold Thread.

8. The gold thread used in weaving is largely imported but a considerable amount is produced in Poona, on the method described on page 140 of this report. The appliances used in this work are very ingenious and efficient: the number of workers is increasing and the war has put a stop to the use of inferior gold thread formerly imported from Austria and Germany.

THE INDUSTRY.

9. The weaving industry is said to be diminishing in Poona, Surat and Ahmedabad: less silk is sent for twisting to Surat, for dyeing to Belgaum or Nasik, less raw silk is imported and used: the number of looms in use before the war was stated to be much less than ten years before and many weavers had taken to other occupations.

I think we may assume that the local demand for silk goods has been of the normal amount, fluctuating according to the character of the season but on the average not diminished: there has not been any import of foreign silk to replace

indigenous and the silk worm is much the same as before : to some extent the cheap silk product of the mills has replaced special classes of silk goods perhaps, but generally speaking the mill product has found a separate market : it has not seriously interfered with the indigenous product. On the other hand the export of silk goods has decreased very markedly : the Burma trade was a very large one and Surat silk fabrics there have been very largely ousted by other goods : the export to Siam has almost ceased : and the general demand in India for the *kamkhwab* has very markedly lessened during the last twenty years.

Probably the increasing production of silk fabrics in Japan has affected the Bombay export, just as it has killed the Bengal export but this goes back too far to be ascertainable now.

10. The prospect for the Bombay weaver is not good : the Burma trade will never increase probably : the use of *kamkhwabs* may return but this is uncertain : the chances of an export of the existing fabrics is small : and the industry will persist to supply the large local demand. There is scope for improvement if this can be coupled with co-operation among the weavers but unless the actual workers can be combined, probably not much can be done. In Bombay, as elsewhere, the craftsman is apt to be in the hands of an employer who gets all the profit : to get greater returns he adulterates with cotton : to cheapen his goods he pays less for work and gets bad work : and in the process the character of the fabric deteriorates, to the detriment of demand and to the ultimate destruction of the trade : but the class who really suffer are the workers, not the employers. In Burma, this process has been checked by the Co-operative Credit Society : in Bombay the same process has gone on unrestricted.

11. The industry in Bombay would repay detailed study and organisation : the craftsman is well skilled, and with technical help could probably make a much wider range of fabric and compete successfully in new markets : but it must be organised, probably best on co-operative credit lines, with proper technical advice. This could be done if the Presidency provided for the local inquiry and were guided by competent advice : the industry in Bombay is capable of improvement and there is probably very good scope for development on the lines suggested in Chapter XXVII for all India.

CHAPTER XXVI.--MADRAS.

The silk industry in this Presidency embraces the production of mulberry silk and the weaving of silk fabrics : there is a very small amount of tasar collected in the Ganjam district and a small amount of tasar weaving : this is discussed under tasar (Chapter XIII).

2. The Kollegal silk production has an area of from eight to twelve thousand acres of mulberry, with a production of cocoons that may be as much as 50,000 maunds, giving silk worth say eighteen to twenty lakhs : it is an extension of the Mysore area and the general description given under Mysore applies also to Kollegal : it needs mainly a seed supply from a hill station of an improved disease-free race, either the Madagascar or a Madagascar Mysore hybrid : probably the production could be increased by thirty per cent. on the same area : and an extension in area could take place on suitable high land.

3. The question of further extension of silk culture has been discussed elsewhere (see Chapter III) the experiments in Travancore and Banganapalle will be of interest if they develop. The main interest of the province lies in its weaving industry, which concerns probably some 150,000 people and produces fabrics worth nearly eighty lakhs. An account of this will be found in Mr. Thurston's "Monograph of the Silk Fabrics of Madras (1899)": an abstract of the weaving centres of his monograph is appended (App. XVII) and some figures provided for me by N. Subramanian Aiyar, the Weaving Superintendent : a short statistical abstract occurs in the "Handbook of Commercial Information" just produced by Mr. M. E. Couchman : and a statement of the Madras trade occurs in Mr. Anson's report on Trade (Volume II) : (if the figures of the two last differ, it is because the first was produced when the second was with the printer and not available for reference). Mr. Anson's account of the industry will be found in his report and my account follows here : the separate preparation of these was due to my transfer to military duty at this point.

Weaving.

4. The weaving methods of Madras differ in detail from those of North India. The silk is opened out, and placed over two bamboos laid on the ground at a slope: the thread is run off on to two *latais* or more according to its quality. It is then run on to reeds (quills) and twisted. In Berhampur twisting is done on the *charkha*, a little at a time: elsewhere the twisting machine is like the Nagpur one but the receiving reel is vertical and not horizontal.

5. In Madura the silk is then run off on a very neat little reel which has an eccentric on a wheel below the axle, which pulls a cord running round a pulley so as to run parallel to the axis of the reel: in this cord is a ring, opposite the middle of the reel: the thread passes through the ring: as it is wound off, the eccentric pulls the ring to and fro, against a coil spring, and the thread is not laid parallel on the reel but in a figure of eight; the eccentric is on a toothed wheel in mesh with a wheel on the axle: two turns of the receiving reel is equivalent to one to and fro motion of the ring and thread. When the skein is removed and opened out, the threads are in a figure of eight. This is a very neat and rapid way of getting this effect as compared with the Nagpur and Surat method of laying the threads criss-cross over two upright pegs.

6. In Kumbakonam, the thread is laid criss-cross on the receiving reel of the twisting machine by an adaptation of the Madura cross reeler: the threads from the spindles pass through fixed rings and then to a set of rings hanging vertically opposite the vertical receiving reel: this hanging set of rings moves vertically up and down by means of a cord running over a pulley to an eccentric pin on a horizontal wheel in mesh with a wheel on the axle of the reel: the gearing is two to one so that two turns of the reel equals one motion up and down: there are pegs on the reel and the thread falls between these and is taken off in a leased skein. This is a very interesting labour saving device and in one large establishment the gear was all boxed in and regarded as a secret.

7. Dyeing is with lac, cochineal, kamela, indigo, etc., in the usual way.

Warping is done on upright sticks, on pegs fixed in the wall or rarely on warping mills.

8. Weaving is complicated: there are separate sets of border healds worked from a series of loops over the warp; each loop has a metal ring and when its turn comes, it is hooked on to a fixed hook over the warp. This the weaver does: the loops controlling the body healds are under the warp about 4 feet from the weaver and are worked, first by a boy who pulls the cords in order, secondly a man sitting beside the warp puts in a flat wood strip, and passes this up to the reed, where by turning it he raises the pattern threads and makes the shed. There are thus four people on the loom: the weaver working the main pedals, the border healds and the main shuttle and one border shuttle: a child working one border shuttle: a boy working the loops of the body healds below the warp: a man pulling up the threads to form the shed by putting in his flat board and then putting it up at the reed to form the shed for the weaver. The weaver works two pedals, controlling the ordinary shafts for the plain tie. The Ampthill loom is a patented loom in which this system of heald manipulation by loops hooked successively by rings, the loops passing horizontally across the loom, was protected. The special feature is the loops running horizontally across a rectangular frame and the use of cords in place of wood shafts, thus allowing many heald combinations in small space. It is a modification of the Benares and Surat method and the patent is a doubtfully valid one.

Turban looms $3\frac{1}{2}$ yards wide are worked by two people, with a gold border pattern worked by 8 or 12 shafts and a check of gold threads woven in.

9. In Trichinopoly where mixed cotton and silk and pure silk is woven for Mohammadans, they use a very neat loom in which the cords controlling the healds are across the loom and a girl sits beside the weaver pulling them. There may be cords controlling the border healds and the border is only at one side: and there will be cords controlling the body and the girl also controls these putting a wedge in when she has elevated them, but the weaver then has to put in a wedge on the other side also. Weaving is done there with four shuttles say gold and blue for the body, gold and red for the red-warped border. In another

loom a Dobbie result was got with some 16 shafts linked to 16 cords and running over a pulley down to the floor where a child pulled the 16 cords in turn.

Very pretty bandana results are got by warp tie and dye in Trichinopoly and Madura and also spot effects on cloth. The waved cloths of Trichinopoly are a combination of tied warp arrangement, stripe weaving in tooth stripes with four shafts and an ornamented border. In some cases, eight and twelve shaft looms are used to give simple effects with loop controlled border healds for the pattern.

10. In Kumbakonam one weaving master has five Jacquard looms working at figured saris and bordered cloths: and there is reason to think that the hand Jacquard loom may have a future in producing the bordered cloths made on the complicated system described above. —

The Jacquard loom costs Rs. 350 when fully set up: it requires one weaver only: it works much more rapidly than the other systems: and any modification of pattern can be worked out with a set of cards: it will not produce the separately coloured borders of course, which require separate border shuttles: if the three-shuttle border loom now being experimented with turns out well, then the separate operator for the border shuttle will be dispensed with. One difficulty in the Jacquard and the Dobbie is the high building required, which is not always possible to the ordinary weaver.

11. In Berhampur, weaving is done on many shaft looms, sometimes with three sets of shafts for different parts of the pattern: the weaver works shafts with his hands and the methods are generally simple and primitive, as in the Bengal and Orissa looms.

12. The Madras weaving is as a rule extremely skilled and the weaver is very expert: the systems of heald manipulation by cords are very perfect, far more so in my opinion than that of any other part of India: the designs are standardised, are those in demand locally and the output is almost wholly absorbed locally. The fabrics are mainly saris, body wraps, turbans, bodice cloths and other articles of wear: the ornamentation is often on one border only and in a block at one end, this being the part worn outside. There is a large production of peculiar cloths worn by Indian Christians, with peculiar ornamentation. In some places gold thread and very beautiful designs are put in on mercerised cotton, which is a deplorable practice: but it is the usual short-sighted practice of the master-weaver to secure large immediate gains at the risk of an ultimate failure of the industry.

The weaving is organised in Madras chiefly by weaving masters who employ labourers for the work, paying by piece work. I formed the impression that the weavers are as a rule slaves, badly paid, in the hands of wealthy weaving masters: and I generally endorse all that Mr. Ansorge has written on this head, though I did not accompany him on his tour but visited Madura, Trichinopoly, Tanjore, Kumbakonam and Berhampur some months after he did. I fancy that he overstates the earnings of the weavers and twisters: the earnings of women warpers is put at one to one and half annas a day: and the skilled craftsmen are regarded as "coolies", as no better than the least skilled field labourers.

On the other hand it is apparently true that it is excessively difficult to help this class: the experience with introducing fly-shuttle looms for cotton has been that if the weaver could do with that in six hours what formerly took nine, he did not make any more cloth but slept the three hours he gained: and it is impossible to doubt the evidence obtainable on all sides that any attempt to help the craftsmen will be excessively difficult from his own unwillingness to be helped.

13. The improvement of weaving at present is in the hands of N. Subramanian Aiyar, Government Weaving Superintendent, who is in charge of a peripatetic weaving party, which moves from place to place introducing improvements. The fly-shuttle loom, the Dobbie, the Jacquard are being introduced: the three-shuttle slay on the fly-shuttle principle is being experimented with: and the general improvement of the cotton and silk weaving industry is in their hands. Ultimately this will presumably be centred in the Madura Technological Institute. N. Subramanian Aiyar is the author of a series of articles on the weaving industry and has a very thorough knowledge of the industry and of the methods used.

14. The Victoria Technical Institute, Madras, was opened in 1908, to further technical education and to be the headquarters of information on industrial art

and industrial activities. Typical industrial products of the Province are brought together there and exhibited: they are also sold, at the same rate to the public and to dealers: special attention is devoted to maintaining an interest in articles not stocked by dealers, and in providing a demand for artistic products the manufacture of which is dying out. The tendency generally in the industries is that the dealer, to increase his earnings, wants his things cheaper and so screws down the craftsman in material and in workmanship: gradually the product deteriorates, the craftsman's skill lessens and finally the article becomes so poor that demand ceases and a handicraft is lost. Thus the cupidity of the dealer ruins the industry: and this is not a feature of Madras alone. The Institute counteracts this by stocking good articles, by helping the craftsman in technique, *e.g.*, dyeing, and by helping to keep the standard up. Traders have objected that it was unfair competition as the commission charged is much less than the trade charge: but the commission is a reasonable one and the Institute is doing good: the weaver is getting his return and at the price goods are sold at there is a better demand than if the dealer was making huge profits and charging high rates. The Institute's chief difficulty is in obtaining goods from the craftsmen direct and not through dealers, thereby ensuring the craftsman getting full earnings; these are very unbusiness-like people and hard to work with: but on the whole the method succeeds and the industries are helped.

The amount of help given to any one industry is of course not large: about Rs. 10,000 worth of silk goods are sold in the year, largely to tourists: but silk is of course only one of many industries dealt with.

15. The prevailing note of Mr. Thurston's "Monograph of the Silk Fabric Industry of the Madras Presidency," was that the industry was declining, chiefly due to the competition of silk goods, similar to those locally produced, woven on power looms in foreign countries and selling for two-thirds of the price of the indigenous hand-loom product. Such fabrics can be made now in silk mills in Bombay and Calcutta but are not made to any large extent: and now, seventeen years after Mr. Thurston's Monograph was published, the evidence all goes to show that the indigenous silk industry is larger than before, the import of cheaper cloths has not developed and Madras weaves what Madras wears. It is a curious position, in view of the position in Burma at the present time, where for every silk cloth made one is imported: and the distinguishing factors may be (1) the superior methods and organisation of the Madras industry as opposed to the Burma one and (2) the conservative demand of the Madras people as compared with the demand for novelty and variety from the Burma people.

16. It is difficult to get any real insight into the customs and ways of thought of Indian communities but I am of the opinion that the wearing of special classes of silk or silk and cotton fabrics is very closely and intimately bound up with the social and religious customs of Madras, while it is not so in Burma. If this is so, the only factor in the future that will affect the industry will be deterioration in quality of cloth or the competition of equally well made cloth of exactly similar design at lower prices: the competition of mill-made goods seems to have been experienced and failed: and the only source from which would come cheaper hand-loom fabrics would be Japan. I am seriously apprehensive of the deterioration of fabrics in one respect, the use of mercerised cotton for silk: it seems to me inevitable that the weaving of elaborate patterns in gold on dyed mercerised cotton can only lead to the downfall of the industry: Surat has suffered in that way, as has Benares: and the Madras master-weaver seems to me to be making a very serious mistake in using cotton. As things stand at present, the industry seems otherwise to be a sound one in the main: a really determined effort to introduce co-operation, to give the weaver the reward of his skill, is worth making but will require a sustained effort: personally I am of opinion that success could be obtained by working first in the smaller places: I would survey all the districts and investigate all the smaller weaving places: if in any, weavers could be induced to co-operate and to make cloths for which a demand was found, this could be helped with organisation, labour saving methods and better designs: as these were worked up, the larger places could be taken in hand: such organisation will be most difficult in large centres where master-weavers and dealers are well organised, and where improvements and new ideas will be most strenuously resisted. As regards new fabrics, there is probably scope for making the fabrics that now reach

Burma in such large quantities from Japan : and it is an undecided question if with the best methods and the finest organisation the Indian weaver will be able to compete with Japan : but it is well worth testing and the fabrics in demand in Burma could be well made in Madras probably.

17. I have discussed elsewhere (see Chapter XXVII) in this report the kind of trade organisation that seems to me the only way to revive the industry in India generally : but it is questionable how far this can be applied to the present Madras industry as a whole. It certainly is not needed for the industry in the large centres, which have a local market and do not really need a wider one at present : but if co-operation, better methods and new designs can be applied in smaller places, then the organisation there sketched could be applied to these places also. The case for this kind of assistance is probably weaker as regards Madras than other parts of India : and I have not sufficient knowledge of the smaller weaving centres in the Presidency to know how far the weavers there would respond to such organisation or would benefit by it. In this matter census figures are of little use as many weavers are recorded otherwise, often as cultivators or field labourers.

18. In other respects, the industry can be benefited probably most materially by a decision as to the value of the Jacquard loom in producing not only local patterns of saris, etc., but the fabrics so largely in demand in Burma. It has been stated in this connection that the hand Jacquard is merely an attempt to do by hand what is better done by power : and that if using Jacquards in mills does not enable the mill to compete successfully, it is useless expecting the hand-loom weaver to succeed. Undoubtedly the silk mills in India, using Jacquards, have not succeeded : but equally undoubtedly the Japanese and Chinese, using hand Jacquards and Dobbies, are very successfully ousting the mill product. Why they do so is not known : but they are certainly supplying Burma with fabrics that are the production of hand-looms and that compete successfully with the power-loom fabrics.

19. In weaving there is a difference in quality between the power-loom product and the hand-loom : it is probably just the difference in quality produced by personal attention and skill as opposed to mechanical skill : and the Madras weaver undoubtedly has the skill. Whether with perfect organisation the Madras weaver is likely to compete with Japan or China is uncertain. I am not very sanguine : but at least it should be attempted. If he can produce fabrics that can undersell Japan or compete on level terms and if the production and sale is organised, there is a market in Burma that requires over thirty lakhs worth of piece-goods annually and Madras could well produce a large part of this. The really vital question is whether it can be done : and personally I attach the greatest importance to finding that out. At present the Jacquard is used by one employer producing local cloths : if it succeeds for that purpose, well and good : it can be extended and developed, and will probably produce local fabrics more cheaply : but it will not develop the industry further unless other markets are found and the real problem of the Jacquard is whether it will enable the Madras weaver to make the goods now imported from Japan and China. If it can, then the Madras weaver has two strings to his bow : and if trade is bad in one, he can turn to the other : if a fresh production and market can be found, it seems possible that this might, from the start, be developed on co-operative lines, so that the profit went to the craftsman and not simply to the middleman and employer. I think it will be considered that there is no call to do this : undoubtedly it would be a fine thing to do, for increased demand and increased work can only ultimately help the craftsman : at present there are more workers than work and they are sweated : but if there is more work than workers, then the workers' conditions are improved and he can make better terms : and I think the Madras industry could probably nearly double its output if it had a wider market for its produce. Burma offers a very good market and I think it will be worth while testing this. But it is not a matter of urgent necessity as it is in some other parts of India, and I have no certain information as to whether there are sufficient weavers outside the large centres to make the effort worth while attempting.

PART VIII.—RECOMMENDATIONS.

CHAPTER XXVII.—DEVELOPMENT OF THE SILK INDUSTRY.

CONDITIONS OF THE INDUSTRY.

The conditions under which weaving is done in India vary very much as has been indicated and the details of the methods to be used in developing it will vary: to some extent the actual twister or weaver may be said to be anxious to get improved methods and organised help but he is often a paid labourer, with no organisation, no means of expressing himself and no influence: to a large extent any organisation and improvement of the industry is deliberately stopped by the attitude of the dealer or employer, who fears to have his position interfered with. If the weaver was given better methods, a wider market, steady work, he might regain his independence, and the enormous profits of the employer would cease. The earnings of the actual craftsmen in many places are absurdly low and the middlemen and employers make gigantic profits: if the weaver could sell direct, if he could get his own materials, his condition could be bettered: furthermore, Indian silks would not be so costly as they are: if the employer and dealer were content with reasonable profits, Indian silk would have a much better chance of competing: but this class, a wholly useless class, are in some places certainly the cause of the decline of the industry and the bar to any improvement or organisation. One way round them is the co-operative credit method: it has worked well in some places and it looks as if it alone will really help the actual craftsman.

A feature of the Indian silk industry is the specialisation of fabric that is produced in each place and the standardised designs for which alone there is any demand; and this limits demand and to some extent prevents any further development. It can be overcome probably but not easily, and it makes an added difficulty to be coped with.

Where the industry is less highly organised, and where it exists over a large scattered area, as in the tasar weaving districts, the difficulty is one mainly of communications, trade organisation and better supplies: the weavers formerly made the cloth for the villages and before the railways developed, every one wore local fabrics: but now the demand is different, the weaver has no outlet for what he does not sell and in some cases is having difficulty in this way. This could be overcome and the less organised weaver will be easier to help than the worker in the large cities of Madras and Bombay.

It is very difficult to discuss India as a whole when we know so little: no one has a real inside knowledge of the Indian silk industry: silk production is simple compared to the silk weaving industry: whether you can grow silk-worms or not is a matter of climate, soil, definite economic conditions and so on: but whether you can get Champanagar to successfully produce say figured silk cloths for Rangoon is a matter depending upon very many factors peculiar to Champanagar: and a few months enquiry will not enable us to understand the conditions of all the different places: and the key to the whole business, the factors of success in Japan, is at present wholly unknown to us.

What enquiry does show above all is that no one method can be applied over a large area: the conditions vary very much, the economic organisation is not the same, and the first requirement is a better understanding of the economic conditions of the weavers and twisters, in each place.

CLASSES OF PRODUCTION.

(a) *Special fabrics.*

2. The largest item in the Indian silk industry is the manufacture of the peculiar cloths worn in the country, to the extent of seventy lakhs in Madras,

fifty lakhs in Bombay, forty in the Central Provinces, thirty-eight in Burma and so on : these are largely peculiar fabrics such as saris, etc., which are useless for any other purpose than wearing in the peculiar manner of the native of these places : and the conservative fashion of the Indian is what has maintained the industry. This is the backbone of the industry now and while it can be very largely helped and improved, it is already the most stable part of the industry. The industry will be ruined if the short-sighted policy of adulteration continues : but in other respects the only disquieting feature is the deplorable condition of the worker.

(b) *Piece-goods.*

3. The second feature of the Indian industry is the manufacture of piece-goods of the ordinary kinds, with which imported goods compete, or which were formerly exported. In this class there is a constantly growing import : satins for instance are made at Benares, Azamgarh, Surat, Ayyampet, etc., but the trade there is badly organised, the goods are in small quantities and the demand in India is not met by these but by Chinese or Japanese. There are two reasons for this : one is the defective weaving methods : the other is the hopeless trade methods. The Chinese importer offers satin in fixed qualities, breadths, colour, etc., in any quantity : the Indian offers nothing similar, odd pieces, not in bulk, not properly finished or dyed : he cannot possibly meet a real trade demand at present. It is in this class of thing that India daily imports more from Japan, and it is in this class that it is to be seen if Indian production can be organised and helped to compete successfully with imports and ultimately to be exported.

(c) *European and Anglo-Indian Trade.*

4. The European shop trade in India may be taken as typical of the trade in piece-goods, etc., sold to the European, Anglo-Indian and wealthy Indian in the cities of India. The fabrics are plain, spot and striped silks, petticoat silks, satins, lining silks and satins, tasar silk, and silk for suits, dust cloaks, and pyjamas : there are also the fine chiffons, silk muslins, and silk scarves : knitted silk coats, jerseys, ties, etc. : and silk goods such as shawls, scarves, mufflers, stockings, socks, etc., which fluctuate with the fashion. In the main these are not Indian : a certain amount of fine Benares silk finds its way to the shops and to the box-wallah : a good deal of imitation silk is sold by the box-wallah and a small amount of real Assam or Benares silk cloth for suits. An enquiry was addressed to large firms in India with shops in the big cities and to firms of tailors : they were asked why Japanese and Chinese goods were listed and not Indian, whether there was any prejudice against Indian goods and whether if they could get what was in demand, in constant qualities and sizes, they would stock and list Indian silks : a selection of replies is here extracted and illustrates the position :—

Phelps and Co., Calcutta, March 6th, 1916.

The reason we have not been able to stock or sell any Indian made silks, is due to the fact (1) there is no uniformity in them, (2) they are as a rule made up too soft, with no pretence or attempt of making cloths that will keep their shape. The reason that the Japanese have gained such a big hold on the market, is because, apart from there being a very big indigenous industry of native silks in Japan, they have gone in largely for copying Western ideas, in making the style of silks that are used in the making of European dresses and suits. We refer particularly to lining silks and satins for ladies' dresses, and we have no hesitation in saying, that if a similar article could be made in India, they would in almost every case replace the foreign silk, but at present, as far as our experience goes, there is no comparison between the products of the two countries.

Messrs. Hall and Anderson, Ltd., Calcutta, 30th March 1916.

Provided that Indian silks compare equally with China and Japanese, both in quality and price, there should be no reason why we should not do very

well with them. It would be very necessary to rely on a constant supply of particular qualities.

Blouse and dress lengths would not be of any use to us, it would be much more to our advantage to have in lengths of 30 to 40 yards. We could of course give you a much better idea of the possibility of extending the sale after seeing a range of samples. The reason why Japanese silks figure in catalogues, is because up to the present we have not seen Indian silk to compare with them. As far as the public are concerned, we should not think it would make much difference to them if it were Japanese or Indian silk they were buying, provided the qualities were identical.

Assam silk was a few years ago in great demand for suits and we had a big market opening out in the colonies. The quality however could never be depended on and the supply and price were so uncertain, that we dropped it, and what promised to be a very large business is quite dead as far as we are concerned.

Messrs. Badham Pile and Co., Poona, 26th April 1916.

In continuation of our conversation sometime ago, regarding China silk, I now beg to enclose a couple of samples of best Cheffoo silk. This quality is greatly used in the production of summer clothing for the European community, and the better class Indians, consequently there is a great demand for this class of material.

India has a name for silk, in my way of thinking ought to be able to produce cloth equal to this in every way, and at a much lower cost. It only requires some one with expert knowledge both in the farming, and method of weaving to get the Government to set the concern going. It seems a sound business proposition, and if the goods can be turned out equal in quality but at a lower cost, then it would be an easy matter, to find a market for all the silk that could be produced, especially as there is no exchange to worry the purchasers.

Army and Navy Co-operative Society, Ltd., Bombay, 19th March 1916.

I think myself that Indian silks should be able to compete successfully with the Japanese production, but before this can be done and you can get European business houses to take the sale of it up the following will have to be strictly attended to. Standardisation of quality and finish, the latter specially being in my opinion very important. Lengths of pieces is also a very important consideration, silk of 27" to 29" wide should be made in lengths of 7½ yards or multiples of same. It would be impossible for me to say if we could take up the sale of Indian silk as so far the few we have tried have been very far from successful.

It is impossible to assess what this trade is, but it is large enough to make it worth while to the Japanese to consider it carefully and to meet it.

FOREIGN COMPETITION.

5. Ultimately, whether in India, or outside it, it always comes back to that, that you cannot now produce the goods at the price that China or Japan do: the raw material is imported: the methods are bad; the weaver is lazy and not enterprising: the goods are badly finished: the dealer and middlemen need to make large sums on it: and by the time it reaches the buyer it is too costly. Why it is that China or Japan can make silk so cheaply I do not know: but I do think that the business man in India knows he cannot make what he wants and sell it at the same price as they can.

If, on the other hand, you can eliminate the middleman, if you can work as directly as possible between the craftsman and the shop, can India then compete with the imported product? This has to be seen and there is a certain

amount of evidence to support the view that with co-operation, with the elimination of middlemen, Indian silk can be sold in India at prices equal to foreign silk and of equal quality: but no business-man will touch this sort of thing, least of all in India, where he expects to make from twenty per cent. upwards with absolute certainty: and it is to be remembered that Japan and China have the advantage of India in having already organised their industry on sound lines.

The foreign factor is a wholly unknown one: we do not know whether it is superior organisation, small profits, better methods, better workers, that enable Japan to sell silk cloth cheaper in Burma than India can: this needs to be ascertained. Once this is clear the development of Indian weaving industry can be proceeded with: it will be slow, costly, arduous: it will need much energy and enthusiasm: it will not be an easy routine piece of work: it will need continued effort over many years: but I believe that in the end it will be done. It is clear I think that the development of weaving depends upon a definite set of factors: the efficiency of the weaver, the excessive profits of the employer, the possibility of co-operation; these same factors need to be known for Japan and for China: and if on a consideration of these factors it is decided that India cannot compete with Japan, then development is not possible: if it is settled that competition is possible then its proper lines need to be worked out.

METHODS OF DEVELOPMENT.

(a) Raw materials.

6. It is a curious feature of the Indian industry that so much raw silk is imported and used in India much of which could be produced in the country: and there is at present no means whereby any one can find out what raw silk is available in India or where to get it. Kashmir makes and exports raw silk and waste: the Punjab imports many qualities of silk, as does Bombay: Assam imports white China silk similar to that of Midnapur: Nagpur uses *khungru* silk from Bengal but has trouble with it; a trial was made there this year of filature silk with encouraging results: nearly all the China silk imported has to be first sorted into qualities as does most of the Bengal and Mysore: the following are the actual figures of winding off 17 tolas of China silk costing Rs. 3-3-0:—

No. 1 quality	8 tolas	1 masha	.	.	.	.	.	47	per cent.
No. 2	"	7	"	0	"	.	.	41.5	"
No. 3	"	9	"	11	"	.	.	5.5	"
No. 4	"	0	"	10	"	.	.	5	"
Waste	0	"	2	"	.	.	.	1	"

Cost of winding 12 annas.

In actual cost, the No. 1 and No. 2 here are dearer than equivalent Kashmir silk, but Kashmir silk is unknown and there is no means of making it known. I have referred to this elsewhere (see page 50) and the study of the new materials by a bureau from which information could be got would help the producer: furthermore, the development of sericulture in Bengal, in the Punjab, in Assam can be so directed as to producing exactly the qualities for which there is a large demand in India.

(b) Improved processes.

7. Throughout the description of the weaving industry, I have referred to processes used in different parts of the country and known there only. There is little doubt that production can be cheapened and quickened with better methods: the Burma hand-reel, the Madura cross-reel, the Surat twisting machine, the Pusa automatic twister and doubler, the Burma compound wheel, the Bassein Dobbie-loom, the Churchill loom, these are examples of methods which deserve to be more widely known and to be fully perfected: and if the principle of the co-operative finishing factory can be adopted, there

is scope for much introduction of better methods and labour saving devices, worked out to suit the people : in India they fill one pirn at a time : elsewhere they fill twenty : in Benares they twist each thread singly, in Surat forty threads at once. It is a characteristic feature of India that a large number of people should do slowly and laboriously a simple operation that could be done rapidly and more cheaply.

This introduces us to the difficulty that looms up at once : in ordinary weaving, a large number of people make a poor living by doing slowly and tediously some operation such as twisting. If you introduce a labour-saving appliance, you enable one worker to do what ten did, you cheapen production but throw nine out of work ; you must at the same time introduce greater demand so that the nine can find work, not necessarily at twisting but at bobbin reeling or pirn-filling : that is, you have to get improved demand before you can adopt labour-saving appliances.

This is probably economically unsound, but one has to think of the people who earn a precarious living at some minor branch of the trade and not dislocate them : the object is not to enrich one person, but to improve the circumstances of the poorest. Improved appliances may be a curse if they throw people out of work who already have a hard time to live at all. So I put first the economic enquiry into supply and demand. Wherever there is a chance of demand, you step in and stimulate supply : if enquiry shows that supply cannot be organised to meet the demand, at its price, nothing can be done.

(c) Improvement in design.

8. Throughout the Indian industry there is a very marked want of originality in design and colour schemes, due to the isolation of the workers and the limited resources in weaving, dyeing and the like. In some areas, this is necessary as the demand is for a definite unvarying article : but in others, original designs from abroad have succeeded for the very reason that they were new.

This is very markedly shown in Kashmir and in Burma. In the former, the enterprising and intelligent dealer has adopted designs suggested by European visitors, employs trained designers, is on the look-out for new ideas, new patterns, new colour-schemes : the result is a very great variety of beautiful patterns and colours, and a constant demand. In the latter, the stereotyped colour patterns for longyis and other cloths have given place to new designs, in some cases suggested by European firms, in others devised on the spot : but these new designs succeed and the Burman buys also the new patterns of Japan, not wanting an established pattern but something new. The cloths made to the order of European firms, with new colour schemes and new weaving methods, made at Mandalay, succeed very well : and there must be the new patterns if the Burma weaving industry is to hold its own against imported fabrics. India is a large continent of many peoples and what succeeds in one place fails in another : but it is opening up, and the demand is more for new things and less for the fabrics made to pattern for so many generations.

I think this is vital to success : the weaver must be helped to new ideas, to making new fabrics, to using other colours : and the improvement of design is a vital necessity.

9. There is one aspect of the European shop trade which is worth attention and that is the designing and making of new fabrics and new articles. Some years ago, it was the fashion to wear silk wraps with ornamentation at the ends and Pusa prepared designs and worked them out. They were very attractive and would probably have sold well in quantity : similarly at Pusa a peculiar " carriage rug " was designed, which was attractive and would have sold well in quantity : some new dress fabrics were made there in the same way : I think a great deal could be done in this way and I would also spend money in getting from London or Paris specimens of new fabrics and ideas, so as to be ready to put any new thing out at once in an attractive way. It involves being able to place a volume of orders very quickly and getting

supplies made: it involves also the intelligent co-operation of dealers and shops, but if once the fabrics get known, the demand would be large.

I believe the same could be done with fabrics of native use, but I am less certain about this. It has been done for silks for wear in Burma by an English firm with conspicuous success and they have silks woven for sale in Burma to their own designs with good results. To carry this out involves a large establishment on the lines of Pusa, where ideas of all sorts can be thoroughly tested. If a novelty is found, arrangements are at once made to get it made, to supply the trade and to get it on a proper trade footing; and I think India could work up a trade of this sort exactly as Japan has done. I would work on the same lines for the testing of new ideas for the native trade and, with a large margin for loss, I think that new ideas could be evolved which would hit the native fancy. As soon as one such developed, it would be put in the trade and, by employing designers, by having a staff on the look out for new ideas, I think that very much could be done with new designs and new fabrics. If the Japanese, the German, the Austrian can put out new designs that appeal to the Indian trade surely an Institute in which Indians produced designs would be still more successful and would stimulate the demand for Indian-made goods. I think this deserves a fair trial for long enough to really test its value and, sympathetically handled, the interests and co-operation of the Indian public could be assured.

(d) *Commercial organisation.*

(i) *In India.*

10. If you go to Murshidabad, or Bhagalpur, or Amritsar, or Ahmedabad, or a number of other weaving centres, you will find certain classes of fabrics being produced and probably a good many weavers idle. If you go to Bombay, Calcutta, Lahore, Allahabad, Delhi and other places, you find silk being sold that was made in Japan or China, that could just as well have been made in Murshidabad, Bhagalpur or Amritsar: and when you ask the seller why he does not get his cloth in India or the weaver why he does not sell his cloth in Delhi, both say they know nothing about it.

The man who will do most for the industry now is the man who will first find out what every weaving place in India can produce, will then find out what India needs and will put supply and demand into communication. This is not going to be effected by any exhibitions, museums or the like: it is going to be done by personal knowledge of the possibilities of production and of demand. It is going to be done by men getting to know all about production and then going round to find out where their goods will sell; it is going to be done also by their being able to go to the weavers and say "such and such a new cloth is needed, this is how you make it," and the man to say it has to be one of the caste of people who produce it: but behind him has to be an organisation, which has found out all about making it and can tell him the best and most efficient way.

11. It would be worth while making an attempt to organise supplies of Indian fabrics to deliberately meet the demand and there is one way only in which to do it: it requires a knowledge of the fabrics likely to be in demand, a knowledge of how to make them and an organisation that can place orders for them and show how to get them made. Messrs. John Smith anticipate selling 1,000 yards of a fabric, in $7\frac{1}{2}$ yards lengths paying Rs. 2 per yard for it: what is the peculiarity of it, where can it be made, at what price? If enquiry shows it can be done, the order has to be backed by some organisation in order to be obtained and to be carried out: this organisation must be supplied.

I think it is worth trying to supply that organisation for at least long enough to thoroughly test it and I would obtain an assistant with some knowledge of the trade and employ him as a commercial traveller for Indian silks after thoroughly teaching him what India produces. This the Central Institute could do and it is possible that an export trade might develop through firms dealing with Ceylon, Singapore, Mauritius, etc. Madras

exports to these places and it would be a good thing to send an assistant round to these places and investigate the demand: he would take with him a big range of Indian fabrics and find out all about the possible demand. To some extent this could be done through consular officers also and this branch of the trade needs developing.

The possibilities of this method of developing trade have been realised by one firm in Burma but have not been fully exploited: with sufficient capital, with some organisation, this method could work well to the advantage of the weaver, instead of to the benefit solely of the middlemen, if it was developed.

12. What is most required in silk is more direct organisation and if this cannot be supplied from within, it can be from without. It will be best applied in this way: for a definite area, say Bengal, a native of that area will need to be found who is well acquainted with the production of silk fabrics; he would probably be the son of one of the large traders in silk cloths. He would be trained and then visit every weaving place, every weaver's village: he would buy sample *thans* liberally and get to thoroughly know supply. He would visit all big centres and study the demand: for every area there would be a similar man: these men would be employed from one centre and would there discuss what was wanted from outside their area and what other area could supply it.

These men could also very materially assist firms who issue price lists, etc., in making these presentable and attractive: they would help in introducing improved methods and in finding out what advice the weavers needed. I would have special men for the different classes of trade: and one specially for the European shops: above are the views of some of the English firms as to silk: their requirements should be studied and could be met. In this question, I am compelled to apply knowledge derived from a limited experience of the methods of native trade, and it is possible that such a scheme would not suggest itself, if I had a real inside knowledge of the native trade. I understand better the methods of the trade as carried on by European firms in India and in England: and the most difficult part of organisation will be to help the native trade.

I cannot see any other system by which Government can assist the industry: if India were less divided, a Silk Association would enrol all the large traders and common action would be taken over all India: or an All India Silk Supply Co. would be started and do the work on a proper commercial basis. As it is, I think an attempt should be made to organise the trade on these lines and to give it a trial. The experience gained will at least show in what way the necessary organisation can be supplied and if the method succeeds, it may be possible to turn it over to a commercial body.

I am aware that this is the most difficult and uncertain part of the organisation and it will require tact and discretion in its working: my limited experience with weaving firms, weavers, dealers and the trade generally has shown me that a great deal can be done and that it is easy to get the confidence of all classes; but when this comes to practice, and to be applied through assistants over large areas, it is not so straightforward.

13. Clearly the scheme will depend much upon co-operative effort on the part of weavers: if a fabric is found for which there is a demand, who will make it? That is decided from the knowledge of production and the order is placed with different places: in each some one must guarantee the supply and the quality, and business must be done through a master-weaver or a co-operative society of weavers: such can be created and I think this kind of organisation will greatly stimulate co-operation among weavers.

(ii) *Export Trade.*

14. India produces above all a great variety of silk and I believe there is a special demand in big cities for this: the big London firms sell cheap: but there is a separate demand for variety, uniqueness and high quality: I believe that there is a reaction taking place from the cheap and nasty mill-made product to the genuine hand-woven and artistic fabric. I would test this in two ways: arrange with a firm of very high standing, (not one of the

big stores), to sell Indian silks for say six months: pay for all advertising, expenses, etc.: offer every possible kind of Indian silk: use influence socially through the India Office and so on: give Indian silk one real trial, not as a commonplace everyday fabric, but as a special, exclusive, artistic fabric, which could only be obtained in small quantities and was not worn by everyone. For the second, I would send a commercial traveller round the big firms with samples, sending a big stock of Indian goods with him and selecting these on his knowledge of what was required and on our knowledge of what India could produce. I would do the same in Paris, in New York, in Washington, in Philadelphia, in Melbourne, if the London experiment looked like succeeding: and I would transfer the control to a firm as soon as it succeeded. For the first trial, I would spend at least a lakh on fabrics: I would arrange to duplicate every piece sold at once: and I do not think that there would be any large loss on the trial. In this connection, I believe that America offers a very good market for the very best class of fabric such as the kamkhwab and the elaborate brocade, the Burma pattern and shot silk, if these were known there, just as they offer a market for good carpets: price is not the consideration so much as design, workmanship and perfect material: and India can supply a range of hand-loom fabrics to be equalled probably by no other country than Japan. It would be worth attempting this market and getting a demand there for the very fine fabrics that were made for the Indian princes, the demand for which is now lessening in India.

15. I have referred above to the value of getting from London, Paris, etc., the latest ideas in fabrics and silk goods, so as to be ready to meet a possible demand in India for a similar thing: to do this it will be necessary to retain some one in a position to give information as to the fluctuations of fashion, etc., and this agent can intelligently estimate what Indian fabrics, if any, would be in demand there and if so in what form. I think the idea can be developed: it is at least worth trying and the experience gained would be worth while. Some years ago a well known firm specialising in art furniture and fabrics wanted from India a supply of hand-spun hand-woven eri cloth in simple stripe patterns: they were obtained but at great delay, as the organisation did not exist that could at once place the order and guarantee it: had this order been carried out at once and well done, it might have led to a larger demand and finally to a steady export business in this particular class of fabric.

It will be seen that development on these lines would be slow, would at first be costly and would perhaps never amount to a very vast trade: it would not necessitate new mills or much industrial development: but it would bring prosperity to many weaving villages and would help the scattered industry to develop and improve.

In this connection, there is one point that requires to be remembered: a certain amount of silk or silk-embroidered fabrics leave India and are sold in London, Paris, etc., at very high prices. The firms who take them sell them at twice or three times their original cost but in small quantities for special demand. This is doing harm to India as the profit goes to the middlemen, the sale is small on account of the high price and the Indian craftsman does not benefit. It is to the interest of the Indian worker that his fabric should sell at a reasonable price, so that the demand shall be great; and the Japanese trade has developed largely because it has been in the hands of their own people, who have sought to stimulate demand and have sold at a reasonable price. I think that a scheme such as has been outlined would give Indian silk a chance of finding a market.

(e) *Methods of organisation.*

(i) *Survey of production.*

16. The first requirement in trade organisation is to know what is being produced and this is best ascertained by sending an assistant round each area, letting him buy freely and collect these fabrics as a nucleus stock: if any look promising, a stock can be got. The distinct weaving areas in India are South India, Orissa, Burma, Assam, Bengal, Chota Nagpur (tasar), United

Provinces, Punjab and North-West Frontier Province, Central Provinces and Bombay : the production in each is distinct and the available fabrics are different : each will require separate investigation.

(ii) *Survey of demand.*

17. The next thing is to know what is wanted, partly what is being sold in the bazaars, partly what is being imported. This requires the collection of samples of imports, and a survey of what is being sold : it is not a difficult matter to arrange and a knowledge of what is wanted would materially help in developing the industry. It would enable us to see how far the existing industry could supply what was in demand and how far new methods will be required to produce the competing fabrics.

(iii) *Advertisement.*

18. As a sequel to the survey of production samples are circulated, advertisements are published, attractive information is prepared about Indian silk : there is considerable scope for mere advertising, if intelligently done, and there are not many people, who know about the wide range of fabrics available in India. If this is done there must be the stock available for supply : and the mere publication of information about Indian silk without publication also of where to get it will be useless. At the start the silk will need to be supplied from one centre : but as reliable suppliers are found the different qualities can be left to them.

(iv) *Experimental production.*

19. Having discovered what is wanted that is not already made in India, it is necessary to know how to make it : and it is essential that there shall be an institute where this can be worked out. It is quite useless to talk about making crepe, say : you want to actually do it, then get ten weavers on to it, sell the output, and see if it pays : if it does, it can be turned over to a co-operative society or to a master-weaver or it is started in a centre where there are weavers available : but it must first be worked out on proper business lines and this can be done only in one central place, where the best technical methods can be applied.

(v) *Exhibitions and diplomas.*

20. Having ascertained how to make the fabrics, you want to directly organise their production : and there will be many methods of doing this, each suitable in the proper circumstances. In the first place there will be the museums, exhibitions and the like : they are not of much value but they need not be wholly neglected : the Commercial Museums in Madras and Calcutta are instances in point : neither of them really reaches the weaver at all : the Madras Institute sells goods and so helps but one will need to go much further than that.

An exhibition of silk fabrics at which prizes and diplomas were given for good craftsmanship would be a definite benefit, especially if the awards were really to the best craftsmen. As good a diploma would go to the man who made a perfect piece of plain silk as to the weaver who wove a *kamkhwab*. The excellence of workmanship is the test : and I think nothing would more keenly stimulate competition than a real exhibition of fabrics, classified, priced and with the maker prepared to deliver at his price. I would put all the weight of the Institute behind such an exhibition and I would make the diploma of the Department an honour to be won with great difficulty. I think the method would work well and that it would stimulate firms to work in with the Department. There is nothing that the master-weaver or dealer wants more than a certificate that his fabrics won a prize at an exhibition and I would make the Department's diploma a very hard thing to get, giving real *kudos* to the firm that got it. I would go further and I would investigate the

condition of the weavers who worked for those firms and see that they were well off. This could be easily done and the exhibition would help the weavers: it would also help the Institute to establish relations with the trade.

21. In Calcutta and in Madras there are permanent exhibits of local products, with an organisation that gives information as to obtaining them. It would be possible to add products not competing with those of Bengal and Madras, derived from other provinces, which could be shown there: it would be possible to arrange such exhibits at other centres, showing products from all provinces and also to have a single exhibition of products from all India at a single centre.

I am not sure that these exhibits do much good: it depends upon whether the trader comes and gets useful information as to what to stock that really sells well: at present he does not do so and it is the tourist who buys chiefly, but at least the idea could be well tested with a proper organisation.

(vi) *Departmental influence.*

22. In the second place there will be the direct influence of the department in buying its samples and stocks of fabrics, in promoting trade and in supplying exhibitions and the like: the assistants who make the surveys will be known in trade centres and will have direct influence: the more intelligent employers, being told that there is a demand for a particular fabric and that it can be made in such and such a way, will probably go into it if they find it practicable: if there is a really competent department that does know its business, a great deal will be done by direct influence.

(vii) *Schools.*

23. It may be more satisfactory in most places to start a "school": the name seems to attract: the fundamental idea in the school is (1) that there are weavers and that no one else shall attend (2) that they learn how to make a class of fabric for which there is a market (3) that when they have learnt they go home and weave it (4) that the school is in touch with markets and finds out what is in demand.

If a central co-ordinating and advising institute existed, a district in which were weavers would apply to it, get advice and start a school say to teach them how to weave satin or suitings. Such a school would be a centre to which the trade organiser would appeal when he wanted say 1,000 pieces of a new fabric to meet a demand: the success of the school depends on its being able to find a new fabric for which there is a market and teaching its manufacture to weavers only.

This is a very simple method, apparently suited to India: a weaving centre has weavers idle: some one brings the matter up at the District Board or Municipality and proposes to start a school: the district officer supports it: Government is asked for a grant, a local magnate gives a donation and the Sir John Smith Jubilee Memorial Weaving School is started. Provided that weaving school knows what to make and can show weavers how to make it, it is doing good work: often it cannot do so and after a few years it is closed, having been of no real use to the community. That this is possible is shown by the silk schools of Bara Banki and Amarapura: but whether it will be possible elsewhere depends wholly upon local circumstances. In most cases it would fail owing to the opposition of dealers and employers to any change or alteration in affairs locally. But the influence of Government and of influential local people can overcome this and it is possible to get round the opposition if capital is available.

In no single thing is failure so likely as in this and I have discussed this question above under "Development of Sericulture": there is in India very much wasted effort, very much "eye-wash" in schools and the like: and to a great number of persons in India, it is sufficient to have a "school," regardless of all other circumstances and considerations. Nothing will kill progress more surely than the formation of schools if they are not on sound lines: and it is a method which requires to be used with the greatest caution.

The success of Bara Banki and of Amarapura gives evidence that developed properly, the weaver can be helped and that when he is helped he adapts himself and takes to new methods : but the secret of success lies in having proper methods and teaching them properly.

(viii) *Finishing factories.*

24. A method that, on paper certainly, looks promising is the establishment of small finishing factories, which are centres from which the production is organised : from them the raw materials are issued : the cloths come in, are cleaned, polished, finished, properly packed and sold : and it will probably be easy to develop production from these where the conditions are right and the weavers can produce a saleable fabric. One cannot of course put down hundreds of these and start them all at once : but here and there, when circumstances are favourable, they can be put down and the industry organised. Whether they are run by the State experimentally or whether a local man is helped to start and run it, is immaterial. The lines on which these must be run need to be worked out at the Central Institute first.

(ix) *Direct demonstration.*

25. A certain amount can be done by direct demonstration but chiefly only where there is a definite new process that is easily shown. The start of the improvement in the Burma industry was in an Amarapura weaver seeing an automatic beating loom working at an exhibition in Rangoon and this loom is now in common use in Amarapura. Where there will clearly be a benefit in cheapening methods, the improved method can be demonstrated and thus introduced.

(x) *Co-operative Credit.*

26. There has, as yet, been little sign that co-operation can be successfully applied to weavers : in Madras it has failed to draw in the silk weaver : the best case known to me is Amarapura in Burma but the possibilities of developing co-operation among weavers are practically unknown. Where weaving is highly organised, where the craftsman is in the hands of wealthy employers as in most big weaving centres, who have no intention of altering the present state of things, it will be very difficult to organise any co-operative developments : but where the industry is small, where there are weavers who have taken to other occupations, where the distress is really serious, there development is possible and its extent will probably depend a good deal on taking advantage of these opportunities.

(xi) *Direct organisation.*

27. For a great part of the industry, especially the smaller centres, direct organisation will be the only method, and this is exemplified by the case of Olsing in Bihar and Orissa (discussed under that province—Chapter XX).

28. If enquiry shows that there is a sale for a certain fabric, its supply will be arranged in this way : a co-operative credit society or a village will be authorised to make say 1,000 pieces : the raw material will be advanced, if necessary wages paid, and the finished cloth collected, finished and sold : it will deliberately be sold to compete with imported cloth even at a loss : as soon as that production is satisfactorily arranged for it will be left to private enterprise but will be watched. The department will here be taking the place of the business man risking capital and expecting ultimately to make profit : it will finance and direct an ordinary transaction, but doing so because the risks are such that no business man would touch the matter : but it will do so through co-operative credit societies.

(f) *Industrial development.*

29. It is useful to consider separately what openings there are for industrial development as apart from the improvement and development of the

existing rearer, reeler, twister and weaver. Can the investment of capital be considered in any part of the industry and if so, how?

30. *Rearing*.—There is very good scope for development in rearing in suitable places, on one of two systems: the first is exemplified by Khan Bahadur Ghulam Sadiq of Amritsar, who has spent money in developing sericulture in Gurdaspur: he rents the trees from the District Board, he has a small staff that issues seed and gives advances, he takes all the cocoons produced at a fixed price. His activities extend over the whole district and he issues 400 oz. seed and gets 150 maunds of cocoons in. He owns carpet factories in the district and so has staff available on the spot who are engaged in these factories for the greater part of the year. The second system is that exemplified by the Raja of Kalakankar, who started the industry among tenants and provided the capital. A similar system is discussed elsewhere (page 114) for Tirhut. Both such systems are possible wherever the conditions are right: and one would like to see large landowners and influential people taking up this method. It requires capital and may legitimately be included here among industrial enterprises.

31. *Reeling*.—The second opening lies in reeling, and is exemplified by the filatures of Bengal already described above. There are many native filatures in Bengal now and there is probably scope for more. Khan Bahadur Ghulam Sadiq has a filature in Amritsar which reels the cocoons he produces: in every new tract such a filature will be desirable and the lines on which to start them are perfectly definite. It is interesting to note that the filature system is unknown in Mysore except as regards the two filatures of the Salvation Army at Bangalore and Closepet, which are not typical since they depend on grants from the State. If sericulture develops in Mysore there is scope for filatures.

32. *Re-reeling* is a separate business and there is very good scope for it in Bengal, in Mysore, and probably in places where much foreign silk is imported. Its success depends on the re-reeled silk making a name and getting an increased price to compensate its cost. Seeing that nearly all silk in India has to be re-reeled and sorted by hand by a very tedious process, it is probable that small re-reeling factories, worked by hand, would pay well. I think they should be combined with warping, as below.

33. *Spinning waste*.—*Spun-silk* is at present made at two Indian factories, mainly for their own use, and there is a large import of spun-silk, largely made from Indian waste silk. If it pays to send waste silk from Mysore to Madras, from Madras to Turin, to send the spun-silk back to Bombay, paying import duty and through middlemen to Amritsar, Benares, Madras, etc., surely it would pay to spin it in India. Yet it is apparently not sufficiently remunerative to tempt the existing mills to meet the local demand. Japan has the bulk of this trade now and the imports are increasing.

To set up a spinning mill is not like setting up a small hand-loom factory or a re-reeling shop: spinning requires large machinery, a certain supply daily of hundreds of pounds of waste, a certain demand for the produced yarn: and at present the Japanese are underselling the Indian and Italian producer.

34. *Warping*.—In this connection, the new import of warps of spun-silk is worth note and these are being increasingly used. In connection with all silks, except the ornamental ones, the use of warps is an economy: obviously a factory devoted to warping only will be quicker and more economical than individual warping and one wonders that warping shops have not been set up for reeled silk, spun-silk and other thread at centres such as Benares, Amritsar, Murshidabad; the best system could be used, it could be coupled with dyeing, twisting, etc., if it expanded and the use of prepared warps would be an economy.

35. *Doubling and twisting* is another branch that should offer an opening. Except in Surat, the systems in use are very slow, very tedious; there is scope in every big centre for a small factory, using hand power or small mechanical power, to produce the various grades of weft and warp thread

required. Not much capital is involved and probably master-weavers or a co-operative society of weavers would be the best agency to start them.

36. *Dyeing* clearly offers a very good opening in big centres and a small factory, using only really fast dyes, could probably do good business. It is not long since yarn from Gauhati was sent to Amritsar for dyeing. At present much yarn goes to Belgaum for this purpose. Really fast dyeing is so difficult and so important that it is worth sending yarn away for dyeing. In establishing this, confidence is to be gained and it is essential not to make any mistakes: it is only after the fabric is sold that the dye fades if it is bad. By dyeing samples and sending them to the trade, the quality of the dyeing is easily verified and the consumer can satisfy himself as to their fastness.

37. *Weaving* has already attracted the investor and there are hand-loom factories which work well. They require little capital but need to be worked on a large enough scale. Such a factory should do its own doubling; warping, etc., and each department is capable of expanding to do work for others, so increasing the scope of the business.

38. *Finishing*.—In no detail does the Indian fabric show so badly as in its finish and there is scope for small factories that will clean, sponge, polish, calender, or size the finished goods, and pack them well. Here the mill scores as it puts up its goods well: I think there is scope for this in Benares, Amritsar, Nagpur, etc., in every place that has any trade by post or outside its own bazaar. Certainly this is essential where the European shop trade is concerned and it is a factor generally neglected in India.

39. *Gold thread*.—There is a large import to India of gold thread (lace) and a considerable production also in India. There is certainly scope here for development on sound lines: it is unfortunate that the factory in Madras failed: but the failure was not due to the impossibility of making gold thread but to other causes.

40. There are instances in India of good industrial development: and many of very bad development: two excellent examples are in my mind, one dealing with the native trade chiefly, one dealing almost wholly with European and Anglo-Indian. At both the same lines are followed: a definite range of fabrics is decided on; labour-saving devices are used for warping, for filling pirns, winding bobbins, etc.: the looms used are fly-shuttle looms of simple pattern, well adapted to the local weaver: the buildings are of the simplest and there are some twenty or thirty looms employed: the weavers earn good wages and live near by: the amount they earn depends on their own exertions; the factory issues a well printed pattern list; in the first case the factory has connections with native firms in big cities, who sell on commission: in the second the trade is wholly by V. P. P. I think there would be more of these if industrial development was more generally understood and if technical advice as to obtaining raw materials, appliances, looms, etc., was really available: I do not think that this kind of advice can ever be supplied from weaving schools or technical institutes: but it can be supplied by trained men who visit the weaving centres.

In this I am relying on the experience of the very small silk section at Pusa, which could have done a great deal to further the industry if it had been developed: but its influence was not due to its visitors but to its direct influence in the weaving centres and to the visits to these centres. I would aid such a development by the provision of capital provided the factory was started on lines approved by the Sericulture Department and this could be done independently by each province if they had expert advice to fall back upon.

It is difficult to distinguish in this between the hand-loom factory in which the workers actually weave in the building and the organisation of weavers who work in their own houses but who work for a firm, a weaving master or for a co-operative society. I think the latter especially should be aided, not necessarily with capital only but with the organisation that a co-operative society has and that is backed by the Registrar of Co-operative Societies. Whether it is to be a factory or a co-operative society of weavers

depends on the circumstances of each place : but whichever it is, pretty much the same result can be achieved if the matter is properly supervised.

CONCLUSION.

41. The gist of the whole matter so far as the development of the industry is concerned, is this : the production must be thoroughly understood : the Japanese and Chinese production must be studied : the improvement and development of the industry must then be taken in hand, place by place, with the aid of co-operative credit and capital or of other methods ; the processes must be improved, the sale of cloth helped, the production of new fabrics undertaken in suitable places : capital may need to be provided for developing finishing centres with which weavers are in touch : and in this way probably the weaving industry can be helped, stimulated and developed.

We may express this in another way : the steps to be taken are these :—

- (1) study and understand existing production,
- (2) circulate information of what is obtainable and where,
- (3) cheapen raw materials and methods of production wherever possible,
- (4) develop the production of fabrics in demand, by learning how to make them and then showing weavers how to do it,
- (5) help local " schools " with expert advice,
- (6) assist local effort with orders and financial help.

It is at present utterly impossible to tell how trade organisation will work but it can be fairly easily tried : and I think it should have a good trial on which, if necessary, some money is lost. In many places I have asked weavers if they would make a fabric I have shown them, for which I knew there was a sale and in most cases they appeared willing : but until it is put to the test it is impossible to tell what can be done.

42. If in any weaving centre a finishing factory were put up (which is not costly) and if fabrics were brought direct from the weavers, if weavers were given materials and advances for weaving, I believe they would weave any fabric they could be shown how to weave and that was within their capacity ; and the cost of this fabric, without the middleman's charge would enable it to find its market : but till co-operation could be developed an outside organisation would have to finance it, bear the cost and make as much as was possible on it towards expenses : ultimately either co-operation would step in or a reasonable employer would be found : otherwise the weaver would fall back into the hands of the employer and there would be the same stagnation and sweating. I do not propose that Government should continue to do it : whenever and wherever ordinary organisation will do it, leave it alone : but the initial effort must come from a Government department.

Naturally the method is not going to be applied simultaneously in some scores of weaving centres : it will be necessary to proceed slowly, to systematically investigate, to pick place by place, to start here and there as the circumstances show we have an opportunity : and it will probably be best to confine our efforts at first to one province or area. Also it will probably be best at first to attempt to make the goods so largely imported into Burma when it is decided to go in for making new fabrics.

43. I think it is possible that in, say, five years, experience will show that progress is possible only in certain directions : I doubt for instance if the Kumbakonam weaver will readily take to making say satin or lining silk for the Calcutta market : but I think it is quite possible the Champanagar or the Bankura weaver would if properly helped : and I would concentrate on places where things looked promising.

In discussing this proposal it should be remembered that we have an imperfect knowledge of the industry and that it is an industry in which there is an enormous variety of method, custom, people, organisation and material.

It is at this point that the commercial community in India will say that the scheme is impossible, the method wrong and that the intervention of a Government department is wrong. If successful business can ultimately be done, it should be left to ordinary business methods and firms to do it: the fact that business firms do not now do it shows that the case is a hopeless one. I am very fully aware of this point and I quite sympathise with the attitude of the commercial community: but I am absolutely convinced that if some one does not make the effort, the industry will die, and I cannot see any other way in which the effort can be made. If trade organisation is what is required and if the Indian silk-weaving can be developed on proper lines, why do not business people do it: why is a profitable business not further developed and how is it that enterprising firms are not having goods made for export or collecting existing productions?

I think that the answer is that it is impossible to do anything and that the capitalist in India knows it quite well; to take a concrete instance: China satin is selling in Nagpur at Rs. 3-4 per yard: Nagpur contains many weavers and much silk: why does not the Nagpur master-weaver make satin: he knows that by the time he has learnt how to do it, has taught his weaver, spoilt some yarn, got perfect satin, and sold it, he is not making the profit that he can make in other ways: and to make his accustomed profit he must charge a price at which he cannot possibly compete with China. If then the business man, *i.e.*, the capitalist, is not going to do it, no one can but the co-operative credit society which is able to work direct on reasonable interest and to deal in wholesale quantities: I believe the ideal development of weaving silk goods lies in the production of co-operative finishing factories, which collect the fabrics, finish them, sell them from one place, but in which all the weavers work at their own homes. At present where these exist they are run by firms whose profits are far too high and they simply cannot compete for that reason: but if that middleman was removed, quite a third would fall off the cost and business might be possible.

44. I have tried here to explain what seems to me the only possible way in which the industry can be assisted and a beginning has been made in Madras, Calcutta and Cawnpore by the formation of centres where indigenous products can be seen and bought: only I think that these are not carried far enough, do not reach the widely scattered silk worker and do not take sufficient account of his circumstances; they may help the large dealer, they do not help the craftsman. This is the experience of the Director of the Victoria Technical Institute, Madras, who finds that it is extremely difficult to deal directly with the weaver and to help him. Extra business means profit to the middleman and not to the craftsman.

45. The Director of Industries in the United Provinces tells me that an effort is being made to help the hand-loom weaver in cotton by supplying him with yarn direct from the mills, without the middleman, and selling his product direct, without any middleman. I think this is doing for cotton what I am proposing for silk: only the range of cotton fabrics is small, there is an immense demand for coarse cotton cloth everywhere and if the weaver can make quite plain dhoties, saris and the like, as cheap as the mills, there is a big constant demand.

Silk is more difficult as the range of fabrics is so great, the processes are more difficult, the markets less universal. There must be expert help with processes if production is to be cheapened and there must be an organisation that extends beyond the limit of a province if it is to succeed.

I am fully aware that my proposals are open to criticism and particularly to the criticism that success depends too much upon the character and ability of the personnel: but I think it is useless to do anything less than to go right to the bottom of the thing: exhibitions and industrial museums look nice, read well in reports and are easily visited by influential personages, but they do not influence the actual weaver or twister away in the mofussil.

46. The development of the weaving industry has this in common with the development of the silk-producing industry, that it depends fundamentally on doing for the craftsman what he will not or cannot do for himself,

namely improving and organising the industry from outside, without his initiative and without any demand from him. If the production of cocoons will be developed only against the will of the people, so too will the weaving industry develop and prosper only by action taken by Government, for which no one has asked and which no one obviously wants: but there is this difference, that the actual weaver responds and is amenable to co-ordination and suggestion. It is a reasonable view to take that until the industry asks for help it is not the business of Government to take the matter in hand: the means of development may be provided, the expert advice may be rendered available and the possibilities of development may be shown: but that is very different to the action that is required, which means the active co-ordination and improvement of the industry, and the creation of the organisation that in more advanced countries would be supplied by the ordinary commercial means. If it is possible to do good business in weaving, in dyeing, in twisting, in the production of new fabrics, why should it not be left to ordinary commercial enterprise; and the reasonable view is that while the necessary expert advice should be available, the rest should be left to the commercial enterprise of the country. Some day India will awake to the fact that there is a better career in this kind of business than in entering the service of Government as a clerk, and then the natural commercial development of the country will commence. Given expert advice, there is probably no better opening for moderate capital and business enterprise than in many ramifications of the silk industry: the essential is advice as to where to start in, what to do and how to do it: the next essential is help in establishing connections, in getting wider markets, in expanding and developing to the fullest extent. If the Indian is not enterprising or energetic enough to strike out for himself and to develop, it will be going very far to attempt to help him out by supplying the trade organisation required: but there is at present no other way to help the industry, and in the absence of such help, there is not much doubt that the greater part of the industry will gradually disappear.

THE SILK INDUSTRY, AND THE WAR.

47. At the present time, the industry has been affected by the war in a fairly definite manner, and in considering development, it is impossible to ignore the effect of the war and its influence during the next few years. Here and there in the report references will be found to this: the most notable are Mr. McNamara's under Kashmir (in Appendix V of this Report) and the appendix to Mr. Ansorge's. There has been a rise in values of cocoons, of waste, of raw silk, affected to some extent also by high freights and by prohibition of exports of cocoons altogether or of waste silk to Italy. This was preceded by a large fall when the war commenced, when values were high for all classes of raw silk, waste and cocoons: it is impossible to get figures for this and they would be of no value as trade was so tremendously dislocated by the war. The important thing is that prices for raw silk, cocoons and waste are likely to be high and likely to remain so for some time.

There has also been a rise in values of all classes of raw silk from China and this tells against the weaver but helps the Mysore and Bengal producer: Bengal cocoons were at Rs. 32 a maund in December 1915, at 38 in August 1916: Kashmir cocoons at Rs. 160 a maund could have been sold at over Rs. 400 if export had been possible. There has been a general appreciation of values in silk, due to a variety of causes of which some are dislocation of the French trade, cessation of raw supplies to Italy, decreased total output of the world, increased consumption for some purposes, enormously increased consumption in the United States (due to prosperity in certain trades); the total effect is that after the shock of the first dislocation, the raw silk values of all sorts have steadily increased: what the future holds is impossible to tell.

48. In regard to silk fabrics the position is different and this is extremely difficult to estimate. When trade suffered, the demand for silk goods fell off: Nagpur is perhaps the most conspicuous case: Burma was little affected: and Japan has continued to pour in cheap goods. It is apparently not much

affected by the war. In this, a factor of great importance is the dye question: aniline dyes were largely used in India: they are almost unobtainable now and the prices are very high: for certain colours there are substitutes, especially in the reds from cochineal and lac, black from catechu or myrobalans, blue from indigo, orange from kamela or anatto; but many industries especially in producing pinks, yellows, pale blues are likely to be much dislocated.

India is perhaps better off in this respect than some countries: the biggest item of production is the sari, dhoti and other cloths of purely indigenous design and colouring, formerly dyed wholly with plant and insect dyes: and the bulk of the indigenous production can still be done with these. Some branches of the trade will suffer: but if Japan can produce dyes to dye her goods, she will presumably also produce dyes for export to India. It is difficult to see how the shortage of aniline dyes can seriously affect the Indian trade now; but there is no doubt it is important. If the whole industry falls back on indigenous dyes, there will be a serious shortage and the production of plant and insect dyes will get a big stimulus: it would have been satisfactory if there had been an organisation that could have helped indigenous dyeing as its opportunity to get back to the use of the really good fast dyes would have been immense: but it is an occasion to seize presently and when dyes become available (from Germany), it will be an opportunity to push the use in India of only fast dyes such as the alizarine dyes. It is humiliating to think that we can only look forward to the supply of German dyes: it would be so satisfactory if in India we could have got madder, or alizarine, whether natural or synthetic: but I agree with Dr. Marsden that it is now difficult to get the enormous supplies of natural dyes required, especially in view of the enormous quantities of synthetic dyes Germany must sell to India (and England) to get the indemnity required by the allies in a few years.

49. Another aspect of the influence of the war is discussed in Mr. Anson's report: it is perhaps worth pointing out that the spun-silk trade must fall wholly into Japanese hands with the inability of Italy to supply and that quite possibly the production of spun-silk in Bombay may be stimulated if prices rise. It would be extremely satisfactory if India could eventually produce in India the spun silk so largely imported: and this is a question that should interest Kashmir, Mysore and Bengal. If the war sends up the price of spun silk, there is hope of the production in India and this is an industrial feature that should not be lost sight of.

50. One other aspect of this question deserves mention: enquiry is being made as to sources of raw material and a Committee of the Imperial Institute is at work: before the war, the price of eri cocoons was high: prior to 1911, we had received enquiries from Europe for large amounts of eri cocoons: and if prices had kept up a larger export in them might have been possible. India produces large amounts of raw silk, and silk waste: India could produce large amounts of eri cocoons and there could be a large export of tasar. Whether any of these will come within the purview of the Indian Raw Products Committee is to be seen: enquiries have been received from the Imperial Institute as to raw silk here and there: but at present there is no organisation to push Indian silk raw products in England.

If there is to be a serious attempt to supply silk raw products to the United Kingdom from India, as there apparently is from the Colonies, then the development of a trade organisation should be commenced at once. Presumably this will be originated in England: if it is, full advantage should be taken of it and the trade in raw silk, silk waste, eri and tasar should be developed. Presumably this will wait for action by the various committees sitting in England: and it is possible that the war may end before any English industry needs or can use any form of raw silk supplies.

CHAPTER XXVIII.—FORMATION OF A SILK INSTITUTE.

In the following section the organisation required to systematically develop sericulture and the silk industry has been discussed, chiefly because

it is an advantage to think out the detailed working of such an organisation and its cost. The estimate of staff required is not meant to be complete: until one got to actual work it would be impossible to know how many clerks were needed, or store-keepers: but the estimate is intended to be near enough to actuals to give an idea of cost. As regards the higher staff the actual pay would naturally depend upon the right men: for at least six of the posts the men who should be appointed are in India now and their cases require individual consideration. For this reason, actual amounts of pay are not put down and only the gross total is given (see Appendix XVIII).

2. The function of the Institute is to practise and improve all branches of sericulture, to give expert advice and to send technical experts to organise processes, to watch supply and demand, to seek wider markets and better supplies, and to be an organising centre for the development of sericulture in all its branches.

The activities of the Institute include the following main branches:—

1. The cultivation of all varieties of silkworms of India, and of races from abroad, as a seed supply centre and for the trial of new races. The production of new races by hybridisation, the amelioration of existing races by selection and good cultivation. The issue of hibernated seed or of all varieties of seed required, including the Bengal races, the Assam races, the Mysore, the Madagascar, the French, and also the eri.

Artificial cold storage will be required, a model "village rearers settlement" will be required for training men and for providing trained men for demonstration. There must be trained men available. The cultivation of mulberry, the varieties of mulberry to be studied and cuttings or seed provided of the best varieties. The problems of hibernation of seed, of the supply of seed produced in India and of artificially hibernated seed for hatching in October will come under this section.

2. The processes of reeling, re-reeling, twisting, doubling, warping to be practised, tested and improved. New machines to be devised or tested, trained mechanics to be available to demonstrate better processes. Model re-reeling, twisting, warping factories to be established.
3. The trade in raw silk, new openings for Indian silk, the methods of making chassam and improved waste, the testing of raw silk, the trade in imported raw silk, the trade in chassam and spun silk to be dealt with and studied, also the trade in muga, eri and tasar yarns, waste and cocoons.
4. Dyeing to be practised, studied and improved, including indigenous dyes and artificial dyes. A dyeing expert to be available for demonstration and for advising on model dyeing houses. A model dyeing house to be worked for show.
5. Designing, including the collection of fabrics, designs, etc., and the preparation of new designs, colour schemes, etc.
6. Weaving, the preparation of all fabrics possible in silk, to be practised, improved and taught. A special establishment to be maintained of the most expert weavers for the preservation of methods liable to be lost.
7. The best processes of cleaning, sponging, polishing, calendering and packing silk fabrics to be studied and developed. A model finishing factory to be established.
8. The cloths made and sold in India, imported cloths and fabrics of all sorts to be collected, and their possibilities investigated. The trade in silk fabrics, the possible demand, new markets, new fabrics, to be studied. This is to be separately dealt with for the European and the Indian trade.

9. Questions concerning foreign tariffs and bounties, legislation in India, and the development of co-operative credit to be dealt with and watched.
10. Wild silks including muga and tasar, to be studied. Eri cultivation and its development to be studied.

3. The functions of the assistants on the Institute staff may be shortly described, with reference to the sections on the Development of Sericulture and of Weaving above. The hybridising assistant is specially for the testing of new races obtained by hybridising, selection or otherwise, and for the production of improved races with particular qualities. A really good white multivoltine race is needed and heat-resistant races. Associated with him, is the Rearing Assistant, whose duties are to do industrial rearing of races, to study rearing methods, the best method for worms spinning, and to train any men in rearing, mulberry cultivation and pruning and the like. He is also responsible for seed production, hibernation, artificial hibernation, etc. Under him are (three) fieldmen, all specially trained in rearing and mulberry culture, available for sending out to start rearing. It is essential that the industrial rearing shall be done, not in a single large house, but in small rearing houses such as are used in India; and provision is made for local labour for this purpose. The cocoons produced by the above assistants are handed over to the reeling assistant, and are reeled industrially in the model reeling house. No other test is so useful as this and instead of assessing races in number of cocoons to ten grammes, it will be done in number of kahans and seers to the seer of raw silk. A fieldman is attached to this section, to supervise when the assistant is away, to tour when required. The assistant will test all methods of reeling and work out the details of small reeling factories employing up to 20 reelers, erecting one on the best system to serve as a model. In the same way, he will devise and erect a model re-reeling house, when the best system is ascertained.

This staff will be stationed on the Seed Supply Station. The re-reeled silk will be sent to the Institute for use there. At the Institute, there will be a small rearing and reeling establishment if the Institute is situated in a tract where rearing is possible, and the reeling there will be under the charge of a reeling master, who will also control the model re-reeling house, when all raw silk purchased will be re-reeled. There will also be an assistant whose business will be to study the trade in raw silk, the imports, the possible substitution of Indian for Chinese, the sizes to which it should be reeled to the amount of waste in re-reeling Chinese silk and so on. He will advise the Seed Supply Station, if, say, a particular white cocoon is needed to yield a silk to compete with an imported one. He will have testing instruments in a room in the Institute and be the consulting authority on raw silk. The methods of distinguishing real from artificial silk and the estimation of silk in silk mixtures will be done by him. The trade in chassam, in spun silk and in cocoons and waste tasar, etc., will naturally come into his work though ultimately another assistant may be required, and he will train a fieldman to demonstrate the best method of making high quality chassam. Another assistant, with a mechanic, will study all processes from winding of after re-reeling to warping. All the silk to be woven will be handled by them and eventually model sheds for twisting, warping, etc., will be erected. These, like all the model sheds, will be as simple as possible and made exactly as a master-weaver would himself make if he were going into the business. They are to be models for the master-weavers to see and copy. The weaving expert will be in charge of the looms and will specially work out the best methods of making fabrics which the trade require. He will work in the experimental weaving house and ultimately work out details of a model handloom factory and erect it.

The dyeing assistant will be an expert on dyes and will put up a model dye house suited to the industry. His business will be to master indigenous and artificial dyes and dyeing, to dye fabrics as required for weaving in the Institute and to provide dyed yarns of every possible kind for the artist.

The artist will be the nucleus of a school of design as applied to silk, and his ideas will be carried out by the Institute weavers, etc. He will be able

to get together fabrics of all kinds, and with the assistance of proper loom setters and pattern prickers, to have his ideas put into concrete shape on the spot. I think that such a school of design will help the industry and that it should cater for both the Indian and the European trade. It would be interesting to be able to collect the best craftsmen, to put them in a sympathetic atmosphere and to maintain the complicated and beautiful weaving processes now in danger of being lost. I think this will be done by the Institute staff getting into touch with the weaving centres rather than carrying out these processes at the Institute with their own weavers. Funds are provided for this since the best weavers can be employed to make sample pieces and so their craft can be preserved. It is possible that there is a very large demand abroad for the very best fabrics, such as are woven as saris, etc., if a stock is collected and if more can be made; but a good deal of preliminary work is needed and the artist is the nucleus of this development.

An European assistant is proposed for the development of the European demand and to exploit Indian silk in England, etc. Two assistants are allotted to investigation of the trade and to ascertaining what fabrics are in demand, what are available. These work in with the technical assistants, who carry out experimentally the production of the new fabrics, which these assistants want. Once it is past the experimental basis, the assistant puts it on a commercial basis by arranging for the production wherever there are suitable weavers. A separate assistant is allotted to the development of co-operative credit societies, who will chiefly advise in each province as to the proper lines on which to work.

A special department is to investigate and perfect 'finishing,' i.e., the preparation of cloth for sale, its attractive packing and proper listing. Indian methods of finishing are crude in the extreme and some simple method of calendering and paper-pressing is required, as well as labelling and the like.

Assistants are allotted to the tasar and muga work and to eri. The former is needed to undertake the investigation of tasar utilisation as a separate enquiry and to be an expert on this question; the latter is immediately required for temporary work only, but will be permanently, if there are any prospects of an eri industry. There are investigations to be made immediately on the source of the Assam eri seed and the existing industry in some parts of India.

4. Funds are provided for starting a single model weaving shed employing hired weavers. I think either more must be provided or close relations will be necessary with such small factories run as business enterprises, for it will be necessary to properly test, on a commercial basis, the making of certain fabrics. This could well be done for instance by employing say 20 weavers to make a fabric likely to be in demand, to keep its expenses separate and be able to turn the whole production over to a firm or a master-weaver, going on then to another fabric. It is one thing to tell a master-weaver that the making of, say, striped eri twill for pyjamas pays and another to show him 20 weavers making striped eri twill and let him see the books for himself. The alternative to the model weaving is to have funds to guarantee any losses made by a firm that takes it up (provided they work on the lines laid down).

5. A sum of Rs. 10,000 is provided for experimental work: this should cover, not only experimental work at the Institute, but grants to experimenters anywhere: for instance the Coryton reverser, the Churchill loom, and any promising twisting machine should certainly have been aided by funds when they were being produced.

Information Bureau.

6. There is scope for an information centre from which firms can obtain help and particularly can learn where to obtain fabrics and raw materials. I would register there every weaving master, firm or person, who was dealing in cloth or silk or any other product. I would have samples of his products and be able to tell enquirers exactly where to get what they needed. I would include in this every firm that exported silk yarns to India, every supplier of

raw silk in India, I would add all firms selling silk cloth, particularly those in the big towns and record all their catalogues, samples and prices. If a dealer wanted a particular quality he ought to be able to write to the Bureau and get his information.

This is the nearest that will be got to the Silk Association, and I would give every one enrolled a diploma or ornamented document that he could show.

7. The Bureau should have another function. It should be possible for anyone, a zemindar, a planter, a trader, any one who liked, to write in and ask and get advice as to his chances of doing silk worm rearing or weaving or anything else. If he lived in the middle of the desert he would be told it was hopeless, if he lived in Chota Nagpur he would be gently encouraged till the conditions in his area could be enquired into and he could be really advised; perhaps some one could be sent to help him at the proper season, but at least he would be helped, he would be saved wasting money if it was utterly hopeless and if the Bureau can get anything approaching the prestige that the entomological section at Pusa did, they would have a great and beneficial influence. This work would in the first place be in the hands of the Assistant Director, who would have no other work than to follow the activities of all the staff, be an expert in all branches and be able to give the most practical advice. Ultimately this would be placed in the hands of an assistant.

Staff.

8. It is easy to see that starting with a number of assistants of equal standing, all are not going to develop alike and that a scheme planned on a paper basis is not going to work out in this simple manner. Each assistant will find his proper bent and will be used in the best way. A great deal will turn on the spirit of co-operation of the staff themselves and no routine administration is going to make the Institute a success. Its ultimate influence will depend upon the selection of the men and I have no hesitation in saying that these men will have to be found in India and have to be trained there. There are two pitfalls to avoid, one is the foreign expert, who has no experience of the country, the other is the superficially trained Indian graduate of a Japanese or French school, who is completely and utterly out of touch with his country. I would rather staff the Institute with untrained men, who had ability, energy and a desire to help their country, than with men trained in sericulture abroad and having a superficial book and laboratory knowledge of the silk industry as practised in a large Sericultural Institute in Japan or France. There is a good deal of sericultural activity in India, now that may be characterised as "eye-wash." The real test is, does it help the people, and that should be the motto of the Institute; but to help the weaver and twister in the village you have to understand him and his difficulties and not be above doing so. It will not be easy to get the right class of men, but it is possible and it is absolutely essential to the success of the Institute.

Further it is essential that no post shall be made permanent: it will be better to pay more for men, who retain their initiative and energy, than to be staffed with permanent men intent on doing stereotyped routine work.

Existing Agencies.

9. In every province, there are weaving experts, who are developing and improving weaving, and who naturally enter into a scheme such as is proposed. At present, their chief attention is given to cotton weaving or to weaving as a process, regardless of the material, and it is not possible for the weaving master or expert to devote sufficient attention to silk to really develop it. In Madras and Burma more progress has been made with improving silk weaving than in other provinces and the industry there is in a fairly flourishing condition. Elsewhere there is full scope for the improvement of silk and this should be effected by a combination of the activities of the local expert aided and advised by the expert help of the Central Institute.

If the Central Institute decide that in the interest of the whole industry they should assist with money or otherwise a particular group of workers or a

process, it is reasonable that the funds or help should come from them; if it is desirable to assist the foundation of a model dyehouse or the like, to help a local industry, then it is reasonable that funds should come from the Local Government.

The respective positions of the Central Institute and the Provincial Expert are thus easily defined, and while the Institute investigates the possibilities of improvement, it does no more than advise the Provincial Department and urge that action should be taken where it is thought to be advisable.

If the Institute is successful, its advice and help will be welcomed; if it is not able to carry out the programme and cannot give effective assistance, then the scheme will have failed; but it is impossible to expect any single province to maintain specialised experts and the results of the work of weaving or textile experts, who have to deal with the cotton, silk, and wool industries for whole provinces, have been small, as might be expected.

Advertising.

10. A sum of money is provided for advertising, for literature and general propaganda purposes. It will be necessary to educate the public about Indian silk, to advertise it, and to give the press information about it. There should be information as to what can be obtained, the qualities of Indian silk, and where to obtain them; it may be desirable to have a catalogue of all available qualities of silks produced in India, with the names of suppliers and to keep this up to date and periodically re-issue it. An attractive pamphlet, with illustrations of processes and methods, with photographs of weaving villages and workers, with descriptions of the Indian silks and their qualities, will interest tourists, will interest dealers abroad and will generally help to make the industry known.

The issue of this pamphlet, the preparation of articles for the press, the general advertisement of the industry will place the Silk Department in a strong position with the trade and this is an essential thing. Probably a great deal can be done to promote the industry, to influence better production, to improve design, to prevent adulteration, by a department, which can influence the trade and create demand: it will pay the weaving master to support the department, to follow their advice and to expand his ideas: and the trade can be gradually organised till the way is clear for the formation of a Silk Association, which will undertake much of this trade organisation.

CHAPTER XXIX.—LEGISLATION.

Examples are summarised or reprinted below of legislation in various countries as affecting the cocoon-producing industry. They illustrate the effort made to develop or to control sericulture: further information will be found under Kashmir, both in the Director's report and in the rules regulating the use of mulberry trees in Kashmir (in Appendix V). Legislation is mainly directed to increasing production by means of bounties, to maintaining a seed supply free of disease, to controlling disease: the French law also gives a measure of protection to home-produced cocoons by reducing the bounty paid on the use of foreign cocoons. An abstract of the French Act is given below and full text appears in Appendix XIX.

France, 11th June 1909, Bull. Econ. XII, 1910, p. 85.

1. From 31st May 1909 to 31st December 1929.

60 centimes bounty per kilo of green cocoons = Rs. 15 per maund of green cocoons.

2. Packets of seed are all to be stamped with name and address of producer or seller and weight in grammes (5 per cent. error allowed).

3. From 1st June 1909 to 31st May 1929.
 - 400 francs bounty per basin doing more than 3 threads.
 - 200 francs bounty per basin doing double cocoons.
 - 400 francs bounty paid to preparing basins for more than 3 or less than 5 at 1 basin per 3 basins.
 - 400 francs paid to preparing basins for more than 5 threads at 1 basin for 2 basins, for factories doing more than 5 threads, 400 francs for each lot of knotters and "rattacheurs" for 6 basins.
4. Bounty not to exceed 6 francs 50 per kilo in first 4 years, 6 francs in next 8, and 5.50 in next 8. 6 per cent. of bounty taken for health insurance society of the workers.
5. 400 francs bounty above reduced to 340 if foreign cocoons used.
 - 200 francs bounty above reduced to 170.
- i.e.*, 25 cents is deducted per kilo, if dry cocoons reeled, from the bounty.
6. Cost of supervision to be got by a tax of 1½ per cent. of bounty paid. Details of administration are given in the full text in Appendix XIX. It applies to France and to Algeria.

OTTOMAN EMPIRE.

Reglement relatif aux encouragements a accorder a l'industrie sericicole.— 22nd May 1914.

1. The sum of Pt. 70,000* is set aside for—
 - (a) free distribution of plants and seed of mulberry,
 - (b) bounties for the best plantations newly made,
 - (c) bounties for the best rearings of worms.
2. Of this Pt. 50,000 is set apart for (a).
3. This sum will include cost of nurseries established to supply trees, etc.
4. A list of localities in which bounties will begin is prepared every year.
5. Bounties are given from the 4th to 10th year after planting mulberry at the rate of—

acres.		Rs.	A.	P.
2/9 to 10/9	1-5 deunums at Pt. 50 per deunum	6	12	0
12/9 to 10/3	6-15 " " " 40 " "	5	8	5
32/9 to 20/3	16-30 " " " 30 " "	3	0	10
Over 20/3	over 30 " " " 1200 " " in all	162	0	0

6. Pt. 7,500 is set apart for this bounty.
7. Bounties for rearing on trays is to be given—
 - (1) for 30—120 square metres of tray Pt. 100—Rs. 13-8-0.
 - (2) for 121—300 square metres of tray Pt. 300—Rs. 40-8-0.
 - (3) for 301—600 square metres of tray Pt. 500—Rs. 67-8-0.
 - (4) above 600 square metres of tray Pt. 1,000—Rs. 135-0-0.
8. The sum of Pt. 7,500 is set apart for this.
9. Names of bounty receivers to be published.
10. A sum of Pt. 5,000 is set apart for the travelling expenses of the technical commissions who do this work.

These regulations to come into force from the day of publication.

* Pt. 100 has been taken equivalent to 18s., *i.e.*, Rs. 13-8-0, deunum = 100 ft. × 100 ft. = $\frac{1}{16}$ acre = $\frac{1}{4}$ acre.
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Premiums for Silkworm Breeding in Brazil. The Board of Trade Journal, No. 742, p. 378, London, February 16, 1911.

The President of the Republic is authorised to expend 10,000 milreis currency (about 17,000 fr.), by way of premiums to silk cocoon producers, to be awarded at the rate of one milreis (1.70 frs.), per kilogram of cocoons produced in Brazil, and 5,000 milreis currency (about 8,500 frs.) in premiums to silk producers, who can prove that they have at least 2,000 mulberry trees devoted to this industry.

Japan—Law No. 47, respecting sericulture, 28th March 1911.

1. Defines sericulturists as rearers and producers, reelers, waste silk makers, cocoon stiflers, dealers in seed, cocoons, raw silk, waste silk, middlemen and persons concerned in the storage of the above products.

2. Seed producers are persons who produce seeds to be delivered to other persons.

3. Diseases are pebrine, flacherie, muscardine, grasserie and "uji" (the fly).

4. Persons who rear worms, shall destroy diseased worms, disease organisms, maggots, chrysalides and adults of the fly uji, according to the official methods.

5. Whoever wishes to be a "seed producer" must take out a license.

6. Seed producers are to disinfect rearing houses and appliances, according to official instructions.

7. Seed is to be produced only from cocoons from selected seed, *i.e.*, cellular seed.

8. Seed producers are not to produce seed from—

- (1) "Cocons composés"—Joined cocoons.
- (2) Cocoons with thin shell or irregular form.
- (3) Cocoons of which the weight of the shell is less than 11 per cent. of the total weight of cocoon in the case of univoltines, 8 per cent. for bivoltines and 7 per cent. in multivoltines.
- (4) Cocoons from unhealthy or small worms.
- (5) Moths whose body is imperfect.
- (6) Cocoons reared by unlicensed rearers.

9. Seed producers may not also rear cocoons for silk production.

10. From the time the eggs hatch to the time the new eggs are laid, seed producers may not use the same rearing house or appliances as another rearer.

11. Provides for inspection of cocoons and eggs.

12. Gives power to the Minister to declare eggs to be "selected" in spite of the last article.

13. The local inspecting officer is to "seal" all passed eggs, to burn all others.

14. Eggs not passed may neither be sold nor reared.

15. * * * * *

16. Only licensed producers may produce eggs.

17. Seed from foreign countries or from places where this law is not in force may not be imported.

18. The Minister may limit the production, sale and purchase of seed or limit the number of kinds of seed.

19 and 20. * * * * *

21. Those who wish to be professional "refrigerators of seed," must obtain a license.

22. Article 4 may be applied to wild silk rearers also.

Later articles arrange for Associations of Sericulturists and for penalties for breach of regulations.

INDIA.

2. At the present time there is no legislation dealing with any branch of the silk industry except the Sea Customs Act which imposes a duty of $7\frac{1}{2}$ per cent. on imports of raw silk and silk manufactures, and the Factory Act which regulates labour hours in mills. The possibilities of improving the industry by legislative means come under these heads :—

- (1) a bounty on cocoon production or the growth of mulberry,
- (2) regulation of the supply of seed,
- (3) regulation of rearing diseased worms,
- (4) bounty on reeling, whereby better methods can be adopted,
- (5) protective import duties on silk goods; and
- (6) regulation of the sale of silk and non-silk goods.

3. There is no doubt that large amounts of mulberry would be planted if a sufficient bounty were put on it: and mulberry would be used for feeding silkworms as it is useless for anything else. Without experience of the method in India or in other countries, it is difficult to assess the possible value of the method: in view of India's conditions it is probable that the money could be better invested in a Department which supplied expert advice and which could aid experimental cultivation with grants suited to the conditions of each tract: in any uniform tract the provision of a fixed bounty per acre or per tray of worms would be possible: but it would not hold for all India or for any province as a whole. To administer it would require some staff and would be difficult at first: a far more flexible method is to provide money for grants to cover the cost of experimental cultivation undertaken by District Boards or by influential zemindars, administering this through the Silk Department.

4. The regulation of the seed supply by means of legislation has been proposed by members of the Bengal Silk Committee, who desired to limit the sale of seed to that produced in the nurseries. It is clearly impossible at present, since the nursery seed is not disease-free and is not sufficient.

Whether it will ever be possible to limit the sale of seed, as in Japan, to disease-free seed produced by a special class, is doubtful: it might be done in Mysore or in Bengal: it would be difficult to carry out, a source of much corruption and probably not very effective. The benefit would probably be less than the cost and the seed supply can be controlled better by more direct means.

5. The regulation of rearing diseased worms is perfectly impossible under present conditions: it would require a large staff, give large opportunities for corruption and be excessively difficult to administer.

6. The question of bounties on reeling is one that affects only Bengal and Mysore: it would be possible to encourage better reeling by paying a bounty such as that of France, but it would be excessively difficult to administer. It is by no means certain that there is any need for improved reeling while the present class of cocoons is grown: probably the present system does the best for the poor cocoons produced. The French bounty is applied to filatures, easily controlled and regulated: the only filatures in Bengal now are those of one firm, unless we include the small ones of native reelers. It is unlikely that any system of bounties would be possible at present and the cost of administration and bounties would be better spent in other ways.

7. *Protective duties.*—When one sees quantities of imported silk goods sold in shops and bazaars, when one realises that the Indian trader sends away samples of what India will buy for Japan to manufacture, when one knows that neither the Indian buyer nor the trader has any preference for Indian as opposed to Japanese goods, one is tempted to believe that a large import duty is called for. If the Bengali lady prefers to buy Japanese silk rather than Bengal silk, it seems reasonable that she should pay a little more so that the benefit her countryman would have not by the sale of his cloth may

be realised by the duty and spent on him. But, in the main, the imported silk goods are kinds not at present made in India, or are raw materials not so cheaply produced in India as abroad and the import duty would need to be on special classes of goods only.

There are really four classes of imports: raw silk to be used in India, of a quality not now produced: spun silk, which is imported chiefly because the Indian manufacturer does not produce so cheaply: mill cloths, of silk or silk and artificial silk, of a kind beyond the scope of the hand-loom weaver: hand-loom or mill cloths of a kind that could be made in India but which are imported on account of better finish, better packing and better business methods.

A high import duty on raw silk would hit the weaver in India very hard: he would turn to Indian raw silk: if he can now use Indian raw silk, he can be persuaded to do so by commercial organisation better than by a high duty: and if Indian raw silk cannot be produced so cheaply as Chinese, it seems a pity not to let the Indian weaver benefit by the cheap silk offered by China.

Regarding spun-silk, it has to be ascertained why Indian mills cannot produce spun silk at the price Japan and Italy can: the two mills in Bombay make spun-silk and use it themselves: but they cannot sell at the price the Japanese do, in spite of the $7\frac{1}{2}$ per cent. duty. Why this is is not known and only enquiry in Japan and Italy can clear this up. A high duty on the figured silks so largely imported from Japan would help the mills: but here again, one wants to know why the mills are undersold by Japan. If the industry in Japan receives help from the State which is equivalent to a bounty, then a corresponding bounty should be given in India or a protective tariff equal to the bounty. The matter cannot be decided without further enquiry.

Lastly a duty on the plain silks and fabrics that can be made in India would directly benefit the Indian weaver as his production would be in greater demand: but here again, it seems likely that the weaver in India would benefit more by being organised and aided, rather than being assisted by a tariff. Higher price for Indian silk does not necessarily mean more silk sold or better wages for the weaver: it probably means more profit for the dealer and more dealers, and the industry is so broken up and scattered that it would probably not benefit by a tariff to any very great extent. Personally I am convinced that only organisation will help the weaver and not any tariff.

8. *Regulation of sale.*—A great deal of silk is sold in India, which is not silk but is a mixture, or is cotton or "art" silk or some other substitute. This is of course not imported as anything but what it is, but it is sold as silk or is sold under circumstances that lead the buyer to think it is silk. The European shops in large towns are engaged in this business: the box-wallah, the bazaar trader is an offender: and the Kashi silk producer has spoilt his market for spun silk goods by using adulterated yarn or mercerised cotton.

If buyers want mercerised cotton, it is right they should have it, but they should not buy it thinking it is silk. There is one method of meeting this and it will be effected by stamping every piece, whether made in India or imported, with a statement that it is silk, spun-silk, artificial silk, silk and cotton, cotton, or other fibre. This is not easily done in the case of imports: but it is still less easy in the case of silk made in India; and in the latter case stamping should be optional but must include the name of the dealer or master-weaver for whom it was made and a penalty must be prescribed for false description. In this case, a dealer or master-weaver who does not stamp, will suffer in competition with those who do: but the one who does renders himself liable to prosecution if he wrongly describes any article.

In England the Silk Association of Great Britain and Ireland have undertaken prosecutions of firms selling fabrics with names calculated to give the impression they are silk while not being silk but they do so under Acts which are not applied in India. I think legislation is called for in this case, first to provide for the stamping of every imported fabric with a statement of its composition (applying the term silk to no fabric that contains more than five per cent. of other fibre), second to providing for the optional stamping of Indian fabrics subject to penalty for false description, third to providing

for prosecution of any firm or dealer who describes or sells fabrics which contain less than 95 per cent. silk in a manner calculated to deceive the customer as to its composition. Thus a dealer will prepare a catalogue of silk fabrics and include fabrics of mercerised cotton: that is calculated to deceive unless he distinctly and clearly states which are cotton and which silk.

I think that with reasonable powers of prosecution, the Silk Department could do a great deal to make silk adulteration impossible and in that case the Indian silk would recover much of its lost reputation.

9. I am not at all anxious to have recourse to legislation to control the adulteration of silk and I think the same result can be attained by other means, in regard to the indigenous silk fabric. If a Silk Institute is formed, if the policy outlined in Chapter XXVII of this report is followed, especially as regards advertising and trade organisation, it will be possible to exert influence directly on the master-weavers and to assist the sale of genuine silk fabrics, while hampering that of adulterated fabrics that pretend to be silk. It would even be possible to arrange a system whereby a master-weaver's raw materials, looms and fabrics were inspected and he was given a certificate, which he could quote in advertisements, that he used only pure silk in his silk fabrics. I am hopeful that in time the whole of the ordinary silk fabrics now imported will be made in India: and it would not be difficult to arrange that only genuine silk fabrics were supplied and to certify these as pure silks: but the stamping of every silk fabric imported and the compulsory retention of that stamp on the roll of silk so that any customer could see it, would be the only method of dealing with imported fabrics.

CHAPTER XXX.—SUMMARY OF RECOMMENDATIONS.

In the previous sections the industry in India has been described and its characteristics discussed: in this, the questions are gathered up and the problem discussed as a whole.

2. The diminution in silk production in India is mainly that of Bengal and is due to—

- (1) the increased production of Japan,
- (2) disease,
- (3) the increased value of other crops,
- (4) the inferiority of the Bengal worm.

The silk crop of Bengal is now almost limited to areas in which silk is the most suitable crop: with a better race, which is now available, with the existing resources in nurseries, the industry can be largely revived if the new hybrid races are introduced and if a competent European officer is appointed to organise the introduction.

The industry in Mysore and Kollegal is capable of extension on the same lines: and its production of silk can be considerably increased if disease-free seed of an improved (probably hybrid) race can be issued from a station situated in a suitable climate.

The industry in Kashmir is in no need of anything, but local extension in regard to tree planting and the production of silk is nearly at the limit of the existing trees. The question of developing seed supply must depend on the conclusions reached by the Imperial Agricultural Bacteriologist on the pebrine question.

The small industries in Assam and Burma are capable of considerable extension with better races of seed, better plant: new areas for silk production are being tested: there is large scope for development in the Punjab, United Provinces and Bihar submontane tracts, but this will require extensive organisation at the start and will develop slowly: other areas for silk production are uncertain and can be tested only by continued experiment.

3. The development of the industry depends primarily upon continued expert organisation, and a seed supply: with expert organisation, with a source of seed in India, there can be a large extension of production in Bengal

and Mysore, some extension in Assam and Burma, a steady growth probably in Northern India, and all likely areas in India can be tested.

The ultimate limit of development is a perfectly definite one decided by climatic and economic conditions, the latter of which are not yet ascertained for all parts of India : but it is probable that a very large increase in production is possible and may be confidently looked for if competent organisation is applied through ordinary channels : the expenditure involved is small and the lines of progress are definitely ascertained.

The detailed minor improvements in each area are indicated above : the broad requirement is the provision of an expert organising staff and a central seed-producing station.

4. There has been a diminution in the tasar industry due mainly to the increased value of food crops, partly to the better control of forests, and partly to the decreased demand for tasar goods : the production of cocoons can be assisted only by a prolonged investigation into the biology of the insect, the result of which must be uncertain : the position of the tasar producer is not such as to justify this investigation and it is not worth undertaking. The closely related industry of tasar weaving can be assisted probably only by the provision of organisation in disposal of fabrics, better methods and the extension of co-operative credit : the latter is the most vital, the tasar worker being very generally hopelessly indebted and unable to work under proper conditions. The industry is a very scattered one and will be difficult to organise on that account : but it is very large, and falls chiefly within a single province : its production is not exported and the position of the industry is a matter wholly of local concern : no real effort to assist the industry has been made during the last forty years and there is probably good scope for development on co-operative lines : this could be easily done and the cost would be fully justified by results.

5. The muga and eri industries are small and practically confined to Assam : they are capable of improvement with expert advice but will probably never develop to large proportions ; eri might possibly become a large industry if the use of Indian raw materials was developed in England.

6. The production of silk cocoons of all kinds and the disposal of the produce can be considerably developed by the provision chiefly of expert organisation similar to that of the Agricultural Departments in India : and it is essential that this organisation shall also be in close touch with the manufacturing part of the silk industry.

7. The question of the utilisation of silk and the development of the silk weaving industry is less simple than that of silk production : the decline in the export of manufactured silk, the growth in the imports of manufactured silk are due to the continuance of defective methods in India, bad economic conditions, want of organisation in India, the increased cheap production (probably due to better organisation of weaving) in Japan : the export of manufactured silk from India is unlikely to be considerable unless the industry can be organised and the existing methods improved : this will be possible only by such an extension of co-operative credit among weavers as will make them independent of the employers, who have prevented improvement and resisted organisation : and it will require a combination of expert advice, commercial organisation and co-operative credit extension that will be extremely difficult to apply. It is uncertain if the Indian worker will ever be able to compete successfully and work for an export trade : it is more likely that the extension of weaving will be limited to meeting the internal demand, except in such articles as require fine imported raw materials : but the deciding factor in this is the question of how Japan is able to produce silk fabrics cheaper than is now possible in India : and it may be that it will ultimately be decided that it will be impossible ever to develop an export in manufactured silk.

The inquiry into the production in Japan has yet to be made : it is certain that the Indian weaving industry suffers, in competition with other countries, in its defective methods, in the deplorable position of the workers, in the excessive profits made by the dealers and employers, in the lack of ordinary

business organisation and commercial enterprise : defective methods cannot be remedied until the actual craftsman can be put in a position to adopt better ones : and the Indian weaver can probably compete successfully if he can be properly financed, organised and developed.

To do this requires, first, the means for experimentally producing silk fabrics : secondly, capital with which to finance development and the production of better goods : thirdly, thorough local inquiry into the circumstances of the weavers and the means of organising them : and fourthly a co-ordinating organising staff whose operations can extend over all India and who can stimulate trade development inter-provincially and outside India.

In doing this it is essential that the ordinary commercial methods are adopted and that considerable sums of money are risked : until the production and sale can be taken over by commercial agency, the ordinary business of trading must be done by the State : and some further experience is required to definitely ascertain in what areas better methods, proper economic conditions and good organisation will enable the Indian weaver to successfully produce the articles now in demand. Some areas, such as Burma, are far more promising than others : and there is justification for the belief that if a real effort is made, with sufficient capital, the greater part of the silk required can be produced in India and that possibly an export trade can also be created.

It is useless to ignore the difficulties : it is also certain that nothing but a real business-like effort will achieve anything : the mere creation of schools, institutes, etc., will do nothing : it will be easy to have a large permanent staff and to really achieve nothing : and it is unlikely that any solid progress will be made during the first year or two.

8. The best plan is to provide the organisation and to attempt to reorganise the industry in suitable areas, with a combination of local effort and central advice, commencing on small lines in suitable places : the organisation required for this is discussed and the creation of a Central Silk Institute, to work with provincial silk assistants, is recommended. In the first place this should be limited to the provision of a Seed Supply Station in a suitable climate : the necessary staff for hybridising, for seed production, for the supervision of rearing experiments should be provided : and there should be an officer in the Imperial service whose advice should be available to all Provinces and States in the improvement and development of silkworm cultivation. This having been provided the development of the weaving should be considered and the action that will be taken by Local Governments will determine how far it will be necessary to provide the staff of the Central Silk Institute suggested : also the inquiry suggested in Japan and China should be undertaken before any development is commenced. For the first year probably the expenditure in this direction will be small : but if Provincial Governments generally agree to the proposals and the work commences to develop the staff of the Institute will be required and the buildings and appliances will need to be provided for. Including non-recurring expenditure and capital, the amount required annually during the first four years should not exceed Rs. 1,50,000 : in recurring expenditure it should not exceed Rs. 75,000 the first year and rise to Rs. 1,50,000 in about four years. I am assuming that nearly all provinces develop their silk industry and that the full scheme is worked up to.

9. It is impossible to lay down rigidly what the development should be : two things are absolutely essential : the first is that the officer responsible shall be given as much freedom as possible in deciding in what direction to make progress first and shall not have his budget too minutely subdivided : the second is that it shall be recognised that progress will be slow and that it is useless to embark on any development at all unless it is likely to be persisted in for a period long enough to really test its value : if success is to be achieved it will require a steady effort maintained over more than one generation, and during this time many methods will need to be tried and there will be some failures.