Correspondence relating to cultivation of silk / presented to both Houses of Parliament, by command.

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Bennett, George, 1804-1893
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Publication/Creation

Sydney : Thomas Richards, govt. printer, 1870.

Persistent URL

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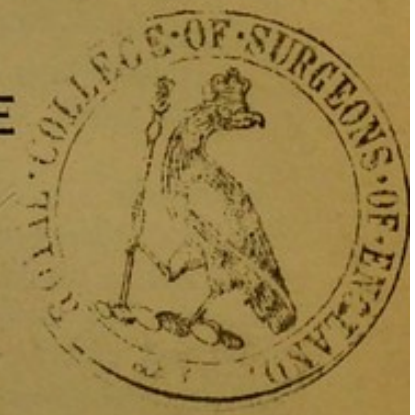
NEW SOUTH WALES.

CORRESPONDENCE



RELATING TO

CULTIVATION

OF

SILK.

Presented to both Houses of Parliament, by Command.

SYDNEY: THOMAS RICHARDS, GOVERNMENT PRINTER.

1870.

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CULTIVATION OF SILK.

THE HON. SECRETARY, ACCLIMATISATION SOCIETY, NEW SOUTH WALES, to THE COLONIAL SECRETARY.

Acclimatisation Society of New South Wales,
Sydney, 7 June, 1870.

SIR,

This Society having exerted itself to promote the establishment of silk culture in this Colony, has recently received from His Excellency the Viceroy of India, a valuable stock of silkworms, and most useful information relative thereto. I wish to submit the despatches containing this information for your personal inspection, in the belief that in the interests of the Colony you may think proper to publish a selection from the papers.

To direct attention and impart a knowledge of facts about the rearing of silkworms, the present time seems very appropriate. First, the extremely critical condition of all European breeds gives the gravest reason to fear that if they experience adverse weather another year the whole may become utterly extinct, or for all practical purposes so unreliable for stock to breed from, that all the principal European silk producing countries will of necessity be compelled to have recourse to importations of eggs from other countries where the disease affecting the silkworms does not exist, or is less severe. Secondly, the well known operations of Mr. Brady in the Colony have already caused considerable attention to be directed to Australia; and the very remarkable system originated by that gentleman, and carried on from time to time during several years under the observations of this Society, of producing a succession of daily broods and crops of silk during a great part of our long season, is highly encouraging. This very important fact, so honorable, and, if rightly understood, so calculated to do good to the Colony, was thus commented on by Mr. Dickins, President of the Silk Supply Association of London, at a public meeting held at Coventry,—"the fact of producing silk day by day was most wonderful, and was what was not done in any other part of the world"; and Mr. Chadwick, M.P., at the same meeting took occasion to say, in reference to this Australian plan, "that the daily production exhibited an improvement in the production of silk which would be as important a fact as ever occurred in the silk trade." Thirdly, there are now most excellent varieties of silkworms in the Colony, from which beginners could be supplied, wherewith to commence the creation of a new export.

It seems, therefore, that the dissemination of the requisite instruction only is yet wanting to implant this lucrative occupation in Australia; cognizant as this Society is of the advantages we possess in soil and climate, and of the value of the information and means at our disposal, as well as inducements to profit thereby, I am desirous of urging upon you very strongly the policy of adopting measures to bring practical knowledge on the subject within reach of the colonists.

I have, &c.,
GEORGE BENNETT, M.D.,
Hon. Secretary, Acc. Soc. N. S. Wales.

Simla, 13 August, 1869.

My Dear Lord Belmore,

Enclosed is a letter written under my orders in Council to Dr. G. Bennett, Honorary Secretary to the Acclimatisation Society of New South Wales, in reply to an application made by him for a supply of silkworms and seeds from India. I shall feel very much obliged by your causing the same to be delivered to that gentleman.

It will afford me very great pleasure to assist the Acclimatisation Society as far as may be possible in the direction indicated.

I remain, &c.,
MAYO.

[*Enclosure.*]

No.

From E. C. Bayley, Esq., Secretary to the Government of India, to G. Bennett, Esq., M.D., Honorary Secretary to the Acclimatisation Society of New South Wales.

Home Dept.
Public.

Simla, August, 1869.

Sir,

I am directed to acknowledge the receipt of your letter, dated the 16th June last, containing a request on behalf of the Society for a supply of silkworms and seeds, for acclimatisation in the Colony.

2. In reply, I am desired to state that His Excellency the Viceroy and Governor General in Council will be very glad to afford the Society every assistance in his power, in the direction indicated, and that immediate inquiries will be made with a view to compliance with the Society's wishes.

I have, &c.,
E. C. BAYLEY,
Secretary to the Govt. of India.

Simla, September, 1869.

My dear Lord Belmore,

In continuation of my letter of the 13th ultimo, I enclose a copy of a pamphlet by Captain Thomas Hutton, entitled "Remarks on the Cultivation of Silk in India." A copy of the pamphlet has also been despatched to Dr. Bennett.

I remain, &c.,

MAYO.

[*Enclosure.*]

Remarks on the cultivation of Silk in India, by Captain Thomas Hutton, F.G.S., C.M.Z.S., Corresponding Member of the Agri-Horticultural Society of India.

(From the Journal of the Agricultural and Horticultural Society of India. Vol. I, part 4; new series.)

To the Secretary of the Agricultural Society of India,—

My dear Sir,

In answer to your call to make a few observations on the cultivation of silk in India, and with special reference to the Conference on this subject, as reported in the Journal of the Society of Arts for 9th April, 1869 (No. 855 of Vol. 17), I now do myself the pleasure of sending a few remarks in support of the many papers I have already published upon this subject; but as from former hard work, care, and sickness, I have become a somewhat prematurely feeble old man, I must beg of the Society to kindly overlook the poverty of detail, on the plea that "*non sum qualis eram*" and can no longer so fully enter into the subject as I might have done some few years since.

Keeping in view the fact, as I believe it to be, that the present movement in England regarding silk, has for its object the opening up in India of new localities for the introduction and cultivation of the silkworm, it appears to me that the first thing to be done is to raise a warning voice, founded on the failures that have already, in many districts, taken place against rushing headlong into speculations which from the very nature and constitutional condition of the insects could only end in disappointment. The fact that many such failures have already occurred, furnishes valid evidence of the truth of my declarations, long since made, that such would assuredly be the ultimate result. My remarks however only then served to provoke the displeasure and sneers of sundry individuals, on the ground that I was only a meddling naturalist, and not a practical cultivator; and it was further hinted that even as a naturalist I was foolishly endeavouring to establish the existence of several distinct species of *Bombyx*, while in reality, as they sapiently insisted, there was but *one*. On this point, however, events have fully justified my views. Thus naturalist or no naturalist, since one of my opponents facetiously and elegantly remarked, "that the proof of the pudding was in the eating," facts have in both instances declared that "*magna est veritas et prevalebit;*" while the peculiar pudding that my friend was concocting turned out by some mistake to be—*a hash.*

I was not, however, the first to point out that the climate of the North-western Provinces was unsuitable to the constitution of the mulberry silkworm, Dr. Royle having come to the same conclusion long previous to the time when I entered upon the subject.

As the subject of silk cultivation in India is of vast importance, both to this country and to England, and Mr. P. L. Simmonds not having fully exhausted the subject, I shall endeavour to add what little information I may have picked up since the publication of my last papers on the cultivation of silk.

Experience having shown that while the hot lowland plains are wholly unsuited to the constitution of the annuals, and that the *multivoltine* species on the other hand are checked by the want of leaves for a longer time during the winter season than their period of rest can meet, so that the young worms again appear before there is a sufficiently abundant supply of food, it is clear that the efforts of cultivators should be confined only to those parts of the country in which the worms have thriven well and profitably; so that while Bengal should redouble her efforts to increase the stock and quality of the silk of the *multivoltine* species that have hitherto, in spite of much mismanagement and want of proper care, manifested their ability to ensure good returns, the annuals should be altogether confined to suitable elevations in the hills from Sylhet upwards to the Indus. Experimentalists who know little or nothing of the constitution and actual condition as to health of the species they would introduce, and who set common sense and experience at defiance, are simply acting upon the *sic volo sic jubeo* principle, and are certain in the end to throw away their capital. Even in an elevated position there are many points to be considered before entering upon such a speculation: *Imprimis*, plenty of capital; 2ndly, the nature of the climate of each district, for it does not follow that the same elevation will be equally suitable to the worm at Simla in the north, and at Darjiling to the eastward; the elevation may be the same, but owing to a difference of latitude the climates cannot be the same; 3rdly, the species of worm best adapted to each climate; 4thly, the prospect of a remunerative return upon the outlay, founded upon sound logical and inductive reasoning, and not as hitherto upon mere surmise and guesswork. It must be borne in mind that although good silk may for a time be produced while the health of the insect is unimpaired, even in a climate which will eventually prove injurious to the worm, yet the out-turn will never be what it ought to be in a climate fully adapted to the constitution of the insect. Good silk was no doubt produced both in Oudh and in the Punjab, but in neither case was the yield commensurate with the outlay and expectations of the cultivators.

Therefore, I ask "*cui bono*"—For if you can only produce good silk by an outlay of double the value of the crop, what kind of a fortune are you likely to make? In short no yield of silk that does not fully cover every item of expense, *leaving the insect in its original strength*, and bringing in a really profitable return, is worth the trouble of cultivation. For the question to be solved is not so much whether a district will *for a time* produce good silk, but whether it will do so *permanently*, without having recourse to annual importations of fresh seed; and also whether from a given number of worms it will produce a return equal to that from a similar number of worms, and at no greater outlay, as Bengal or Cashmere. Facts, we all know, are stubborn things, and they have already solved the question by proving that the Upper Provinces are wholly unsuitable to either annuals or multivoltines.

A word likewise must be said regarding the quality of the food upon which the worms are reared. Much has been said on the score that the facility of rearing mulberry trees proves that India is a country adapted generally to the successful cultivation of silk; yet this is entirely a fallacy supported by very indifferent logic, for the worms are not generally fed upon *indigenous* trees, but upon trees from time to time imported from foreign countries possessing climates often quite at variance with that of India. That such importations apparently grow well and look healthy, furnishes no proof whatever that the constitution of the plant is sound, and that the nourishing properties of the leaf remain unimpaired by the change of climate; no experiments have been instituted to ascertain this point, but the logic seems to be that a mulberry leaf is a mulberry leaf, and as the natural food of the worm is the mulberry leaf, therefore they must thrive equally well upon every species. Yet when we reflect that multivoltines prove themselves to be the creatures of warm climates, while annuals are restricted by nature to the

north, is it not reasonable to inquire whether each individual species may not originally in its native climate have been furnished with some particular tree upon which it throve better than upon others? It must at least be evident that the annuals of the north could not have been nourished upon trees that are peculiar to the south, and *vice versâ*. To feed the northern worm upon the finer leaf of the southern tree would be nothing better than a silly attempt to destroy its constitution by slow starvation.

That some leaves are preferred to others every cultivator must have seen, and during my experiments to restore the health of *B. mori*, I often found that although sometimes when pinched by hunger some of the multivoltines would sparingly eat of the leaves of the coarse wild mulberry of the hills, yet on the supply being intermixed with the leaves of the China mulberry (*Morus Sinensis*), the former were at once abandoned for the latter; while as to *B. mori*, although a northern species, it would never touch the wild leaf at all. Nor does the above opinion appear to be wholly unsupported by facts, for the wild silkworm (*B. Huttoni*) of the north-western Himalaya must have been wholly restricted to the coarse leaves of the indigenous trees previous to the introduction of the cultivated Chinese plants, and indeed in many parts of the hills they are so still. That they readily eat the leaves of other mulberry trees is nothing to the purpose, the question being, did nature restrict them to any particular tree? The answer being—undoubtedly she did, until man interfered to upset the arrangement. Another point to be considered in the rearing of northern worms upon southern leaves is the fact that, from their thinness, twice or thrice the quantity will be required to properly nourish the worm, and this increases the outlay; besides which, the longer the time consumed in feeding, the less repose does the insect receive, and this is injurious to its well-being.

But supposing, as is most probably the case, that the leaves of imported trees in an uncongenial climate are deficient in proper nourishing constituents, the worms and consequently the crop of silk must likewise be affected, and the very same thing arises from the injudicious method practised in Bengal of constantly cutting down the bushes for the nourishment of the worm; for in such cases the leaves are wholly immature, watery, and poor, and therefore do not furnish the worm with the necessary constituents for producing good silk, while the quantity must likewise be reduced. Doubtless the natives will tell us that this is the cheapest method and they can afford no other, and this may be true, but the purchaser of cocoons should be wiser in his generation and remember that as *veal* is not *beef* so in like manner are young mulberry shoots inferior as an article of food to the mature leaf. The niggardly policy that would put every shilling into the pockets of the cultivators and bestow nothing upon the worm and its produce, is the very worst that could be adopted, and is decidedly one of those causes which have hitherto led to such lamentable and disastrous results. A thorough revision and alteration of the prevailing system is absolutely necessary, and if the purchaser of cocoons does not strenuously endeavour to repair the mischief which is manifested in the failing constitution of the multivoltines of Bengal, he will soon have reason to bewail his negligence.

Now it appears to me that the great number of mulberry feeding silk worms now known to exist, amply warrants the conclusion that a corresponding variety of trees has been furnished for their nourishment, each probably being modified to suit the climate and other conditions under which the worms themselves may have *originally* existed. Some perhaps may have been restricted to one species only, while others may have had a wider range, for had not something of this kind been intended why has such a variety of mulberry species been created? If all worms throve equally well upon the same species of tree in every climate in which indigenous, why create such a number of other species, many of which probably differ in

specific properties? It would seem to prove only a waste of power and resources, and be consequently inconsistent with nature's laws and usual course of procedure, which is never to act redundantly.

Granting then that the variety of trees corresponded with the variety of the insects, it would appear that we, with our conceited notions of *improving* upon nature, have at last so intermixed and deteriorated the quality of the natural food of each, that our boasted improvements, as Mr. Bashford called them, have nearly ended in the destruction of the worms.

It may probably be said that there is now no remedy for this state of things, as so much time has elapsed since the introduction of the insects that no one now remembers upon what trees they were originally fed, and even in some instances from whence the worms themselves were procured. The objection I think is scarcely valid, and if we are really seriously inclined to repair as much as possible the evils and mismanagement of the past, it behoves us manfully to push all difficulties aside and commence *de novo* upon a sounder system. The French appear to find no difficulty in procuring eggs from foreign lands,—then why should we? Practised hands could surely be despatched to China and its isles, in search of stock, and the *indigenous* (not imported) trees of the district. These once obtained would fairly replace the cultivator upon his legs, and instead of making the supplies over to the natives, each cultivator of silk should have his own plantations, and all other necessary requirements in his own hands and under competent European Superintendents. The present native system should be rooted out, for it is nothing but a patent method of reducing the yield of silk and gradually starving the worms. It is of no use crying to Jupiter to give you better crops,—you might just as well invoke the Saints with a farthing rushlight;—the speculator must himself gallantly put his own shoulder to the wheel, and so earn a right to the aid of Jupiter. But supinely to sit down and pursue the present system can only gradually and surely tend to the eventual destruction of the insects.

I have treated the subject as a naturalist, because he, from his knowledge of the habits and requirements of the insects, ought to be the proper person, in the first instance, to lend a helping and a guiding hand to the cultivator. More than this I cannot do as I am not sufficiently versed in commercial politics to enable me to step forward as a practical sericulturist.

Some have imagined that as the annual worms of Cashmere cannot be successfully cultivated in Bengal, it would be wise to cross them upon the monthly worms in the hope of thus obtaining more than one crop of cocoons of a superior size, a method which has always appeared to me to be a patent way of destroying the good qualities of both. For the blood (so to speak) of the annual Cashmere worm being as it were prepotent over that of the multivoltines will speedily reduce the cross to annuals, and so destroy their good qualities, while at the same time the inferior size of the monthly worms, as compared with the cocoons of *B. mori*, acts injuriously in reducing the size of the cocoons of the latter. Mr. Bashford, on whom well merited praise is bestowed by the Conference, was for a time perfectly unreasonable on the subject of crossing, and became highly indignant at my declaring, what eventually proved to be true, that all would sooner or later revert to their own natural characteristics, or be swallowed up in the stronger annuals. "Look," said Mr. Bashford, "at our breeding establishments in England,—horses, fowls, sheep, &c., &c.; everything is most successfully crossed, and the improvements are permanent."*

Yet this is after all but idle talk, displaying a decided want of knowledge of the subject, since no "*improvements*" either are, or can be, *permanent*, unless the crossing is from time to time renewed, and the animal kept up to some required standard. If this be not attended to, the animal, be it what

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* Note on Hutton's remarks on the improvement of silkworms.

it may, when once left to nature will gradually revert, and all the boasted improvements become obliterated,—and why? simply because the standard is wholly an artificial and not a natural one. Mr. Bashford however appeared to be surprised to see his worms revert, and that nature, abhorring all crosses, exercised a greater influence over the worms than he did. I will quote a portion of his concluding remarks, placing those parts which support my argument, in italics. "On my return from Europe I found a good supply of healthy looking eggs of the different sorts, and have continued the experiments this year (1856) with unabated perseverance; they began hatching early in January, *but just as irregularly as before*, a small quantity only came out daily, and did not cease till May. The early worms were all good, fed and thrived as well as I could desire, and cocoons from them were very fine.* I had an opportunity of again comparing the pure French cocoons reared by me, with the different crosses, and the choice *was greatly in favour of the pure;* but the cross cocoons were vastly superior to those of Bengal, and what I reeled off in the filature gave a most beautiful silk, and a yield in quantity more than twice as large as the common cocoons of this country, which we were then reeling in the filatures. Thus much of the intrinsic value of the French cocoons remained, but none of their original shape. I supposed now that I had so much reduced the original nature of the frequent crosses, as to be nearly certain of their now assimilating in habits, &c., &c., with our country worms, and *I did not reduce them by further crossing*, but allowed the moths to couple with themselves.

Great was my astonishment to find after the eggs had been deposited three days that most of them turned black, *indicating that they still had too much French nature;* a few remained yellow and hatched after ten days; how to account for this freak of nature with regard to the rest, I cannot understand, but I had still to be more surprised after this. I have to wait of course until next year to see the result of the black eggs, but those that hatched gave me ample occupation for the time, and I watched and cared for them with the greatest interest; the young worms looked healthy, ate, and throve well, and in due time gave cocoons; the white colour alone proved the China portion, and the superior size of cocoon and fibre, and lighter colour of some, with less floss than with our common sorts, shewed the French and Italian cross. I was on the whole satisfied with this crop, and trusted my labours had met with success, but great was my astonishment, after the pairing, to see more than half of these eggs again revert to annuals, though there had been *a complete break in their nature* by their having hatched in January, given cocoons in February, eaten out in due time, paired in themselves, deposited eggs that ten days after hatched, and now to fall back not to hatch again until the ensuing January of 1857, *I fancy is extraordinary in the extreme.* I have many pounds of eggs of the different crosses still retaining the nature of annuals, but as I have spent three years in trying ineffectually to engraft a superior nature, and invigorate our common stock without changing their nature of hatching, I feel discouraged, and would gladly have the opinion of naturalists as to the probability of my object ever being attainable, and the proper steps to be taken for realizing it."†

It was in consequence of this pathetic appeal to naturalists that I wrote to Mr. Bashford a letter which he published in your Journal, and which ended in obtaining me the honor of a *snub* because my opinions were not in accordance with his wishes. Yet subsequently he acknowledged the utter failure of his endeavours, and that the worms had all reverted to annuals.

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* This cross was effected with French, Italian, and China females of *Boro-pooloo*, upon *Madrassee* and *dasee* stock.

† A few remarks "On Experiments with Silkworms," by F. Bashford, Esq. *Journal A. and H. Society of India, Vols. IX and X.*

The parts italicised in the foregoing extract are these :—

First—" *The irregularity of hatching ;*" showing that the cross was already acting injuriously upon the eggs.

Secondly—" The choice between cocoons of pure French stock and those of the cross was altogether on the side of the former"—Proving the *unmixed* to be the best.

Thirdly—Fondly imagining that he had succeeded in amalgamating or fusing the two natures, he did *not reduce them by further crossing*,—and what was the result ? Simply that from the moment when crossing ceased, nature stepped in and asserted her authority by again casting out the effects of the cross, and causing the hybrids to revert to annuals. In this likewise we perceive the folly of declaring that " everything is most successfully crossed, and the improvements are permanent." I can only suppose, if this be the fact, which however it is not, that there *were no improvements* in these hybrids to become *permanent.*

Fourthly—The dark colour of the eggs " indicated that the hybrid had still too much French nature ;" that is to say, that the influence of the stronger *Boro-pooloo* (B. textor) was prepotent over the weaker monthly worms, and had reverted them to annuals.

Fifthly—The worms became annuals " after there had been a complete break in their nature." The fact is otherwise : There had been no break in the nature of either species, but simply dire confusion for a time, succeeded by reversion to their natural condition, by which the temporary union was dissolved and again contemptuously cast out.

Sixthly—Mr. Bashford thought it a very extraordinary thing that reversion should have succeeded to what he considered the accomplishment of his wishes ; yet there was nothing extraordinary throughout these changes ; they were simply indications of a struggle between nature and Mr. Bashford for the mastery, the one being determined if possible to preserve her species pure, and the other if possible to destroy them by the application of what he termed "*the arts and sciences.*" However the long and the short of the matter is, that all these experiments signally failed, as fail they always will, and I therefore advise the cultivator, if he wishes to possess good silk, to eschew all crossing, and to busy himself with a more careful management of the pure races. Such experiments are well enough in the hands of a naturalist who wishes to learn what can possibly be effected by such crosses, but for a practical sericulturist to enter into them will ever prove but time and labour thrown away.

Let us now consider the subject of silk cultivation in India from another point of view. The first thing that appears to arrest attention is the ardent wish in England to extend the cultivation of the worms generally over districts where at present none exist. I have however already shown that this desirable object cannot be obtained ; all efforts, and they have been zealously pursued, having failed with considerable loss. Let not the sometimes over-earnest advocate for such extension run away with the very erroneous impression that all parts of India enjoy the same climate and are equally favourable for the growth of silk, for nothing can be farther from the truth. The very geological features of the land will at once point out that from the coast line upwards, for more than 1,200 miles, the climates must necessarily be modified by outlying hills and mountain ranges of considerable elevation. These mountains are often densely clothed with forests and other vegetation ; at other times are bare and rocky ; and while well adapted in many parts for the larger wild species, such as the Tussar (*Antheræa paphia*) and its congeners are, totally unsuited to the growth of the finer silks. Yet these wild species are by no means to be despised, and excellent silk is even now turned out at Beerbhoom, Palamow, Bhagulpore, and lately at a place near Sasseram. The cocoons of Palamow, especially, are sometimes of very large size, and in all these, and such like localities, careful management in reeling appears to be all that is necessary to insure a very profitable

return. The worms are wild, and are fed upon the forest trees at no expense to the cultivator, who consequently does not experience the same temptation to turn rogue and starve the worm, as is the custom among the Bengal cultivators of the monthly Bombyces.

The group of silk spinners of which I now propose to speak differs widely in form, in habits, food, and silk from the Bombyces proper; they are all wild species, and what is a great advantage, are all indigenous to this country and widely diffused wherever there are hills. The type of the group is the well-known Tussar Moth (*Antheræa paphia*) which occurs not only at the places already mentioned, but likewise along the coast line from Bombay through Pondicherry, and eastward to Bengal, and thence through Cachar, Assam, Darjiling onwards through the Dehra Doon, and even to the Punjab. The insect therefore has already indicated to us the various localities in which it may be expected to thrive; there is no need of experimental trials, for nature has declared that wherever her species are indigenously placed, that is the locality in which they are certain to thrive best, so that knowing this, all that the sericulturist has to do, after the selection of the district in which he proposes to reside, is careful attention in the selection of cocoons, and the finest manipulation in the reeling. At present this silk as an article of commerce is altogether in its infancy.

All the species of this group (and there are several) are wild, and, as a rule, when left entirely in a state of nature, appear to be only annual, or single-brooded, yet such is the curious effect even of a semi-domestication that no sooner do they become subject to man's control than this habit is completely changed, and from two to five broods a year may be obtained. The occurrence of a strong sharp-pointed horny spine at the shoulder of the wing in *Actias Selene* and others of that genus, and its presence likewise in *Antheræa*, sometime ago suggested the propriety of ranging these in a separate family, under the name of *Plectropteronidæ* and genus *Plectropteron*, but as the suggestion appeared to meet with little favour I did not venture to make the alteration. The mere fact of *Actias* possessing long narrow tails to the lower pair of wings, while there are none in *Antheræa*, would not, I conceive, have sufficient weight to prevent the amalgamation of the two genera which, in other respects, present but few if any generic differences; for the very same thing occurs in the *Papilionidæ* or butterflies of the genus *Papilio*, between which no difference is made on that account. As we are not, however, here concerned with the *tails* but with the *produce* of the insects, and their capability of being turned to good account as silk producers, we may for the present let the scientific question rest.

In all the members of this group the cocoon is firmly closed all round, and the fibres, especially in *Antheræa*, are strongly and compactly glued together so as to render the action of the wing-spur necessary for the separation of the threads. The head of the cocoon therefore being first moistened as in *Bombyx* by a liquid secretion from the mouth of the insect, the wing spines are then alternately brought into play in making a cross cut, or it may be perhaps in separating the threads without cutting, a sharp grating sound being plainly heard the while, until the moth effects its exit. The silk, when reeled, although from the great size of the insects, coarser in the fibre than that of *Bombyx*, is nevertheless a valuable product, and with good reeling would soon command a very profitable price.

In *Actias* the cocoons are by no means so full of silk as those of *Antheræa*, but what there is has been well spoken of as "strong, tenacious, elastic, and brilliant." At Mussooree the worm of *Actias Selene* is found in a wild state upon the *Andromeda ovalifolia*, *Coriaria Nipalensis*, *Xanthoxylon hostile*, *Bradleia ovata*, *Carpinus bimana*, *Cerasus puddum* (the wild cherry), *Pyrus kythul* (wild pear), the walnut and others, so that there should be no difficulty in rearing it on the cherry, pear, and walnut either in France or England, and as it will yield three or four crops in the year an abundant supply of silk might be obtained, the worm being as easily reared in the house as on

the trees. In India it has wide range, occurring along the coast line from Pondicherry, eastward, along the base of the Himalaya, even to the Sutlej in the North-west, and it has been found also in Central India, so that there can be no question of its being rendered otherwise than productive in this country.

Of the Tussar I have already spoken, and shall only now remark that in the whole family of the Lepidoptera there is perhaps no insect so variable in the imago stage in point of colouring as this; so much is this the case that a novice would scarcely believe the varieties to be all of one species. I have a cabinet now before me of silk spinning moths, in the drawers of which there are no fewer than a dozen variations chiefly from Palamow. There is likewise a species (for I am much inclined to regard it as such) from the Sonthal jungles, some miles to the westward of Colgong, and procured through the kindness of Mr. Barnes. I have received it from no other part of the country, and have provisionally named it *Antheræa nebulosa* from the cloudy bands on the wings. The cocoon is in all respects like that of the common Tussar. I have also some which, if not crosses between *Anth. paphia* and *Anth. Frithii*, must be new also.

Antheræa Assama, of Assam, occurs also sparingly in the Dehra Doon, and could a brood be once procured would doubtless soon become a very profitable speculation. The great difficulty however is to find persons capable of discriminating and willing to assist the experimentalist in procuring eggs and cocoons from various districts. If we had but a Mr. C. Brownlow, a Mr. Barnes, and a few other equally liberally-minded men in every district, what a glorious harvest might be made.

In parts of the Himalaya, and more especially in the north-west about Mussooree and Simla, there occurs a fine species known as *Antheræa Roylei* feeding on the oak, the silk of which is also excellent and could easily be reared in considerable quantities by tying the females out at night, or placed in coarse gauze tents or cages, the wild males being almost certain to visit them before the morning.

In 1867 I received from Dr. Wallace, of Colchester, a few eggs of *Antheræa Yama-mai* of Japan; very few hatched, and although they gnawed at the oak leaves (*Q. incana*) for two or three days, the worms then shrivelled up and died. I have now a small batch of the same, received from M. Gúerin Menéville, but none have yet hatched, and from their appearance at present I fear that none will do so;—*Mais nous verrons.*

Of the Eria group (*Attacus*) little need be said save that the Ailanthus worm, *Attacus Cynthia*, is abundant at Mussooree, and occurs along the Terai region through Kumaon, eastward to Cachar; it is the species which I formerly named *A. Canningi*, and which the French persist in calling by that name, although it is nothing more than *Attacus Cynthia*. This might be reared in any quantities either on the *Ailanthus glandulosus*, or on our native plants such as *Coriaria Nipalensis*, *Xanthoxylon hostile*, the woodbine, and other species, but some difficulty would probably be experienced in the reeling. As to *Attacus Atlas*, I scarcely think now that anything can be done with it on account of the difficulty in procuring eggs; the worms thrive well when found and taken from the jungle, but I never could induce the moths to breed. At Mussooree however we appear to be on the confines of its range, but it is abundant in Kumaon and extends eastward to Cachar. Here it is found chiefly, if not as I suspect altogether, upon the long milky leaves of *Falconeria insignis*, while in Kumaon the barberry appears to be its favourite food. As with *A. Cynthia*, the difficulty of reeling will be somewhat troublesome, but the silk is decidedly good.

Here surely is range enough for the cultivation of silk, for it literally carries us throughout the country; there is no need to institute experimental trials as was done with the Chinese Bombyces; the sericulturist has but to select the locality in which he finds the worms abundant and labourers at hand, and then by strict attention to the proper rules of feeding and reeling

he can scarcely fail to realize good profits. But beside this, how many as yet wholly untried species are there to be brought under cultivation for the first time; some even whose existence is only as yet suspected, and which will have to be carefully sought for by an experienced eye. Some years ago, when I asked permission to start upon such an errand, the Government answered that "the subject was far too scientific to be entertained," and my application was consequently refused.

Now I am somewhat too old and shaky to carry out the wishes of those days to their full extent, and yet if those worms are to be sought after and cultivated, somebody will have to do the work, or half the resources of the country in this branch will be cast away. There is no reason however why the question should be "*too scientific*" for a practical sericulturist, because it was so for the government officials of those days. If the cultivation of silk in India is to be extended in earnest, it is with these wild worms that the game must be played, for we already know that nothing can be gained by introducing the *Bombyces* of China into localities where experience has shown us that they cannot thrive.

As when the trumpet sounds the old war-horse is said to sniff the battle from afar, so the trumpet you have sounded in my ears has in some measure reawakened a wish, if possible, to be of use in this important matter; and temporarily shutting my eyes to the disgust engendered by the treatment I have hitherto received from various Governments as the reward of my long continued endeavours to assist the sericulturist, a disgust which tempted me to cast to the winds the experiments of several years, I shall still be happy if by my advice and the little assistance I may be able to give, I can in anywise promote the views and wishes of those who are now bestirring themselves in the matter of silk cultivation in India. In saying this however, I must frankly confess that I am now but "the miserable remains of an ill spent life," and have no longer either the health or the strength to enter into much field work, and yet if I could procure good living samples either of the eggs or cocoons of the various species of *Antheræa*, such as *A. paphia*, of Palamow, and of the district round Colgong, of *A. Frithii*, *A. Helferi*, and *A. Assama*, I should be very much tempted to begin my experiments again; with Bombyx I will have no more to do, for I am convinced that if anything worthy of the name of *silk extension* is to be effected it must and can be done only with the aid of the hitherto too much despised and neglected wild species. Old friends, however, who some years since most liberally assisted me in procuring what I wanted, have either left the districts from which my best specimens were procured, or, as in several instances, have departed as I hope to happier hunting grounds.

Anth·rœ1 Assama in particular is a worm in which I have always had great faith, and still think that it might become of the greatest value, yet I have never been able to procure its eggs or cocoons in sufficient quantities to enable me to judge from actual experiment what might eventually be effected. As to Mr. Moore's imaginary species, which he has named *Anthe·œa mezankoria*, its existence as a species distinct from *A. Assama* is in my opinion altogether apocryphal, the word "*mazankooree*" being applied by the Assamese not to a worm distinct from *A. Assama*, as he has been led to suppose, but to a particular quality of the cocoon and silk of the latter, precisely as in Beerbhoom the assorted cocoons and silk of *A. paphia* bear different distinguishing names, though all are procured from the same species.

A parting word now with respect to the cultivated Mulberry Bombyces.

1. The common mulberry silkworm or type of the northern worms is the well known *B. mori*, the largest of the genus known in India, and generally called in this country the Cashmere worm, although equally well known throughout Afghanistan, Bokhara, Persia, Syria, and all Europe. If this be one of the species which it may be thought advisable, in spite of experience, to introduce into the Plains, I say again *beware*, for the result of such an attempt will only prove the truth of the old adage that "*a fool and his money*

are soon parted." In the hills of the North-west no doubt suitable localities and elevation may be found, but I confess I do not consider Mussooree either sufficiently elevated or far enough north to enable anyone to work the worm with full success, or extract from it all that it is capable of yielding. The district of Kunawur, I should imagine, would be as fine a field for the cultivation of this species as any locality in India, or throughout the Himalaya. The lower part of the valley experiences far lighter rains during the monsoon than are experienced in the lower hills near Simla, while the upper part, towards the Tartar frontier, is altogether out of the reach of the monsoon. It is precisely because this is the case that the district yields such good grapes, while in the Sub-Himalaya they are acid and watery, and of little worth. Hops doubtless would there thrive equally well; they grow luxuriantly even at Mussooree, but there the heavy rains act injuriously in preventing the formation of the seed; the plants flower well, but as the bitter principle resides most strongly in the seed the value of the hops is almost nil. Like the grape, however, the plant might in Kunawur arrive at full perfection, and be rendered serviceable to the brewers in the lower hills. Why then should not such a district be equally favourable to the growth of silk? The elevation and the temperature might be selected according to the requirements of the insects, for the valley is a wide deep trough, through which the Sutlej flows, and with shelving sides and fields cut out in steps; here too the worm would be actually on the confines, as to latitude, of its native land—the Chinese districts from which it originally came, lying, as does this Himalayan tract, between 32° and 34° of north latitude. Cashmere might likewise receive a helping hand.

2. *B. textor* (Hutton), the Boropoolloo of Bengal, and which is apparently fast fading away, being likewise an annual, would no doubt thrive equally well in the same district. The cultivator however might be surprised to find that the crop of silk derivable from these, although at first of a silvery white, had now all turned to a golden yellow, the effect as I maintain of returning health and strength.

3. No monthly species could of course be expected to thrive in such a land, and consequently would not be introduced. These must be left entirely to the climates of Bengal and the western coast line.

The object to be gained by the cultivation of all these species should not be their extension into other districts where they have never yet been found to yield a successful crop, but to rouse the sericulturist from his present sleepy state of apathy, and teach him that silk can only be increased in quantity and improved in quality by a proper attention to the condition of the food upon which the worms are fed; if he is too idle and supine to do this, and positively insist upon an improved system among the natives from whom he obtains cocoons, then farewell for ever the expectation of ever profitably introducing the cultivation of silk in India,—change the name of Bengal into that of "*Sleepy Hollow*," and let those valuable insects go dwindling downwards step by step until the whole are either lost or worthless. The present system is altogether wrong; in saying this I feel that I am again travelling along a road that formerly was productive only of sneers and ill-will, but that I little heed; my wish is, if possible, to benefit those who are now or who may hereafter be engaged in the cultivation of silk, and therefore I am determined to speak only that which I believe to be the honest truth. Improvement in the method of producing food—improvement in the quality of the food itself—the improvement in the actual *quantity* of food furnished to the worms, and which a native will always stint—improvement in the smoky, dark, ill ventilated huts in which the worms are reared, and which like Irish cabins appear to contain a regular Noah's Ark. These are at least some of the improvements to be effected before any increase in the quantity of silk can be expected. There is in truth no difficulty in this beyond that which the pig-headed native obstinacy of the rearers opposes to all improvement. What then? Is your silk to stand ever

at the same low standard, because an avaricious grasping ignoramus is determined to pursue that course alone, which an equally ignorant "*Papa* pursued before him?" Go to; you must entirely "*changez tout cela*," and take every branch of the system into your own hands—the trees, the mode of cultivating them, and the rearing houses; in short from first to last everything pertaining to the growth of the finest silk must be taken over *in toto* by the sericulturist, whose money, whose common sense, and energy of mind and body, must all be invested in the speculation. It is the "Master's eye that makes the horse fat," and the very same principle applies equally well to the cultivation of silk. Pursue this system if you wish to thrive; if otherwise, then you must be content to remain, as the drill sergeant says—"*as you was.*"

4. The wild mountain species known as *Bombyx Huttoni* is in some seasons found in thousands; every mulberry tree, whether wild or cultivated, being literally covered with them. The worm is double brooded, and the eggs remain exposed to the inclemency of a mountain winter, securely glued to the bark of the tree. The silk is decidedly first-rate and of an ashy white colour, but the insect is so intractable that it will not submit to domestication, and must therefore be reared upon the trees, a method which must always render the crop precarious. I have repeatedly tried to introduce this species into France and England, but always unsuccessfully, the reason being that while our worm hatches in early March, when the young mulberry leaves appear, in England there is not a leaf procurable until May. I therefore propose (D.V.) if alive this coming autumn, to convey a bundle or two of cuttings to my friend Dr. Wallace, of Colchester, of the wild mulberry tree, in the hope that they may find a congenial climate somewhat resembling our own in this "*Ultima Thule*," and so continue to put forth their leaves at the season when the worms are hatching; it may be considered as a wild attempt and forlorn hope, but nevertheless the value of the ultimate results in case of success proclaim it a venture well worth trying.

I have lately read, although I cannot at this moment remember where, that what are termed the perforated cocoons of the Bombyces, that is of cocoons from which the moths have effected their escape, are contrary to received opinions, quite capable of being reeled off like the others, the silk not having been cut but only pushed aside. If such be the case the cocoons of other species may likewise be turned to profitable account, and a large additional quantity of silk be saved.

In the Supplement to the *Oudh Government Gazette* for May 29th, 1869, appeared a communication from "The Silk Supply Association of London," upon some portions of which I propose to make a few observations for the benefit of those who are far more prone to be led astray by the sophistry extant in high quarters, than to be guided by hard facts and the experience of the past. Gentlemen in England are very apt to take a purely English view of silk cultivation in India, and appear to think the natives of this country are such a docile and teachable people that they will readily lay aside "the superstitions of ages," as upheld by their ancestors, and adopt the suggestions of foreign speculators, who in many instances are as far from pointing out the proper course to be pursued as the natives are slow in adopting it. Thus Messrs. Chadwick and Dickins at a meeting in London, convened by themselves, propose first "to stimulate the production of silk by cottage cultivation and otherwise, in every country where the mulberry tree is capable of giving food to silk-worms." In this first clause, as stated by the Association, there are two points to be considered, which appear to me more likely to prove injurious to the worms than to extend the growth of silk. These are, first—"The production of silk by cottage cultivation," and secondly—"the introduction of silkworms wherever the mulberry is capable of giving food to the insects."

Now if by "cottage cultivation" is meant the rearing of silkworms by cottagers in Europe, the thing may probably be feasible enough, because

the people, being of cleaner habits and more alive to the absolute necessity of attending strictly to the welfare of the insects in the matter of food and ventilation, than are the obstinate and caste-enchained ryots of India, would at once adopt those modes of treatment which were pointed out and insisted upon by competent instructors. But on the other hand when we come to urge "the mild Hindoo" to adopt a better system than he has hitherto pursued, we shall at once be met by the declaration that his poverty and dislike of innovation will prevent his making any alteration; he cannot afford to cultivate the mulberry in any other manner than that which his respected forefathers pursued; giving the worms more food and of a better quality would increase his expenses so much that he would be compelled to raise the price of the cocoons. To this the purchaser would object, and a system of "pull devil, pull baker," be introduced which would effectually keep all real improvement at a stand-still. The native cultivator however must not only alter the quality and quantity of the food, but he must be compelled to erect more suitable rearing-sheds, free alike from the dirt, smoke, and malarious influences arising from neglect of free ventilation and the non-adoption of common sense sanitary principles. Dirt to a poverty-stricken native is second nature, and you cannot wean him from it, nor from his determination to squeeze as much profit out of the worms as he can, at the very least expense to himself,—not considering in his blindness that the more he saves in the feeding and rearing, the less he gains on his cocoons? The cottage system therefore (that is to say what is so considered in Europe) is the one of all others when applied to India the best calculated to insure a bad supply of cocoons; in short it is the present Bengal system, and ought to be extinguished. If the quantity of silk cultivated in Bengal is to be increased, and the quality improved, it can only be done by restoring the worm, through a better system of feeding, to renewed health and vigour; this the ryots will never effect, and the sericulturist in Bengal must consequently do it for himself. But how, he may ask, am I to do so if the natives persist in thwarting me? Simply, I reply, by sending the native to Jericho until he comes to his senses; and in the meantime, as I have repeatedly pointed out, the European sericulturist must take the entire system of cultivation into his own hands; he must in short become in truth a practical cultivator himself, instead of remaining, as now, a mere purchaser of bad cocoons, or being compelled to shut up his filature; at present he has none other than "*Hobson's choice*"—bad cocoons or none at all. He will probably tell me that he can reel an excellent silk from these cheap cocoons, and doubtless this is true enough, but the real question is whether he gets as much silk and of as good a quality from these cocoons as he would have done had they been more judiciously attended to, and here I answer for him that he certainly does not. Then why not have the best cocoons by putting his own shoulder to the wheel, and forming a plantation from which he may derive *ripe* leaves containing in perfection in their juices the best material from which the purest silk gum can alone be secreted by the worm? The lands now occupied by the mulberry bushes in which the natives put such faith should be thoroughly ploughed, manured, and then replanted with young healthy trees or cuttings of the very best description procurable, taking due care that such trees are, if possible, *indigenous* in those districts of China, Japan, or elsewhere, in which the monthly worms are themselves either indigenous or extensively cultivated, for by so doing you may fortunately apportion to the insects the very trees, or some of them, upon which they in the first instance existed. Then as to the rearing-houses; they too should be solely under the control and supervision of the capitalist himself, with an intelligent European superintendent under him, the ryots being employed under his eye in picking and bringing in the leaves as frequently and in such quantities as the case requires; let there be no stinting, but see that the work is properly attended to, for a saving in the feeding will be a loss on the cocoon. By this method the health of the worms would be improved

and the cocoons become well stuffed with silk of a superior quality; ventilation, cleanliness, temperature, all being properly attended to, the yield of silk in the hands of the sericulturist would in all probability be double what it now is. The greatest difficulty to contend against would no doubt arise from the dislike to introduce a new system. Yet this I am confident will be the only means of putting the present vicious system on a better and more remunerative footing. It may be said that it is advisable to "let well alone," but unfortunately the present hue and cry and stir at Home for the extension and improvement of Bengal silk at once proclaims that there is very little that is good enough to be let alone. A radical change must be effected, for after all it simply comes to this, that if you wish to increase the quantity of silk you will never be able to do so under the present faulty system of feeding and rearing; consequently you must either change it for a better, or be content to remain as you are at present. Let your efforts, however, be confined to Bengal and Southern India, for if you attempt to introduce the monthly worms into the Upper Provinces, nothing but failure and loss of capital will be the result, and as you cannot with all your skill "make a silken purse out of a sow's ear," so neither can you force these worms to thrive in localities and climates where nature has decreed that they shall not thrive.

By the term "extension of silk cultivation in India" I apprehend is meant a more general diffusion of the worms, a greater quantity of silk from a given number of worms, and greater attention in the reeling; if such be the case I warn the sericulturist against the diffusion of the monthly worms beyond Bengal, for the reasons already given,—while with respect to the Boropooloo, or *B. textor*, it should be at once removed from Bengal, where it is said to be fast dying out, to a colder climate in some parts of the Sub-himalaya, where it could be profitably cultivated side by side with *Bombyx mori* from Cashmere.

It is an utter fallacy to suppose that the silkworm requires a climate free from moisture; it is the want of humidity in the climate of the Upper Provinces that enfeebles the worm and makes it languid and limp, thus rendering it incapable of yielding a full crop of silk. This has been well proved this season (1869) at Mussooree, among the wild silkworms (*B. Huttoni*), for while last year this species was found in hundreds on every tree, there is now, from the great heat and want of rain and humidity, not one to be seen. The eggs of last autumn still remain upon the trees; a few have hatched and the worms have been literally shrivelled up by want of rain and by the prevalence of scorching heat, while other eggs are still unhatched in June and are waiting for the setting in of the periodical monsoon. If then the heat thus injuriously operates upon the *indigenous* worms in our climate, what must be its effect in those scorching districts which are subject to the furnace-like blast of the hot winds? Where the speculator possesses "more money than brains" the best possible way of equalising the two will be to attempt silk cultivation with Chinese worms in the North-western Provinces of India. Taking it for granted, however, that the majority of our sericulturists are something superior to mere blind speculators acting on "the rule of thumb," and simply following their noses with nothing but the doctrine of chances to guide them, I think we may safely predict a rapidly approaching time when prejudice and red tape will be cast aside, and a new era be ushered in. The time for mere experiments has passed away; the mulberry worms have been introduced into districts where they had previously had no fair trial, and in every instance signal failure has been the result; we have now hard facts and experience before us as a guide, and if we do not profit by what we have thus learnt there will be nothing but failure in the future.

Secondly, with regard to "the introduction of silkworms wherever the mulberry is capable of giving food to the worms,"—I view the doctrine simply as a piece of claptrap, calculated only to spin out a speech and lure

the sericulturist to destruction. Wherever the mulberry is found it is no doubt "capable of giving food to the silkworms"; this is a mere truism,—but does it follow as a natural consequence that where the mulberry is capable of growing there the worms must necessarily thrive upon its leaves? The logic of the argument runs somewhat thus,—"John Bull is fond of beef, and in a climate suited to his constitution will thrive upon it," but it does not therefore follow that he will thrive upon it in a climate injurious to his constitution? It is a well known fact that the food of mankind varies in every climate of the world; the coldest regions require the most nourishing and stimulating food, but in tropical climes that same nourishment would be productive only of disease. Man can exist in every climate, but as a species he does not thrive equally well in all; and so is it with the mulberry tree; it will grow, but it does not therefore follow that in every clime it will yield the same quantity and quality of aliment; to grow is one thing but to thrive is quite another; the leaves will everywhere be "capable of giving food," because that consists of the fibrous portion of the leaf, but if those substances which go to the production of silk be wanting either wholly or in part, little or none will be furnished for the fabrication of the cocoon. I have already stated above that where the leaves are deficient in silk producing properties the worms will require more frequent supplies, and that the rest of the insect being thus interrupted, and greater labour imposed upon it, the effect must eventually be deterioration. To support my argument I invite the practical sericulturist to look round on nature that he may see with his own eyes how, after feeding, every animal seeks repose. Why is this? Simply because it is ordained that continued exercise after feeding impedes digestion. This was many years ago well proved by an experiment tried upon a brace of greyhounds; both were well fed; then one was chained up and left at home, while the other was taken to the field and coursed. When the coursing ceased both dogs were killed, and it was then found that the sleeping dog had nearly digested his food, while that of the other remained *in statu quo*.

Again, we know that every part of India will nourish mulberry trees, but at the same time we at present know positively nothing in regard to the quality of the leaves, except that from the repeated failure of the worms wherever they have been introduced we are entitled to infer that the quality of the nourishment afforded, together with the heat, are alike unsuited to the worms. Even with respect to the *indigenous* trees, their existence does not prove the districts in which they grow to be suitable to the *imported* worms; on the contrary, nature herself, by having placed no indigenous species upon such trees, at once gives warning that she never intended them to exist there. In the Himalaya she has acted on another principle, having furnished the indigenous trees with a species peculiar to them and the climate in which they grow, by which means she has proclaimed these districts to be adapted to the production of silk, and backs the assertion by the further evidence derivable from the existence of *eleven* other species of the Bombycidæ, nourished upon various indigenous trees. What plainer speaking man can desire I am at a loss to conceive. If then nature has placed indigenous species upon the indigenous trees of the Himalaya, while she has placed none upon those of the lowland mulberry, are we not fully justified in declaring that as the book of nature was intended to be man's earliest guide and primer in appropriating to himself the wisdom of his Maker, so it must be mere wilful folly to attempt by artificial means to obtain results which nature plainly tells us are contrary to her plans and the wisdom displayed around us. At the same time, however, although she refuses to introduce the mulberry worms of other climes, she does not leave the lowland provinces a blank, but on the other hand points out that perfect suitableness for the cultivation of those other wild species which she has everywhere bountifully scattered over the length and breadth of this vast and generally neglected Empire.

These are points which probably none but a naturalist would take into serious consideration in the treatment of this important subject, and yet it is absolutely essential for the sericulturist to know how nature acts and what she wills should be, for it is only by the rational study of her works that he can ascertain how far she may feel inclined to assist him, and if he wilfully shuts his eyes to facts, and determines to pursue an unnatural system of his own by acting in opposition to her *dictum*, he will only have himself to thank should his efforts eventually end in total failure. "Go to the ant, thou sluggard; consider her ways, and be wise." In the present instance let us go for wisdom to the mulberry feeding Bombyces, and we shall find them answering to our inquiries that "Nature, by not placing any of them upon the indigenous trees of the lowland provinces, proclaims aloud that she does not consider their climates suitable to their constitution, and therefore located them in different latitudes and climates, upon trees there previously provided for their nourishment; therefore be wise and profit by the warning and advice thus given by a Master Mind, rejecting the illogical doctrine that wherever the mulberry grows there too ought silkworms to exist and thrive; or if you will not be guided by such evidence as their non-existence in those provinces affords, at least let the frequent failures in the attempt to introduce them arrest your steps in time to save you from an otherwise inevitable loss."

I have no expectation that my croaking views will be more readily attended to now than formerly, while yet I believe it to be my duty to my fellow men to speak out boldly what I consider to be the honest truth. "*Hinc illæ lachrymæ.*"

I may be asked what species of mulberry tree I would recommend for the rearing of the worms, and I would certainly reply that this must be regulated by the nature of the species under cultivation, and the climate in which they are situated. In Bengal where alone in India the monthly worms are capable of being cultivated with any prospect of success, the trees selected should come from the districts from whence the worms themselves were originally procured, while the annuals of the north should be reared on the leaves of northern trees. I have tried at Mussooree the Phillipine mulberry (*M. multicaulis*), the large leafed *Morus cucullata*, the Chinese *Morus Sinensis*, and several other species, and invariably found that the silk was both more abundant and of better quality when the worms were reared upon the leaves of *Morus Sinensis* and *Morus nigra* than upon any others; while worms fed upon the leaves of *M. multicaulis* and *M. cucullata* produced nothing but a thin flimsy web, through which the pupa was distinctly visible. It is to be remarked however that this experiment was tried upon northern worms, and with the trees growing in a northern climate, so that the advantages were all on the side of the northern species, and against the southern trees. In Oudh, however, where the southern *M. cucullata* might be supposed to possess an advantage over the *M. Sinensis*, the very same results were observed, as my son, Mr. A. R. Hutton, of the Oudh Commission, who conducted an experiment under the orders of that Government, informs me that when he first entered upon the experiment with *Bombyx Mori*, *B. textor*, and *B. Sinensis*, it was found with respect to the latter worm that it was in such a weakly condition as to be unable to gnaw the epidermis of even so thin a leaf as that of *Morus cucullata*, and it was found necessary to chop the leaves very finely for them during the first stage, when, instead of eating the fibrous portions, they contented themselves with the sap exuding from the edges. Placed upon the unchopped leaf, they wandered about and died, being unable to pierce it; in the following year he changed the leaf for that of *Morus Sinensis*, and found that his worms had improved, and that in the third year they had improved still more. From this it was somewhat hastily inferred that if the experiment had been continued the worms would have annually improved until they had reached the Bengal standard, when nothing more would be needed, and the experiment would have been successful. Unfor-

tunately, however, when we look further into details, we find that this inference was entirely a false one, there being in point of fact no real improvement in the worm at all, except that it was healthier when fed upon the more solid leaf of *M. Sinensis* than upon those of the thin watery leaf of *M. cucullata;* moreover, there was no improvement upon the worms of the first year, for these died off in such vast numbers as to render a fresh importation from Calcutta necessary, so that it was only annually commencing the same experiment *de novo*. To establish an improvement in the worm required that the worms of the first year should have perpetuated themselves, and then gone on annually improving, and this they did not do; in short, the experiment never advanced at all, but annually recommenced with the importation of fresh ones from Calcutta. The fact that the worms annually imported throve better on *M. Sinensis* than the first batch had done on *M. cucullata* is *á propos* to nothing, as it only shows that the worms thrive better upon good than upon bad food. Besides which it appears that the alleged improvement was entirely the exception, the majority of worms dying off, and leaving a few good ones *to prove the rule* that *the climate was inimical* to the species. As to *B. mori* and *B. textor*, they are acknowledged to have been a failure.

In conclusion then, permit me to say one more word on the crossing of species. Darwin has stated that if a plant's own pollen be brought on a brush it will invariably prove prepotent over that of a foreign species, that is to say, that nature rejects all crossing so long as a plant's own pollen is available.

Now if we apply this natural law to the silkworm, it will at once show why the progeny of two different species when crossed invariably, sooner or later, revert to their original state, or more commonly to that of the strongest species. We cross *B. fortunatus* upon *B. mori;* the moths produced have, so to speak, the blood of both species; but when they couple there is a struggle for the mastery between the two, each striving to cast out the other, and the blood of the stronger species will prove prepotent over that of the weaker, and consequently, unless the latter be recrossed by its own species, it must by the law of nature revert to an annual. Here the stronger blood of *B. mori* in the male moth meeting with an equal portion of the same blood in the female proves prepotent over the two parts of the blood of the weaker *B. fortunatus*, and casts it out by reverting to annuals.

These two species at Mussooree, when the crossing is judiciously kept up, produce a very excellent silk of a golden colour, the cocoon being much larger than that of *B. fortunatus* of Bengal,—but when once the crossing ceases *B mori* invariably reappears. But it is time to stop, for methinks I hear you cry—"*Ohe, jam satis.*"

THE HON. SECRETARY OF THE ACCLIMATISATION SOCIETY OF NEW SOUTH WALES to HIS EXCELLENCY THE VICEROY OF INDIA, SIMLA.

Acclimatisation Society of New South Wales,
Sydney, 24 February, 1870.

MY LORD,

I have the honor to acknowledge receipt of despatches from your Excellency, No. 3749, dated 13 August, No. 555, 22 September, and 4771, 20 October, and to express the warm thanks of the Council of this Society for the pains taken in virtue of your Excellency's instructions to comply with our desire for silkworms' eggs and seeds.

The valuable paper of Captain Hutton and the other enclosures have been very carefully read, and have furnished this Society with important information, for which we feel greatly indebted to the gentlemen who have furnished the same.

I have also to acknowledge receipt of the package of eggs and seeds from Dr. De Vecchy, of Mysore, and have the great satisfaction of saying that they arrived in most excellent condition; they were immediately placed under the care of Mr. Charles Brady, F.L.S., of Manly, our most experienced silk grower. I enclose copy of Mr. Brady's report, and am happy to add that I am assured of the continued well-doing of the silkworms which have turned out quite healthy, and prove a most valuable acquisition to this Colony.

The Council of this Society is gratified by the promise of silkworms' eggs and seeds from Mr. Henry Cope, of Umriteur; these though announced as having been forwarded, have not yet arrived, but will be most thankfully received.

In that part of my letter, dated 16 June last, referring to wild species of silkworms, I solicited your Excellency's aid to obtain certain specified sorts, indigenous more particularly to Bengal and Assam; we are greatly impressed with the opinion expressed by Captain Hutton as to the value of these neglected races. Captain Hutton's views are so much in accord with the opinions of our most expert and well informed men here, that fortified by his judgment this Society is very anxious to pursue the experiment in this Colony, of growing silk out of doors; our range of climate seems admirably adapted and inviting to make the essay, and the Council earnestly hopes your Excellency will continue us your powerful assistance, and cause a few hundred cocoons to be forwarded of the species named in my letter, and of any others procurable; for the Eria, the Tusseh, and the Joree, we are well provided with food, and the moment appears most opportune.

Should your Excellency, upon consideration of the great present importance of applying the aids of science to the efforts of industrial enterprise in such a widely diffused and financially important a matter as the production of silk, determine that your Government should undertake experiments, or sanction assistance being rendered towards improving or enlarging the sources of silk production in India, as urged by the Silk Supply Association of London, this Council will most gladly and freely place at your Excellency's disposal any assistance this Society can render. Situated as we are in a new country, under circumstances entirely different to those of any and every other country, our enterprises not infrequently (rejecting the shackles of old habits) achieves results unlooked for elsewhere; hence science giving her instructions and aids to industry in this very matter of silk growth produces many crops of silk instead of one in a year, to an immense

economy of labour and capital as well as risk. We feel diffident in saying much more to your Excellency, as your desire to improve the condition of the people under your rule, as well as to benefit your countrymen elsewhere, is so well understood, but it may not be impertinent for me to say that in many ways parts of the empire may act and react on each other with mutual advantage, and it is very evident that with judicious encouragement England and her possessions may enjoy a very large share of the most profitable trade in silk.

The Council of this Society trusts your Excellency may be pleased to direct that Captain Hutton to be made aware of the sense of obligation the Society feels to him for his paper, and also to Dr. De Vecchy for his valuable packet.

I have, &c.,
GEORGE BENNETT, M.D.,
Hon. Secretary, Acclimatisation
Society of N. S. Wales.

[*Enclosure.*]

Charles Brady, Esq., to Dr. G. Bennett, Hon. Secretary, Acclimatisation Society of New South Wales.

Dear Sir,

I have carefully examined the parcel of silkworms' eggs just arrived from India, and have the pleasure to say that although the varieties are in part similar to some of my own, they form a very desirable and valuable addition to the useful sorts which Australia is now acquiring. The society may be congratulated on the success which has in this instance attended the Viceroy's efforts to assist the difficult enterprise of introducing the silk industry into Australia; the eggs were admirably packed, and arrived in perfect condition.

A portion of the eggs was already hatched so that a further short delay would have been fatal, but there is every probability of saving enough of each breed for reproduction in the Colony.

There appear to be two, if not three, separate varieties—one a high class race from Italy, by way of India; a second unnamed; the third Japanese green (apparently different to that already imported by the Society) partly acclimatised in India by Dr. De Vecchy, from whose estate also the Italian eggs were obtained.

At present the young worms appear healthy though small and pinched—it will probably take two or three generations to bring them up to our standard; indeed pretty well all my experience goes to convince me more and more that the fresh food and new climate both operate powerfully towards restoring the natural vigour which, for now so many years, appears to have deserted the finest stocks of silkworms in Europe—and there are not wanting symptoms that even the pure and clean races of Japanese varieties may shortly become more or less desolated by the same scourge which has deprived several millions of people in France and Italy of their most alluring and profitable occupation.

What I mean by our standard, is simply that degree of health and physical vigour in the silkworm, which, for three consecutive years, gives it power to commence, under ordinary circumstances, its natural course in due season, and not before, and passing through all its changes without disproportionate casualty (its management without unusual difficulty or special

pains), to consummate its progress in forming a firm, stout, and clean cocoon of moderate size, and whose moth neither too bulky nor too attenuate, is perfect in its form, development, and covering of down. This standard is attained by continued and assiduous attention, first to cleanliness, second to rigid selection, and thirdly to judicious use of various kinds of mulberry as food plants, according to season—one kind being used from first to last (or at any rate during the last two stages at least) with the males, and a different mulberry with the females. Pure races bred in and in in this way soon acquire additional vigour, and are afterwards much more manageable than I have found them on their first introduction.

I remain, &c.,
CHARLES BRADY.

January 8, 1870.

From Lieutenant-Colonel William Agnew, Officiating Commissioner of Assam, to the Secretary to the Government of Bengal—(No. 331, dated Gowhatty, the 7th December, 1869.)

Sir,

In compliance with the instructions conveyed in your letter No. 3086, of the 2nd September last, I have the honor to submit a memorandum, drawn up from the reports of the district officers of this division on the silkworms of Assam, and embodying the information asked for by the Acclimatisation Society of Australia.

2. With regard to the question of despatching cocoons to Australia, I would beg leave to point out that of the three species cultivated, viz.,—the Moogah, the Pat, and the Erie, the two latter are found in Bengal, and I therefore think it would be better to send their cocoons thence than from this more distant province.

3. I have great doubt as to whether it will be possible to ensure the safe arrival of specimens of the moogah insect. From the enclosed memorandum it will be seen that the chrysalis does not remain dormant for any length of time as is the case with some species; but after the cocoon is formed, the moth soon emerges and lays its eggs, which again are hatched in a few days. The difficulty, however, may be overcome if the method of packing described in the 5th paragraph of Dr. Bennett's memorandum operates to retard the hatching of the eggs. The best time for sending the cocoons would be the winter season, as heat accelerates all the stages of development. The month of December is perhaps to be preferred for all reasons.

4. I shall be able to collect and despatch as many cocoons as may be required if I am furnished with perforated zinc cylinders (which I cannot procure here) of the description recommended by Dr. Bennett, and should I be desired to procure cocoons I request I may be informed by what route and to what address I should send them, so that by despatching them direct loss of time may be prevented.

5. I shall despatch by Bhanghy post specimens of the various kinds of silk, raw and manufactured, as requested in your 2nd paragraph; and eggs of all the varieties shall also be sent packed in the manner described by Dr. Bennett, and also in bottles, as suggested by Mr. William Becher, who at one time cultivated silk extensively here. I have desired the district officers to collect seeds of as many of the trees mentioned by Dr. Bennett as possible, and these I shall also forward to you on receipt.

Memorandum on the Silkworms of Assam.

Mooga.—(Otherwise '*Moogah, Moonga, or Mungah*') *Antheræa Assama* or *Saturnin Assanunsis.* This is the commonest silkworm in Assam, and its produce is second in estimation, that of the "pat" worm being superior. It is bred and treated in the following manner:—On the third day after the cocoons have been completed the cultivator sets apart a certain number for breeding, choosing those which were commenced on the day when the greatest number of worms began to spin. These are kept in open-work bamboo baskets in a dark, secure place in the house; and in a certain number of days, varying from ten to twenty, according to the state of the weather—heat accelerating and cold retarding the development—the moths emerge. The males, known in the cocoon by the sharpness and length of the "tail" of the cocoon, and in the moth stage as being smaller than the females, are left with the females for a day, and all are then placed on bunches of grass, generally the "ooloo" grass, in pieces of 18 inches in length and 3 in circumference, or on strips of bamboo fastened to a rope and suspended from the roof, and the females are tied to the grass or bamboo by their wings with pieces of thread. In about three days the eggs are laid and remain attached to the bundles of grass. The cultivator only keeps those laid in the first three or four days, the rest are supposed to be useless. In about ten days—the period varies with the weather as above-mentioned—the young worms appear, and in some places are fed for a day or two in the house with tender leaves, and then—or in places where this practice is not resorted to, immediately on the worms being hatched—the bundles of grass are taken out and tied on the trunks of sooaloo or soom trees. Great care is taken previous to this to clear the soom groves of ants and other insects inimical to the mooga, for which purpose all undergrowth is destroyed, and the ants, &c., having been collected by baits of molasses, plantains, decomposed fish, &c., &c., are burnt wholesale. The worms, crawling up the trees, feed first on the smaller and afterwards on the larger leaves, and are prevented from coming down by a band of plantain or other smooth leaf, over which they are unable to move, fastened round

the trunks of the trees. They remain on the trees about twenty-six or twenty-seven days more if the weather is not favourable, and then leave off eating and descend, and are gathered in the evening, and taken to the cultivator's house, where they are placed in parcels of clean dry leaves, mango or plantain, and commence their cocoons, which they finish in about five or six days; and the same series of changes then commences anew.

From the time the young worm is placed on the soom tree till it commences spinning, the greatest care and attention are required to preserve it from its numerous enemies. Birds of all kinds, crows especially, devour it by day; and bats, owls, and rats are equally destructive by night. Men are always, day and night, on the alert with bows and arrows, pellet bows, and slings, and with the aid of these and constant shouting manage to prevent the birds, &c., from doing much harm, but the worms are still destroyed in numbers by wasps, ichneumon flies, and other insects. Hot, dry weather, is the most favourable to the mooga worm, but excessive heat is often fatal to those which are moulting. Rain, unless it fall in very heavy showers, does not injure them as they find shelter under the leaves. If the rain, however, be very heavy it washes them off; and in this way sometimes a large proportion is destroyed.

The mooga is generally spoken of as yielding five crops of silk in the year, which are designated as follows from the season or month in which they are yielded :—

The Jarooah crop (cold weather) January, February.
„ Jettooah „ (Jeyt) May, June.
„ Aharooah „ (Ahar) June, July.
„ Bhodia „ (Bhadro) August, September.
„ Kotia „ (Kartik) October, November.

Of these the first two and the last are considered superior to the others. Sometimes a larger number of crops is obtained if the weather is more than ordinarily favourable.

The duration of the existence of the worm under ordinary circumstances may be taken to be—

From the laying to the hatching of the egg ...	10 days
From that time till the fourth moulting ...	20 „
From the fourth moulting to the commencement of the cocoon	10 „
In the chrysalis state	20 „
As a moth	6 „
Total	66

In the hot weather it is sometimes as short as six weeks; in the coldest as long as twelve weeks.

It is difficult to obtain reliable statistics as to the amount of silk produced by each worm. The commonly accepted idea is, however, that from 4,000 to 5,000 worms produce 1 seer (2 lbs.) of silk, the value of which varies from 6 rupees to 15 rupees. A "dhoti," 18 feet long by 3 feet broad, is worth from rupees 12 to rupees 20, the price varying with the excellence of the silk and of the manufacture. Breeding cocoons are generally sold at rupees 2 per 1,000. The silk is of a yellowish colour.

Pát, or Pát Pooloo (*Bombyx mari*). This is identical with the mulberry worm of Bengal. It is never found wild in Assam, and is cultivated entirely indoors. Its produce is white and highly esteemed; formerly indeed its use was restricted to royalty, and now only the "Jogi" caste raise it. Its culture is as follows:—The cocoons selected for breeding are kept in a loosely tied cloth so that air can reach them, and put in a quiet, clean place. In some twenty or twenty-five days (more or less, according to the weather) the moths emerge and are left together a short time, and are then removed either to slender sticks of bamboo, or to pieces of cloth, where the females are tied by the wings with thread. In a short time they lay, and the eggs, if laid on cloth, are carefully packed up as they are; and if on pieces of bamboo are not touched for some days, and then are removed to earthen pots or bamboo baskets, and kept with care till the hatching season, which in Upper Assam is generally the end of December, and in Lower Assam the end of January. The eggs are then taken out and exposed to the air; and as soon as the young worms appear they are placed on round shallow bamboo trays, which are sometimes lined with cloth, and fed with tender mulberry leaves (the "noonee" tree). The cultivators are particularly careful that the place where the worms are kept is very clean and free from all obnoxious smells. Dirt of any kind is supposed to be fatal to them. The worms are sorted after six or seven days, the larger being separated from the smaller; and the size of the leaves given to them is gradually increased as the worms grow. When the worms evince disinclination to eat they are removed either to bundles of clean, dry leaves, or to bamboo trays with matting divisions about 2 inches apart, where they spin their cocoons, which they complete in five or six days.

The duration of the breed may be taken roughly as follows:—

From the hatching of the egg to commencing the cocoon	30 or 40 days.
In the chrysalis state	10 to 20 „
As a moth	3 or 4 „

From the laying to the hatching of the egg, about ten months, or altogether one year. The cocoons required for use are put in the sun three or four days, and then boiled in a solution of potash obtained from the stalks of rice plants. The silk is worth

20 or 25 rupees a seer and is more valuable than any other, partly on account of its whiteness, partly its fineness, and also from the fact that but one crop is obtainable in the year, which makes it scarce. The fabric woven from it much resembles the "tusseh" silk of Bengal, and the worm is, I believe, identical with that from the silk of which "tusseh" is made.

There is another description of pát called the chota, or small pát, the culture of which is the same, but the silk is not quite so good. It is but little reared.

Eria, Erie, Erie, Eree, Arrea, or Arindee (*Phalæua cynthin*). The treatment of this worm is similar to that of the pát pooloo, except that it is fed on the castor-oil plant instead of on the mulberry. It yields a coarser silk than either the pát or moogah, and is cultivated generally by lower-caste Hindoos, Cacharies, and Meekirs. It is reared entirely in the house, and the duration of its existence is from six to eight weeks, less in the hot than in the cold weather, and its produce is better in quality and quantity in the former than in the latter season. Cocoons for breeding are selected in the same manner as are moogah cocoons, and for the rest they are treated much as are pát pooloos, except that so much care and attention to cleanliness are not necessary. When the worms are rather old (after the second moulting) they are generally induced to crawl into bundles of leaves suspended from the roof, which saves the trouble of feeding in trays. They are allowed to form cocoons in bundles of dry leaves. There are said to be seven breeds in the year. The thread of the "erie" silk is worth from 2 to 3 rupees per seer, and the fabric made from it, which is warm, thick, and durable, fetches about 14 or 15 rupees for a piece 15 feet by 4½ feet. This worm is found in Bengal.

Kootkoori or *Kootkoori Moogah* is a wild species of silkworm found in the jungles of Upper Assam; no use is made of its silk, and the natives say that it is in fact worthless.

Megankoori is the name given by the Assamese to the produce of the moogah when fed on the adakoori-tree instead of the soom. The silk of the adakoori fed worm is lighter in colour and therefore more highly valued. Among worms fed entirely on the soom, however, some will always produce lighter coloured silk than others, and this, being set apart, is generally called "megankoori." There is no distinct insect known by that name. The *joree* is not known to any of the district officers.

From H. A. Cockerell, Esq., Officiating Commissioner of the Presidency Division, to the Secretary to the Government of Bengal, General Department—(No. 77, dated Fort William, 30th October, 1869.)

Sir,

The only district in this division in which silk is grown is Kishnaghur, and there only to a very limited extent. Mr. Scott Moncrieff, of Salgamoodia factory, has, however, been good enough to favor me, through the collector, with a very complete report on the subject, copy of which I submit for the information of Government, with reference to your letter No. 3086, dated 2nd September. I also forward the two specimens of silk sent by that gentleman.

From R. Scott Moncrieff, Esq., to H. Lattman Johnson, Esq., C.S., Joint-Magistrate, Kooshtea—(Dated Salgamoodia Factory, the 4th October, 1869.)

Sir,

As requested in your note of 25th ultimo, I have carefully perused the copies which accompanied it of letter of 2nd ultimo, to the Commissioner of the Presidency division, from the Government of Bengal, and of the memorandum by Dr. Bennett, referred to therein, on the subject of the supply of silk-worm eggs for the Acclimatisation Society of South Australia, and I have much pleasure in submitting the following observations on the subject, premising that my chief authority for them is Mr. P. Veyrin, who superintends my small silk filature here,—a gentleman conversant from his youth with the rearing of silk-worms and manufacture of silk, and who was employed for some years by a few of the leading firms in Lyons in the purchase of silk-worm eggs in the Caucasus and Persia, and in transporting these to France.

2. *Wild Cocoons.*—We have very few in this district, and do not manufacture silk out of them. Mr. Veyrin has personally superintended experiments with them, and has watched the manufacture of silk from them in the districts of Bancoorah and Beerbhoom, and in the province of Assam, in which as well as in many other jungle districts of Bengal they are very abundant. A large quantity of silk is made from them, but entirely for native consumption and of very inferior quality. The value ranges from rs. 2 to perhaps (but very rarely) 5 per seers (2s. to 5s. per lb). The well known *tusser silk* cloth of Bhaugulpore is made from silk of the wild cocoons, and is generally in demand for export to Europe. Mr. Veyrin is of opinion that the silk of some kinds of the wild cocoons is of such very desirable quality for certain classes of silk manufactures, that if it could be produced of a quality suitable for the purpose by the same simple and inexpensive process as that followed in spinning ordinary Bengal silk, the

produce would prove a very valuable commodity for export, but the cost of manufacturing the silk of the required quality proves prohibitive at present. This remark especially applies to silk of the Moongah cocoons of Assam, made by the ordinary native process; it is wholly unsuitable for the European market, but it could not be manufactured to suit the latter at a cost which buyers for that market could afford to pay. There is such a quantity of gummy matter in the wild cocoon that the thread of it cannot be unwound without much more difficulty than is met with in spinning the thread of the yellow cocoon from which Bengal raw silk is made; and as yet no experiments for unwinding the former by any other than the native methods have proved successful.

3. The *eggs* of the *wild silkworm* could easily be procured for export; but Mr. Veyrin fears that unless the worms from them can be fed on leaves of the trees on which they feed in this country, they would perish. In Assam the Moongha cocoon is fed solely on the tree known to botanists as the *Jetrantena quadrifolia*, called by the natives the *soom* tree. From this cocoon is made the bulk of the silk used by the natives of that province. Their priests use cloth made of silk of the Mezan koonee cocoon, of a quality much better than that of the Moongha. Another kind of silk is made by them from the Erea cocoon, fed on the castor-oil tree. This cocoon is of a very large size when full-grown; the silk is not unwound from it, but is taken much as cotton is taken—from the pod—of very short fibre. The wild cocoons of Bancoorah and Beerbhoom are fed entirely on the sâl tree, which abounds throughout the jungles.

4. The breed of silkworm from which the silk known as Bengal raw silk is made is the *Bombyx Mari*, and is reared very extensively throughout the cultivated districts of Lower Bengal. There are two distinct families of this worm; one of these propagates its species only once in a year, but of the other six or seven generations successively are produced in one year from one pair of moths. The former is the kind from which silk is produced in Europe, Japan, and China; the latter seems peculiar to Bengal, and is the only kind of worm from which Bengal silk is made, as a rule, though the other is not unknown in the province, but is so much less productive that the natives find little inducement to rear it. Though much more silk is produced from the worm which propagates the more frequently of the two, its cocoons are in every way inferior to those of the other family, and the silk made from them is never equal in point of quality to that of Europe, Japan, and China.

5. From natives intimately acquainted with the process I have the following particulars descriptive of the method followed in producing cocoons:—A native considers one pound weight of eggs sufficient to commence with, for which he pays two or three

shillings, if he requires to buy them. The eggs are made over to the women of the family, who alone are permitted to attend to them. These women while thus employed are required to exercise the strictest personal cleanliness (and to confine themselves to certain kinds of food even in some families). The eggs are ranged on shelves in dark rooms during the first week after they are hatched. The worms are fed with very young mulberry leaf. At the end of the second and third weeks they receive older and stronger leaf; in the fourth week they are considered full-grown, and are supplied with abundance of full grown leaf. During the first three weeks a light is kept in the room, but for one night only in each week. During the fourth week a light is burned every night and a fire is kept up if the weather is cold. Towards the end of the fourth week the worms become gorged and refuse food, a sign that they are ready to spin. They are then put out in the sunshine for a few hours, or near a fire, if the weather be cold and cloudy, and soon commence work. In about two days the worm has finished his cocoon, and in about seven days he commences cutting his way out at one end of it. If he succeeds, he emerges as a small white moth, but the cocoon is rendered useless by being cut. In order therefore to prevent this the cocoons are baked before the worms commence to liberate themselves, and this kills them in the cocoons; the latter are then placed in hot water and the silk is reeled from them very easily. The best cocoons are generally reserved for breeding purposes. From these the moths are allowed to escape, and they breed almost immediately; then eggs are laid and hatched within two days, and from these a new supply of cocoons is obtained within five weeks. Under ordinary circumstances, from one pound weight of cocoons reserved for breeding 100 pounds of cocoons are produced, and very frequently 200 and even 300 pounds are the result of one breeding.

6. The worms are fed exclusively on mulberry leaves gathered, not from trees as in Europe, but from plants very carefully cultivated in fields set apart for them; the leaves are plucked five or six times in one year from each plant, and the owner so arranges as to have always ready leaf of different growths suited for the worms of various growths which are reared in his house.

7. In Mr. Veyrin's opinion, an insuperable difficulty is presented to the transport to Australia of eggs of the family referred to in paragraph No. 5, in this,—that even if the hatching of the eggs could be delayed by keeping them very carefully from the air in transit, as they would hatch immediately on exposure to it; after arrival, the worms would perish without a supply of food of the tender leaves of the mulberry, and in Australia it would be impossible probably to command a supply of such food for every new generation of worms. He states that eggs of the species breeding annually have been conveyed to Europe very successfully

from Cashmere, where they are abundant, by his agents, Messrs. Wattenbach, Heilgers, and Company, of Calcutta, who will be happy to procure a supply for Government if requested to do so.

8. I have the pleasure to forward herewith a skein of silk made here from the Moongha cocoon of Assam as an experiment. It is of a light brown color and glossy appearance, and silk of this description would fetch ten shillings per pound in the Calcutta market probably. I also enclose a skein of fine Bengal silk equal in quality to the finest made at this season of the year, and worth twenty-two shillings per pound in Calcutta.

The annexures received with your note are returned herewith.

From J. P. Grant, Esq., Collector of Bancoorah, to the Commissioner of the Burdwan Division—(No. 124, dated Camp, Sonamookhy, the 16th November, 1869.)

Sir,

I have the honor to reply to your memorandum No. 134, dated 25th September, 1869, on the subject of silkworms.

2. The private rearing of silkworms is not practised in this district; but as it is practised in a tract only just over the border, *i.e.*, in the Bograh (Midnapore) pergunnah of the Gurbettah sub-division, and as the raw silk thus spun is largely manufactured into fabrics in the district, I have considered it useful to lay before you the information received by me from Baboo Ruttun Lall Ghose, the deputy collector of Gurbettah, although you have in all probability already received it through the collector of Midnapore.

3. The deputy collector has evidently, from the terms of his report, understood the inquiry of Government to extend only to the domesticated silkworm. As, however, the Australian memorandum appears to refer exclusively to *wild* silkworms, I have added such remarks as I have been able to collect on the culture of the *tusser* silk moth, which is to a limited extent carried on in the jungles of this district, and to a very much greater extent in the jungles of the neighbouring district of Maunbhoom. I may here remark that the second name in the list given in the Australian memorandum of worms sought for from India is evidently that of the Indian *tusser* moth, disguised in atrocious typography.

4. Of the silkworms proper, *i.e.*, of the domesticated breed, the Baboo describes two species, one very much larger than the other, but both reared in houses, on trays and *machans*, and fed upon cut mulberry leaves. There is however a vast difference between the two species in point of prolificness; the smaller kind being reproduced in constant succession every six weeks or two months, while the larger kind breed only once a year. I

have been unable to secure any specimens of the silk of the larger kind, but I forward specimens of the smaller kind, both in cocoons and in skein. It seems that both species give a produce of a varying colour, from a flaxen white to a golden yellow.

5. The *tusser* moth can hardly be looked upon as a domesticated silk moth, inasmuch as it is never privately reared. It does, however, undergo a rough kind of culture in the following way. A number of wild cocoons are collected by the speculator, generally a Sontal, who has already fixed upon a patch in the jungle containing a number of young *sal* or *assun* trees, but not more than his family can watch. As soon as the moths are hatched they are turned loose in quantities on these trees, where they lay their eggs, which are hatched in due course, the young caterpillars being reared upon the growing leaves. No kind of interference is practised with them, and all that the cultivator and his family have to do is to take care that the worms are not carried off by the birds, which do not fail to find out the cultivated trees from the vast number of moths which they bear. When the cocoons are sufficiently formed to be handled, they are detached, packed in baskets, and are taken to the nearest bazaar for sale. The cocoon is of a dirty brown colour, and larger than a hen's egg. I have been unable to obtain specimens either of the cocoons or of the skeined silk.

6. The cocoons of all these species appear to be in the months of Magh and Falgoon, or February and March. Being now encamped at Sonamookhy, the centre of the silk and *tusser* manufacture of the district, I have made arrangements for the procuring of a number of cocoons, as well as of the eggs, of all the species employed in the district.

From Baboo Ruttun Lall Ghose, Deputy Collector of Gurbettah, to the Collector of Bancoorah—(No. 98, dated Gurbettah, the 8th November, 1869.)

Sir,

With reference to your memorandum No. 189, of the 29th September, 1869, received immediately before the last Dusarah vacation from Bood-Bood, I have the honor to report on the following points connected with silkworms and cocoons mentioned in the Government order No. 3086 of the 2nd September last, on a copy of which your memorandum was endorsed :—

1st. What varieties of worms are obtainable?

2nd. What is the mode of supporting and treating them, and the quality of silk produced therefrom? (Specimens to be sent if possible.)

3rd. Is there any difficulty in procuring silkworms for despatch to Australia?

4th. At what time should cocoons and eggs respectively be sent?

2. What varieties, &c.? There are two sorts of worms which people in this part of the country breed; one large and two smaller, or those of the ordinary size. The large worms' cocoons are larger in size; they are thrice as large as the cocoons of the smaller or ordinary size. All worms and cocoons are of two colours, white and yellow.

3. What is the mode, &c.? In the intensity of the cold of the months of Aughran and Pous, *i.e.*, about December and January, the worms here die. People therefore go to the villages in the vicinity of Tumlook, in the district of Midnapore, and to villages near Moorshedabad, for the purchase of worms (within cocoons) in the latter end of Magh and beginning of Falgoon. The worms, confined in cocoons of the smaller or ordinary size, are kept in *handis* (earthen vessels) made air-tight by some means or other for eight days. On the ninth day, generally, butterflies come out from the cocoons. These butterflies are preserved in large drawers of bamboo, kept on bamboo shelves, in a hut closed up in such a manner as would protect the worms, &c., from ordinary flies, which are their great enemies. Butterflies then give eggs in the course of one day. The eggs are innumerable of the white colour and very small in size. One butterfly gives upwards of 250 eggs; and they all die no sooner the eggs are given. On the eighth day young caterpillars come out from the eggs. They are then distributed into the numberless small compartments of the bamboo drawers, each containing about 3, 4, or 5, moths, as they chance to fall in the distribution. Of these moths some have yellow and others white colour. *Toot* leaves cut into very small particles are given to them every second or third day for their eating. They grow in one month sufficiently developed to spin cocoons. In three days the cocoons are made of the size sent herewith as specimen. Some of these cocoons are kept, from which again the butterflies and eggs are produced. The process described above is repeated; and at the end of every month and half or so a fresh set of cocoons are produced by the smaller worms. The huts where they are kept are made almost air-proof in the rainy season, and are so closed in all other seasons that no flies can enter therein and destroy the moths. Next, I observe, that the treatment and breeding of the other sort of worms are a little different from what have been described above. The butterflies which come out from the larger cocoons are preserved on a few yards of cloth laid over the bamboo drawers. On the cloth the eggs are given; and these wrapped in the said cloth, are carefully kept in an air-tight *handi* (earthen vessel). The handi is not opened, not even touched by anybody, till the fifth day of the month of Maugh next year. By that day the eggs give birth to the moths; and if they are not hatched by that time the *handi* is again left closed for a few days more. The time

the eggs take in giving birth to the worms is generally one year. These moths are kept for thirty-two to thirty-six days in the manner described above. They then become sufficiently old to prepare their cocoons in three days. The quality of silk produced by both sorts of insects is nearly the same. These generally produce silk in the month of Chaitra; and Chaitra silk of the smaller worms of white color is whiter than the silk of other months. Large cocoons could not be procured by me; a few of the smaller ones, together with two skeins of silk produced therefrom, are herewith submitted as specimens.

4. Is there any difficulty, &c.? Cocoons can be easily sent from the places mentioned above, from which people of this part of the country procure them in Magh and Falgoon, to Australia or other distant places in the manner indicated in the memorandum annexed to the Government letter.

5. Cocoons and eggs should be sent in Magh and Falgoon, *i. e.*, part of January, the whole of February, and part of March every year.

6. Price of the silk sent herewith is rupees 14 per seer of 80 tolahs.

7. The annexures to your memorandum are herewith sent back.

From J. H. Henderson, Esq., Deputy Collector, for Collector of Burdwan, to the Commissioner of the Burdwan Division—
(No. 548, dated Burdwan, the 15th December, 1869.)

Sir,

In answer to your letter No. 134, dated 25th September, 1869, calling for a report on the mode of treating silkworms and cocoons, I beg to lay before you the following statements:—

1. No silkworms are obtainable in the Raneegunge sub-division. Silkworms are imported from Maunbhoom into Bood-Bood and Ausgram, and from the silk produced by them tusser cloth is manufactured. In Cutwa the trade in silkworms is carried on on a limited scale, the domesticated polloo being introduced there. In Katoogram the varieties are the domesticated chukkan, the neto, and the madrassie. In Culna the burra and chota polloo are imported.

2. The cocoons of the domesticated, otherwise called the chota polloo, are imported from Beerbhoom. They are placed in open baskets in a warm dry room. In cold weather the moths emerge on the eleventh or twelfth day, in hot weather on the eighth or ninth day. The males and females at once copulate; and after the lapse of three or six hours the males are taken away and die. The females are put on flat baskets, and the eggs are laid during the night. The eggs are hatched on the eleventh or twelfth day in cold weather, and the eighth or ninth in hot weather, and the caterpillars are fed on the leaves of the mulberry-tree. On the

eighth, fifteenth, and twenty-first day after leaving the egg the caterpillars are dormant and require no food, but after the twenty-first day they have an adundant supply of leaves for fifteen days, at the end of which period they are placed on bamboo shelves with divisions. The caterpillars form cocoons which must be placed in the sun for three mornings successively. In hot weather the chrysalises are killed by the sun, in cold by boiling water. It is most essential that the room in which the caterpillars are placed should be clean, warm, and free from insects.

3. The chukkan breeds in December, and the eggs must be kept in a warm room for eight days. After the eggs are hatched small bits of leaves should be sprinkled over the young caterpillars for seven days, and after that whole leaves should be given three times a day for eleven days. The caterpillars then form cocoons, which must be put in the sun four days for three, six, nine, and twelve hours respectively, after which they are placed in a warm room and are ready for use.

4. The eggs of the burra polloo are kept suspended in an earthen pot in a closed room for twelve months, after which they are treated like the eggs of the chota polloo.

5. The value of the silk produced by these silkworms is as follows:—

Chota polloo	...	...	Rs. 16 to 20 per seer
Madrassie ...	...	...	„ 25 „
Chunkkan	...	...	„ 14 „
Neto ...	...	...	„ 9 „
Burra polloo	...	...	„ 25 to 26 „

The breeding time of the madrassie is in January, and that of the neto in July.

6. The Deputy Collector of Cutwa is of opinion that the silkworms cannot be exported; but the Deputy Collector of Culna thinks that the eggs and cocoons of the burra polloo might be exported successfully.

7. There would probably be little difficulty in procuring a supply of silkworms for exportation.

From C. S. Turnbull, Esq., to R. V. Cockerell, Esq., Magistrate and Collector of Hooghly—(Dated Ghattal, the 7th October, 1869.)

Sir,

I have the honor to acknowledge receipt of your office memorandum No. 440, dated 30th ultimo, enclosing copy of a letter from the Government of Bengal, with memorandum received from Dr. Bennett, descriptive of the mode of treating silkworms and cocoons in the exportation to Australia, and calling for any information I can give on the subject.

1. The varieties of cocoons obtainable in this district are burra polloo (annual), madrassie, and dasee and China (monthly).

2. They are fed on mulberry leaves, and the quantity of silk produced from a maund of cocoons of passable quality is 2 seers 12 chittacks to 2 seers 4 chittacks, $2\frac{1}{2}$ to 2, $2\frac{1}{4}$ to $2\frac{1}{2}$, $2\frac{1}{8}$ to $2\frac{1}{2}$, respectively. Specimens of silk and cocoons will be forwarded in due course when the cocoons come to maturity, except the burra polloo, which is an annual, and the cocoons won't be in before the middle of March. I may as well also add that eggs of the burra polloo were sent to Captain Hutton, Mussoorie, and he got two crops of cocoons, whilst in Bengal such a thing is unknown.

3. I think it will be impossible to send eggs from the monthly cocoons to New South Wales, as they will hatch on the voyage, and will die for want of food.

MEMORANDUM regarding certain kinds of Indian silk-yielders, domesticated and wild, for introduction into Australia, by Captain Thomas Hutton, corresponding Member of the Agricultural and Horticultural Society of India.

WITH regard to Dr. Bennett's inquiries, I begin by noticing the confusion among the names of the species of silkworms required for Australia.

1. The name of *Bombyx Arracanensis* (Nobis) was given only provisionally (not *Arracauniris*) to the Arracan worm, which may probably prove to be either *B. posi* or *B. fortunatus*.

2. *The wild silkworms.*—The eria or arindy worm, which feeds on the castor oil plants at Dinapore (? *Dinagepore*) and Rungpore, is the domesticated *Attacus ricini*. The wild *Attacus cynthia* is a distinct species, found at Mussooree and eastward to Cachar, feeding on various trees and shrubs, and now largely cultivated both in France and in England, where it is reared upon the Chinese tree *ailanthus glandulosus*, which grows well in any soil; this worm, or *Attacus ricini*, has already been introduced into some parts of Australia; at Mussooree *A. cynthia* is common upon several trees and is an annual. Cocoons would only be safe in the cold weather.

3. The tusseh (not *Jusseh*): The *Bughy* of Beerbhoom, and the *Rolisurra* of the Deecan, are one and the same species, or antherœa paphia (not pappia).

4. The *Kootkooree Mooga* of Assam: The mooga of Assam, feeding on the *Soom* (not *Loom*), and the Mezankooree of Assam, are all the same, or *Antherœa Assama*. These different names being applied by the natives to different qualities of cocoons and silk; in Beerbhoom the same distinction is made with the silk and cocoons of the tusseh.

5. The *Joree* worm, called by Dr. Helfer *Bombyx religiosus* (not *religiora*) is suspected to be no *Bombyx* but an *Ocinara*, a very small species, whose cocoon is not worth the trouble of cultivation.

Then, with regard to Dr. Bennett's second paragraph, cocoons and eggs can only be sent off with due regard to the time of eating out and of hatching. I do not consider it safe to despatch any species until the winter or cold season, as all then take their longest rest. The eggs of all the *Bombyces*, if sent off earlier, would assuredly hatch *en route*, and until the cocoons of the last brood of all the *Antheraæ* and *Attace* are procurable; the moths would also certainly break out and be lost. If packed in perforated metal cylinders, as Dr. Bennett recommends, the ends of such cylinders should be simply covered with a strong piece of gauze, and all the cylinders packed in a strong wooden box with perforated sides; these may be placed close to each other to keep them steady in the box, but no *cotton* or any other packing stuff likely to promote heat and prevent a free circulation of air should be used. No shaking of the slightest consequence would occur, because the cocoons in the cylinders would steady each other, and the cylinders in the box would act in the same manner to each other. As to leaving room for the moths to come out, the great and most desirable object in my opinion is to prevent all hatching, for, without a very large and inconvenient space, no moths would couple in the box, nor would have space to do so. If it could be managed, I would recommend an outer cylinder containing ice, in order to retard hatching; but care must be taken to prevent any moisture reaching either eggs or cocoons. I do not see, however, how this can be done without excluding air, and that must be admitted. Again, on no account ought the boxes to be placed in the hold of the ship, or they will certainly ferment and rot; they must be kept between decks, where air can freely circulate without exposure to sun or rain. I have always packed cocoons in perforated boxes without suspending them at all; and indeed as the boxes are almost certain to be turned bottom upwards, or on their sides during transit, suspension with room to move becomes perfectly useless. The chief thing is not to squeeze them into the cylinders, but simply lightly touching each other.

The eggs of the *Bombyces* usually hatch from eight to ten days after being deposited, so that all would certainly hatch *en route*, unless the eggs of the last brood were selected; for as yet, I believe, we have discovered no method of transmitting packets by the telegraph wire, and even if we had there is no wire between India and Australia, so that Dr. Bennett's plan of despatching eggs, as soon as laid, would never answer, while even annuals, whether in cocoon or the eggs, will often hatch at improper seasons whenever they experience a suitable temperature; and as

there would probably be many such changes during so long a journey, the changes are greatly in favour of many worms and moths hatching *en route.*

As regards the fifth paragraph, the eggs may be made into packets without fear of injury, but I would certainly not advise their being wrapped in cotton, tow, or anything of the kind, as all are heating and liable either to hatch the eggs, or to rot them by the steam engendered.

Let each packet of eggs be placed in a perforated tin box, and these boxes be enclosed in a perforated wooden box; there could then be no undue pressure upon the eggs, unless the packets were smashed. A better way, however, is to place each kind of eggs, whether on cloth or loose, in a separate unperforated cylinder, with the ends merely closed with fine open gauze for the sake of ventilation; and these cylinders being duly labelled could then be placed in a perforated wooden box. A little shaking rather does good than harm, as it prevents the eggs from sticking together should sweating occur.

In recommending what species should be selected, one requires first to know what kind of nourishment has been provided, for there is no use in sending the insects until an ample provision has been made for feeding them; mulberry trees, for the *Bombyces; Bicinus communis* for *Attacus ricini; Ailanthus glandulosus* for *Attacus cynthia;* species of *Tetranthera* for *Antheræa Assama;* of *Zyziphus* and other trees for *Antheræa paphia*, and so on. Supposing, however, that such provision has been made, the best species of *Bombyx* to import would probably be *B. cræsi*, *B. fortunatus*, and *B. arracanensis*, while as an experiment *B. Huttoni* might be added with strict injunctions to leave it entirely on the trees, for it cannot be cultivated in the house,—like a true Highlander preferring coarse fare and liberty to the daintiest treatment in captivity.

Of the wild species, I should recommend *Attacus ricini*, *Attacus cynthia*, *Antheræa paphia*, *A. Assama*, and, if the oak has been introduced, *A. Roylei*, of Mussooree; whether or not the last-named would thrive in such a climate as Australia remains to be proved; I should have little hope of *Bombyx mori* and *B. textor*, unless a tolerably cool climate can be found.

Mussooree, September, 1869.

From G. E. Makgill, Esq., Officiating Collector of Howrah, to the Commissioner of the Burdwan Division—(No. 840, dated Howrah, the 6th January, 1870.)

Sir,

In compliance with your circular No. 134, dated 25th September last, I had the honor to forward, on the 31st December and 4th instant, two cases—one case containing forty cocoons

of the yellow variety (lal poka), and another containing the same number of the white variety (shiti); and I now forward two samples of the silk produced by the former (one finer quality and one coarser), and one of that produced by the latter, reeled in the native manner. Of the cocoons twenty of each sort have been procured from Shampore in the south of the district, and an equal number from Ampta in the west. As the species of worms appear the same in both places, I thought it needless to multiply packages by sending them separately. The samples of silk sent from Ampta have also alone been sent for the same reason.

2. The culture of the worms is carried on solely in the native manner; no artificial means for incubating the eggs are used. They are laid on the same bamboo trays where the rearing process takes place, and thus placed, they are hatched in two days, or three at the most. The rearing house is a common hut without windows, the door darkened with a curtain, and the uprights on which the stages are supported are placed in basins of water to prevent ants reaching the worms. The trays are plastered with dried cowdung.

3. From the time when they commence feeding to the completion of their growth, they feed without any intervals of rest, until the twentieth or twenty-seventh day, according to the heat of the season, when, having attained their full growth, they are dormant for three days. They are then placed on trays of matting, on which strips of bamboo are fastened in concentric circles about an inch apart, and these mats are placed at an oblique angle to the sun along the sides of a shed, so as to give plenty of air and light, without exposing them to the direct rays of the sun. The completion of the cocoons occupies about three days. The chrysalides, not intended for propagation, are destroyed simply by being exposed to the full heat of the sun. The others are stored in the darkened chamber in an airy situation.

4. The period during which they are dormant varies in this climate from twenty days in the hot weather to one month in the cold. The total period of evolution thus takes from six and a half weeks to nine weeks, according to season, and there are six or seven such periods in most years. Eight is unusual. I am told that the silk produced in February, June, and November, is usually considered the best, that at other times being inferior. The two specimens of yellow silk sent are both of the November produce; the difference in class being due to preparation from inferior cocoons.

5. The packets of eggs are expected to be ready in a fortnight at furthest.

A. H. Blechynden, Esq., to Dr. G. Bennett, Hon. Secretary of Acclimatisation Society of New South Wales.

[Per Steamer "Hindostan."]

Agricultural and Horticultural Society of India,
Metcalfe Hill, Calcutta, 11 April, 1870.

Dear Sir,

In continuation of my letter of the 11th February last, I I have the pleasure to advise despatch, by this opportunity, per pattern post, registered and paid, of a small perforated tin box, containing eggs of the "Boro Poloo" (Bombyx textor), or annual silkworms, and trust they will reach safely and in good order.

Other silkworms' eggs from Assam, the plants the worms feed on, together with seeds of such plants, are in course of collection, and will have despatch immediately they are procured.

Yours faithfully,
A. H. BLECHYNDEN,
Secretary.

Charles Brady, Esq., to The Honorable the Colonial Secretary, Sydney.

Curl-Curl, Manly,
17 March, 1870.

Sir,

I desire to call your attention to a subject which, under present circumstances, may become of large and immediate importance to the interests of the Colony.

I believe that some time last year a despatch from Lord Granville made this Government acquainted with the representations of the Silk Supply Association of London, and thereby, both with the urgent necessity in England for a larger import of silk to make up the actual deficiency of raw material for manufacture, and also with the excellent opportunity for Colonial producers to enter the market at the present time, when not only England but every Continental country suffers from the extreme scarcity and high price of this article. The scarcity, owing to the continued devastations by disease of silkworms all over Europe, in all probability may last for years, and it appears opportune for me to request your particular consideration of Lord Granville's despatch, and the contents of this present letter, which may largely conduce to the future welfare of the Colony.

My own personal knowledge and experience in the treatment of silkworms in New South Wales and Queensland for several years justify me in expressing my conviction that this part of Australia at any rate is peculiarly well adapted for the production of cocoons. I began the study of the subject in 1862, and have since devoted myself exclusively to this pursuit in all its

relations, particularly to experiments and efforts to take advantage of our brilliant atmosphere, and of various food grown in this climate, to introduce and breed superior races of silkworms, and especially to free them from the dire disease which now for so many years has all but destroyed an industry yielding annually more than thirty millions of pounds sterling to the present cultivators of Southern Europe.

My experiences have been most conclusive and satisfactory, and it is proved that the importance of our proceedings here is not unappreciated in England by persons capable of forming an estimate of their value.

I am well aware that the public mind is prepossessed with the idea that the growth of silk in Australia must prove unremunerative on account of the high relative price of labour in the Colonies, but I have never met with even one person who had investigated the subject, or qualified himself in any way to form an opinion, who held this idea; in fact, there not only is nothing to prevent silk being raised as cheaply in Australia as in France or Italy, but there is very good reason to believe that, favoured as we are by climate and cheap land, we may be in a position to undersell any country in Europe.

When I first engaged in this enterprise I own I myself entertained some misgiving about the cost of labour. It was this very circumstance which set me to work to contrive means to obviate what might prove a serious obstacle to a commercial success in silk growing in these Colonies, and I devised the plan of multiplying the number of crops obtainable in a single season. In every country besides this the most valuable worms (being annual only) give but one brood or crop a year, and this occurring at the most unsettled and precarious period is attended with great risk, and frequently with serious expenses and casualties, it occurred to me to profit by our long season of clear weather, repeatedly to take advantage of our opportunities for providing sustenance during many months continuously for the worms, and by managing to have worms to consume the food at such times as the many different varieties of mulberry are severally in perfection. This is done by employing cold and moisture as well as warmth in the preservation of the grain, and also by having many varieties of mulberry silkworms adapted by their nature to thrive on the different varieties of food plant.

To thoroughly carry out my plan I imported at great expense mulberry plants of every country, the quality of which at all gave hopes of obtaining useful sorts; and I also, at even much greater cost, and after many and repeated failures, succeeded in introducing and rearing in this Colony and in Queensland, all the most celebrated and choicest breeds of silkworms from every silk-growing country. A large number of these have, after years of severe labour and close attention, become thoroughly accli-

matised, and many important races, under the influence of careful as well as special treatment, prolonged through several generations, have become freed from the taint of disease, and are now healthy.

I believe the Government has long entertained a wish to afford our settlers in the interior—and more particularly the younger portion—instruction, and the means to profit by the same wonderful source of wealth which renders the rural population in silk-growing countries so prosperous; but there have been available neither the special knowledge nor the food plants, and not even one single species or variety of *profitable* silkworm has been established in the Colony until I had the good fortune to succeed in introducing and naturalising them. Now the case is different to what it was some years ago, and I submit for your consideration the expediency of the Government at once adopting measures to impart information, and spread the industry, in such districts of the Colony as may offer a fair prospect of doing well.

I would urge upon your attention the financial importance of silk. First, the eggs (grain), small as they are, and prolific as is the animal, it is a well-known fact that Europe in one year paid to Japan alone cash to the amount of £1,250,000; the next year nearly one million and a-half. The last season in Japan was a failure; and, notwithstanding the money was there to pay, enough eggs are only found to take the foreigner's money to the extent of half the quantity demanded. In Europe this spring (April and May); it is estimated that, to supply the demand in France and Italy alone, not less than 7,000,000 ounces of eggs are required, the present money value (an exorbitant one) is nearly £8,000,000; and of these seven million ounces required but six millions are forthcoming, so that in this one item there would be a very large opening for a new export from Australia. I ought, however, to say that it would be preposterous for anyone to entertain the idea of supplying such a market without adequate knowledge and the right sort of stock. I may add, as matter of information, that in every country the production of eggs is distinct from the production of silk; and that the producers of silk, as a rule, do not use eggs from their own stock, but purchase every season grain grown by others than themselves. The production of good seed is a special craft.

Cocoons are silk, and in this primitive condition should form a new staple in our exports. It is usually thought necessary to wind or reel the cocoons to render the produce marketable, but such is not the case; the cocoons thoroughly dried (or, more correctly speaking, desiccated) in a proper manner may be packed and pressed with hydraulic pressure. If properly desiccated (the grub inside being pressed into dust), upon unpacking and immersion in water the cocoons resume their original shape uninjured.

Cocoons thus treated may be sold to the merchants or to the mills in bulk for proper reeling according to the purpose for which the raw silk is required, but wound or reeled silk, unless so handled or prepared to meet the requirements of the throwster, is merely of value as "waste" and of no value as "raw silk." The markets of Europe are open for illimitable quantities, and the nature of silk being unlike that of any other material there is no danger of a substitute coming into competition but rather that as civilization and trade extend so will the demand for silk increase. It is to the production of *cocoons* that the attention of growers in this Colony should be directed.

There are many districts in the Colony suited to the rearing of out-door silkworms. Among others not yet satisfactorily established I have introduced three different species, the most valuable of their class, now domesticated in the Colony, producing severally one brood, two broods, and three broods in one season—first the "Yama," feeding on common English oak (quercus of several varieties) furnishes light green silk of the most superior kind; it is the most valuable of all but the most difficult to rear; the two latter, the "Perny," also feeding on the same kinds of oak as the Yama, and the "Ailant" feeding on ailantus glandulosa, find the climate and food singularly congenial, and thrive to perfection. The natural increase of such prolific creatures multiplying two and three times in one Australian season must necessarily yield under proper conditions and intelligent management a prodigious amount of cocoons.

It is manifest that silk growing in these Colonies once established or fairly set going would give lucrative employment to large numbers of persons of both sexes, and tend greatly to elevate as well as to enrich them; time was when the peasants of Europe were at least as unimpressionable and as difficult to receive new ideas as our own wide and thinly spread population is now supposed to be. Such as our colonists are, we may at least consider that if worthy of being entrusted with political power they are not unworthy, by reason of their want of intelligence, of having such attention bestowed on their welfare as may in some degree make up to them for the disadvantages under which people who live in the bush necessarily labour; in truth our distant settlers have but few benefits conferred upon them, and any new export raised in any part of the Colony enriches not only the producers but is capital gained to the community.

Nor is the production of silk in these Colonies without interest in regard to immigration. I have stated in another quarter my conviction that the exhibition of Colonial grown silk and healthy silkworm grain of good quality by authority of our Government at some of the chief seats of this industry in Europe, would have a powerful effect in directing the thoughts of enterprising and energetic people towards these shores. I am sure that authentic

information as to our capabilities and reasonable facilities would induce families skilled in many arts and employments, which have yet found no footing here, to come amongst us ; not a few would come at their own expense, or at any rate pay part, bringing with them (for silk growers are generally well to do) besides their experience and labour, their tools and appliances, and some capital. We should implant at very small cost amongst us new industries suited to our soil and climate, while the immigrants from whatever country they might come would enjoy the advantages of our liberal institutions and land policy. The first step is to let people know that they may find here fair scope for the particular occupations in which they have been brought up. Silk growers in all countries are generally the most temperate and intelligent of their class. Manufacturers and capitalists are eager for new sources of supply, and would require no other inducement to turn their attention to this country than the demonstration that certain results are obtained. That we can do as well in a general sense as any country cannot be doubted, and in what has actually been done in eradicating disease and in multiplying the power of production it is plain we are in advance of every other ; the reputation of Australia is already such as to favourably prepossess enquiring minds.

My operations and experiments have all been carried on by myself, unsupported by any extraneous aid ; what I have effected alone and single-handed is work that in every other country, where any parallel success has been accomplished, has been done by Governments, with the resources and at the cost of the State. I take no reproach to myself for not having before communicated with you on this subject ; and I think that the very fact of my having effected what I have done without assistance is valid argument why Governments should be very reticient in taking up every likely scheme for promoting new industries ; but now that success is a demonstrated fact, and the opportunity so good, I venture to suggest to you that it may be sound policy not to ignore the experience and knowledge gained. There is no secret nor patent in my proceedings or methods. I have been ever ready, and always have shown living stock in every stage of growth at whatever period of the year information has been sought of me ; and I have made the mode of operation clear to every inquirer ; what I have found out with much labour and difficulty, and by suffering many failures, is plain now, and the way is easy for anyone to follow. It is true I have special qualities, education, training, and opportunities peculiar to myself for the work, but is it social or political wisdom to wait until the masses of untutored minds become spontaneously imbued with craving for knowledge and instruction, and undertake the toil, and incur the anxiety of doing over and over again, each one for himself, that which now once done is done for all ?

I therefore shall be happy, should you determine to pursue the matter, to afford you, without reserve, any information you may be in need of, and any personal assistance I can render. The Government already possesses several useful varieties of mulberry and other silk-producing plants at the Botanic Gardens, and I would willingly supply other varieties in my possession in which they are deficient. In regard to the silkworms themselves, the case is difficult; besides myself, there is no one in the Colony, as far as I am aware, qualified to judge of their value. It by no means follows that what succeeds with me will do equally well with inexperienced, and perhaps careless or clumsy hands; hence, I am not disposed to risk the liability to reproach, or to be held responsible for the possible failures of others. Should you therefore approve of my suggestion, and accept as afree gift from me such stock as may be required, I will, on timely notice, furnish any quantity of acclimatised silkworms or silkworms' eggs of any varieties, races, or species I possess, that may be needful to spread the culture throughout the Colony. I say as a free gift, as this would relieve me to some extent from discomfort in case of an unsatisfactory result. If the worms perished, or did not turn out well, the loss would be mine; and if, as I think we may reasonably hope, they take a fair hold on the country, I entertain no doubt that a liberal Legislature in due time would mark its sense of service rendered by a private individual, and requite my endowment by a grant of land, or in such way as it may deem appropriate.

I have, &c.,
CHARLES BRADY.

CHARLES BRADY, ESQ., to DR. G. BENNETT, HON. SECRETARY, ACCLIMATISATION SOCIETY OF NEW SOUTH WALES.

Curl-Curl, Manly,
1 August, 1870.

MY DEAR SIR,

It is much easier to ask for the information you desire than to give it in a few words. What I have always considered, and which is now demonstrated to constitute a special advantage to silkworm grain producers in this climate and hemisphere for the supply of European markets, is the faculty we possess of obtaining here, grain of the best annual mulberry silkworms, laid several weeks before the great heats of our summer, in fit state for transport to the northern hemisphere, so as to arrive in cool and cold northern latitudes at a season admitting a thorough natural hybernation there before the eggs are again subjected to conditions of spring.

This matter of hybernation is very important, and particularly with regard to the most valuable annual mulberry silkworms; annual worms, strictly so called, are beyond all question the largest givers, individually, of silk, and in quality also they are at the same time much superior to any of the double, treble, or many brooded varieties. With the exception of one single wild or out-door worm, feeding in the open on mulberry trees, every known variety and race is absolutely a creature of domestication, produced by long ages of artificial rearing and treatment, more or less strange to natural conditions. The one wild mulberry silkworm yet extant is understood to be incapable of domestication. I do not vouch for that fact, but from what I have been able to learn of the history and habit of this solitary species which has escaped the influence of man, it seemed to me to indicate most forcibly the necessity of a proper hybernation with all silkworms. I think the double and many brooded varieties may, in some sort, be considered abnormal and in a certain sense impaired. (See my communication, June, 1868.) It is true, generally, that they are vigorous and prolific, and show indications of health now but seldom (in Europe) seen in the annuals; but the annuals in countries untouched by the disease are much inferior to the annuals of Italy and France, and by no means so highly superior as are both these latter to the double and many brooded. Hence, the great importance of endeavouring to save some of the fine races of Europe before they all become, as many are already, utterly extinct.

I consider it a very proper subject of speculation, whether indeed the stand-point of excellence reached in Europe is the ultimate degree of perfection attainable. Centuries ago mulberry silkworms were introduced into Europe from Asia. In progress of time, by change of food and climate, or treatment and management, or by a concurrence of causes, they became greatly superior to Asiatic descendants from the same origin which we are well informed are treated now in precisely the same way as were their ancestors of many hundreds or thousands of years ago. Many high class races were gradually produced, and so to speak, ennobled, by the skill and care lavished on them by the French and Italians. It is possible that the disease which has so suddenly swept away the best European silkworms may have been a resentment of nature, not of improvement having been pushed too far, but of conditions of further improvement not having been maintained or continued, and fresh elements of vigour supplied. It was this idea that led me to urge others to do as I am myself doing, namely, to endeavour to take the highest stand point reached in Europe as our Australian starting point—to obtain the finest silkworm grain obtainable, and treat it systematically for improvement, rather than merely reiterate here the self same treatment to which the worms were before accustomed. If five and twenty years ago (before the disease revealed itself in Europe)

good grain of the best kinds had been introduced on to this continent, and treated with judgment and discrimination, how good long ere now would have been the position of Australian silk-growers; how thoroughly we should now be able to command the markets of the world for grain, as well as of Europe for silk. In all probability the disease would never have made its presence known in this country, for the silkworms reared here would have escaped the causes, whatever they may be, which have been so disastrous in Europe, and these Colonies would now be enjoying the profits of a production, greatly exceeding the aggregate value of all the gold, wool, and other commodities now raised here. The policy, however, of introducing such a wealthy industry was not then, and still is not felt; the statesman is yet to appear, who will take up the subject and deal with it effectively.

We are familiar enough with the phenomena of hybernation, both in the vegetable and animal worlds. In a true sense all nature requires a rest; and yet, during the period of sleep, wintering, or hybernation, very influential causes and processes are at work, which give tone and character to the future course of the organs which determine the greater or less development of every animal or plant. To Englishmen, accustomed in their notions of high culture, whether of animal or vegetable life, to endeavour by selection and well-considered nurture to produce and perpetuate the qualities most desired, and in which all experienced persons are very careful not to overstep or overstrain the limits of time or season, it is remarkable that no other people should have paid due attention to this simple but most important matter of hybernation. It is only quite recently (last September, and long after the publication of our doings in Australia) that a French gentleman, highly distinguished by his talents and acquirements in science, in some experiments with which he was charged by his Government, bethought him of the same notion which had occurred to us, that of artificial hybernation, and his success is announced to the world as a "singular discovery" (*une découverte singulière*). (See the French papers, December, 1869, and January, 1870). The Italians appear to have tried artificial hybernation previously, some ten or twelve years or even longer before this "singular discovery" (as experiment only); while here, in Australia, as you are well aware, we have acted for years habitually throughout whole seasons working by cold and moisture to produce and maintain hybernation. This artificial wintering is the principle with which I started to obtain when required a succession of rearings hatched out at will, day by day through the season, of the annual mulberry silkworm. Perhaps it was my procedure in this respect, so strongly commented on, and the knowledge of it circulated by the Silk Supply Association of London last year, which directed the attention of the French authorities to the subject.

As to the probability of a continued demand for foreign raised silkworm grain in Europe I wish to be very careful in answering such an enquiry. It is generally believed that the entire mass of all the silkworms in all the great silk growing countries of Europe is more or less affected or predisposed to disease, and I therefore think that even under the most favourable circumstances, whether in Europe or elsewhere, a considerable time must elapse before the worms regain their old standard of health; the disease has to be worn out and time or science to reinstate the elements of health and prosperity; but all this while what is to become of the stock now dwindling away? Many years ago in a certain district in England sheep fed for a lengthened period on the same pasture gradually lessened year by year their yield of wool and otherwise deteriorated, until suddenly one season they had no fleece at all. Science was called in and investigation made, when it appeared that for a long period the wool had been exported or deported from the locality year after year, and no representative matter placed in its stead; in short the soil had parted with all its wool, so the sheep had no wool to gather, and dame nature was too hard pressed to be allowed time to collect and replace unaided in the soil the deficient elements; it was recommended to manure the pasture ground with refuse wool from the factories; this was done and in due time the sheep reappeared clothed in fleece. Now I have never heard of refuse silk, I mean silk rags (whatever becomes of the rags is a mystery, for the annual quantity must be enormous), being used as manure for mulberry trees, nor of its chemical constituents being used to make good the drain which for many centuries the land has undergone. We use up cloth and rags of every kind, except silk, again and again in one form or another, but old silk what becomes of it? Is it waste pure and simple? I do not pretend to say that the European silkworm will not recover in its old homes its old vigour and excellence, but I do opine "not yet."

I hope these replies will satisfy you. I am very tired and can write no more at present; but I remain

My dear Dr. Bennett,
Yours very faithfully,
CHARLES BRADY.

P.S.—When I speak of *the* disease in this letter, I mean that *extraordinary* visitation which has destroyed and still ravages what is left of the most valuable stocks in Europe; this disease is of quite a different character to any of the many *ordinary* and often very severe maladies to which the silkworm has been liable for many years. The cause or causes of *the* disease are yet found inscrutable—there is something not yet revealed or at any rate not comprehended, for the plague seems to be heedless of any influences for good, except fine weather and the best food or change

of climate, and at best these are by no means effective at once; with bad weather and inferior leaf the process of dissolution is marvellously rapid and the worms perish by millions; this is especially the case when the caterpillars are near maturity.

Extract from the *Sydney Mail* of the 23rd July, 1870.

Dr. Bennett has obliged us with a letter written to him in his capacity of President of the Acclimatisation Society, by Mr. Brady, from which we make a few extracts. Mr. Brady gives an account of his twelve months' transactions at Curl Curl, where he is nursing what he supposes to be the germ from which the silk industry of New South Wales is to spring. He says:—

"I have now closed up active operations for the season with all living silkworms (except the moths, a few of which remain); and, as you desire to know the result, as far as concerns the importations of the Acclimatisation Society, I have the pleasure of confirming my first report, and informing you that the mulberry worms from India continued to the last to do well. Of course the yield of silk is much inferior in quantity to that from the principal European races, but the quality and lustre are excellent. For my own part I think the outturn of these small yielding worms, double, treble, or many brooded in the season—taking into account the cost of labour, food, and management, &c., as well as the safety of a profitable result if worked in a proper manner—bears a very favourable comparison with the outturn from the more valuable but much more difficult to rear and precarious-lived single-brooded worms (annuals) of Europe or Japan. In the first case, operations continue for months at any time—spring, summer, or autumn, or for as long or for as short a time as mulberry leaf is available; in the latter only for a few weeks in spring, subject to all the vicissitudes and chances of the most uncertain period of the year, unless indeed the grower adopts my system of bringing the annuals into period by cold and moisture, as well as warmth, whenever they are wanted. If there was any attention given to this subject in the Colony, or it could be made worth while, I could easily manage to supply not eggs unhatched or uncertain, but young living silkworms, of fine kinds, which other persons growing or possessing the food could at any time procure from me, and rear through the rest of their natural course, and thus avoiding expensive preparations, requiring a good deal of skill and management, reap a certain profit from a very small outlay."

Private letters contain information relative to the reception of a packet of silkworm eggs, by the highest silk authorities in Europe, from Mr. Brady's stock raised at Manly. In Italy they were received with great favour. "They were everywhere pronounced to be splendid fertile eggs, which is a point of great importance in France and Italy, as their own native races are so diseased as to be useless for mercantile purposes," says one correspondent. Cocoons of the same race (Milanese) possessed by Mr. Brady pleased them exceedingly, and the writer informs his correspondent that "eggs of that species would find a good market in France and Italy." One of the best authorities in France on silkworms pronounced the samples in fine condition, and greatly admired the system adopted in transporting them.

Other distinguished and practical men expressed the same opinion, and stated that "you may at once calculate on my being able to place for you a large amount of eggs." Another letter says, "the eggs were found in excellent order—not a single egg was hatched and not one was crushed."

This, then, is the information we get concerning Australian "*grain*" (the technical term by which eggs are now known). Mr. Brady's observations on these facts, in the letter alluded to, is this:—"The result of the first shipment also bears out what I have so often told you and others of the practicability of supplying from here the markets of Europe with better and more reliable grain than can be obtained in any other part of the world."

It thus appears that Mr. Brady's experiments have put us in possession of knowledge with relation to our advantages over the rest of the world as silkworm egg producers, for which we have reason to be very thankful. Our advantages are twofold. In the first place, in our climate the Italian, French, and Japan worms have been produced without any trace of the disease which ravages them at Home; and in the second, we are in a position to supply newer seed to the European sericulturists than can be done from any other part, seeing that the "grain" season here is December, January, February, which allows of the seed or grain arriving in the cold season, and having no tendency to hatch before the food is ready for it. In Japan and California the grain season is the same as in Europe, and consequently time is lost, and the seed is comparatively old when hatched.

Something should be done in this matter. We can produce cocoons with the assurance of obtaining an active market for them, which never has been the case before; and should Mr. Brady's expectations be confirmed, the climate of New South Wales will enable several crops to be produced in the year. And then, further, for the more skilful we have accorded to us, apparently by geographical position, the speciality of producing eggs for exportation of great superiority.

Sydney: Thomas Richards, Government Printer.—1870.