
III. *Account of the Tusseh and Arrindy Silk-Worms of Bengal.*

By William Roxburgh, M.D. F.L.S.

Read January 5, 1802.

THE TUSSEH SILK-WORM.

PHALÆNA PAPHIA.

P_{H.} *Attacus pectinicornis* elinguis flava, alis falcatis concoloribus ocello fenestratis. *Linn. Syst. Nat.* 2. p. 809. 4.

Cramer, 13. t. 146. f. A. t. 147. f. A. B. t. 148. f. A.

Phalæna Mylitta. *Drury*, 2. t. 5. f. 1. Mas.

Bombyx Mylitta. *Fab. Ent. Syst.* 3. a. p. 411. 11.

Bughy of the natives of the Burbhoom hills, where the silk (which the same people call *Tusseh*) is manufactured.

A native of Bengal, Bahar, Assam, &c. Feeds upon the leaves of *Rhamnus Jujuba*, (*Byer* of the Hindoos;) and of *Terminalia alata glabra* Roxb. (*Asseen* of the Hindoos.)

The insects figured on the 75th table of the third volume of Rumphius's *Herbarium Amboinense* appear to be the same, though they are there represented feeding on the leaves of *Rizophora caseolaris* of Linnæus (a tree now called *Sonneratia acida*). His description at pages 113 and 114 in the same volume also tend to confirm the idea of their being the same.

They are found in such abundance, over many parts of Bengal and the adjoining provinces, as to have afforded to the natives,

from time immemorial, an abundant supply of a most durable, coarse, dark-coloured silk, commonly called Tusseh-silk, which is woven into a kind of cloth called Tusseh doot'hies, much worn by Bramins and other sects of Hindoos. This substance would, no doubt, be highly useful to the inhabitants of many parts of America and the south of Europe, where a cheap, light, cool, durable dress, such as this silk makes, is much wanted.

Description of the Insects in their various Stages.

EGGS white, round, compressed, with a depression or pit in the centre on each side; the circumference crossed with rugæ, corresponding with the rings of the inclosed animal. They hatch in from two to four weeks, according to the state of the weather.

LARVÆ, or caterpillars, acquire their full size, which is about four inches in length, and three in circumference, in about six weeks; they are nearly the colour of the leaves they feed on, and are composed of ten segments, of which the posterior one is in some degree bifid. There is a light yellowish-coloured stripe on each side, which runs from the second or third anterior segment to the fissure of the last; immediately under these stripes the middle five, six, or seven segments are marked with an oblong gold-coloured speck. The back is also marked with a few round darker-coloured spots, and a few long, coarse, distinct hairs issue from these spots, with others of a smaller size scattered over the insect. They are furnished with eight pairs of legs. The pectoral or anterior three pairs end in a single claw each. The abdominal four pairs are very thick, and truncated like the feet of an elephant. The caudal pair is similar to the abdominal. When the larvæ approach near to their full size, they are too heavy to crawl in search of their food with the back up, as is usual with most caterpillars, but traverse suspended by the feet, as represented in Tab. II. fig. 4.

CHRYsalis.

CHRYSA LIS. When the caterpillars are ready to spin the cases in which they are to pass this state of their existence, each of them connects, by means of the recent glutinous filament of which the case is made, two or three leaves into an exterior envelope, which serves as a basis to spin the complete case or cocoon in; besides, the case is suspended from a branch of the tree in a wonderful manner by a thick strong consolidated cord, spun of the same materials from the bowels of the animal. See Tab. II. fig. 5. This case is of an exact oval shape, and exceeding firm texture: in it the animal remains dormant and perfectly protected for about the space of nine months, viz. from October until July, so that they make their appearance in time for the caterpillars to come into existence when Providence has furnished them with the greatest plenty of proper food, viz. during the months of August, September, and October. When the insect is prepared to make its escape and be changed to its perfect state, it discharges from its mouth a large quantity of liquid, with which the upper end of the case is so perfectly softened as to enable the moth to work its way out in a very short space of time; an operation which is always performed during the night.

IMAGO. In their perfect state they are wholly taken up in providing for a continuation of the species, and do not exist more than from six to twelve days when confined: how long they may live when at liberty is hard to say, but I imagine nearly the same as when restrained. While in this state of perfection they receive no nourishment whatever, nor have they any mouth or channel by which food can be received. When the female is impregnated she deposits her eggs on the branches of the tree she may be resting on, to which they adhere firmly by means of the gluten they are covered with when newly laid.

The wings of the male expand five or six inches, and those of the female from six to eight; the following part of the description applies to both:

Head scarcely projecting beyond the anterior margin of the first pair of wings.

Eyes large, of a dark brown colour.

Antennæ pectinated; of the male oval, of the female lanceolate.

Palpi four, the exterior two ascending, hairy, covering the inner vesicular, cream-coloured, deflected pair which hide a concavity where the mouth is generally situated in other species.

Mouth none, nor is there any kind of proboscis or tube.

Thorax oval, completely clothed with long fine hair, of nearly the prevailing colour of the wings hereafter to be mentioned.

Abdomen oblong, (of the female much larger) composed of seven segments, and clothed with much long fine hair, like the thorax.

Legs six, hairy, nearly equal. The tarsi with a pair of long, strong, incurved claws. All the articulations are much contracted.

Wings horizontal, expanded, slightly striped in the directions of the tendons. Superior, or first pair, of a cream orange buff, or brownish colour, or a mixture of these; first, all the anterior margins rather concave, beyond that much curved, and bounded with a beautiful light blueish gray coloured belt. Posterior (fan) edges somewhat concave, scalloped, and ornamented with a pretty broad, beautiful, circumscribed, scalloped border, of sometimes a darker, sometimes a lighter, colour than the rest of the wings; inner or abdominal edges nearly straight. In the centre of each wing there is a remarkable eye, with the large pupil of micaceous transparency, and a beautiful party-coloured iris.

iris. Inferior, or second pair, are in point of colour like the first pair; the posterior margins are also scalloped, and with a similar border, but convex; the eye in the centre of each is also the same. All are clothed with much soft hair, which becomes longer and longer towards the shoulder or points of insertion.

The following interesting history of these most beautiful as well as most useful animals, I have had the good fortune to procure, by means of Mr. William Pope of Mahometpore, and with the writer (Mr. Atkinson's) permission, I transcribe in this place:

To William Pope, Esq.

DEAR SIR,

"I duly received your letter of the evening of the 24th, together with the questions put to you by Doctor Roxburgh on the subject of the Tusseh silk-worm, and shall, with great pleasure, give the best answers in my power to the Doctor's inquiries, previously remarking, that I have an opportunity of consulting two of the hill people, in whose neighbourhood a good deal of Tusseh silk is produced, and whom I have questioned on points imperfectly known to myself. To reply to the Doctor's questions regularly.—

1st. "The cocoons of the insect, which feeds on the Byer leaf, are called by the natives Bughy, producing a Tusseh silk. They are annual, and are said to remain in the cocoon nine months, and to be three months in the egg and worm state.

2d. "This species cannot be domesticated. I am informed that the natives cannot even retain any of it for seed. The hill people say that they go into jungles, and under the Byer and Asseen trees they find the excrement of the insect; on which they
examining

examine the tree, and, on discovering the small worms, they cut off branches of the tree sufficient for their purpose, with the young brood on the branches; these they carry to convenient situations near their houses, and distribute the branches on the Asseen tree in proportion to the size thereof, but they put none on the Byer tree. The Parieahs, or hill people, guard the insects night and day while in the worm state, to preserve them from crows and other birds by day, and from bats by night.

“ I myself have seen them thus watching the brood. This species cannot be confined, for so soon as the moth pierces the cocoon it gets away; and the people add, that it is impossible to keep it, by any precaution whatever.

3d. “ To wind off these cocoons, they put them into a ley made of plantain ashes and water, for about two hours, after which they take them out of the ley, and put them in their wet state into an earthen pot; those which are properly softened are first applied to the reel, and so on, as the cocoons become soft, for four or five days, till the whole are wound off.

“ The implement used for taking off the thread is a small common reel of four bars. The cocoons are laid in a smooth earthen dish, without water; the reel is turned by the right hand, whilst the thread of four or five cocoons passes over the left thigh of the spinner, and he gives the thread a twist with his left hand upon his thigh. The operation is this instant in my sight, with a thread of five cocoons, the produce of another species called Jarroo, and described below, but the reeling is exactly the same as that of the Bughy, and therefore one description answers for both. I must add, that the thread is exceedingly apt to come off double and treble for several yards together, which is not regarded by the natives, as breaking off double threads would diminish the produce,

duce, and, moreover, would occasion loss of time : a very even thread, however, may with care be reeled from either the Bughy or Jarroo cocoon.

4th. "The Bughy silk-worm feeds indifferently on Byer and on Asseen leaves, and is a species in every respect perfectly distinct from the insect of the Palma Christi, the latter being different in size, much less cultivated, and fed in houses as regularly as the mulberry worm. I shall not proceed to describe it, as the species is not at all included in Dr. Roxburgh's questions.

"The Jarroo cocoons alluded to above, are so called from being produced in the coldest month of the year, say January ; the Bughy being about a month before them. The Jarroo are likewise annual, and the history of them is nearly the same as that of the Bughy ; they are however different, I am assured. The Jarroo will eat the Byer leaf if he cannot get the Asseen, but he will always prefer the latter, and produce a better cocoon when fed on it. His silk is more of a dull colour than that of the Bughy, which latter worm the hill people put on the Asseen alone, not because it prefers it to the Byer, but because they have greater plenty of Asseen than Byer, and, moreover, trim and dress out plots of Asseen on purpose for the worms. The principal difference between the above two species is, that the natives retain a part of the Jarroo cocoons for seed ; these they hang out on the Asseen trees when the proper season of the moth arrives ; when the moths come out, the male insects invariably all fly away, but the females remain on the trees. These are not impregnated by the males bred along with them, but, in ten or twelve hours, or perhaps one, two, or three days, a flight of males arrive, settle on the branches, and impregnate the females ; by the bye, the hill people calculate good or ill fortune in proportion to the speedy or tardy arrival of the stranger males. These insects die as soon

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as the purposes of nature are effected, and the females live only to produce the eggs on the branches of the trees, and then expire. In regard to the Bughy species, they all take flight, females as well as males, and hence the natives firmly believe that they are all males, though I cannot see any physical reason for supposing them so. I have frequently endeavoured to detain the males of the Jarroo species, and have kept them locked up in a box for that purpose; but whether they did not like to make free with their female relations, or from what other cause I know not, but I could never obtain a breed in the domestic state, and the efforts of the male to escape were wonderful, and at last always effectual. The accounts given by the natives of the distance to which the male insects fly are very astonishing. I have put, at different times and occasions, innumerable questions to them on this subject, and they assure me that it is no uncommon practice amongst them to catch some of the male moths, and put a mark on their wings previous to letting them fly, the marks of different districts being known. I am told that it has been thus ascertained that male moths have come from a distance equal to a hundred miles and upwards; I of course cannot vouch for the truth of this, but have no hesitation in declaring that I believe it. The Jarroo worm is guarded on the trees in like manner as the Bughy; this I have had opportunities of seeing on the hills westward of me: the cocoons are darker coloured than the Bughy species, and are wound off as described above. The accompanying skein I had reeled off at my elbow this morning; it consists of five Jarroo cocoons at first, of four when one cocoon was finished, and of three when two cocoons were ended: I then stopped the reel; the three that remained of course gave a filament the entire length of the skein.

“ There is still another species of wild silk-worm produced in
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the Burbhoom hills, which I heard is more capable of being domesticated than the one above described; but I dare say you will excuse my saying any thing respecting it, as I can only speak from hearsay, the insect not being produced in these hills.

“Yours very sincerely,

“MICHAEL ATKINSON.”

Jungypore,
28th November 1796.

*Extract of a Second Letter from the same Gentleman,
dated 16th December 1796.*

“I send you herewith, for Dr. Roxburgh, a specimen of Bughy Tusseh silk. I kept the cocoons by me several days after they had been steeped in the alkaline ley, and they reeled just as well as if they had been newly soaked. The cocoons do not, I think, differ from those of the Jarroo species, except that they are lighter coloured. I send one which the moth has pierced, and will send for more to take down with us. There are none of the Palma Christi species of Tusseh to be had here, but I have sent for some. I fancy this last is the most valuable kind, for the silk piece wove from it is uncommonly durable. The head sircar of the factory here has an outside cover of a palanquin, which, he tells me, has been worn eleven years; also some purdahs, which, he says, have been in constant use nine years, and are not much decayed yet. I remember examining the palanquin cover about five or six years ago.

“I have heard that there is another variation of the Tusseh silkworm in the hills near Bauglipore; its cocoon is said to be smaller than the cocoons of the Bughy and Jarroo species; perhaps this may be the kind furnished to Doctor Roxburgh by Major Hutchinson: but, after all, I confess it may be suspected that all the variations

are derived from the same insect originally, and that they have assumed different habits by different modes of culture or food.

“When I return from Calcutta I shall make particular inquiries on the subject.

“You will observe that the inclosed specimen is tinged of a deeper colour than the filament of the cocoon: this they say is from the alkaline ley.”

The same gentleman (Mr. Atkinson) has, since writing the foregoing letters, sent me large supplies of the cocoons of both the Bughy and Jarroo insects, and I have received parcels of them from other quarters. These have all produced their insects; and after minute investigation I am not able to observe any difference, except in the size, and that is even trifling, so that I can at most only call them varieties of the same species. But very different is that which lives on the leaves of the Palma Christi plant, a species I am now able to give an account and drawings of, having often reared and conducted them through their various stages in my own room within these three years.

THE ARRINDY SILK-WORM.

PHALENA CYNTHIA.

Drury, 2. t. 6. f. 2.

Cramer, 4. t. 39. fig. A.

Antennæ pectinated; no mouth; wings incumbent, and expanded, with their angles rounded: superior pair falcated, with a black eye near the exterior angle. Prevailing colour brownish, with white and ferruginous curved bands; and an obscure, semi-lunar, subdiaphanous mark near the centre of each.

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This insect, known to the Hindoos by the name of *Arrindy* in some parts, in others *Arundi*, appears to be peculiar to the interior parts of Bengal; and, so far as I can learn, to two districts only, viz. Dinagepore and Rungpore, where the natives breed and rear it in a domestic state, as they do the common silk-worm. The food of the caterpillar consists entirely of the leaves of the common *Ricinus*, or Palma Christi, which the natives of these districts call *Arrindy* (hence the name of the insect), and is abundantly reared over every part of India, on account of the oil obtained from the seed. Feeding these caterpillars with its leaves will, therefore, make it doubly valuable where they know how to spin and manufacture the silk.

The late Sir William Jones mentions this animal, in a letter to Dr. Anderson, dated 17th May 1791, under the name of *Phalæna Ricini*, a name that I cannot well continue for fear of confounding it with Fabricius's *Bombyx Ricini*; which is certainly a very different species.

Description of the insects through their various stages.

EGGS numerous, ovate, pure white; size of a pretty large pin's head. Hatch in from ten to fifteen days, according to the temperature of the air.

LARVÆ arrive at their full size, which is from two and a half to three inches, in the space of about one month; during which time they, like the caterpillars of the common silk-worm, cast their skin three or four times. They are also composed of ten segments; across the middle of each are several small, soft, conic-pointed tubercles; otherwise they are smooth and delicately soft. The prevailing colour pale or sea green. In this state they are very voracious, devouring daily many times their

own weight of food. Like the caterpillars of *P. paphia*, they are furnished with eight pairs of legs, viz. three pairs of pectoral, four pairs abdominal, and one pair of caudal.

CHRYsalis. The cocoon, or covering thereof, white or yellowish, of a very soft delicate texture; in general about two inches long, and three in circumference, pointed at each end (*Tab. III. fig. 5. 5.*). Enveloped in this case the animal remains dormant from ten to twenty days, according to the state of the weather; when, like the common silk-moth, the now perfect insect, or **IMAGO**, (as Linnæus terms it) issues forth from one end, and in this state exists from four to eight days, during which period it is wholly employed in the grand work of nature, generation; remaining perfectly contented in its chamber, seldom attempting to fly away. In this respect it differs exceedingly from the Bughy and Jarroo moths.

The wings of the female expand from four to five inches; those of the male considerably less. In other respects the following description applies to both:

Head roundish.

Eyes large, bright, dark brown.

Antennæ pectinated, light brown; those of the male narrower; length equal to that of the head and thorax.

Palpi four, as in *P. paphia*.

Mouth none.

Thorax oval, completely covered with long, fine, brownish hair, with a band of white down round the neck.

Abdomen oblong (in the female greatly larger), clothed with much fine white down above, and with alternate triangular spots of white and brown on the sides and belly.

Legs six.

Wings

Wings incumbent, expanded when at rest. Superior, or first pair, falcated; prevailing colour brownish gray. A subdiaphanous, curved, white, and rust-coloured band crosses from the centre of the anterior (sector) margin to near the middle of the inner (slip) edge; from nearly the middle of which, on the inside, another short, white bar runs to the posterior edge of the shoulder, and one to the inner part of the sector edge, forming a dark angular spot in the centre of the junction of these two small bars with the first-mentioned long one. Adjoining to the fore part of this angular spot is a semilunar, somewhat pellucid speck, with a yellowish centre. Near the rounded falcated apex of each wing is a small dark-coloured eye, with the anterior margin thereof white. Their posterior margins are entire, and concave towards the point, with a lighter-coloured border. The inner margins are nearly straight and entire. Both the angles are rounded. Inferior, or second pair, are nearly of the same colour, with a whitish, horse-shoe-shaped belt near the centre, opening on the inner, or slip edge; and inclosing a semilunar spot, like that of the first pair. Exterior margins entire, convex, with a somewhat waved, lighter-coloured yellowish border.

Mr. Atkinson, who furnished me with the most interesting parts of the history of Tusseh silk-worms, has also contributed most of the following remarks on this species.

They are, like the common silk-worm, reared in a domestic state, and entirely fed on the leaves of the Palma Christi plant. Their cocoons are remarkably soft and white, or yellowish; the filament so exceedingly delicate as to render it impracticable to wind off the silk: it is therefore spun like cotton. The yarn,
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thus manufactured, is wove into a coarse kind of white cloth, of a seemingly loose texture, but of incredible durability, the life of one person being seldom sufficient to wear out a garment made of it; so that the same piece descends from mother to daughter.

“Since I last wrote to you,” says Mr. Atkinson, “I have reared two parcels of Palma Christi silk-worms, with a view towards winding off the cocoons, but all my endeavours to obtain cocoons that would reel off were in vain. I even brought a man from the country where this species of silk-worm is cultivated, and he laughed at my endeavours to get cocoons to reel; asserting that it was impossible, and that they were always spun off into a thread like cotton by the women only: he attempted to show me how, but made a very awkward hand of it, and a very bad specimen of thread: the operation, too, appeared tedious, so that I do not think that any thing is to be expected from this insect, except as a natural curiosity.”

Mr. John Glass, the surgeon at Bauglipore, writes to me as follows on the same subject:

“I am glad to hear you have got the worm that feeds on the *Ricinus*, but sorry to say there is no possibility of winding off the silk from the cones. Inclosed is a little of some I bred a few years ago, when I sent a quantity of it to the directors, but have never received an answer. I at the same time sent a little to my friends in England, and I understand that some manufacturers, to whom it was shown, seemed to think that we had been deceiving them by our accounts of the shawls being made from the wool of a goat; and that this *Ricinus* silk, if sent home, could be made into shawls equal to any manufactured in India.”

Extract

Extract of a letter on the same subject from Henry Creighton, Esq. of Malda, dated 12th February 1800.

“The Palma Christi silk-worm goes by the same name as the plant does among the natives, which is *Arrindy*. They accordingly call it *Arrindy-worm*, *Arrindy-thread*, *Arrindy-cloth*, &c. They rear it in their houses much in the way the silk-worm is reared. Their manner of spinning it is as follows: Four or five of the cocoons are fastened to a stick stuck in the ground, or sometimes they hold it in their hand. These are united into one thread, and made fast to a piece of wood, with something heavy to make it spin round while suspended by the thread: when they let out sufficient of the cocoons from their hand, it is twisted by this piece of wood spinning round, and when well twisted it is wound round the wood, and another length let out from the hand. The cocoons are spun wet, but only with cold water. The cloth is woven in small pieces in a loom, and is as coarse as light vit-tree, but more open; and on being washed and beaten well, is made very soft and pliable. It is entirely confined to the districts of Dinagepore and Rungpore; no other place in Bengal having got it. Its uses are for clothing, for both men and women. It will wear constantly ten, fifteen, or twenty years; the merchants also use it for packing fine cloths, silks, or shawls. It must, however, be always washed in cold water; if put into boiling water, it makes it tear like old rotten cloth. There is a cocoon produced wild upon the mango-tree, which they gather, and mix with Arrindy cocoons in spinning. I have only seen one caterpillar of it, and I did not succeed in rearing it. I shall inquire for some, and get a drawing made, if possible, as they cannot be sent or carried to any distance.”

EXPLANATION OF THE FIGURES.

TAB. II.

Fig. 1. The eggs of *Phalæna Paphia*.

2. The newly hatched caterpillar represented feeding on the uncoloured leaf of the jujube-tree.

3. The same, about half grown.

4. The same, full grown, and ready to spin its case or cocoon.

5. The male cocoon suspended, &c. as mentioned at p. 35.

6. The female cocoon, which is always larger.

7. A branch of the jujube-tree in flower, and with the fruit a little advanced.

8. The ripe fruit thereof.

TAB. III.

Fig. 1. The eggs of *Phalæna Cynthia*.

2. The newly hatched caterpillar upon the uncoloured leaf of *Ricinus communis* Linn. or common Palma Christi.

3. The same, about half grown.

4. The same, when full grown and ready to spin.

5. The cocoons, sometimes yellow, sometimes white.

6. A branch of the Palma Christi in blossom, but uncoloured, rather smaller than natural.

IV. Description



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