THE "NETTLE GRUB" PEST OF TEA IN CEYLON.

G. D. AUSTIN.

(Continued).

NATADA NARARIA. Mo.

This Nettle Grub has been a great plague on one or two estates in Uva. Although the smallest of the stinging pests, it has in the past defoliated large patches of tea. The fact that they feed on the underside of the leaves and do not bite through them until they have grown considerably renders the detection of an attack much later than is desirable. It may be pointed out, however, that at the conclusion of an attack, the next one may be expected to begin about a fortnight later. Whether it does so or not will depend to a great extent on weather conditions, a storm occurring at this period being most likely to bring about an emergence of moths.

FOOD PLANTS.

Food plants of insects may be said to be divided into two classes, viz., "favourite hosts" and "casual hosts", while the former may yet be sub-divided into "alternate hosts" and "additional hosts". "Favourite hosts" or "preferred hosts" are those plants which are most favoured or preferred by insects, and on which the insect is capable of breeding.

"Casual hosts" are the plants on which a gravid female may oviposit, irrespective of the fact that the plant might or might not be a suitable food plant for its offspring.

"Alternate hosts" are those plants on which an insect is capable of breeding when it is unable, for some reason or the other, to propagate on its "favourite host".

"Additional hosts" may be said to be those plants (perhaps of secondary importance) on which a pest is observed to breed while it is simultaneously on its "preferred" or "favourite host".

Tea undoubtedly is the favourite host of *Natada nararia*, while Dadap (*Erythrina lithosperma*) is its "additional" host. The following is a list of "casual hosts" recorded from Passara—*Gliricidia maculata*; *Crotalaria* spp; *Tephrosia candida*; "Gums" (*Eucalyptus* spp.); Toona (*Cedrela toona*); *Ficus religiosa*; *Citrus* spp; Patna Oak (*Careya arborea*); Roses; Honeysuckle; and Cannas.

It is conjectured that perhaps coffee may have been *Natada's* original host in Ceylon, since this crop is one of the host plants recorded in India. There is however, no conclusive evidence available in support of this conjecture, while it sounds very improbable

because, if *Natada* had been present on coffee, it is very unlikely that it would have escaped the notice of either Neitner or Green and especially the latter, who was such a keen observer.

It is commonly believed in Uva, that Nettle Grubs breed in the patna, and that patnas are sources of infection. In other words wild plants growing on patnas are the alternate host of *Natada* when the pest is not in the tea. A careful search was made through the patnas round Passara, when there was no *Natada* on the tea, in order to find what *alternate* host plants might be harbouring the pest. On no occasion were any grubs found nor was there any evidence to show that the pest had even existed in those areas. Proof that Nettle Grubs had fed, or attempted to feed, was observed on a few wild plants on the patnas bordering the tea, but never at a considerable distance away from the latter. Damage observed in such cases showed symptoms of attack by only the *young* stages of the grubs. It seems reasonable to think that moths invaded the patna from the tea. Moths, as will be explained later, deposit their eggs promiscuously on many kinds of plants, and especially those with a smooth surface, and those which would give a certain amount of protection to a gravid female.

Consequently, during a severe outbreak in Passara in 1928, as recorded by Hutson, [19] "young *Natada* larvae" were found "feeding on eighteen different wild plants growing in a ravine bordering one side of the field and on the adjoining patna across the ravine". These wild plants were evidently casual hosts only during that particular outbreak, and were noticed on the patna and on the tea at the same time. Observations are still being made to ascertain whether *Natada* grubs are able to complete their life cycle on these wild plants.

EGGS.

Eggs are pale-yellow, flat, oval-shaped, scale-like objects, deposited singly on the upper surfaces of mature leaves. Very rarely, and perhaps only during severe outbreaks, have eggs been found on tender leaves. A day previous to hatching the eggs turn brown, and with the aid of a pocket lens it is possible to see the young larvae through the almost transparent shells or egg coverings.

OVIPOSITION

Eggs are deposited promiscuously on the upper surfaces of leaves, especially those with a smooth surface, and on which a gravid female may happen to rest.

Oviposition takes place at night and commences on the day following the emergence of the female moth from its cocoon. Moths become active at dusk and egg laying begins by 6 or 6-30 p.m. and

continues till midnight. In several cases it was observed that the majority of eggs laid in a single night were deposited before 8 p.m. while, on the aggregate, the majority of eggs were deposited during the first three or four days after oviposition commenced. The maximum number of eggs deposited on a single leaf in the field, and counted after the examination of several hundred leaves, was 45.

OVIPOSITION EXPERIMENTS.

The following procedure was adopted when over a hundred female moths were isolated on different occasions to ascertain particulars regarding oviposition. Cocoons were collected in the field and on moths emerging they were paired and placed in various types of cages, e.g., huricane lantern chimneys, glass tumblers, and glass tubes of various sizes. In some instances two males were placed in each cage to ensure fertilization. The moths were fed on a solution of sugar and water. Owing to the limited number of cages available it was not possible to transfer the females daily into fresh cages and thereby make correct counts of the eggs deposited every night. The alternative was to keep the moths in the same cages till they died and make an estimate of the eggs which hatched daily and those which failed to hatch at all.

INCUBATION.

Under insectary conditions eggs commenced to hatch from 5 to 8 days after oviposition, with an average of 6 days. (Results of 95 experiments).

LARVAE OR GRUBS.

The following description is taken from Hutson [17]:—

"*Caterpillars.*—These are about 1/25th inch long on hatching and of a dull whitish colour, but become pale-green after feeding has begun. The body is fringed with minute tufts of white stinging hairs and there is a double row of still smaller spiniferous tubercles along the back. The young Nettle Grubs move to the underside of the leaves soon after hatching and begin eating away small portions of the under-surface, leaving only a thin skin, the upper epidermis. When a number of young caterpillars are feeding on the same leaf, this soon becomes marked with numerous small brownish spots. After about two weeks of feeding the caterpillars are able to eat right through the leaves, which very soon assume a notched and ragged appearance. By the time grubs are full grown the damage is more marked and if the outbreak happens to be severe, complete defoliation is not an uncommon sight—the bare stems standing erect and the bush looking more like a broom or bundle of twigs."

When several hundred larvae were bred in the insectary, in varous types of cages, the larval period ranged from 29 to 42 days with an average of 36 days.

COCOONS.

Cocoons are dark-brown, or purplish-brown, globular objects about 1/6th inch in diameter, covered with a thin webbing of brown hairs. They are usually found beneath the bush, round the collar, under stones, among dead leaves, in crevices, and during severe infestations on the lower branches of the tea bush.

The pupal period, or stage of the grub within the cocoon during its transformation, prior to emerging as a moth, occupies 18 to 22 days with an average of 21 days.

MOTHS.

The description is taken from Rutherford [13].

"*Male*.—Forewing whitish at base, reddish-brown, with a central black dot in middle area. The reddish-brown area is bounded outwardly by a black line backed by a much more distinct whitish band. The fringe and edge of the wing is broken. Antennae are bipectinate. Expanse 12-20 mm.

"*Female*.—The female is larger (22 mm.) and the antennae are simple. Forewing reddish-brown, except for a broad band of paler-brown towards the apex. At the junction of these two areas is a black band. Black scales are scattered all over the wing."

Moths are nocturnal in their habits and remain in hiding during the day.

As regards the proportion of sexes emerging from cocoons collected in the field, many observations showed that males emerged earlier than females, and that as the period of emergence proceeded the females predominated. In the aggregate, however, there was a slight preponderance of males over females. Of a total of 3289 moths observed on emergence, 1733 were males, and 1556 were females, or nearly 53% males and 47% females.

Mating first takes place on the night of emergence and may last a couple of hours. It has also been observed to occur during the day. While in copula the heads of the moths are in opposite directions.

MOTHS.

Longevity.—It was noted that females and males lived an average of six days, while the maximum and minimum length of life for both sexes was 12 and 3 days respectively. This was ascertained when 224 moths, of which 101 were females and 123 males, were isolated in cages at different times of the year.

PARASA LEPIDA. Cram

Parasa lepida—the blue striped Nettle Grub, originally a pest of coffee, and then of tea, is perhaps not such a pest of even the latter as it is of coconuts. In 1929 [23] it was reported "to have almost defoliated six acres (of coconuts) on two estates off Chilaw." It is the only local species of Nettle Grub known to attack a variety of plants of economic importance. In addition to the three hosts mentioned, it has been known to breed on cacao, plantains or bananas, and on roses. Even in India its list of food plants is quite varied and consists of mango, castor, *Ficus* spp. and the country almond (*Terminalia catappa*).

A characteristic of the pest is that the grubs are gregarious and hence damage is limited to definite areas. In the few instances it has been recorded as causing "extensive damage", it is doubtful as to whether *Parasa* alone was responsible for such defoliation, or whether it was the combined attack of *Parasa* along with the other species of Nettle Grubs, like *Thosea* and *Natada*, with which it is associated when on tea.

Its distribution is wide; it has been reported from almost sea level to elevations approximating 5,000 ft. Previous to 1914 it was "reported from Ratnapura, Peradeniya, Wattegama and Marawila" [18], and since 1928 it has been found in Badulla, Passara, Madulsima, and Pussellawa (on tea), Chilaw and Kurunegalle (on coconuts).

LIFE-HISTORY.

In Passara its life-history has not been worked out in detail as yet. Moths in captivity lived a maximum of 9 days, and pupal periods ranged from 45 to 60 days. Larval periods must be extremely long because when large-sized grubs were once received for identification they lived for 7 weeks before commencing to construct their cocoons.

Descriptions of the stages are taken from Rutherford [13] and Hampson [4].

"Eggs are oval, flat and overlap each other.

"The caterpillar is about ¾ inch* long when full grown. The general colour is greenish-yellow with three broad, pale-blue longitudinal stripes each edged with blue-black, one mid-dorsal and the others lateral. Between the mid-dorsal and lateral stripes on each side is a row of tubercles bearing spines in tufts. Another row runs ventral of each lateral stripe. The spines are green with black tips.

* This is an understatement, the average maximum length being about 1¼ in.

Several of the spines on two pairs of dorsal thoracic tufts and also on a pair of tufts near the anal end are modified into stout, brownish, cylindrical processes. Arranged round the posterior end are four large tufts of short black hairs. On the dorsum of the prothorax are two small, black plates of chitin, straight on their mesal margins." —Rutherford.

MOTHS.

"*Male*.—Head green, red-brown at the sides; thorax green with a brown stripe on the vertex; abdomen brown; forewing pea-green; a red-brown basal patch on the costa (front edge of the wing), outer area red-brown, widest at inner margin. Hindwing yellowish at base, red-brown towards outer margin. Legs with joints pale-tipped. Expanse 30 mm.

"*Female*.—The red-brown stripe on the thorax wider and nearly the whole of the hindwing red-brown. Expanse 42—50 mm."

THOSEA CERVINA Mo.

Within recent years *Thosea cervina* Mo. has rather quickly assumed a status of economic importance as a pest of tea, almost equal to that held by *Natada nararia*, the 'Fringed Nettle Grub', during the last three decades or more. In Passara, since 1928, it has superseded *Natada* in a few localities.

In India [7] it first attracted attention in 1894 when it was reported as a pest of tea in Assam—hence its common name "the Assam Nettle Grub". In Ceylon it was not recognised as a pest till 1906 when it appeared in millions on tea in Bandarawela. No other reference is available of its presence in any part of the Island till 1914 when Rutherford [13] recorded it on the Pepper Vine (*Piper nigrum*), also from Bandarawela. In 1921 it appeared simultaneously in Dolosbage and Wattegama during the month of August, and the following year in the Badulla district. Since 1928 it has been reported from several localities in the Uva and Central Provinces.

LIFE-HISTORY AND HABITS.

In the insectary it has been one of the most difficult insects to breed. Moths have either failed to emerge from cocoons spun in the cages, or, when they have emerged, failed to make and oviposit fertile eggs. Over fifty female moths were isolated during the period under review.

On one occasion a few eggs (six) were casually observed on a leaf picked in the field. They were elliptical in shape, yellow in colour, flat, rather shiny, and situated along the margin, on the under

surface of the leaf. The eggs hatched in a couple of days and the larvae or grubs lived 45 to 66 days before reaching pupation, and the adults took 35 to 47 days to emerge from their cocoons. Female moths lived a maximum of 12 days and males a maximum of 11 days.

Moths emerge from their cocoons at dusk and are very active during the earlier part of the night, and more especially the male. The female moth is larger than the male: the former is of a light brown colour, while the latter is of a very much darker shade. In the insectary eggs were laid singly or in masses on both sides of the foliage offered. The larvae emerging are of a pale-yellow colour and gradually assume their pretty colouration as they grow older. The writer is obliged to Dr. Hutson of Peradeniya for the following descriptions:

"*Young larvae*.—Yellowish-green with 5 sub-dorsal pairs of orange-coloured spiniferous tubercles, spines sometimes dark coloured. A sub-lateral series of green tubercles with pale spines. Dorsal band divided into anterior, middle and posterior areas, all purplish and separated by two greenish areas. A medium dorsal whitish line running nearly the length of the body.

"*Full grown larva*.—Nearly 1¼ inches long, greenish to yellowish-green, sometimes turning yellowish above and pinkish below before pupation. Dorsal band very variable in shape, colouration and markings. Some with narrow white dorsal bands, others with broader bands of colours varying from lilac, through purplish-brown to brownish. Spines on sub-dorsal series of tubercles tipped with black, those on sub-lateral series paler.

"Cocoon, broadly oval to globular, smooth, dark-brown, rather like a small tea seed."

THOSEA RECTA Hmp.

Thosea recta was the first Nettle Grub to cause a scare in the Island. Originally described by Hampson [4] in 1892, it appeared in the form of a pest of tea in 1899 when it broke out in the Morawak Korale. Since then it has been reported from at least fourteen planting districts, and is the Nettle Grub with the second widest distribution. In Uva it appears along with *Thosea cervina* but never in large numbers. It is presumed that it is probably a species more adapted to the mid-country.

Its life-history has been exceedingly difficult to work out under insectary conditions. It is evidently more susceptible to wilt than *Thosea cervina*, because grubs kept under observation frequently succumbed to this disease.

On the few occasions this insect succeeded in completing a life cycle, the following facts were ascertained. Larval period 49 to 56 days; pupal stage 30 to 33 days; longevity of female moths 9 days, and of a male moths 6 days.

The following description is taken from Rutherford. [13]

"The caterpillar is about ½ in long. Small thoracic legs are present.

"The colour is variable. The ground colour is bright orange or green and there are three, bright crimson, purplish or brownish areas on the dorsum, the most anterior of which is narrow and slightly constricted at two points, the middle one broad and diamond shaped with a lateral expansion on each side, and the posterior one of intermediate width and more or less deeply constricted.

"The dorsal areas sometimes bear shining white spots, one at the caudle end of the most anterior, one near the cephalic end and one on each lateral expansion of the middle, and two, one behind the other, on the posterior dorsal area. There are two rows of spiny tubercles on each side, one just outside the dorsal areas and the two lower down on the side.

"The cocoon is attached to leaves or twigs. It is about 3/10th. of an inch long, oval, dark-brown with lighter patches. The adult escapes by a circular lid at one end. The pupal skin protrudes and may even come to lie outside the ruptured cocoon."

Food plants:—Tea and *Albizzia* spp.

THOSEA CANA Wlk.

The writer is not familiar with this particular species of Nettle Grub. It is quite likely that, if it were seen, it was mistaken for *Thosea recta*, a species it is reputed to have a striking resemblance to. Both Green [5] and Rutherford [13] have recorded their inability to distinguish the larvae. The former wrote: "The caterpillar of this moth (i.e., *Thosea cana*) is practically indistinguishable either in form or colour from that of *Thosea recta*. It is perhaps more usually without the red patches on the back, but this character is very variable in both species. The two insects have similar habits and appear to be equally destructive. The moth of *T. cana* may be distinguished by its more uniform greyish-brown colour and by the absence of the short white streak which marks the forewing of *T. recta*. *T. cana* has two indistinct brownish lines across the wing, with a small brown speck in the space between them."

The food plants on which it has been observed are tea and *Albizzia*.

A feature of its distribution is that it has never been recorded from Uva. Rutherford [13] records "Kelani Valley, Elpitiya, Avisawella, Galaha and Deniyaya." Ratnapura and Balangoda are additional localities from Peradeniya records.

SCOPELODES VENOSA

Green [8] was the first to discover *Scopelodes venosa* on tea when he recorded it from Peradeniya in June 1903. It is obviously a very rare species because it was not observed or recorded again till December 1930 when the writer received a solitary specimen from an estate in Passara. In February this year, two young larvae were found among a collection of *Thosea* grubs sent in from another estate in Passara. In June a solitary grub was received from Demodera. Attempts to breed the previous few larvae were not successful as the grubs died within a couple of days. This may have been due to the rough handling the grubs must have received at the hands of the collecting podians.

The grub which came from Demodera was 1½ inches long and rather broad. It was of a bright green colour, with two rows of large densely spined tubercles, and a conspicuous white, orange and dark blue band across the hinder part of its back.

After living for over a month in the insectary it spun a cocoon on a leaf. The cocoon is oval in shape, of a dark chocolate colour, ¾ inch in length and ½ inch in diameter.

Food plants:—In addition to tea, according to Thwaites and recorded by Moore, [2] the grubs are nearly omnivorous on coffee, and roses.

SPATULICRASPEDA CASTANEICEPS Hmp.

This particular Nettle Grub appears to be indigenous to the Island, and Hampson [4] who originally described the insect, records it only from Ceylon. The writer is not aware whether it has been found elsewhere in the tropics.

As a pest of tea it first attracted attention in 1900 when it was reported from "several parts of the Kelani Valley", and Green [6] recorded it in his report for the year when he wrote the following descriptive note:

Spatulicraspeda——then known as *Spatulifimbria castaneiceps*, "has only recently attracted attention as a tea pest. It is a small and inconspicuous grub, of a chocolate brown colour, with a reddish saddle-shaped mark on the middle of the back and a few yellow spots. Though belonging to the family of "Nettle Grubs" this particular species is unprovided with the usual urticating spines. The cocoon is very small, broadly oval, smooth and compact. The male moth

is uniform dark purplish brown, with indistinct darker transverse bars across the forewings, the expanded wings measuring just half an inch. The female moth is rather larger, measuring three quarters of an inch across the wings, and is of a much paler shade of brown."

In February 1903 it was reported from Neboda. No reference is made to the grub during the following 11 years in any of the Entomological reports till Rutherford, [13] in 1914, referred to "two larvae of a different species" which he found among a colony of *Natada nararia*. He appears to have been unable to place them at the time as the "larvae perished" while under observation. But his description of the specimens is so accurate that it is beyond doubt that the "two larvae of a different species" were *Spatulicraspeda castaneiceps*.

In 1919 and 1921 Hutson recorded it 'from Up-Country' and in 1926 Light [18] reported an attack from Passara. During the last few years specimens have been received from Badulla, Madulsima, Lunugala, Demodera and Bandarawela. In every case the host was tea. It has not been found on any other host plant as yet.

LIFE-HISTORY AND HABITS.

Moths—emerge from their cocoons at dusk and mating occurs a couple of hours later. Oviposition takes place the following night and the period of oviposition lasts from 3 to 4 days. In the insectary moths of both sexes lived to a maximum of 11 days with an average of 6 days.

Eggs—are deposited singly on the upper surfaces of leaves and resemble those of *Natada* in their similarity to flat scales. They are most inconspicuous. The incubation period is nearly 7 days on the average.

Larvae—on hatching are almost microscopic and appear as greyish specks against the green background of the leaf on which they emerge. Grubs are found on both sides of the leaf. The larval period extends from 39 to 61 days with an average of 44 days.

Cocoons—are spun on the leaves and are conspicuous, greyish, oval-shaped objects. The pupal period, or stage with the cocoon, lasts from 15 to 33 days with an average of 16 days.

Distribution.—Though originally recorded from the Kelani Valley (1900), Neboda (1903) and Elpitiya (1926), it has during recent years only been recorded from Uva.

NAROSA CONSPERSA Wlk.

According to Hutson [19] this is one of the "gelatine grubs" which usually feed on the leaves of coconuts and ornamental palms." The writer has seen it listed among the Limacodids recorded in

Tennent's Natural History of Ceylon published in 1861. This list was compiled by Walker who originally described the insect somewhere between 1858 and 1861. Its first appearance as a pest of tea occurred in December, 1905 when it was recorded by Green [9] who commented as follows: "A small outbreak of a caterpillar pest (*Narosa conspersa* Wlk), on tea has been reported from the Uda-Pussellawa district. Though belonging to the family *Limacodidae* (which includes the notorious 'Nettle Grub') this particular insect has not previously attracted attention as a pest. It does not figure in Watt and Mann's Pests and Blights of the Tea Plant." Its next recorded appearance on tea was 1928 when Hutson [19] found it in the Badulla district along with other species of Nettle Grubs. Since then specimens have been received from Passara, Madulsima, Lunugala, Haputale, Demodera, Bandarawela and Talawakelle.

(Hampson [4] records its foreign distribution as "Nagas; S. Ceylon; Borneo.")

Food Plants.—Besides tea, coconuts and ornamental palms, it has been known to feed on cannas and breed on roses.

Description.—The following description is taken from Hampson [4]:

"*Moth.*—Head and thorax white, slightly spotted with red-brown marks. Forewing yellowish-white, spotted and streaked with red-brown marks, forming indistinct broken transverse oblique lines; a large ferruginuous patch near base of inner margin; two brown specks on outer margin. Abdomen and hindwing pale-yellow.

"*Larvae*:—Naked, oval, and transversely corrugated; with paired dorsal humps; green, with white sub-dorsal lines and a series of white sub-lateral spots; legs yellow and retractile.

"*Cocoons.*—Oval; whitish, with a circular brown spot at one end.

LIFE-HISTORY AND HABITS.

The life-history of *Narosa* was worked out on a few occasions. Cocoons collected in the field were placed in large muslin cages till adults emerged and mated. Otherwise it was difficult to detect the sexes. Mating lasts a few hours, and was observed to take place in the night and during the day as well. Pairs were also recorded to mate more than once. Moths lived a maximum of 12 days while in captivity. Eggs were invariably deposited on the sides of the cages, and on both sides of a leaf when a female did oviposit on the foliage offered. The maximum number of eggs deposited by a female was 235, and the incubation period was about 6 days on the average.

Larvae are exceedingly difficult to detect, owing to the perfect harmonizing of their colour with the foliage on which they hide and feed. Cocoons are spun on the leaves and are very conspicuous owing to their whitish colour. They are sometimes mistaken for the cocoons of *Spatulicraspeda* and vice versa. But the cocoons of *Spatulicraspeda* are much smaller than those of *Narosa* and the latter possess the characteristic 'circular brown spot at one end.' The larval period of grubs bred in the insectary ranged from 33 to 41 days, and the pupal periods from 19 to 26 days with an average of 23 days.

BELIPPA LALEANA Mo.

The first authentic record of this gelatine grub as a pest of tea in Ceylon is Speyer's reference to it in the report of the Entomologist for 1917. Beyond listing it as one of the tea pests of the year he gives no further information regarding locality, etc. Six years later Dr. Hutson [17] included it in his list of the Nettle Grubs attacking tea. The same year (1923 it was recorded as the only caterpillar feeding on *Gliricidia maculata**. Subsequent to this the writer is not aware of any published record relating to the economic importance of this grub in the Island.

In July, 1931, one solitary larva of *Belippa laleana* was observed among a miscellaneous collection of caterpillars received from Madulsima and reported as damaging tea. In September the same year it was reported on an estate in the Badulla district, and the following month it was again received from Madulsima. By November it was observed on another estate in the Badulla district.

This seems to indicate that though this species might be considered of minor importance at the present moment, it is rather widely distributed in Uva.

Appearance of larva.—The larva or grub is rather squat, rounded, bluish-green, gelatinous, and slug-like in appearance and movement. Of the few specimens received during the year, the largest measured a little over 1 cm. in length.

Cocoon.—In the insectary two grubs pupated on the sides of the wooden cage. Prior to making their cocoons they spun a whitish silk-like substance which gave the grubs a certain amount of protection while they passed their stage of transformation from grub to pupa. The cocoons are light brown in colour and rather oblong.

Life-History.—Nothing is known of its life-history. The pupal period must be a long one because no moths have emerged as yet from cocoons formed sixteen weeks ago at the time of writing.

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