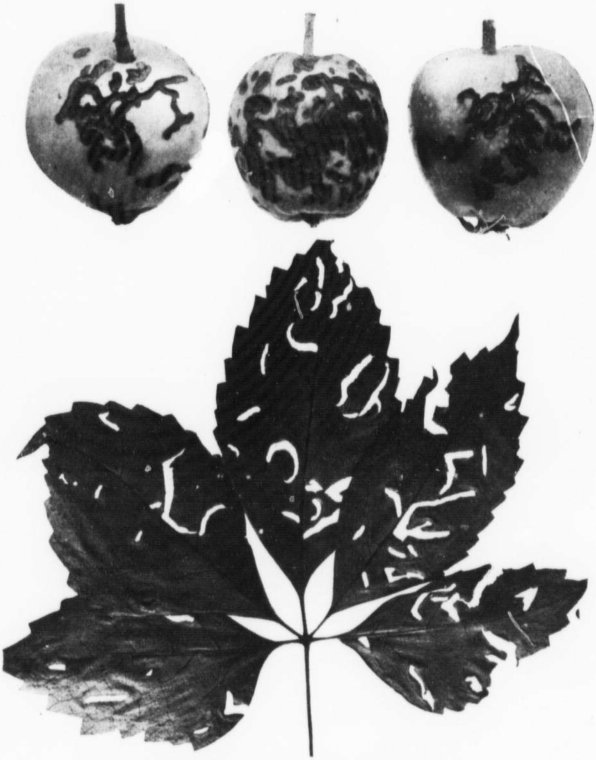

RHABDOPTERUS PICIPES Oliv.

Work of beetles on immature Grimes' Golden apples and on leaf of Virginia Creeper.

The Canadian Entomologist

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POPULAR AND PRACTICAL ENTOMOLOGY.

The Cranberry Rootworm Beetle (Rhabdopterus Picipes) as an Apple Pest. (Coleoptera).

BY WESLEY S. SAWYER.
Cornell University, Ithaca, N. Y.

On June 28, 1920 the writer's attention was called to a peculiar injury to apples in an orchard near Sodus, New York. Small, bronze-coloured leaf beetles were found in great numbers feeding on the fruit. They were later determined by Mr. Charles W. Leng as *Rhabdopterus picipes* Oliv. This beetle is widely distributed throughout the eastern United States, ranging westward to the Dakotas and Texas. The beetles have been recorded as feeding on the leaves of basswood, myrtle, wild grape, and on the foliage and fruit of the cranberry. In the larval stage the insect is a serious enemy of cranberry, attacking the roots.

In the orchard at Sodus the beetles confined their attack to the fruit, especially Grimes Golden, eating out a shallow, irregular, hieroglyphic-like channel on the surface (Plate VIII). About 75 per cent. of the apples were injured in this manner. The beetles continued feeding until about the middle of July, after which time they were to be found feeding on the foliage of Virginia creeper, dock, and wild strawberry. Apple leaves were not attacked. When feeding on the foliage the beetles ate out holes through the leaf, shaped very similar to the channels on the fruit (Plate VIII); in some cases riddling the leaves so that only the veins remained. About the first of August the beetles disappeared.

During the past season, the work of the insect seemed to be confined to the vicinity of Sodus and Savannah, New York. In the latter place it was most abundant on the foliage of wild strawberry and dock. The damage to the apples in this locality was not great.

Attempts to kill the beetles by spraying with arsenate of lead were unsuccessful. Arsenate of lead (powdered) five pounds in one hundred gallons of summer strength lime sulphur was applied with great thoroughness, without either killing the beetles or driving them away.

NEW LEPIDOPTERA FROM BRITISH COLUMBIA.

BY E. H. BLACKMORE,
Victoria, B. C.

NOCTUIDÆ.

Cænurgia erechtea Cram. form **parva** form. nov.

This form is the spring brood of *erechtea* and is distinguished from the typical or summer form by its uniformly smaller size, measuring 35 mm. in alar expanse as compared with 42 mm. in typical *erechtea*.

The colours and markings of both male and female are exactly the same as in *erechtea* but, of course, on a reduced scale. It flies in April and May, while *erechtea* is not on the wing until July and August.

Described from 10 specimens, 6 ♂'s and 4 ♀'s collected by the author.

Holotype.—♂, Victoria, B. C., April 29th, 1913.

Allotype.—♀, Victoria, B. C., April 22nd, 1912.

Paratypes.—5 ♂'s, Victoria, B. C., April 22nd, May 4th, 6th, 13th, 1913, April 22nd, 1917; 3 ♀'s, Victoria, B. C., April 18th, May 4th, 1913, May 13th, 1917.

Types and paratypes in author's collection.

LASIOCAMPIDÆ.

Tolype dayi, n. sp.

Male.—Palpi seal brown tipped with white; front seal brown; thorax slate-grey shading into pale grey on metathorax, with the usual brown crest of raised scales; abdomen dark slate-grey shading into lighter grey laterally. Primaries light grey with median and sub-terminal spaces dark grey; maculation very close to *velleda*, but differs in the course of the outer edge of the median space, which is more sinuate in the new species.

The sub-terminal space is much narrower in *dayi* than it is in *velleda* and is of a more even width throughout. Terminal line white; fringe grey, paler externally. Secondaries, basal area smoky; median band paler followed by a sub-terminal smoky band which is produced into an angle at vein 4.

Underneath much as above but paler and the maculation less distinct.

Female.—Front and thorax chalk white in contradistinction to the yellowish white of *velleda* Stoll, and *lowriei* B. & McD.; abdomen banded with dark and light grey and densely clothed with longish white hairs. Primaries very much paler than the male, and all the veins outlined in white.

In this sex there is a tendency in the dark grey sub-terminal space to become obsolete outwardly from vein 6 to inner margin, thus giving the lower half of the s. t. space the appearance of a narrow, dark band.

Secondaries same as in the male but much paler.

Expanse.—Male 34–35 mm. Female 41–42 mm.

Described from two males and five females all taken on Vancouver Island.

Holotype.—♀, Quamichan Lake, near Duncan, B. C., Sept. 3rd, 1915, G. O. Day, and in the collection of the author, through Mr. Day's kindness.

Allotype.—♂, Sluggett, V. I., Sept. 18th, 1916, W. Downes, and in the collection of the author, through the kindness of the captor.

Paratypes.—One male, Victoria, B. C., Sept. 1st, 1916, taken by the author and in his collection; 3 females, Quamichan Lake, V. I., Sept. 13th, 1906, Sept.

13, 1911, and Sept. 20th, 1914, G. O. Day, and in his collection; 1 female, Sluggett, V. I., Sept. 24th, 1916, W. Downes, and in his collection.

The last-named is somewhat damaged, being broken on inner margin of primaries.

The females vary in depth of colouring on primaries, one of the Quamichan Lake females being very dark, giving the insect a rather slaty-grey appearance.

I take much pleasure in naming this species after my friend Mr. G. O. Day, who has done much good work in describing the life-histories of many of our western species.

The following notes, given to me by Mr. Day, on the egg and cocoon of this species are of interest.

Egg.—"A female found at rest on Sept. 3rd, 1915, extruded 5 eggs when in the killing tin. The eggs were of a dark olive green, joined together end to end, and thinly covered with hairs from the tail of the parent moth. The hairs appeared to be fastened on by the sticky surface of the egg itself—sideways and irregularly. The surface of the eggs were pitted all over. The eggs were evidently infertile as they became concave on one side after a few days."

Cocoon.—"On a former occasion a cocoon was found on an old fence post, a small cavity having been made by the larva and covered by a tough web composed of silk and fragments of excavated wood. The cocoon resembled a blister on the post."

GEOMETRIDÆ.

Eustroma nubilata Pack. form **macdunnoughi,** form. nov.

This form differs from typical *nubilata* in having the ante- and post-median bands and the terminal area on the primaries wholly suffused with dark brown, which is only a degree lighter than the very dark median band. The extra-discal line is faintly shown as a narrow, white line which is more pronounced costally, while the crenulate s. t. line is also picked out in white.

The secondaries in the male have the basal area whitish, shading into dark fuscous from the extra-discal line outwardly, becoming deeper towards the margin, while in the female they are wholly suffused with brown, the suffusion being somewhat paler basally. It flies with typical *nubilata* and although not common, it occurs regularly every season. Named in honour of Dr. J. H. McDunnough, to whom I am deeply indebted for his kindly help and advice in my efforts to straighten out our British Columbia Lepidoptera.

Altar expanse.—Male 30–32 mm. Female 33–36 mm.

Described from 12 specimens, 8 males and 4 females, taken on Vancouver Island and the Lower Fraser Valley.

Holotype.—♂, Rosedale, B. C., June 19th, 1917, taken by the author and in his collection.

Allotype.—♀, Rosedale, B. C., June 23rd, 1917, taken by the author and in his collection.

Paratypes.—4 ♂'s, Goldstream, B. C., May 18th, 1915; Vancouver, B. C., June 18th, 1917; Rosedale, B. C., June 23rd, 27th, 1917, taken by the author and in his collection; 1 ♂, Vancouver, B. C., May 7th, 1905, R. V. Harvey, and now in the author's collection; 1 ♂, Chilliwack, B. C., June 26th, 1918, W. B. Anderson, and in his collection; 1 ♂, Fraser Mills, B. C., July 20th, 1920,

L. E. Marmont, and in his collection; 2 ♀'s, Rosedale, B. C., June 24th, 1917, Cloverdale, B. C., June 15th, 1917, taken by the author and in his collection; 1 ♀, Duncan, B. C., June 28th, 1895, E. M. Skinner, and now in the author's collection.

Dysstroma sobria Swett. form **swetti.,** form. nov.

In the Can. Ent., Feb., 1917, p. 64 et seq., Mr. L. W. Swett gave a paper on the genus *Dysstroma*, in the course of which he described some new abberations, or, as I would prefer to call them, forms of our large Vancouver Island species, which he had at that time identified as *mulleolata* Hulst.

There has been considerable doubt as to what Hulst's *mulleolata* really is, Mr. L. B. Prout, of London, Eng., being the first one, I believe, to associate this large form with *mulleolata* (vide Trans. Lon. Ent. Socy., 1908, p. 38). Drs. Barnes & McDunnough in further notes on this genus (Cont. Lep. No. Amer., Vol. 3, No. 4, March, 1917, p. 228), accepted Mr. Swett's identification of *mulleolata*, although with a certain amount of reserve, as there were several discrepancies between Hulst's type and his description. Later, (ibid., Vol. IV, No. 2, May, 1918, p. 137) on an examination of the type specimen by Dr. McDunnough, the authors came to the conclusion, for reasons which are clearly set forth and which seem exceedingly logical, that Hulst's *mulleolata* is the smaller, white-banded form of *citrata* L, which Mr. Swett had previously called *punctum-notata* Haw. This is the form which in favourable years is very common on Vancouver Island in the month of August.

Accepting Barnes' & McDunnough's identification of *mulleolata* to be correct, (and with which I fully agree) will leave our large, white-banded form without a name. According to the rules of the International Code, the first-named form ,i. e., *sobria*, given by Mr. Swett, will stand for the group collectively, and I propose to give the name *swetti* to the white-banded form, a description of which follows·

Head, front and palpi, cinnamon brown, thorax the same, intermingled with a few lighter hairs. Primaries, basal area dark brown, followed by another white line, slightly sinuous. The central area is white, irregularly bordered with black anteriorly and posteriorly, the posterior portion being wider and more pronounced costally. The amount of white in the central area is somewhat variable, especially between the sexes, the females as a general rule having a much larger proportion of white than the males. The outer border of central area is edged narrowly with white, while contained within the white area is a black linear discal mark. The subterminal area is tawny, shading into dark brown, especially opposite the discal mark, where it appears as a dark diffused blotch. The s. t. line is white, dentate, and rather faint. There is a small, yellowish-white sub-apical mark on the costa. Fringe pale, darker at the termination of the veins.

Secondaries, dark fuscous with the extra-discal line distinctly outlined in a paler shade and being acutely angled between veins 3 and 4. Black discal dots small but distinct.

Underneath primaries dark fuscous with central area showing through darker, a large yellowish patch on costa. Secondaries same colour with extra- and intra-discal lines strongly marked. Discal spots reproduced on all wings but those on secondaries larger and more prominent. Alar expanse—males, 35–37 mm., females 38–40 mm.+

I take great pleasure in naming this form after Mr. L. W. Swett, who has done a great deal of pioneer work in this group, and to whom I owe much of my present knowledge of the Geometridæ.

Described from five males and five females, all taken by the author at Victoria, B. C.

Holotype.—♂, Victoria, B. C., June 20th, 1914.

Allotype.—♀, Victoria, B. C., May 22nd, 1915.

Paratypes.—4 males, Victoria, B. C., June 22nd, 1914, June 24th, 1915, July 17th and 22nd, 1920; 4 females, Victoria, B. C., June 16th, 1914, June 24th and 26th, 1915, July 17th, 1920.

Types and paratypes in the collection of the author.

It is easily distinguished from *mulleolata* on account of its larger size, its ruddier appearance, and the shape of the extra-discal line on secondaries. Also by the fact that normally *swetti* flies in June, while *mulleolata* makes its appearance in August.

This year, being an abnormally late year, *swetti* did not apparently emerge until the beginning of July, as the specimens that I took on the 17th and 22nd of that month were a little worn and had been on the wing for at least a couple of weeks.

The list of species in this particular section of the genus *Dysstroma* will now stand as follows:—

Dysstroma
- *citrata* Linn.
  - form *immanata* Haw.
- *mulleolata* Hulst = *punctum-notata* Swett. (nec Haw.).
- *sobria* Swett.
  - form *subumbrata* Swett.
  - form *ochrofuscaria* Swett.
  - form *swetti* Blackmore = *mulleolata* Swett. (nec Hulst).

I do not think that *mulleolata* will prove to be a valid species, but will eventually turn out to be a form of *citrata:* for the present, however, it will be better to leave it as it stands until the life-histories of the various *citrata* forms can be worked out.

Eulype albodecorata, nov. sp.

This new species is very closely allied to *hastata* L., and had perhaps better be described in a comparison with that well-known species.

Palpi, head, thorax and abdomen as in *hastata*. Primaries, basal area black, followed by a narrow white basal line, which is gently curved from costa to inner margin. Sub-basal band black and wider, similarly curved. An irregular ante-median band, white, and about the same width as sub-basal. The broad black median band so characteristic of typical *hastata* is in this species broken up and considerably intermingled with white. Post-median white band rather narrower than in *hastata*, especially costally, with black spots on the veins. The spots vary in number; in some specimens there is a spot on each vein, while others have spots on only two or three veins. Terminal area and sagittate mark as in *hastata*.

Secondaries.—It is on these that the most striking difference occurs, the large black basal area of *hastata* giving place to a small, dusky basal patch, the rest of the wing, nearly to the outer margin, being clear white, with the exception of a narrow, irregular, broken, black, post-median band which is more pronounced in the holotype than in most of the other specimens. The black outer margin is slightly narrower than in *hastata*. Underneath, all the markings of the upper side are reproduced in detail. Another slight difference which appears fairly constant is in the fringe of the primaries, which in *hastata* is regularly and evenly black and white checkered, but in *albodecorata* it is quite black from the apex to the sagittate mark, below which it becomes as in *hastata*.

Alar expanse 31–34 mm.

Described from 28 specimens, 14 ♂'s and 14 ♀'s taken by the author at Goldstream, B. C.

Holotype.—♂, Goldstream, B. C., June 7th, 1916.

Allotype.—♀, Goldstream, B. C., May 18th, 1915.

Paratypes.—13 ♂'s, Goldstream, B. C., May 8th, 20th, 1915; June 11th, 1913; June 3rd, 1915; June 6th, 7th, 8th, 1916; 13 ♀'s, Goldstream, B. C., May 8th, 1915; June 3rd, 1915; June 6th, 7th, 9th, 1916; July 4th, 6th, 1916.

Types and paratypes in the author's collection.+

At first I thought this new species was a white form of *hastata*, but having had both species under observation for several years, I came to the conclusion that they were distinct.

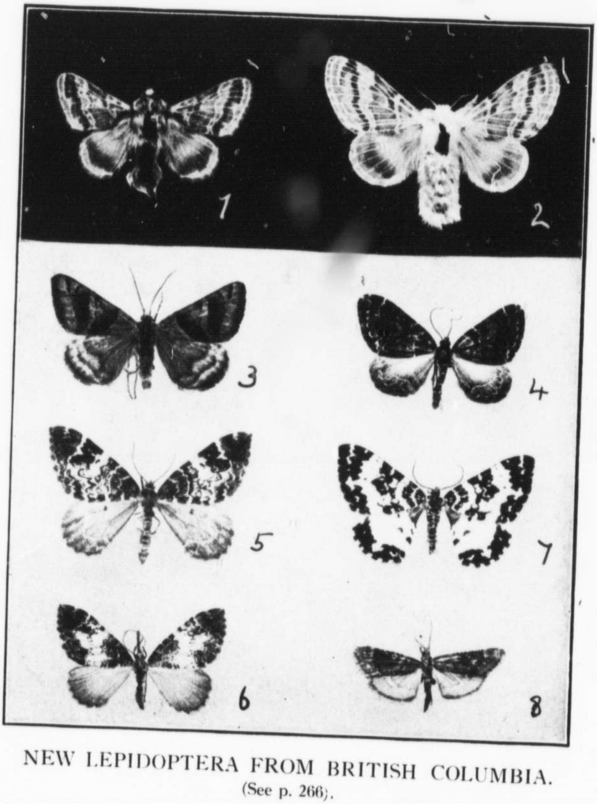
In the first place, *albodecorata* is on the wing from a week to ten days earlier than *hastata*, although the date of appearance depends upon the season. During the years 1915-16 and '17 I gave special attention to the dates of their appearance, and although the season varied in each of those three years (1915 being an especially early year) *hastata* never put in an appearance until the new species had been flying for at least a week. Secondly, although both species are subject to a certain amount of variation within certain limits, I have never known them to intergrade and when one is acquainted with both species, it is comparatively easy to sort them out by their general habitus.

PYRALIDÆ.

Herculia florencealis, nov. sp.

Palpi deep yellow with a few scattered red and black scales exteriorly. Face and head light fawn, thorax a darker shade of same colour. Antennæ fawn, but the scales on each segment are dark tipped, giving them an annulated appearance. Abdomen deep cream colour, each segment ringed with dark brown, posteriorly. Primaries, basal area fawn colour, with a few scattered black scales which are accentuated along the costal region, central area a wide brown band with its interior edge strongly dentate from costa to inner margin; the exterior edge extends obliquely outward from costa to veing b, thence curving gently inward to inner margin and being finely crenate.

On the costal margin of this band are five small sub-quadrate yellow patches. Bordering the wide median band is a narrow yellow streak beginning at costa where it is widest and extending to vein 6 where it becomes obsolete. The



NEW LEPIDOPTERA FROM BRITISH COLUMBIA.

(See p. 266).

terminal area is the same colour as the basal area, with a faint reddish-brown shade running through it. Marginal line dark brown. Fringe dark fuscous.

Secondaries white, overlaid with fuscous scales; a prominent darker curved line runs through the centre of the wing, with another line, less distinct paralleling it exteriorly. Marginal line distinct, dark fuscous. Fringe lighter than primaries with a dark band running through it. Underside, primaries from base to outer fourth, dark fuscous, terminal area lighter with a diffused reddish sub-apical patch and the five yellow sub-quadrate patches showing through on costal margin. Secondaries, light fuscous with the prominent dark line showing through, the second parallel line not being reproduced. Alar expanse 16 mm.

Holotype.—♀, Rossland, B. C., July, 1900. Taken by the late W. H. Danby, and now in the collection of the author.

I am indebted to Dr. J. McDunnough for the generic determination.

Paratypes of the foregoing new species and forms will be placed as far as they will permit, in the Canadian National Collection, Ottawa, Ont., and the Provincial Museum of Natural History, Victoria, B. C.

Explanation of Plate IX.

1. *Tolype dayi* Blackmore. Allotype, male.
2. *Tolype dayi* Blackmore. Holotype, female.
3. *Caenurgia erechtea parva* Blackmore. Holotype, male.
4. *Eustroma nubilata macdunnoughi* Blackmore. Holotype, male.
5. *Dysstroma sobria swetti* Blackmore. Holotype, male.
6. *Dysstroma mulleolata* Hulst. With which *swetti* has been misidentified.
7. *Eulype albodecorata* Blackmore. Holotype, male.
8. *Herculia florencealis* Blackmore. Holotype, female.

A SYNOPSIS OF THE ANTHOMYIID GENUS TRICHOPTICUS RONDANI (DIPTERA).

BY J. R. MALLOCH,
Urbana, Ill.

I have placed in this genus all species of the subfamily Phaoniinæ which have setulose hairs on the posterior upper margin of the hind coxæ. The species which have been placed in the genus *Allœostylus* Schnabl differ in habitus and hypopygial structure from those which belong strictly to *Trichopticus*, but I have included them here because the females are so similar to those of the true species of this genus that there is nothing to be gained by separating them, the more so as they are similar in habitat, all species being found in the north or in mountainous country. I have not seen any species of the genus as here defined from the southern United States, Central or South America, Africa, Australia or any part of Asia, though there is a likelihood of their occurrence in Tibet.

Key to Species.

males.

1. Hind tibia with a strong fasciculate apical thorn on ventral side..........2.
   Hind tibia without such thorn, sometimes with one or two bristles..........3.
2. Yellow species of robust habitus.......................*diaphanus* Wiedemann.
   Black species of slender habitus.......................*coquilletti* Malloch.
3. Legs largely or entirely yellow; hind tibia with setulose hairs and a few long bristles; thorax with two pairs of strong presutural acrostichals....4.
   Legs entirely black; hind tibia usually with long, soft hairs in addition to a few hairlike bristles..5.
4. Hind femur stout and straight, with rather long dense hairs on posterior and posteroventral surfaces; antennæ black; mid tibia with one or two anterodorsal bristles.......................*conformis* Malloch.
   Hind femur slender, curved, with a few posteroventral bristles on apical third; base of third antennal segment rufous; mid tibia without anterodorsal bristles.......................*latipennis* Malloch.
5. Abdomen with paired dorsal spots; hind tibia without posterodorsal bristles; thorax with three pairs of postsutural dorsocentral bristles.......................*maculiventris* Malloch.
   Abdomen without paired dorsal spots; hind tibia with one or more posterodorsal bristles..6.
6. Fore tibia with several strong spines on posteroventral surface near apex..7.
   Fore tibia without spinose armature as above, sometimes with a few hairlike bristles..10.
7. Fore tibial spines four in number, in a single series; mid tarsus without a fringe of fine hairs on apical three segments..........*fimbriatus* Coquillett.
   Fore tibia with the spines in two vertical series; mid tarsus with a fringe of fine hairs on posteroventral edge of the apical three segments..........8.
8. Fore tibia with three spines; mid tarsus long and slender, fourth segment at least twice as long as wide..9.
   Fore tibia with four spines; mid tarsus short and stout, fourth segment as wide as long.......................*septentrionalis* Stein.
9. Halteres yellow; mid femur with a number of long hairs on basal half of posteroventral surface.......................*diffinis* Malloch.
   Halteres black or brown; mid femur without such hairs......*spiniger* Stein.

10. Thorax with three pairs of postsutural dorsocentral bristles: mid tibia with one or two bristles on anteroventral and posteroventral surfaces.......... *melanderi* Malloch.

Thorax with four pairs of postsutural dorsocentral bristles.......... 11.

11. Halteres and calyptræ yellow; mid femur with a conspicuous group of dense, stiff, obtusely pointed bristles on apical third of anteroventral and ventral surfaces, and a series of about 8 very long, strong bristles extending from base to beyond middle of posteroventral surface.......... *johnsoni* Malloch.

Halteres black or dark brown, calyptræ whitish; mid femur not armed as above.......... 12.

12. Second, third and fourth segments of mid tarsus with a fringe of very fine hairs along posteroventral margin; mouth-margin very much produced; arista with very short pubescence; hind tibia with a series of erect setulose hairs on anterodorsal surface, one or two of which are longer than the others, the hairs of entire series at least as long as the diameter of tibia.......... *subrostratus* Zetterstedt.

Mid tarsus without hairs as above; mouth-margin not produced.......... 13.

13. Hind tibia without strong bristles on anterodorsal surface, the hairlike bristles on anteroventral surface much longer than the posterodorsal bristles, which number from five to seven; fore tibia with dense, moderately long hairs on ventral surfaces; mid tibia with a number of bristly hairs of irregular lengths on apical half of ventral surface.......... *villicrurus* Coquillett.

Hind tibia with two long bristles on anterodorsal surface, the anteroventral bristles not longer than those on the posterodorsal surface.......... 14.

14. Mid tarsus distinctly shorter than mid tibia; longest hairs on arista about twice as long as its basal diameter; abdomen with a broad black triangle on dorsal segments 2 and 3; preapical dorsal bristle on hind tibia strong.......... *brevitarsis* Malloch.

Mid tarsus distinctly longer than mid tibia; longest hairs on arista about as long as its basal diameter; abdomen with the black dorsal marks on segments 2 and 3 nearly linear; preapical dorsal bristle on hind tibia weak or absent.......... *innocuus* Zetterstedt.

FEMALES.

1. Thorax and abdomen yellow.......... *diaphanus* Wiedemann.

Thorax and abdomen black.......... 2.

2. Abdomen with paired dorsal spots; hind tibia without posterodorsal bristles; thorax with three pairs of postsutural dorsocentral bristles.......... *maculiventris* Malloch.

Abdomen without paired dorsal spots.......... 3.

3. Legs largely or entirely reddish or yellowish .... 4.
   Legs entirely black .... 5.

4. Thorax with two pairs of strong presutural acrostichal bristles; mid tibia with one or two anterodorsal, and two posteroventral bristles besides the posterodorsals .... *conformis* Malloch.
   Thorax with two pairs of weak presutural acrostichal bristles; mid tibia without anterodorsal and posteroventral bristles .... *latipennis* Malloch.

5. Thorax with three pairs of postsutural dorsocentral bristles .... 6.
   Thorax with four pairs of postsutural dorsocentral bristles .... 7.

6. Mid tibia with an anteroventral and a posteroventral bristle .... *melanderi* Malloch .
   Mid tibia without an anteroventral and a posteroventral bristle .... sp.?

7. Glossy black species, thoracic dorsum with lateral margins and a narrowly divided central vitta white pruinescent; arista almost bare; hind tibia with two bristles on posterodorsal surface, the larger one apicad of the smaller, situated at or just beyond middle of tibia; lower margin of cheek gently curved in outline, with a very strong, upwardly curved bristle before middle in addition to the other marginal bristles .... *johnsoni* Malloch.
   Species not glossy black, at least the thorax with dense, uniform grayish pruinescence; bristles on hind tibia not as stated above .... 8.

8. Hind tibia with one posterodorsal bristle about one-third of the tibial length from apex, anterodorsal surface with two bristles; face almost vertical in profile, the mouth-margin but little produced, almost in vertical line with base of antenna; margin of cheek with a few bristly hairs, one or two of which, near anterior margin, are upwardly directed; halteres yellow .... *innocuus* Zetterstedt.
   Hind tibia with two or more posterodorsal bristles .... 9.

9. Halteres black; mouth-margin very much produced anteriorly, projecting very much beyond the vertical line of base of antenna; base of wings not yellowish; abdomen not densely pruinescent .... *subrostratus* Zetterstedt.
   Halteres yellow; mouth-margin not much produced anteriorly, hardly projecting beyond the vertical line of base of antenna; wings yellowish at bases; abdomen very densely pruinescent .... 10.

10. Fore tibia with a strong bristle near apex on posteroventral surface .... *septentrionalis* Stein.
    Fore tibia without such bristle .... *spiniger* Stein.

N. B.—Holmgren's species *frenatus* which has been placed in Lasiops or Trichopticus by authors belongs, according to my interpretation of generic limits, to Phaonia.

THE NERVOUS SYSTEM OF THE LARVA OF *STHENOPIS THULE* STRECKER.

BY J. M. SWAINE,
Entomological Branch, Ottawa.

The Nervous System of insects is usually treated under two divisions, the Central System and the Sympathetic System. The two are so very intimately connected in the caterpillars of the Lepidoptera that there would appear to be little reason for separating them.

THE CENTRAL SYSTEM.

There are included here the cerebral ganglia and their commissures, with the continuing ventral chain of ganglia and connectives, together with the chief nerves to which they give rise.

The supraoesophageal ganglion, or brain, lies within the head upon the dorsal wall of the pharynx; it is connected by the crura cerebri, stout connectives which pass around the pharynx, to the suboesophageal ganglion lying immediately below the fore-intestine. The nerves arising from these two cerebral ganglia furnish practically all the nerve supply to the head.

The suboesophageal ganglion forms the first of a single chain of ganglia and connectives lying upon the ventral muscles along the median line. There is one ganglion in each thoracic segment and one in each of the first eight abdominal segments. The ganglia are jointed together by connectives, the whole forming a single median chain. The primitive double connectives have been completely fused into a single stout cord throughout the entire length of the chain; even in the thorax, where all caterpillars outside the Jugatæ have double connectives, they are as firmly fused as in the abdomen. The only indication of the primitive double nature of the cord is shown in the slight longitudinal split in the connective immediately in front of each ganglion, from which the median nerve arises. The fusion of the connectives in the thorax is a most interesting character, the more so since it appears in conjunction with the presence of a distinct eighth abdominal ganglion.

Most caterpillars have only seven abdominal ganglia, with the last more or less evidently composite. In *thule* and *argenteomaculatus* the eighth ganglion, composite in itself, is separated from the seventh by a connective nearly as long as that between the seventh and the sixth ganglia.

Each ganglion of the ventral chain lying behind the suboesophageal gives to its segment typically two pairs of nerves. The anterior pair evidently represent the primitive lateral nerves of the connectives, which in this group have migrated backwards until they appear now as the nerves from the ganglia. The nerves of the last ganglion, three pairs in all, are discussed below.

The Brain.

Pl. X, Fig. 8.

The Brain, or the Supraœsophageal Ganglion, is situated on the meson a little behind the middle of the head and well below the dorsal wall. It is very distinctly bilobed, rounded before and behind, and towards the front extended latero-ventrad to the nerves and the crura. The median line is deeply impressed so that the appearance is decidedly that of two ganglia united along the middle line.

The optic, antennal, and fronto-labral nerves arise close together on each side from the cephalo-lateral extension in front of the commissures.

The Optic Nerve, Opt., Fig. 8, is closely connected with the other two at the base and often with the antennal for a considerable distance. It runs cephalad and laterad, curving behind the dorsal condyle of the mandible and ends abruptly on the hypoderm below the cluster of eyes. From its extremity on or in the hypoderm fine branches proceed to the individual eyes. The Optic is usually closely connected for a portion of its length with the cephalic nerve of the lateral sympathetic.

The Antennal Nerve, Ant., Fig. 8, frequently appears firmly united at its base with the fronto-labral, giving the latter the appearance of a three-branched nerve; in other specimens it can be distinctly traced backward to the ganglion. It extends cephalad and lateral with the optic, curves sharply caudad and ventrad behind the dorsal condyle of the mandible and enters the base of the antenna, giving nerve-threads to the nerve-like antennal muscles on its way as well as to neighbouring setae. It sometimes lies immediately behind the optic for a considerable part of its length, crossing below the latter beyond the mandibular condyle on its way to the antenna.

The Fronto-labral Nerve, Fig. 8, arises, as already stated, in close conjunction with the antennal and optic. It proceeds directly cephalad along the side of the oesophagus, or pharynx, and presently divides into two main branches. The mesal division, or sympathetic branch, curves regularly to the frontal ganglion upon the meson, and may be considered a part of the sympathetic. It has no branches. The lateral division, or the labral nerve proper, extends directly cephalad to innervate muscles of the pharynx and labrum, and to give certain fibres to the sympathetic. Slightly cephalad of the frontal ganglion it becomes considerably widened and gives off several branches. One passes dorso-mesad to retractor muscles of the pharynx; a slender unbranched strand, "S.br.2", connects the labral nerve with the cephalic ganglion, "c.ge.", of the median nerve; a stouter mesal branch, "m.br.", runs cephalad along the side of the pharynx and enters the labrum; a fourth branch, "ph.br.", passes to the lower part of the side of pharynx and immediately divides into three main branches which innervate that region. The mesal branch of these is directly connected with a ganglion of a sympathetic plexus, "s. gl.," lying upon the hypoderm of the wall of the mouth, and is through the branches of this plexus connected with the cephalic branches of the median nerve. The main division of the labral nerve, L., innervates the labral muscles, as indicated on the figures. The outermost branch runs cephalo-laterad in conjunction with the mandibular nerve of that side, but curves sharply mesad at its tip, giving numerous strands to the lateral muscles of the labrum. The details of its branching are shown on the figures. The two connections with the sympathetic vary considerably in different individuals. In one specimen these two sympathetic connections seemed to be united, one strand from the labral nerve uniting with the plexus, which in turn was connected with the cephalic ganglion.

The optic, antennal and fronto-labral nerves are variably fused at the base; in some individuals the three are united for a third their length, so that one enormous nerve leaves the brain on each side.

On one specimen, extremely delicate fibres were distinguished running from the ventral face of the brain to the heart immediately below. There were three, one in the middle and one on each side. Whether these are of nervous or connective nature I am unable to say.

The brain is abundantly supplied with tracheoles from neighbouring tracheae.

The Suboesophageal Ganglion.

Pl. X, Fig. 9.

The Suboesophageal or Infraoesophageal Ganglion is a large, flattened, somewhat quadrate ganglion, lying in the caudal part of the ventral portion of the head. It is connected with the supraœsophageal ganglion by the Crura Cerebri, as already described, and, by a very short commissure, is connected with the first thoracic ganglion, thus becoming the cephalic ganglion of the ventral chain.

It gives origin to four pairs of nerves. The first three pairs arise from the cephalic part of the ganglion, at the sides, mesad of the ventral origin of the commissures.

The Mandibular Nerves, Fig. 9. The most anterior pair, the Mandibular Nerves, extend cephalad, more or less parallel with the other two pairs, though usually lateral to them, as far as the ventral condyle of the mandibles. They then turn abruptly and proceed almost directly to the dorsal side of the mandibles in rather close relation with the external branch of the labral. Before reaching the mandible each mandibular nerve bifurcates, the two divisions running nearly parallel to each other. At the entrance to the mandible the cephalic branch enters the mandibular ganglion, which innervates the interior of the mandible, and certain of the mandibular muscles, particularly the retractors (see Fig. 1); while the caudal division proceeds laterad above the ventral condyle and divides into a dorsal and ventral branch. The position of these branches is explained on Fig. 1. The ventral branch extends to the base of the head to innervate various muscles of that region.

A delicate branch from the mandibular nerve fuses on the middle line with its fellow from the opposite side, and the two are continued cephalad as a median strand into the hypopharynx, which it innervates. Before reaching the median nerve each of these branches from the mandibular gives rise to a slender thread which joins the plexus of minute threads lying upon the hypoderm below the mouth.

The Maxillary Nerves, Fig. 9. The second pair, the Maxillary Nerves, extend cephalad nearly parallel with the labial, and bend laterad behind the union of the silk glands to innervate the muscles and sense organs of the maxillae.

The Labial Nerves, Fig. 9. The third pair, the Labial Nerves, proceed cephalad along the sides of the oesophagus and pharynx to innervate the region of the labium. They seem clearly to innervate muscles and glands and to be directly connected with the cutaneous sympathetic; the branches are illustrated in the figures. On some specimens there is an unbranched connective uniting the labial nerves behind the fusion of the silk glands.

Near the union of the silk glands each labial nerve gives a short, thickened branch to the median line. The two branches unite in an elongate ganglion, "M. g.", bifurcating cephalad, which lies upon and innervates the glandular area of the outer part of the mentum.

The Ventral Nerve of the subesophageal ganglion passes to a lateral ganglion lying in front of the first spiracle, which in turn innervates the muscles of that region and sends two strands to the silk gland of its side. The ganglion is connected with a nerve plexus lying among the main tracheal branches, interwoven with a string of gland-like cells, oenocytes, and many tracheal threads. This plexus is in turn connected with the cephalic branch of the bracheal nerve.

THE COMMISSURES.

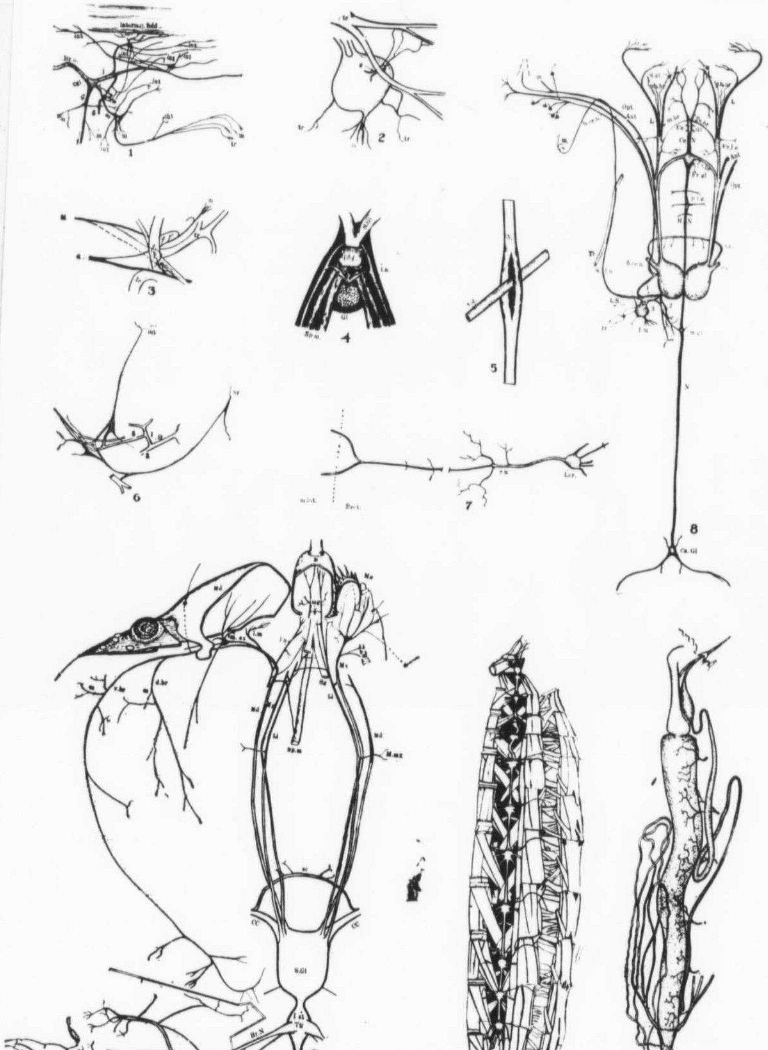
The Suboesophageal Commissure arises from the brain in conjunction with the Crura Cerebri. It soon separates from the latter and passing ventrad and somewhat cephalad forms a complete loop around the oesophagus. Near the middle line below the oesophagus it gives two or more pairs of delicate fibres to pharyngeal muscles. It is a rather stout cord and must have some function other than these small branches would indicate. It assists greatly in holding the brain in position and that is probably its chief use.

The Crura Cerebri proceed from each side of the brain downward and backward to connect with the suboesophageal ganglion below the oesophagus. They are unbranched.

The First Thoracic Ganglion, Pl. X, Fig. 9; Pl. XI, Fig. 2, gives rise to two pairs nerves. The smaller, superficial pair, "A," Pl. XI, Fig. 2, probably represent the nerves of the connectives between this ganglion and the suboesophageal ganglion; they innervate chiefly the superficial muscles, with threads to the hypoderm, passing across the tracheae eventually to the dorsal muscles and integument. The second pair, the Brachial Nerves, "B", divide each into a cephalic and a caudal division. The former innervates muscles in the base of the head, by the recurrent branch, and the anterior part of the prothoracic segment, and is connected with the superficial nerve. An important branch, "5", from the base of the cephalic division passes into the leg. The posterior division gives a branch, "3", innervating numerous muscles, and then, "4", passes directly into the leg.

The Third Thoracic Ganglion. The arrangement of the nerves from the second and third thoracic ganglia are illustrated in Pl. XI, Fig. 5. The Superficial Nerve, "A", passes outward beneath the recti muscles giving many branches to muscles, tracheae and integument. It has two or three connections with the anterior branch of the median nerve of its side. The Brachial Nerve, "B", passes directly to the base of the leg and there gives three branches from a more or less distinct coxal ganglion. The cephalic division, "1", innervates deep muscles and the integument, giving a stout strand, "5", to the leg. The remaining two branches "3" and "4", represent the caudal division described for the first thoracic ganglion. Nerve "3" goes to muscles and integument of the caudal part of the segment, and nerve "4" goes to the leg. Nerves "1" and "3" lie below nerve "A".

The First Abdominal Ganglion, Pl. XI, Fig. 6. This ganglion gives rise to two pairs of nerves; the anterior, "A", evidently represents the primitive lateral nerve of the connective which has migrated caudad and become fused with the degenerate brachial nerve, and the posterior, "C", is possibly the posterior



NERVOUS SYSTEM OF LEPIDOPTERA.
(See p. 275).

division of the median nerve which has fused with the ganglion. Nerve "A" is the chief nerve of the segment. It passes beneath the major recti muscles, giving off a minor, posterior division, "D", and extends across the tracheae to dorsum, innervating muscles, tracheae and integument. It has several connections with the median nerve. Nerve "C" passes backward to unite with a branch from the median nerve of the second abdominal segment, and gives off three main branches, chiefly to the integument. In the segments having prolegs a branch to the proleg of that side is given off from nerve "C" at the point marked "x" on figure 6 of the 2nd ganglion.

The Eighth Abdominal Ganglion, Pl. XI, Fig. 4, possibly represents the united 8th and 9th primitive ganglia. The median nerve is found as usual. The first pair, A, are of the normal type, representing the nerves of the primitive connectives and belonging to the 8th ganglion; the pair, "C", probably represent the second pair of the 8th ganglion. They innervate many muscles and the hypoderm of the 8th segment. The last pair, "D", stouter than the others, go to the last two segments of the caterpillar and to the caudal end of the intestine. They give off numerous branches to all the organs of that region, presenting two large ganglia of varying shape in different individuals.

There is little doubt, from the number of its nerves and its position, that the eighth ganglion in *thule* is composed of the united eighth and ninth primitive ganglia. Nerves "A" and "C" evidently belong to the primitive eighth ganglion, and nerve "D" would, therefore, represent the fusion of those of the ninth ganglion. That "D" is a composite nerve has been suggested by DuPorte and it seems probable from its size, extensive branching, and the passage of the vas deferens through it. This last peculiar condition was described by DuPorte in *Sphida obliqua*. It occurs also in *thule* but apparently not invariably, since I was unable to demonstrate it in several specimens. In *thule* the vas deferens normally passes at right angles directly through the middle of a chief branch of the nerve between the two main lateral ganglia. This condition would apparently be explained best as resulting from a fusion of the two nerves or two branches of the same primitive nerve. The median nerve of the ninth ganglion has disappeared or fused with "D".

The Sympathetic System.

The so-called sympathetic system of insects is usually divided into two or three groups of nerves and ganglia, all of which are very intimately connected with the central system. These are, the Supraintestinal Sympathetic System, comprising the Unpaired Median and the Paired Lateral groups of nerves and ganglia; and the Subintestinal Sympathetic System, or Paired Median Section, comprising the Median Nerves of the ventral chain. In addition to these there is a very delicate network of minute nerve threads and ganglia lying upon the hypoderm, and connected through numerous fine threads with the Central System as well as with the three divisions of the Sympathetic. This has been referred to as the Peripheral or Sensory Sympathetic System.

The Unpaired Median Section.

Pl. X, Fig. 8.

This minor group lies upon the dorsal face of the fore intestine to which its fibres mainly go. It comprises the Frontal Ganglion and the Cephalic and

Recurrent Nerves. The Frontal Ganglion lies upon the middle line of the fore-intestine well in front of the brain. It receives on each side the large sympathetic branches of the fronto-labral, called the Arched Nerves, and gives rise to the Cephalic Nerve in front, and to the Recurrent Nerve behind. The Cephalic Nerve passes directly forward along the middle line of the intestine to the base of the clypeus; here it enlarges to form the Cephalic Ganglion which gives two pairs of nerves to the intestine and receives on each side a slender thread, the Minor Arched Nerves, or the second sympathetic branch from the fronto-labral nerve. The frontal nerve bifurcates at the anterior end of the cephalic ganglion and each branch gives many threads to the muscles of that region. One of these threads is connected through a minute ganglion of the peripheral sympathetic system with a slender branch from the fronto-labral ganglion.

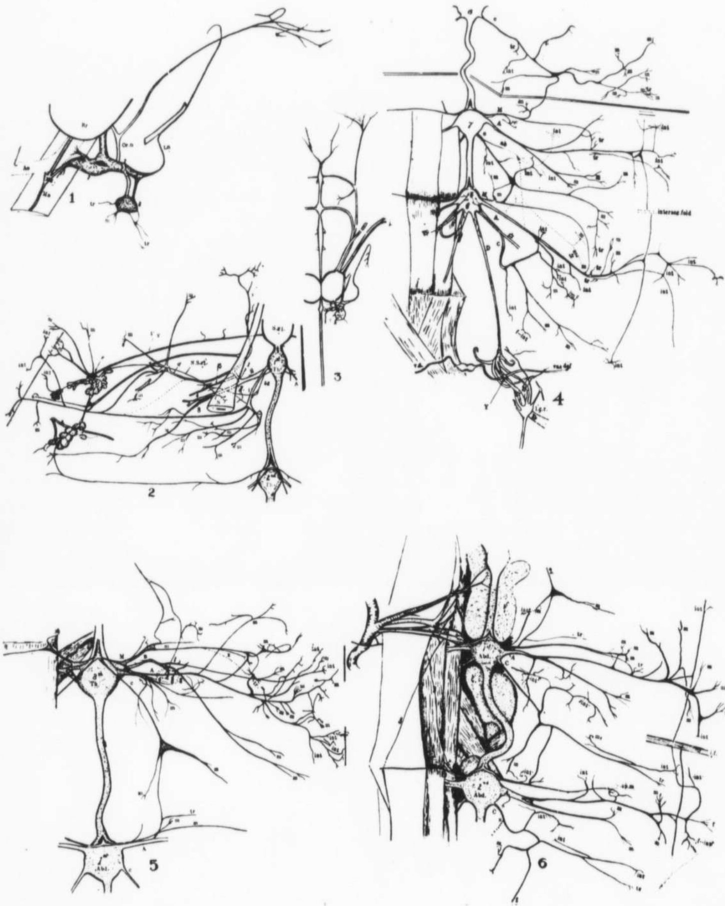
The Recurrent Nerve passes backward from the frontal ganglion as a slender strand along the median line of the intestine, beneath the heart and brain, and expands into a Caudal or Stomachic Ganglion at the base of the oesophagus. From the caudal ganglion several filaments arise as well as two larger nerves which were traced for a short distance one along each side the mid intestine. Nearly midway between the frontal ganglion and the brain the recurrent nerve expands into an elongate ganglion which gives three pairs of lateral nerves to the fore-intestine. A short distance behind the brain the nerve again enlarges slightly, forming a minute Median or Hypocerebral Ganglion connected by a delicate thread with the second ganglion of the paired lateral group. Along its course the recurrent nerve innervates the fore and midintestine, and certain delicate threads were noticed to enter the wall of the heart.

The Paired Lateral Section.

Pl. X, Figs. 2 and 8; Pl. XI, Figs. 1 and 3.

The arrangement of this plexus of ganglia and nerves varies considerably in different specimens. Usually there is found a short nerve arising from the side of the caudal part of each half of the brain. This nerve enlarges directly to form a fusiform ganglion, "1", Pl. X, Fig. 8, which gives rise by short nerves to two others. One of these, "2", fusiform in shape, innervates that part of the intestine immediately behind the brain, sends fibres to the heart, and one to the cephalic ganglion of the median nerve. This ganglion sometimes arises directly from the brain by a separate commissure, but is always closely connected with the first ganglion. The third ganglion, "3", of this lateral sympathetic section is nearly circular, flattened, and connected with the first ganglion by two short nerves; it supplies the fan-shaped muscles of the oesophagus and the neighbouring tracheae. What I have called the first ganglion is sometimes but little enlarged and then appears more like a stout nerve, but as a rule there are three distinct ganglia. The first ganglion, besides apparently giving delicate threads to the tracheae with which it is always in close contact, gives off two very interesting nerves, the Sensory and the Lateral Nerves.

The Sensory Nerve passes from the cephalic face of the ganglion cephalad past the brain, to which it is joined by a short connective, and is continued latero-cephalad in close connection with the optic nerve, which it finally leaves, and



NERVOUS SYSTEM OF LEPIDOPTERA.

(See p. 275).

bifurcates to innervate various setae on the laterodorsal wall of the head. The second, the lateral Nerve, arises from the outer end of the first ganglion and passes laterad and then cephalad, in close connection with a tracheal branch, bending ventrad and innervating certain muscles at their attachment to the ventral wall. In *argenteomaculatus* larvæ, Pl. XI, Fig. 3, the arrangement of this group is closely similar to that just described, but there are, as in many other parts of the nervous system, constant differences. An instance of this occurs in connection with the third ganglion, which has there a direct connection with the caudal part of the brain.

A tracheole crosses the inner face of the 3rd lateral ganglion in *thule* and extends into minute tracheoles which mainly supply the lateral fan-like muscles of the oesophagus, innervated by the 2nd ganglion.

Crossing this tracheole, and extending from the caudal part of the inner face of the 3rd ganglion, is a minute rather elongate ganglion giving threads to the tracheoles entering the brain, Pl. X, Fig. 2.

The Paired Median Section.

This consists of the so-called Median Nerves of the central system, with their branches, and there seems to be little reason for treating it as separate from the ventral chain. The Median Nerve appears in front of each ganglion of the ventral chain as a very short, subtriangular nerve arising from the connective in the median split immediately in front of the ganglion. In the abdomen each median nerve divides into two transverse nerves which proceed outward at right angles to the vetral chain. Their distribution is shown in Pl. XI, Figs. 2, 4, 5 and 6. A cephalic branch connects with a branch of the posterior nerve of the preceding segment; a basal thread goes to the integument, and the distal portion of the nerve innervates the spiracular muscles in addition to giving one or more connections to the anterior nerve of its segment. The median nerve of the eighth ganglion, which should appear in front of the ninth if that ganglion were separate, has apparently disappeared.

The median nerves in front of the second and third thoracic ganglia give off each two pairs of transverse nerves. The second or posterior pair are really oblique in position and pass latero-caudad, eventually uniting with the median nerve of the succeeding segment. It has already been suggested that the posterior nerves of the abdominal ganglia represent these posterior branches of the thoracic median nerves, which have become fused with the ganglia and lost their original connections. The median nerve in front of the first thoracic ganglion is apparently not always present, but has been demonstrated on some specimens of both *thule* and *argenteomaculatus*. It is simple with very few fine branches and passes cephalad and ventrad to muscles at the base of the mandibles. It is possible that the minute branch, Fig. 2, "sy", represents the caudal branch of the median nerve which has degenerated and become fused with the base of the superficial nerve.

Explanation of Plate.

Plate X.

Figure 1, *S. thule*, larva,—Distribution of the brachial nerve of the 1st thoracic segment. c.gl., coxal ganglion; other lettering as on Plate XI, fig. 2.

Figure 2, *S. thule*, larva,—The under surface of the 3rd sympathetic ganglion, showing a slender attached ganglion, g.

Figure 3, *S. thule*, larva,—Distribution of branches from the median and superficial nerves of the 2nd thoracic segment to the main tracheae.

Figure 4, *S. thule*, larva,—Distribution of the labial nerve at the junction of the silk glands, a and b, ganglia arising from the labial nerve, l.n.; S. Gl., silk glands reverted; Gl., a median gland lying below the silk gland; Sp.m., muscles from the spinneret.

Figure 5, *Eacles imperialis*, larva,—The vas deferens passing through a branch of the additional nerve of the 8th segment.

Figure 6, *S. thule*, larva,—The relation of the brachial nerve of the 3rd thoracic segment with the peripheral sympathetic plexus.

Figure 7, *S. thule*, larva,—A portion of the rectal nerve arising from the lateral ganglion of the rectum, l.g.r.

Figure 8, *S. thule*, larva,—Dorsal view of brain, or supraœsophageal ganglion and its Nerves. Ant., antennal nerve; Ca. Gl., caudal ganglion; c. c., crura cerebri; Ce. Gl., cephalic ganglion; Ce. N., cephalic nerve; Fr. gl., frontal ganglion; Fr. l.g., frontal ganglion of the labral nerve; l., labral nerve; m. br., mesal branch; L. S., lateral symathetic; 1, 2, 3, its ganglia; S. ce.n., its cephalic nerve; S. l. n., its lateral nerve; m., fibres to muscles; m.gl., mesal ganglion; phbr., pharyngeal threads; p.f.g., post frontal ganglion; R.N., recurrent nerve; s. br., sympathetic branches of the labral nerve, 1 and 2; S.gl., sympathetic ganglion; tr., threads to brancheoles; Tr., a tracheal; Opt., optic nerve.

Figure 9, *S. thule*, larva,—Ventral view of the subœsophageal ganglion and its nerves. Br. N., brachial nerve: CC. crura cerebri; Li., labial nerve; l. m., l.n., strands from labral nerve; Md., mandible, and mandibular nerve; m.ex., external branch, d.br., dorsal branch, v.br., ventral branch; Mx., maxilla and maxillary nerve; s.c., subœsophageal commissure; s.gl., subœsophageal ganglion; S.g. silk gland; sp.m., muscle of spinneret; 1st Th., 1st thoracic ganglion; m., nerve fibres to muscles; mg., mesal ganglion of labial nerves.

Figure 10, *S. thule*, larva,—A general view of the nervous system.

Figure 11, *S. thule*, larva,—The alimentary canal, showing the silk gland of one side and the malpighian tubes of one side.

PLATE XI.

Figure 1, *S. thule*, larva,—The lateral sympathetic system, dorsal view. 1, 2 and 3, the three chief ganglia; Ao., aorta; Br., brain; Ce. n., cephalic nerve; L.n., lateral nerve; M. g. mesal ganglion; M.n., mesal nerve.

Figure 2, *S. thule*, larva,—Nerves from the first thoracic ganglion, (1st Th.) A., superficial nerve of the segment; B., brachial nerve, with divisions 1, 2, 3, 4 and 5; d., dorsal branch of B.1; g., lateral ganglion of ventral nerve; int., to the integument; M., to muscles; N.S. gl., nerve to silk gland; Y., recurrent branch of B.1; S., silk gland; S.gl., subœsophageal ganglion; V.N., ventral nerve.

Figure 3, *S. argenteomaculatus*, larva.—Details of the lateral sympathetic.

Figure 4, *S. thule*, larva.—The 7th and 8th abdominal Ganglia. D., the additional nerve of the 8th ganglion, representing the nerves of the 9th ganglion; l.g.r., lateral ganglion of the rectum; y., the vas deferens passing through a branch of D.; other lettering as before, see, Pl. 1, fig. 5; V. d., vas deferens.

Figure 5, *S. thule*, larva.—Nerves from the third thoracic ganglion; M., median nerve; c., caudal branch of median nerve; X., and additional thread present on the opposite side of the segment only; other lettering as in Fig. 2.

Figure 6, *S. thule*, larva.—Nerves from the first and second abdominal ganglia. Abd., 1st and 2nd., first and second abdominal ganglia; C., caudal nerve of the ganglion; Cx. branch to the proleg; F., fat body; F. nerve fibres to fat body; int., to the integument; m., to muscles; tr., to tracheae; i.f., inter-segmental fold; A, superficial nerve.

(To be continued.)

BOOK REVIEW.

MANUAL OF THE ORTHOPTERA OF NEW ENGLAND, INCLUDING THE LOCUSTS, GRASSHOPPERS, CRICKETS AND THEIR ALLIES. By Albert P. Morse. Proceedings of the Boston Society of Natural History. vol. 35, No. 6, pp. 197-556, pls. 10-29, 99 text figs. April, 1920.

Even a casual inspection of this Manual leaves the impression of a work of rare quality, and a careful perusal of it only confirms and emphasizes this first impression, every page revealing the author's intimate knowledge of his subject. It is characterized not only by scientific accuracy and scholarship, but also by an attractive literary style, and is undoubtedly one of the best faunistic treatises on a group of American insects that has ever appeared.

Mr. Morse's book is the outgrowth of many years of research in field and laboratory, as everyone knows who is acquainted with his many excellent papers on the New England Orthoptera. It is by no means a mere systematic treatise, but covers a wide field, in which many matters of general biological interest are discussed.

In the introductory matter, which covers 76 pages, the author gives an interesting sketch of New England Orthopterology, an account of the principal collections of New England Orthoptera, and sections on the anatomy, habits, coloration, distribution and many other matters concerning the biology of the order. He also describes the injuries caused by locusts and other Orthoptera and the methods employed for their control, and concludes this part of the book with a very useful section giving full directions for the collection and preservation of specimens.

The general account of the habits of Orthoptera is based on those of the locusts, or short-horned grasshoppers, and is followed by a delightful description of the songs of grasshoppers and crickets and the methods by which they are produced. The next section on coloration contains much of interest. The three types of insect coloration, structural, pigmental and combinations of these, are all illustrated by species of this order, the majority being of the pigmental type. Many interesting examples of sympathetic or protective coloration are given, while the non-sympathetic coloration seen in the brightly coloured wings of the Oedipodinae, is regarded as being due, not to the phenomenon of "contrast mimicry" but as a means of signalling to other individuals of the community. Dichromatism and the varied coloration of certain species, such as the Carolina Locust, are considered to be independent of environmental coloration. The dichromatism of the Green-striped Locust is discussed in a special section by Dr. Phineas W. Whiting, who performed a series of experiments which seemed to show that temperature, and not humidity nor light, is the important factor in the colour determination of this species.

The sections entitled "Geographical Distribution" and "Colonization of New England—Dispersal Routes" are particularly excellent. In the former various faunal zones are characterized and their boundaries within the New England States clearly defined, and the characteristic species of Orthoptera inhabiting each are enumerated. Local distribution is also discussed and the author's well-known classification of locust habitats is introduced in illustration of this subject. Following this section is one on "Wingless and Vestigial-winged Orthoptera," in which the author's views on wing-length as a habitat relation are quoted from a former publication (Publ. 18, Carnegie Inst. Wash.).

The economic aspect of the subject is treated at considerable length in three sections dealing with the injuries of locusts and other Orthoptera in New England, remedies against locusts and earwigs, and natural enemies, including bacterial and fungus diseases, parasites, such as hair-worms, mites and tachinid flies, predaceous insects, amphibians, snakes and birds. Remedies against cockroaches are dealt with under the general account of the Blattidae in the special part of the volume.

In this second part, which deals with the classification and description of the various species, the same high standard of excellence is maintained, and the descriptive matter is relieved of the dryness usually characteristic of systematic works by the many vivid word-pictures of the habits and environmental relations of the different species. The author is wisely conservative in following a system of classification that has long been in general use, and in introducing no changes of nomenclature. The placing of the family Phasmidae, a very isolated group, between the nearly related families Blattidae and Mantidae is the only point we would criticise in this connection, but the matter is of little consequence in a work of this character.

Of the 132 species of Dermaptera and Orthoptera recorded from New England no less than 28 species are introduced forms, among which are 5 species of earwigs, 14 of cockroaches, 3 mantids (none of which are established) and 6 saltatorial species.

The illustrations are well chosen and the three original coloured plates deserve special mention on account of the truthfulness of the figures in both form and colour.

Mr. Morse's book is a fine model for systematic workers to emulate and should rank as a classic in American entomology.

E. M. W.

ERRATA.

For *Gunthrop* read *Gunthorp*, p. 112, line 14.

For *megachile* read *Megachile*, p. 119, lines 5 and 18.

For *argentate* read *argentata*, p. 119, line 11.

For *Tohitic* read *Tahiti*, p. 119, line 16.

For *Tahihan* read *Tahitan*, p. 119, line 17.

For *Trachea fanitima* read *finitima*, p. 121, line 18.

For *Mecistophalidæ* read *Mecistocephalidæ*, p. 184, line 11.

For *Urocerous* read *Urocerus*, p. 216, line 13.

For *flavcornis* read *flavicornis*, p. 216, line 6 from bottom.

CHANGE OF ADDRESS.

The Rev. Professor C. J. S. Bethune has left Guelph and is now residing at Toronto. His present address is as follows:

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Index to Volume LII.

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