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Fig. 1. Plan showing seasonal distribution of *Heplagenia*.
V.

LIFE-HISTORIES OF GEORGIAN BAY EPHEMERIDAE OF THE GENUS HEPTAGENIA.

By W. A. Clemens, B.A., University of Toronto.

(Plates XV—XVIII, and 1 figure in the text)

In the preceding paper on the mayflies or Ephemeridæ of Georgian Bay, the consideration of the genus Heptagenia was omitted for reasons there stated. The present paper is based on the results of observations and breeding experiments in connection with this genus covering a period of slightly over three months during the summer of 1912.

The genus Heptagenia is a comparatively large one as it occurs in America. Rev. A. E. Eaton in his Monograph of Recent Ephemeridæ made a summary of the then known North American species, amounting in all to at least 13, some of them, however, having been referred tentatively to the genus Ecdyurus. In 1910 Mr. Nathan Banks described 4 new species, making a total of 17 species recorded from America. Up to the present the nymphs of only 2 of these have been described namely, Heptagenia pulchella Walsh, and H. interpunctata, Say, both by Professor J. G. Needham in 1901 and 1904 respectively. In this paper are given the descriptions of the nymphs of five more as well as descriptions of the nymph and imago of 3 new species.*

The nymphs of this genus inhabit swift water for the most part; clinging close to the sides and bottoms of stones. They are adapted to this life by reason of many interesting specializations, chief of which are, much-flattened bodies, flaring margins to head, spreading legs with flattened femora, pectinated claws, gills dorsally placed in an overlapping series and spreading setæ. A few species, however, are common in quiet water, notably Heptagenia canadensis, and H. frontalis while H. tripunctata was found to be everywhere abundant. The nymphs are quite active, for when a stone is lifted from the water they scurry over its surface usually seeking the lower side. The clinging habit was frequently demonstrated when quite a number were brought in and put in a vessel of water without a stone or stick for them to cling to; not having anything else, they would begin clinging to each other and soon would all be in a single mass. As for food, being herbivors, they usually find abundance of various algal forms on the stones to which they cling.

A Heptagenia completes its life-cycle in a year. The egg is deposited in the water and hatches in about 40 days. The remainder of the mayfly's life is spent in the water as a nymph with the exception of a short aerial life of from 2 to 4 days as a subimago and imago. As the time of emergence approaches, the nymphs probably migrate to the quieter water. I have not observed a Heptagenia emerge

*Since the above was written these new species have been described by the writer (Clemens) '13.

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in the open, but in the laboratory they were observed to crawl up the sticks placed in the breeding-jar for the purpose and transform just above the water-level. The subimago stage generally lasted a day, but in the early part of the season it quite frequently lasted 3 days, and in a couple of instances 4 days. No doubt this time would have been shortened had the subimagos been out of doors. The imagos never appeared in large swarms as in the case of *Ephemera* and *Hexagenia*, but a swarm would consist of perhaps 50 to 100 individuals. They would begin their flight from three quarters to one half an hour before dusk, dancing up and down in their rhythmic manner at a height of from 12 to 20 feet. On calm evenings they could be found in numerous swarms all along the shore of the island, but on windy evenings would congregate on the lee side. The females of all the species observed at Station Island deposited their eggs by skimming the surface of the water and brushing off the eggs as they appeared from the openings of the oviducts. The earliest species was *H. luridipennis*, mature nymphs of which were taken on the afternoon of May 31, and one subimago emerged the same afternoon. The last was *H. luridipennis*, the imagos emerging Sept. 2, from nymphs collected August 23rd.

The following are the generic characteristics of the *Heptagenia* nymph:

Body flattened; head orbicularly rounded with flaring margins; eyes dorsally placed; postero-lateral angles of abdominal segments produced into spines; femora flattened; gills on segments 1 to 7, placed dorsally in an overlapping series and in life move in waving undulations; lamellae oblong or oval pointed, the 7th small and lanceolate. Branchial filaments bifid and united basally into a flat triangular plate. Setae from one to one-and-one-half times length of body, spreading, fringed with hairs at the joints of the segments. **Mouth parts**—labrum with width nearly twice the length and a row of short spines along the ventral surface, just inside the anterior margin. Anterior margin densely fringed with hair. Mandibles rather triangular in shape; fangs two in number, the exterior one of the right mandible stouter than inner and separated along inner edge; the inner fang bifid at tip. Mandible fringed with hair along the exterior margin. Lacinia of first maxilla externally rounded, the anterior part being beset with spines and hairs. The internal margin beset with a very dense even row of hairs and fine bristles and several spines at upper corner. Palpus 3-jointed, basal one small, middle one stout, distal longer and more slender ending in a curved tip; a row of short spines near the apex. Palpus hairy along outer and inner margins.

Labium with two pairs of lobes. The outer oval and densely covered with hairs; the inner more slender, more pointed and incurved; also hairy. The anterior end of the distal segment of the palpus densely beset with long hairs and sharp pointed projections with teeth along inner sides, somewhat resembling a rake. Beneath this crown is a chitinized ridge. **Hypopharynx** with a triangular tongue; paraglossae extend outwards with ends curved slightly backwards.

**Generic characters of the imago:**

Fore leg of male as long or slightly longer than body. The lengths of male fore tarsi arranged in order of increasing lengths are 5, 1, 4, 3, 2; 3 and 2 equal
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in some forms. Eyes simple; large, especially in male. Antennae short, 1 to 1.5 mm. Setae 2½ to 3 times length of body; segments of basal half alternately darkened; minutely pubescent. Penis lobes extend backwards and outwards, almost L-shaped. In some forms the lateral extension lacking and hence rather oblong in shape. Stimuli adjacent between the lobes.

The species which I have taken fall into two distinct groups:—

In the first group, consisting of H. tripunctata, H. luridipennis, H. flavescens, H. rubromaculata, H. fusca, H. Lutea, the nymphs are characterized by having the lamellae of the gills oblong, claws usually pectinated, the distal segment of maxillary palpus thickest about its middle and with a small tuft of hair near its end. The body is much flattened and the colour more or less brown. The male imagos have the penis-lobes L-shaped and the 2nd and 3rd tarsal segments of fore leg are equal, while the fourth is about 4/5 the length of the 2nd.

In group 2, consisting of H. canadensis, H. frontalis and a third undetermined species represented by the nymph only, the nymphs have the lamellae of the gills oval and produced distally into a sharp point; claws are not pectinated, the distal segment of maxillary palpus thickest toward distal end and the tuft of hair is larger than in group 1; usually there are more teeth along anterior margin of lacinia. The body is less flattened and more reddish or yellowish. The male imagos have the penis lobes oblong, not L-shaped and the 2nd and 3rd tarsal segments not quite equal, while the 4th segment is about ½ the length of the second.

Key to Male Imagos

A. No black spots or bands on face below antennae, Group I.
   b. Very pale species.
      c. Notum ferruginous, stigmal dots distinct ............... H. flavescens.
      c.c. Notum lighter; no stigmal dots ......................... H. lutea.
   b.b. Dark species.
      d. Large, entirely brown species.
         e. Thorax with a broad dark median stripe or two narrow stripes close together ........................................... H. verticus.
         e.e. Thorax without dark median stripe ........................ H. fusca.
      d.d. Not entirely brown
         f. Two very small dots on median carina between antennae ........................................... H. luridipennis.
         f.f. No dots on median carina. Thorax and top of abdomen dark.
            g. Reddish area in pterostigmatic space of wing.
               .............................................................. H. rubromaculata.
            g.g. Without reddish area in wing ....................... H. luridipennis.
   aa. Two black spots or bands on face below antennae, Group II.
      h. A black band on face below antennae, a dark dash in wing.
         Abdomen dark .............................................. H. canadensis.
      hh. A black spot on face below antennae, no dash in wing, abdomen lighter ................................ H. frontalis.
Key to Nymphs.

A. Gill's oblong, Group I.
   B. Nymphs entirely brown without a distinct dorsal colour pattern.
      C. An inverted dark U-shaped mark on ventral surface of 9th segment and
         a dark spot on ventral surface of 8th. Dorsal surface of body has a
         smooth appearance ...................... H. flavescens.
   CC. A row of dark mushroom-shaped marks along ventral surface and a
      rectangular dark mark on 9th. Dorsal surface has a rather granular
      appearance and lateral margins of body quite hairy. H. rubromaculata.
   BB. Nymphs not entirely dark brown and have a distinct colour pattern.
      D. Ventral surface of abdominal segments banded with dark bands
         along posterior margins.
         E. Broad dark bands at posterior margin of each segment on dorsal
            surface .................................. H. fusca.
         EE. Dark bands at posterior margins of segments 7, 8, 9, and 10,
            not as broad as preceding species and a more elaborate colour
            pattern ................................. H. lutea.
   DD. Ventral surface not banded.
      F. Two rows of black dots along ventral surface of abdomen.
         ........................................... H. luridipennis.
      FF. No dots ................................ H. luridipennis.

AA. Gills oval and pointed, Group II.
   G. Two light longitudinal stripes on dorsal surface of abdomen close to
      median line.
      HH. The stripes not of uniform width, very wide on 8th segment,
          very narrow on 5, 6, and 7 so that darker intermediate parts have
          oval shapes. Lighter species .................. H. frontalis.
   GG. Dorsal surface of abdomen has appearance of 3 longitudinal dark stripes.
      Colour greenish yellow ................... H. (undetermined species).
      Mr. Nathan Banks kindly identified the imagos for me so far as possible.
      Description of Species.

Heptagenia flavescens Walsh.

(Pl. XV, Figs. 4-5).

Male imago (Description taken from Monograph of Eaton, '88):

Measurements: Body 9 + mm.; wings 11 + mm.; setae 27-38 mm.

Yellowish. Eyes bright greenish yellow during life. Notum ferruginous,
sometimes verging upon piceous. Dorsum of abdomen ferruginous, darker at
the tips of segments 2-7 and with a pair of subobsolete pale vittae at the base of
each of them; venter pale greenish in segments 2-7 or 8. Setae whitish; the join-
ngs fuscous. Fore leg pale ferruginous with a median and a terminal band on the
femur, the tip of the tibia and the tarsal joinings and tips fuscous. Hinder legs
yellowish with the tips of the femora fuscous and the tarsal joinings and tips a little cloudy. Fore wing hyaline with a pale ferruginous cloud in the pterostigmatic region; neuration fuscous, excepting the basal \( \frac{3}{4} \) of the costa, subcosta and radius which are yellowish; the thickening at the bulla of the subcosta about 0.5 mm. long, is more or less obfuscates.

**Female imago:**

Measurements: Body 8 mm.; wing 10 mm.

Face clear; thorax yellow, slightly tinged with brown. Abdomen yellow; segments banded along posterior margin dorsally with black; stigmal dots marked. Femora with median and distal ferruginous bands. Most of the longitudinal veins of the fore-wing colourless; cross veins heavy and brown; very slightly clouded in the apical costal space; venation of hind wing almost colourless.

**Nymph:**

Measurements: Body 8–9 mm.; setae 10–13 mm.

Head brown, very slightly covered with light dots; a light spot above each ocellus; a small light dot on each side of median ocellus; an irregular light area anterior and lateral to each eye. Pronotum brown with two light spots on each side; part of lateral margin. Mesothorax similar in colour to prothorax. Abdomen of a uniform brown colour dorsally, having a smooth appearance; lighter ventrally with a semicircular brown band on 9th segment and a median brown spot on 8th. Spines of lateral edge short. Setae banded usually 3 dark and 1 light; sparsely fringed, usually only at base of light segment. Femora much flattened, brown and dotted with light spots, and having 3 irregular light bands; covered dorsally with small spines and posterior margin fringed with hairs and spines. Tibia with median and distal light bands. Tarsus tipped with white. Claws with two pectinations.

The nymphs of this species were taken up the Go Home River on June 16, 1912, immediately above Flat Rock Falls, where the water was flowing swiftly but smoothly. The nymphs were clinging to stones in water 1 to 1\( \frac{1}{2} \) feet deep, not far from the shore. On this date they were also found just below Sandy Gray Falls in swift rough water, but close to shore. I was successful in rearing two specimens, but one escaped from the cage over the breeding-jar and could not be found. The remaining one was a female and hence to make the description as complete as possible, I have inserted the description of the male from Eaton. The dates of the two emergings were June 27 and July 3.

**Heptagenia lutea** Clemens.

**(Pl. XV, Fig. 2).**

**Male imago:**

Measurements: Body 9–10.5 mm.; wing 10.5 mm.; setae 20 mm.; fore-leg 10 mm.

This is a light coloured species, slightly reddish on face below antennae; between ocelli and eyes, reddish brown. Thorax almost whitish yellow dorsally; light yellowish brown laterally; dark area on each side of pronotum; slight red and brown markings, beneath bases of fore and hind wings. Each of the abdominal
segments 1–8 banded dorsally at posterior margin, remaining parts of these segments being almost white; segments 9 and 10 entirely reddish brown; stigmal dots not marked; wings clouded in pterostigmatic space, a few cells reddish, femora with median and apical bands; tibia-tarsal and tarsal joints black; fifth tarsi and ungues dark.

**(Female imago):**

- Measurements: Body 11 mm.; wing 12 mm.; setae 22 mm.
- Abdomen more yellowish than male.

**(Nymph):**

- Measurements: Body 10 mm.; setae 13–16 mm.
- Head light brown in colour and dotted with light dots; light areas over ocelli; another at posterior margin of head in median line and a larger one lateral to each eye. Pronotum with a broad colourless lateral margin, remainder light brown numerous irregular light spots. Abdomen darker dorsally and with a rather complicated colour pattern. First segment light with 2 brown areas at side; 2nd, a narrow brown band along posterior margin and 5 brown areas and four light ones placed alternately; 3rd almost entirely dark with a few light dots; 4th with 2 dark spots in posterior lateral angles of segment; also a large dark area in centre of segment with a light area within it; 5th with a dark spot in each posterior lateral angle as in preceding segment; a dark band along posterior margin; 2 light areas surrounded with brown and a dark spot in centre of each; 6th almost entirely brown except for two light areas in anterior lateral angles; 7th with 2 large light areas with a brown dot in each toward inner side; 8th an irregularly light and dark coloured segment; 9th has a narrow brown band along posterior margin and a dark longitudinal stripe in median line; 10th almost entirely dark. Ventrally, the lateral and posterior margins of segments 2–8 dark; segment 9 with two large brown spots. Setae greenish; basal half well fringed at joints, distal half with each two segments alternately light and dark and few hairs at joints. Legs, femora with alternately light and dark irregular bands and covered with minute spines dorsally; posterior margin fringed with hairs; anterior margin also fringed but hairs shorter. Proximal end of tibia dark and has a dark band slightly beyond middle. Tarsi with a reddish brown band, very near proximal end. Claws with two pectinations.

The nymphs were quite abundant along the open shore of Station Island and west of it, my collections dating from June 3 to July 2. Besides I have a few from a small waterfall on the Musquash River, 3 miles south of Go Home Bay, taken June 30, and 3 small nymphs from Sandy Gray Falls, Aug. 23. Imagos emerged from June 27 to July 3.

**Heptagenia fusca** Clemens.

**(Male imago):**

- Measurements: Body 10 mm.; wing 13; setae 26.
- No marks on face; ocelli almost in a straight line, middle one the smallest. Pronotum brown, slightly darker along the median line. Mesothorax uniformly brown. Abdomen with posterior \( \frac{3}{4} \) of each segment of same brown colour as thorax.
and projections from this band anteriorly in the median line, almost forming a continuous longitudinal stripe on the abdomen; the band widens slightly laterally also; remaining portions of each segment somewhat light brown; ventrally very slightly banded. Forceps and penis lobes of usual form. Femora banded in middle and at distal end. Wings large; costa, subcosta and radius light in colour while remainder of longitudinal and the cross veins brown. No cloud in pterostigmatic space.

**Female imago:**

**Measurements:** Body 10-12 mm.; wing 14 mm.; setæ 18 mm.

Quite similar to male, except that abdomen is considerably darker.

**Nymph:**

**Measurements:** Body 12-14 mm.; setæ 15-20; antennae 3 mm.

Head brown, dotted with light spots; usually 3 light areas at posterior margin between eyes and 2 lateral to each eye; anterior margin well fringed with hairs. A light longitudinal median line on pronotum; 2 light areas on each side and lateral margin colourless; remainder of pronotum brown with small light dots. Posterior \( \frac{1}{2} \) of each abdominal segment 6-10 almost black; segments 1-6 brown; the remainder of each segment varying from light brown to greenish yellow; ventrally posterior \( \frac{1}{2} \) of each of the segments 2-8 brown; 9th segment has 2 dark areas laterally. Femora light brown on upper surface with a few lighter areas and covered with minute spines dorsally; posterior margins fringed with hairs; proximal end of tibia dark brown and its third \( \frac{1}{4} \) dark; proximal half of tarsus dark. Setæ well fringed with hairs at the joints.

While on a canoe trip up the Go Home River, June 16th, I collected a number of the nymphs of this species just below Sandy Gray Falls. The only imagoes I have are the ones reared from this collection. The dates of emergence are June 23rd and 24th.

This species is close to *H. verticis* but lacks the dark median stripe on the thorax, and does not show the slightest trace of a dash in the wing under the bulla.

**Heptagenia tripunctata** Banks.

**(Pl. XV, Fig. 1).**

**Male imago:**

**Measurements:** Body 9-11 mm.; wings 12-13 mm.; setæ 25-35 mm.; forelegs 12-14 mm.

Two small dots on median carina, slightly below level of antennæ. Thorax brown; on pronotum a dark spot at anterior margin in median line, sometimes divided into two by a fine light line; two small dark spots just posterior to these; an oblique dark streak on each side of pronotum; a brown stripe on coxa of foreleg and extending up on side of prothorax.

Short dark stripes at bases of fore and hind wings. Abdominal segments 1 to 7 paler than rest of body; segments 8-10 dark, similar to thorax; three dots on dorsum of each abdominal segment at posterior margin; stigmal dots well marked. Setæ with alternate joints of basal half dark. Femur of fore-leg darkened at both ends and with a median band. Tibia-tarsus joint dark. Yellowish in apical costal space of wing and a reddish area in pterostigmatic space.
Female imago:
Measurements: Body 10-12; wings 14-16; setae 22-25.

Nymph:
Measurements: Body 11-14 mm.; setae 12-16.

Head deep brown, occasionally almost black dotted with light spots; three light areas along anterior margin of head and one at posterior margin between eyes. Pronotum similar in colour to head with light dots and about 5 larger light areas on each side; lateral margin with a light area which extends in some distance. A light area in antero-lateral angle of mesothorax. Femora stout with 5 irregular light areas; small spines very numerous; posterior margins fringed with hairs. Tibiae with 2 dark and 2 light areas, arranged alternately. Abdomen similar in colour to head and thorax; a light area on segments 4 and 5 containing a small triangular dark area at anterior margin of segment 5, lateral to which are 2 dark dots; another light area on segments 7, 8, 9 and 10 containing 2 dark dots on 8 and 2 on segment 9; usually the 3 dark spots at posterior margin of the segments of the abdomen of the imago can be distinguished; ventrally two longitudinal rows of dark dots, increasing slightly in size toward posterior end; segment 9 usually with 2 pairs, the anterior pair small, posterior pair larger. Setae with alternate dark and light areas. Gills have the lamellae slightly rounded at distal end.

This species was by far the most abundant at Go Home Bay. The nymphs were found in almost every locality where there was a stone to cling to, except, of course, in stagnant water, and could be taken at any time during the three months. The first specimens bred emerged May 31, but the first capture was not made until June 11. On this date a small swarm of about 20 individuals was discovered about 8.15 p.m., flying from 10 to 20 feet high, facing north. One female and several males were taken. Soon after this they became very abundant and remained so until about July 5th. The last specimen bred is dated Aug. 13.

Heptagenia rubromaculata Clemens.

(Pl. XVI, Fig. 2).

Male imago:
Measurements: Body 8 mm.; wing 8 mm.; setae 17 mm.; fore-leg 7 mm.

No marks on face; darker spot at posterior margin of head between eyes. Thorax dark; median longitudinal dark stripe on pronotum; dark brown stripe on coxa of fore-leg and extending up the side of prothorax. Abdominal segments 1-7 lighter; 8-10 dark, similar to thorax; each segment banded at posterior margin; stigmal dots distinct; wing has a reddish area in pterostigmatic space.

Female imago:
Measurements: Body 9-9.5 mm.; wings 13-14 mm.; setae 15-22 mm.

Often slightly reddish on face beneath antennae. Dark brown on dorsal surface of head behind ocelli. Abdomen varies from a reddish to a yellowish colour in dried specimens.
Nymph:

Measurements: Body 9-10 mm.; setae 10 mm.

Head dark brown, dotted with minute light spots. Pronotum similar in colour to head; two light areas on each side, the outer one sometimes joined to the light margin. Abdomen dark brown with a granular appearance; sometimes a faint broad, dark longitudinal streak can be made out with 2 dots on each side of it on each segment excepting 9 and 10; ventral surface lighter with a median row of irregular dark spots and lateral rows of small dots or lines, the median dots sometimes broken up so that only 4 or 5 small dots remain in their place. On segment 9 the markings are usually jointed, forming roughly three sides of a square. Femora with 4 irregular dark bands; both posterior and anterior margins very hairy. Claws pectinated. A very hairy species, having anterior margin of head, sides of thorax and abdomen very hairy.

This nymph was first taken on June 15 in what is commonly called the Narrows, near the mouth of the Go Home River. The water here had a well-marked current, but scarcely swift. On June 30 I found them very numerous in the very swift water of a rapid near the mouth of the Musquash River. Nearly a month after this on July 20 and 22 I discovered mature nymphs at an old lumber chute on the Go Home River in fairly swift water.

Imagos were bred from the nymphs taken at the Narrows on June 22nd and 25th; at the Musquash rapids from July 3 to 5th; at the chutes July 24-29th. No imagos were captured.

Heptagenia luridipennis Burm.

(Male imago:

Measurements: Body 7-8 mm.; wings 8 mm.; setae 2-22 mm.; fore-leg 8 mm.

Face clear; slight dark marks at posterior margin of head between eyes. Median longitudinal stripe on pronotum; sides brown; mesonotum dark brown; brown area in front of base of middle leg. Segments 1-7 of abdomen light coloured segments 8-9 and 10 dark, similar to thorax, narrow black bands along posterior margins of the segments; stigmal dots distinct. Apical costal area of wing not distinctly darkened and no reddish coloured area.

Female imago:

Measurements: Body 9 mm.; wings 10 mm.

Nymph:

Measurements: Body 7-8.5 mm.; setae 10-14 mm.

Head brown with light dots; anterior margin fringed with hairs. Prothorax similar in colour to head; on pronotum a light spot on each side of median line; lateral to this another larger one and lateral to this again another which extends to the lateral margin. Abdomen similar in colour to prothorax; a row of black dots on each side corresponding to the stigmal dots of imago; segment 3 for the most part light with a round brown spot in median line and with two short projections laterally; segment 4 with a small triangular brown spot in median line.
with base to anterior margin while the apex meets a large brown area leaving a small light area on each side of the triangle; lateral to the brown area is a light one and lateral to this is a triangular dark spot in the posterior angle of the segment; segment 5 much like the 4th; segment 6 entirely dark except for two small spots at anterior margin and 2 toward lateral margin; segment 7 with a triangular dark spot in median line with base to anterior margin and apex reaching about middle of segment; on each side of triangle 2 dark spots; segment 8 similar to the 6th; segment 9 irregularly marked; roughly, it is dark with a darker median longitudinal stripe, 2 light spots on each side and another at lateral margin; segment 10 entirely dark; ventrally 2 dark spots at lateral margins of 9th segment just beside the lateral spines of that segment; sometimes a triangular spot in the median line. Setae with basal half fringed with hairs at joints.

The nymphs of this species were the last to be taken. On August 23rd I found them in a rapid just above Sandy Gray Falls, about 5 miles from Station Island. I was successful in rearing quite a number of these dating from August 28th to Sept. 1.

**Heptagenia canadensis** Walker.

*(Pl. XVI, Fig. 4)*

**Male imago:**

Measurements: Body 8–9 mm.; wings 9 mm.; setae 20–22 mm.; foreleg 9 mm.

A dark species; a black band on face below each antenna; dark reddish brown between lateral ocelli; a small black dot close to inner margin of each eye; posterior margin of head with a narrow black line thickened at median line. Prothorax brown; short dark band along posterior margin of pronotum, the ends of which turn obliquely across the side of pronotum. Mesothorax rich brown dorsally, sides lighter, oblique dark stripes at base of fore and hind limbs; dorsum of abdomen black; slightly darker in median line; and a lighter area in each segment on either side of it. Posterior margins of segment 1–9 margined with black; 10th segment lighter; stigmal dots obscured by the black colour of the abdomen; penis lobes rather oblong in shape; setae almost white, tinged with black; joints darker. Femur of fore-leg almost yellowish tinged with black and having median and distal black bands. Tibia lighter; tibiotarsal joint black; tarsi tinged with black; lengths of segments arranged in increasing order 5, 1, 4, 3, 2; the 2nd slightly longer than the 3rd. Wings with a dark dash and numerous cross-veins margined with black between the dash and base of wing; terminal margin of hind wing slightly tinged with black.

**Female imago:**

Measurements: Body 9–10 mm.; wing 12 mm.; setae 15 mm.

Abdomen very reddish, often blackish red.

**Nymph:**

Measurements: Body 11 mm.; setae 15 mm.; antennae 3.5 mm.

Head reddish brown in colour; a small dark area immediately in front of each antenna; and another about the same size in front of each eye; a black dot behind each lateral ocellus; a light area in front of median ocellus, and a larger light area
between each lateral ocellus and eye. Another lateral to each eye along margin of head; mouth parts of the type belonging to group 2.

Pronotum reddish brown with a dark and an approximate light area in each lateral half; margin colourless.

Abdomen darker than thorax; each segment with four light longitudinal streaks, 2 near median line and the other two near lateral margin; black dots, corresponding to the stigmal dots just inside of lateral light streaks. Ventrally the abdomen is almost white, each segment has two light brown lateral streaks, while 9th has its lateral and posterior margins margined with light brown. Short lateral spines at posterior lateral angles of segments 8 and 9. Setæ of equal length; light brown; joints fringed with hair. Gills oval and pointed, femur of fore-leg light brown with 4 light areas. Two small ones towards anterior margin and two large towards posterior. Distal end light coloured. Femora of hind legs with fewer pale-markings. Tibae alternately banded with brown and white. Tarsi have very broad median bands, legs slightly hairy along posterior margin.

This species was the second most abundant at Go Home Bay. The nymphs were taken from May 25th to June 31st in various localities, but never in swift water, the usual place being quiet bays. On Sept, 5th some small nymphs were found in a small creek which were evidently the next generation.

Almost mature nymphs were taken in this creek on May 31. The first bred specimen is dated June 1, and the last July 4th. Imagos were very abundant at Station Island from June 25th to July 15th.

**Heptagenia frontal** Banks.

*(Pl. XVI, Fig. 3).*

**Male imago:**

Measurements: Body 7–8 mm.; wings 9 mm.; setæ 18–20 mm.; forelegs 7 mm.

Much like *H. canadensis* but lighter in colour, face yellowish a black dot on face below each antenna; a smaller black dot near inner margin of eye; pronotum light brown with a black streak on each side. Mesonotum rich brown; sides of thorax whitish yellow, segments 1–7 of abdomen very light, with posterior margin black; 8–10 reddish dorsally; stigmal dots distinct; setæ white. No dash in wing and cross veins not margined. Femora yellowish with black median and apical bands.

**Female imago:**

Measurements: Body 8–9 mm.; wings 10 mm.; setæ 15 mm.

Head and thorax light yellow; dots on face beneath antennae almost forming bands; sometimes a black dot at lateral margin of each side of pronotum, usually a few cross-veins margined with black on the wing.

**Nymph:**

Measurements: Body 9–10 mm.; setæ 9–10 mm.

Head yellowish brown in colour; three almost round light spots along anterior margin of head; a light area in front of each ocellus; usually a light area along median line between eyes and 2 smaller ones lateral to this along posterior margin.
of head. A black dot below each antenna, in front of each eye and near inner margin of each eye.

Thorax lighter in colour than head; on each side of pronotum, near median line is a small light spot; just lateral to this is a triangular dark spot and lateral to this again is another light area. In anterior angle of pronotum is an oval light spot. Along posterior margin extending some distance on either side of median line is a broad light band, which is connected by a light longitudinal stripe along median line of mesonotum, to a large irregular light area on the mesonotum.

Abdomen usually light yellowish brown; the colour pattern, roughly, has the appearance of a broad light band along median line in which, on segments, 5, 6, and 7 are oval dark areas, in 8 a narrow stripe and in 9 a round dark area in each segment, on either side of this broad light band is a short light stripe; ventral surface almost white with 2 lateral light brown longitudinal stripes on segments 1-9; a broad band across 9th along posterior margin, joining the 2 lateral stripes. Segments of setae alternately light and brown. Legs pale, colour pattern similar to *H. canadensis*.

This species was not nearly so abundant or wide-spread as *H. canadensis*. Nymphs were taken in quite similar localities and at about the same time. They were taken from June 15 to July 2, and imagos reared from June 26 to July 4.

**Heptagenia** sp. indet.

(Pl. XVI, Fig. 5).

*Nymph*:

Measurements: Body 10-11 mm.; setae 12-13 mm.

Head light brown; sometimes 3 light areas along entire margin but frequently middle one is lacking and the 2 lateral ones are connected with the light margins lateral to eyes. An almost black spot in centre of each half of pronotum; around this is an irregular light area, exterior to which is a brown area. Abdomen whitish yellow with 5 longitudinal yellowish brown stripes in each segment 1-8. Setae light greenish yellow; joints abundantly fringed with hairs. Legs yellowish brown in colour; pattern similar to the 2 preceding species.

Mr. R. P. Wodehouse kindly gave me these nymphs which he collected along the east shore of Manitoulin Island on June 26th, 1912. As they were not reared the species cannot be ascertained at present.

REFERENCES.


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EXPLANATION OF PLATES.

PLATE XV.

HEPTAGENIA NYMPHS.

Fig. 1. *Heptagenia tripunctata* Banks.
Fig. 2. *Heptagenia lutea* Clemens.
Fig. 3. *Heptagenia luridipennis* Burm.
Fig. 4. *Heptagenia flavescens* Walsh.
Fig. 5. *Heptagenia flavescens*, ventral view.

PLATE XVI.

HEPTAGENIA NYMPHS.

Fig. 1. *Heptagenia fusca*, Clemens.
Fig. 2. *Heptagenia rubromaculata* Clemens.
Fig. 3. *Heptagenia frontalis* Banks.
Fig. 4. *Heptagenia canadensis* Walker.
Fig. 5. *Heptagenia*, undetermined.

PLATE XVII.

MOUTH-PARTS AND GILL OF NYMPH OF *H. LUTEA* CLEMENS, AND GENITALIA OF *H. TRIPUNCTATA* BANKS.

Fig. 1. Left maxilla.
Fig. 2. Labium.
Fig. 3. Labrum.
Fig. 4. Hypopharynx.
Fig. 5. Left mandible.
Fig. 6. Gill.
Fig. 7. Genitalia.

PLATE XVIII.

MOUTH PARTS AND GILL OF NYMPH OF *H. CANADENSIS* WALKER, AND GENITALIA OF IMAGO.

Fig. 1. Left maxilla.
Fig. 2. Hypopharynx.
Fig. 3. Labrum.
Fig. 4. Labium.
Fig. 5. Left mandible.
Fig. 6. Gill.
Fig. 7. Genitalia.