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LIFE HISTORY NOTES ON EPHORON, POTAMANTHUS, LEPTOPHLEBIA AND BLASTURUS WITH DESCRIPTIONS (EPHEMEROPTERA)

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Ephoron

In June 1932 a very immature nymph of *Ephoron leukon* Will. was found in the Credit R. near Erindale, Ontario. In 1934 full grown nymphs of this same species were found in great numbers in the same locality after their hiding place was once located. They are burrowing nymphs which inhabit a tubular burrow associated with stones in the rapids. Loose stones, when turned over revealed no nymphs and lacked the marks of the tubes on them. Stones, however, which were partly imbedded in fine grey silt (originating from the breakdown of shales in the vicinity) when turned over revealed nymphs clinging on the sides and bottom in the remnants of the tubes. Curiously enough the time of day at which collecting was done was important. On one occasion a great many stones were turned over early in the afternoon revealing not a single nymph where formerly they were plentiful; returning the same day about seven o'clock in the evening the stones produced a great many nymphs in a short time.

Apparently the species is nocturnal avoiding the light during the day in the deeper part of the tube and coming up to the open end in the evening to feed. It is not surprising therefore that the nymphs of this species, although extremely abundant where they occur, have escaped observation up to the present time.

The adult individuals began to emerge about the end of July and continued until the middle of August. The adult associated with the nymph is *Ephoron leukon* Will. a species very close to *Ephoron* (*Polymitarcys*) *album* Say. The basis of the association is provided by the following observations, since the species was not reared. Firstly, the emergence of adults coincided with the full grown condition of the nymphs and when the flight of adults had finished for the season the nymphs had all left the stream. Secondly, when the subimagos of *Ephoron* were rising from the water hundreds of exuviae of this nymph were scouped up in a net held a little below the surface of the water. Thirdly, the fact that the nymph is apparently negatively phototropic, avoiding light, and the adults of *Ephoron* are nocturnal. Fourthly, the very close relationship of European *Ephoron virgo* (Vayssiere, 1882) nymphs to those of the species under discussion is unquestionable, the shape of the vestigial first gill providing a possible differentiating character. A nymph has been described by Howard in Needham (1905) as that of *E. album* Say but there is without doubt a misidentification of nymphs and adult in this case, the nymphal description and also the life history notes of the adult referring to a *Potamanthus* species. Argo (1927) was aware of this and Needham has corrected Howard's error by including the correct diagram of the

head of the nymph of *Ephoron album* in his later work (Needham & Needham, 1927).

The flight of *Ephoron* has been observed by the author on several occasions. Careful search has been made for subimagos and adults on the leaves of trees near the stream during the day but none were found. The first individuals appear flying rapidly near the surface of water about sundown or shortly after. In a short time they are numerous and at this time all the individuals taken are subimagos. A little later, when it is nearly dark, individuals are seen with the subimaginal skins attached to their caudal filaments. These skins later drop off after which all the individuals taken in the net are imagos. Matings were observed and the dropping of the eggs into the rapidly flowing water. It seems probable that the subimaginal period lasts but a few minutes as is the case in *Ephoron* (*Polymitarcys*) *virgo* described by Reamur, 1742. An account of Reamur's observation is given in Miall, (1895).

E. leukon which is apparently more northern in distribution than *E. album* has been taken in the following localities in Ontario and Quebec: Gatineau R., Kirk's Ferry, Que., J. McDunnough, G. S. Walley, F. P. Ide; Lievre R., Masson, Que., 9.IX.1928; Mississippi R., Innsbrook, Ont., 28.VII.1934, F. P. Ide; Woodbridge, Ont., 31.VII.1934, E. M. Walker; Woodbridge, Ont., 11.VIII.1934; Credit R., Erindale, Ont., 30.VII-12.VIII, 1934, F. P. Ide. The species is probably very widely distributed in Canada. A description of the nymph is offered below.

Ephoron leukon Will.

Pl. 4, Figs. 1 (a-f) and 2.

Nymph—Length of male 12 mm. exclusive of the caudal filaments. Lateral filaments 9 mm., median 7 mm. Length of female 16 mm. exclusive of the caudal filaments. Lateral filaments 5 mm., median 8 mm. The general colour is pale yellowish or brownish white with some greyish maculation. Head quadrate with an entire rounded rostrum similar to the same structure in *Hexagenia*. Across the anterior border and passing dorsal to the rostrum a dense mass of long hairs. Eyes and ocelli dense black, the compound eyes of the male much larger than those of the female. Between the ocelli a transverse oblong or rectangular dark area. Mandibular tusks very prominent, longer than the head, their apices convergent; along the dorsal and lateral surfaces blackish tubercles or denticles and long hairs almost to the apex; basally a series of bristles on the lateral surface in the form of an oval. Antennae slightly more than twice the length of the mandibular tusks and whitish.

Pronotum with acute antero-lateral angles. Mesothorax darker grey than head with numerous light areas particularly at the bases of the wing pads which are greyish (especially along the costal border) in the full grown nymph about to emerge.

Forelegs very stout and hairy; femur with anterior tubercles in the basal half; tibia with a line of very long bristles on the dorsal surface arranged in the form of an oval. Mesothoracic legs very weak and small, with segments shorter than those of the fore- or hindlegs. Hindlegs not so strong as forelegs; having broad femora which at rest are usually directed posteriorly and under the wing pads.

Abdomen light greyish above, in some individuals a broad paler band

to each side of the darker median band (Fig. 1); at the base of each gill a jet black dot and mesad a sinuate blackish line passing from the anterior to the posterior border of segment.

Ventrally the abdomen is pale, each of the gill-bearing segments, however, with a dark line marking out an oblique area at the base of the gill extending towards the anterior border of the segment.

Gill 1 vestigial, a small triangular lamella (Fig. 1a). Gills 2-7 similar to one another and usually folded back over the dorsum of the abdomen. They are elbowed about the middle so that the proximal half of the gill passes back obliquely towards the mid-dorsal line and the distal half passes directly back from the bend. The structure of one of the gills is shown in figure 1b, showing the tracheoles the ultimate branches of which end in filamentous extensions of the margin as in the gills of some other genera of mayflies. Penes and claspers pale; penes divergent and conical much as in the adult.

In both sexes the median caudal filament is very much thinner than the lateral ones but the relative lengths of median and laterals is reversed in the two sexes. In the female the median filament is nearly twice as long as a lateral one, whereas in the male a lateral filament is slightly longer than the median. Filaments pale with hairs laterally especially in the female where the lateral filament is hairy to the apex. In the male the hairs are almost entirely confined to the basal halves of the lateral filaments.

Eggs were collected from a female taken in copulation and placed in a jar of water on July 30. Kept in the jar in the laboratory at room temperature the embryos were developing August 7. By the 26th of the month the embryos were well developed and it was expected that they would hatch at any time. They remained dormant, however, and did not finally hatch until the 9th of November when a great number of first instars appeared. No controls were kept but I suspect that they would not have hatched even then but for special treatment that they received. The bottle containing the embryonated eggs was placed outside the window for three days during which time the temperature dropped to very near the freezing point. Then it was brought inside and the temperature of the room raised much above the normal by leaving the window closed over a two-day period. The usual room temperature is about 20°C. but by this means it was raised to 30°C. and the water in the rearing jar was at a temperature of 28°C. It seems probable that part or all of this treatment provided the necessary stimulus for hatching. Joly (1876) describes the difficulty he had experienced in hatching eggs of *Ephoron (Polymitarcys) virgo* of Europe which is a member of the same genus. He finally determined that it took a period of from six to seven months.

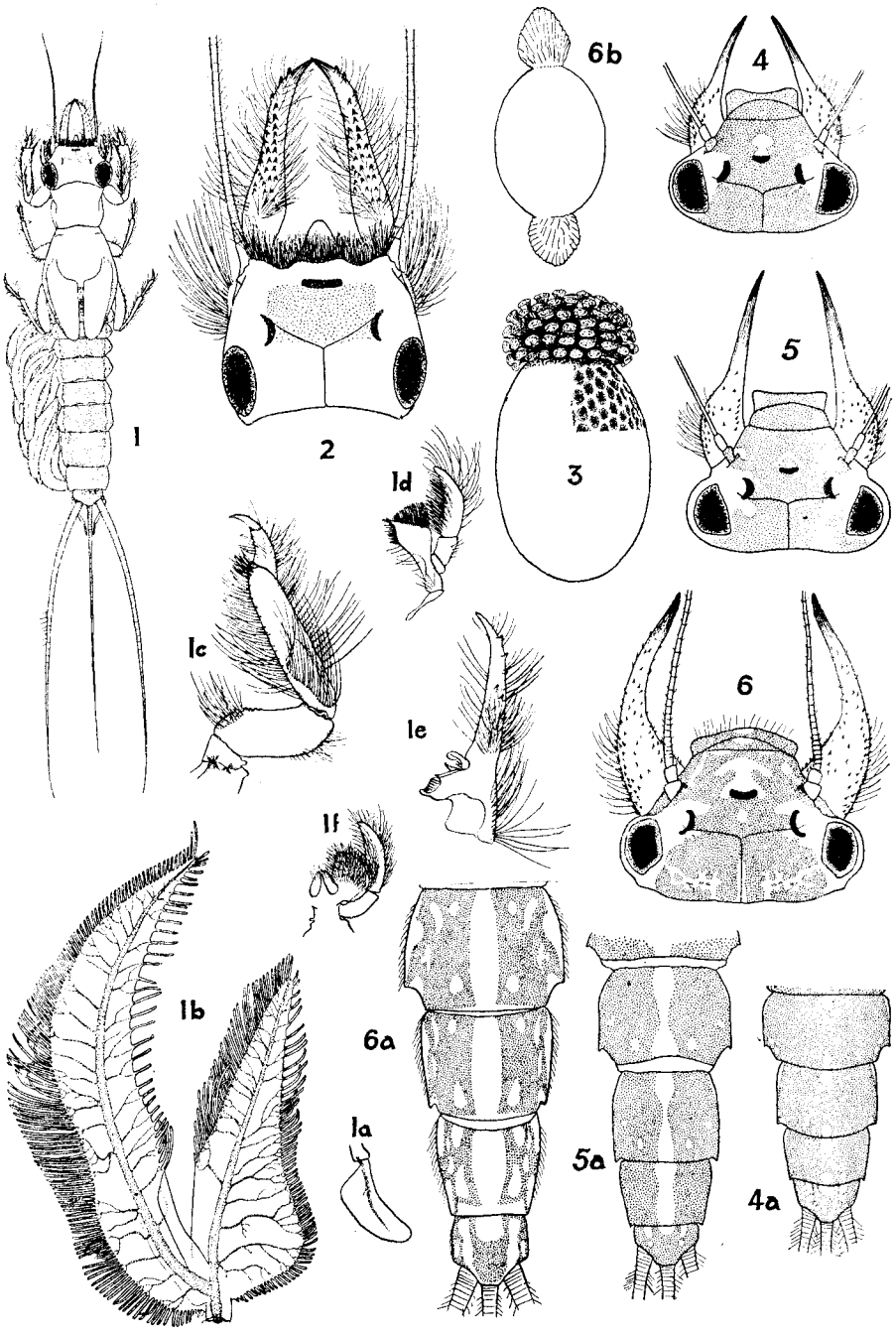
First Instar nymph. Fig. 1, Pl. 5.

Length .9 mm. excluding length of caudal filaments.

Head more elongate than in *Ephemera, Hexagenia* or *Potamanthus* and with sides parallel; anterior part of frons with a series of raised transverse ridges forming a grating. Antennae with two basal segments and a three-segmented flagellum; maxillae and labium as in enlarged figures 1a, 1b, Pl. 5. Mandibles visible from above and lacking a tusk at this stage.

Right hind leg (Fig. 1e, Pl. 5) with one stiff hair on posterior border

CAN. ENT. VOL. LXVII PLATE 4.



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of the femur and a weaker hair; tibia with one strong spine in distal third and a weak hair; tarsus also with one distal spine and a weak hair. The tarsal claw not pectinate.

Abdomen without gills. Three caudal filaments, the median considerably longer than the laterals. Each filament with four segments differentiated including the terminal piece. Three hairs apically in segments two and three and also three hairs at the apex of each filament.

Living specimens were examined in some numbers and portions of the internal anatomy made out.

The ventral nerve cord was conspicuous and the ganglia are relatively large as shown in figure 1c, Pl. 5. The first abdominal ganglion is intimately fused with the metathoracic ganglion. The brain could not be clearly seen so was not figured.

The heart was clearly visible and was functioning. The ostia of the ninth segment seem to be the only ones open to the pericardial sinus and corpuscles were seen entering at this point. The ostia diminish in size anteriorly, none being noted anterior to the fourth abdominal segment, the heart continuing forward as a simple tube. In the tenth segment the ostia (valves?) were directed posteriorly and a duct was made out leading into the median caudal filament. Ducts leading into the lateral caudal filaments as noted by Vassiere (1882) could not be made out. The greatest contraction of the heart was noticed in the ninth segment, the contractions diminishing anteriorly to about the third segment when no further contraction of the vessel was apparent. It is quite probable that in later development other ostia open up and become functional.

The mid gut is distinguishable by its darker more opaque wall which in the first instar has masses of adhering yolk cells. The foregut is transparent and opens into the mid gut by a valve. Beside it lie the salivary glands whose outlet could not be made out. At the anterior end of the hind gut the two malpighian tubules have their origin passing forward as narrow tubes to the second segment where they turn dorsally and pass posteriorly in a wider tube to end blindly in the sixth segment. In the second instar the yolky material which was present in the first instar is greatly reduced in quantity and the form of the mid gut is visible (Fig. 1f, Pl. 5).

Second Instar (Pl. 5, figs. 2, 2a, and 2b).

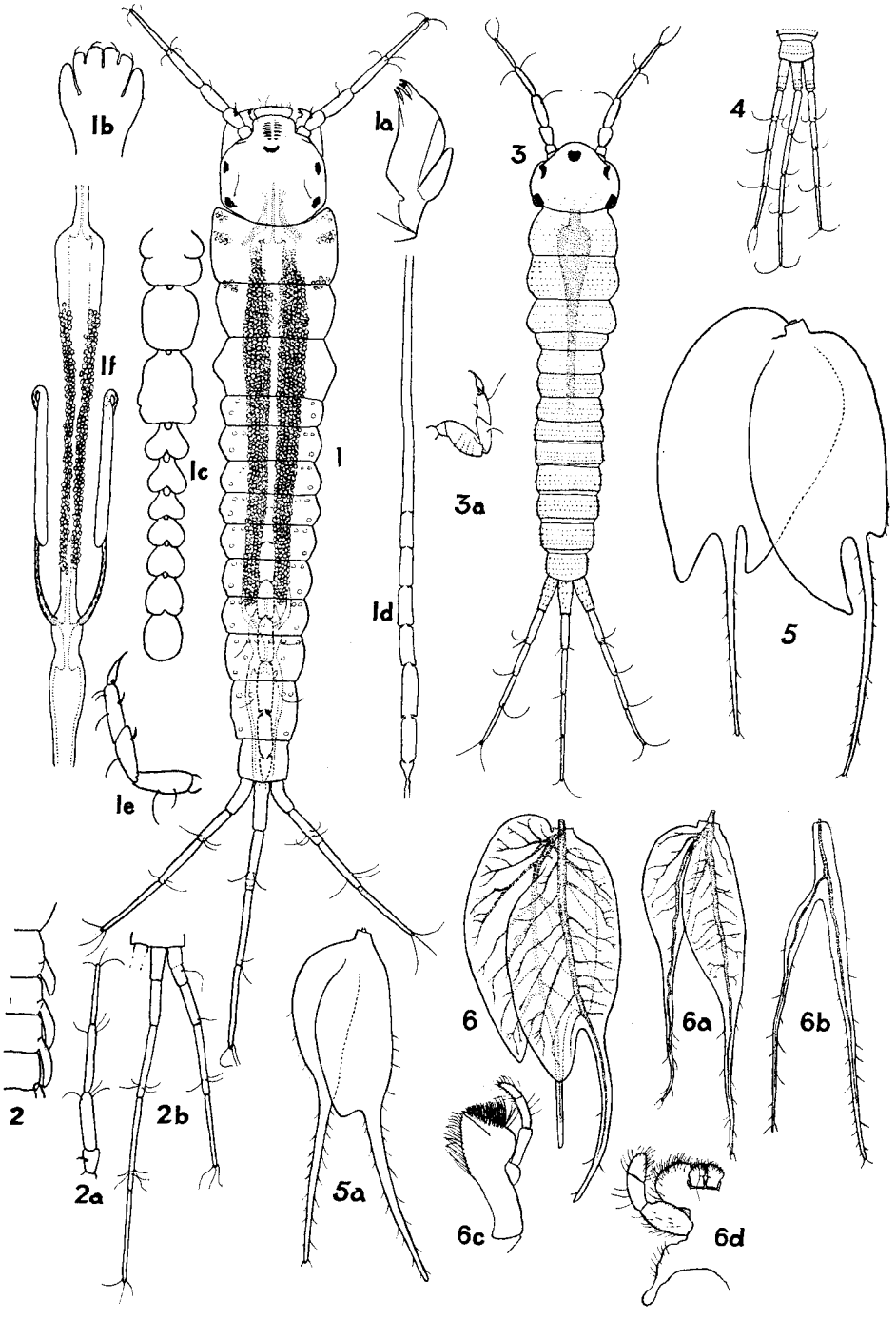
The antennae have the same number of segments as in previous instar but the segments have increased greatly in length. Gills have appeared on segments 2-7 as sac-like outgrowths from the postero-lateral angle of the segment and have a length equal to about one abdominal segment.

The caudal filaments have increased in length, the segments being longer and thinner. An additional segment has been added and the two basal segments have been fused so that the suture is almost obliterated.

Potamanthus

Adults and nymphs of three species of *Potamanthus* were collected at the Credit River in the same locality as *Ephoron leukon* was taken. The first species to emerge is as far as I am aware new and a description of the adults and nymphs is offered below. This species is represented by two males and two females taken from June 6-27, 1934. The other species were taken later in the season and

CAN. ENT. VOL. LXVII PLATE 5.



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are represented by long series of females particularly, taken ovipositing over the rapids in late evening. One of these is a very large species which Dr. McDunnough has identified as *Potamanthus rufous* Argo and was taken July 9-23, 1934. The other species is much smaller than *P. rufous* and answers very well the description of *P. flaveola* Walsh, having large eyes, rufous patches on the sides of the abdominal segments, and, in the female sex only, infuscated crossveins. This species was on the wing July 9-23, 1934, but the maximum of abundance came about two weeks later than that of *P. rufous*. It is probable that *P. rufous* begins to emerge somewhat earlier than these records show and that *P. flaveola* continues to emerge somewhat later.

Nymphs were not reared but their relative size is in itself almost sufficient evidence that the association of nymphs and adults given below is correct. In addition the presence of the full grown nymphs of the various species in the stream and their disappearance coincided with the appearance of the adults. The nymph of *P. flaveola* has already been figured by Morgan (1913) but a brief characterization is given here. As would be expected the nymph of *P. rufous* belongs to a different group than that of *P. flaveola*, and shows in the nymph among other points the much wider separation of the compound eyes which is a striking character of the adults also.

Potamanthus walkeri n. sp.

Male imago; length 10 mm. excluding caudal filament; the latter in the ratio of 3:2:3 and the laterals slightly over 20 mm. Wing spread 19 mm.

Head with ferruginous vertex and bases of antennae. Compound eyes large the distance between being less than the diameter of an eye. Eyes greenish in life. Prothorax with faint ferruginous band dorsally in the type. In another specimen this is not apparent. Foreleg pale with ferruginous tip to femur; joint between tibia and tarsus piceous or purplish and also the joints between tarsal segments. Mesothorax and legs entirely pale yellowish white. Wings with membrane and all veins and crossveins hyaline.

Abdomen, pale yellowish white; posterior segments opaque. Caudal filaments whitish with ferruginous joints.

Female imago. Length 9 mm. excluding caudal filaments; the latter 13 mm. and subequal.

Vertex of head and bases of antennae ferruginous. Eyes smaller than in male and separated by a distance more than the diameter of the eye. Prothorax with median longitudinal ferruginous band in the type which is very inconspicuous in another individual. Prothoracic legs pale, the distal extremity of the femur ferruginous and also the proximal end of the tibia. The distal extremity of the tibia dark piceous or purplish and the joints between the tarsal segments piceous. Mesothorax with very faint ferruginous markings dorsally. Otherwise yellowish white. Legs pale. Wings with dark crossveins in the anterior region of the forewing only. Abdomen entirely pale with no indication of the submedial ferruginous patches found in *P. rufous* and *P. flaveola*. Caudal filaments pale with ferruginous joints.

Nymph—Length of female nymph 12.5 mm.

Head (Pl. 4, Fig. 5). Pigmentation similar to *P. flaveola*, the pale area in front of the median ocellus, however, not so distinctly mushroom-shaped and

the pale area around the compound eye usually extended medially in a distinct pale area behind the lateral ocellus. Mandibular tusks similar to those of *P. flaveola* with this important difference that the distal smooth portion is relatively longer, the ratio of the distal region to the swollen base being 1.65. The compound eyes are also slightly farther apart, than in *P. flaveola.*

Thorax. Prothorax brown with pale lateral border; mesothorax brown with small pale dots in wing-base region and a pair of submedian posterior pale spots. Prothoracic legs with brown tarsus, tibia pale apically and otherwise brown and femur with a brown subapical band extending proximally along the anterior border and also in a dorsal longitudinal brown dash. Other legs with alternate pale and dark bands.

Abdomen. (Pl. 4, Fig. 5a.) Brown with a median pale band which may be constricted in the middle and slightly expanded posteriorly in the segments. A row of submedian pale spots situated near the posterior border of the segment except in the tenth where they are on the anterior border. A small pale dot anterior to the base of the gill in the anterior segments, and the lateral border of the segment pale. Caudal filaments pale, with brownish base and hairy except in the distal eighth. Gills are similar except the vestigal first gill.

Holotype—Credit R., Erindale, Ont., 27.VI.1934, F. P. Ide.

Allotype—Credit R., Erindale, Ont., 17.VI.1934, F. P. Ide.

Paratypes—1 ♂, 11.VI.1934; 1 ♀, 19.VI.1934, Credit R., Erindale, Ont., F. P. Ide.

Types deposited in the collection of the Royal Ontario Museum of Zoology, Toronto. Paratypes in National Collection at Ottawa.

The species comes in the same group as *flaveola* Walsh and *diaphanus* Needh. on the eye size. It differs from *diaphanus* in the presence of the infuscated crossveins in the forewing of the female which are lacking in *diaphanus.* It differs from *flaveola* in lacking the fuscous patches on the sides of the abdominal segments, in its larger size and earlier period of emergence in the season.

It is a great pleasure to name this species after Dr. E. M. Walker, who introduced the author to the locality on the Credit River, where it was found.

Howard in Needham (1905) described a *Potamanthus* nymph as the nymph of *Ephoron album.* The figure of this nymph agrees in the structure of the mandibular tusk, the form of the tibial spur and the maculation of the abdomen with the nymph of *P. rufous* described below. Needham (1917-1918) in transposing Howard's description, has not reproduced the original figure but has figured as the nymph of *E. album* another *Potamanthus* nymph which corresponds very closely with the nymph of *P. walkeri.* The mandibles agree, and also the tibial spine; the abdominal maculation differs slightly in the breaking up of the median pale line of *P. walkeri* into spots. This may be significant or may be merely a variation of the same colour pattern. Needham probably has figured the nymph of *P. walkeri* or *P. diaphanus.*

Potamanthus flaveola Walsh.

Nymph. Length of female nymph 10 mm.

Head. (Pl. 4, Fig. 4.) Brownish with a mushroom-shaped pale area anterior to the median ocellus and a larger pale area surrounding the compound eye and extending foreward to the base of the antenna.

Mandibular tusks smooth and devoid of spines in the distal region. The base of the tusk is abruptly swollen and provided with spines. The ratio of the length of the distal region to the length of the swollen base is 1.15. Distance between compound eyes about twice the diameter of the eye.

Thorax. Prothorax dark with pale lateral margin and inconspicuous pale areas in median and submedian position. Mesothorax brown with small pale areas in wing base region and a pair of submedian pale dots posteriorly. Prothoracic leg marked much as in *P. walkeri* but the femur provided with a subapical brown band and a dorsal brown dash proximally, which typically does not meet the brown band. Other legs alternately brown and pale banded.

Abdomen. (Pl. 4, Fig. 4a.) Brown, with, instead of a continuous pale median band, a series of pale spots one at the anterior border and one at the posterior border of a typical segment. A submedian row of indistinct pale areas near the posterior borders of the segments which are more apparent towards the posteior end of the abdomen. Two small pale dots near the base of the gill and a pale lateral border. Caudal filaments, pale with brownish base and hairy except for the distal extremity. Gills, except the vestigial first, all similar.

Potamanthus rufous Argo.

Nymph. Length of female nymph 15 mm.

Head. (Pl. 4, Fig. 6.) Brown with a very prominent pale area anterior to the median ocellus, somewhat mushroom-shaped with expanded base. A pale area around the compound eye extending anteriorly to the base of the antenna and medially in front of and behind the lateral ocellus. The remnant of a pale median band and a pale vermiculation on the vertex which is often more extensive than in the specimen figured. The mandibular tusks are very unlike those of *P. flaveola,* being provided with stout spines almost to the apex; the external margin evenly curved the swelling at the base being on the median side and the tusk is strongly bent about the middle; apex roughened. The compound eyes are relatively small being separated by a distance of over three times the diameter of a compound eye.

Thorax. Prothorax brown with pale lateral margin and conspicuous large pale areas in the submedian position and a median pale band. Mesothorax brown with conspicuous pale areas laterally in the region anterior to the wing bases. Two pairs of submedian pale dots in posterior half of the segment. Prothoracic legs for the most part pale but with a narrow, brown sub-basal band in the tarsus, a brown patch laterally and a basal brown band in the tibia and brown subapical band in the femur which is frequently incomplete posteriorly. Also a dark dash dorsally and proximally in the femur. The hairs on the tibia much shorter than in *P. flaveola* or *P. walkeri* and the tibial spine very much shorter and blunter. Other legs with dark and pale markings.

Abdomen. (Fig. 6a, Pl. 4.) Brown with pale areas. A median unbroken pale band, the band slightly expanded posteriorly in the anterior segments, and ending about the middle of segment 10. A row of submedian pale spots near the anterior and posterior borders of the segments. In many specimens these areas are much more extensive than in the one figured. Laterad another less distinct row of pale areas or strokes and small pale areas near the

bases of the gills. Caudal filaments hairy except for the distal fifth; brownish at the base. All gills except the vestigial gill on the first segment similar in form.

It was a nymph of this type which Howard figured as that of *E. album* and it was probably this species or *P. myops* Walsh.

Females of this species were flying over the rapids just before sundown on July 9. They were not observed to touch the water when ovipositing and could be distinguished from *Stenonema* females ovipositing at the same time by their undulating flight.

An egg of *P. rufous* is figured (Fig. 6b, Pl. 4). These are extruded in a rounded mass and when dropped into water adhere end to end in long strings.

Eggs of this species and of *P. flaveola* were collected and kept in glass jars in the laboratory. Those of *P. rufous* were collected July 9 and hatched July 23. Those of *P. flaveola* were collected July 21 and hatched August 4. The first instar nymphs are briefly characterized below.

First Instar nymph. (Figs. 3, 3a, Pl. 5.)

Length .6 mm. exclusive of the caudal filaments which are about .28 mm. in length.

Head. Pentagonal and shorter than that of *E. leukon.* The compound eyes convex and directed posteriorly; antenna with five segments including the two basal ones; two terminal hairs.

Thorax and abdomen set with transverse rows of very minute spines which are present also on the femora and basal segment of the caudal filaments. In the latter structures, of which the median is slightly longer than the laterals, there are five segments differentiated including the terminal piece. Hairs present apically in the segments and a seta present distally in the second segment: two terminal hairs.

The first instar of *P. flaveola* (Fig. 4, Pl. 5) is very similar to the same stage of *P. rufous* being about the same size also. The only significant difference seems to be in the length of the median caudal filament which is relatively longer than in *P. rufous.* This is accounted for mainly in the greater length of the second segment in the median filament.

Leptophlebia Westw. (restricted, Etn.)

Leptophlebia johnsoni McD. This species was described by McDunnough (1924).

Nymphs and adults of this species were taken by the author at Kearney, Ontario, in June, 1934, and a description of the nymph is given below.

Nymph. Length 7 mm., caudal filaments 11 mm. additional.

Head dark brown with pale areas above the ocelli, and on the vertex. Antennae long, reaching back beyond the tips of the wing pads; segment next to the basal one brown, remaining part of antenna pale. In the maxillary palp the three distal segments are subequal in length; labial palp with second segment only slightly shorter than distal.

Pronotum brown with pale lateral flange, pale diagonal submarginal dash and anterior submedian pale areas. Mesonotum brown with pale areas at the bases of the wing pads. Legs not conspicuously banded, rather evenly suffused with brown in the older nymphs.

Abdomen dorsally brown with a pair of submedian pale areas in each segment anteriorly placed and oblique. A pale area on the flange of the segment and a small pale spot near the flange. Ventrally the abdomen is paler with a very pale submarginal line on each side. A row of median ganglionic marks in segments 2-7, the mark in segment 7 being double. Immediately laterad of these ganglionic spots are pale marks, a pale dash near the anterior border of the segment and a pale dot in the middle of the segment.

The gills are much more expanded lamella than found elsewhere in the genus and resemble those of *Blasturus nebulosus* from which they may be separated on the following minor differences. In gill 7 of *Blasturus* the dorsal lamella is produced into a rounded posterior angle at the base of the linear terminal part of the gill. This angle is lacking in gill 7 of *L. johnsoni*. (Figs. 5a and 6a, Pl. 5.) In the typical gill, e. g. 4 of the two nymphs *Blasturus* and *L. johnsoni* there are also differences as shown in Figs. 5 and 6, Pl. 5, the dorsal lamella in the latter species lacking the lateral angle. There are also more tracheae present in *Blasturus* than in *L. johnsoni* gills.

Blasturus Etn.

Ulmer (1920) remarks "N.B. Diese Gattung steht *Leptophlebia* so nahe dass sie vielleicht nicht von ihr getrennt zu werden braucht." He is referring to the genus *Blasturus,* erected by Eaton to accommodate species of the *Leptophlebia* type in which the median caudal filament is shortened. Other characters, Eaton found, were not of generic value, the wing venation being similar to *Leptophlebia* and the genitalia of the males very close to the same structures in some of the species of *Leptophlebia.* The nymphs of the two genera in Eaton's conception are quite distinct on gill characters until the nymph of *L. johnsoni* is considered. The gills of this nymph approach very closely the corresponding gills of *Blasturus,* and are unlike those of other known *Leptophlebia* nymphs. The smoky tip of the forewing of *L. johnsoni* is also suggestive of the affinity of this species and some of the *Blasturus* species which possess it also. There is another similarity in the ecological position and migratory habits of this species. Neave (1930) has described the migration of *Blasturus cupidus* nymphs in the early spring carrying them from the stream in which the early stages are passed up tributaries to temporary pools where development is completed and from which the subimagos emerge. There is apparently a similar migration in nymphs of *L. johnsoni.* On June 17, 1934, many adults of this species were taken resting on alders along a small stream. An extensive search in the stream produced no nymphs. The same day, however, the nymphs, full grown and ready to emerge, were found in great numbers in small mossy pools among the alders and these pools were obviously of a temporary character produced by the melting of snow. It seems probable that these insects lay their eggs in the stream and that the nymphs migrate into these pools in early spring. Several were reared to the adult stage in the laboratory and it is on the strength of this association that the nymph is described here. This species is not a common species but I have taken it in one or two other locations of a similar sort where there were temporary pools formed among alders along a stream. Imagos were not found in other locations along the same streams. Many species of *Leptophlebia* show a tendency to migrate inshore prior

to emergence, suddenly making their appearance under stones along the banks at the season of the emergence. *L. johnsoni* has apparently developed this migratory habit still further, pushing up the small temporary tributaries of the stream into temporary pools in much the same way as the species of *Blasturus*. By this change of habitat the nymphs reach water which is much warmer than the stream and so grow faster than they otherwise would thus emerging earlier in the season. In consideration of the above facts and especially the similarity in nymphs of *L. johnsoni** and *Blasturus* and the similar adaptation to the peculiar habitat involving a migration it seems advisable to consider the former species an intermediate one between *Blasturus* and the other *Leptophlebia* species and to drop the generic name *Blasturus*. *Leptophlebia* then would become a more inclusive genus including the species at present comprising the genus *Blasturus*.

*Dr. McDunnough, on receiving the present paper, wrote me suggesting that *Leptophlebia johnsoni* McD. and *Blasturus gracilis* Traver (Mayflies of North Carolina, Jour. Elisha Mitchell Scientific Society 47 (1): 85-161, 1932) were synonymous. I had not seen Dr. Traver's description of *B. gracilis* at the time of writing the above description and on comparing the nymphs of *L. johnsoni* with Traver's description it is found that the agreement is very close indeed: the only differences apparently being slight variation in abdominal maculation and general colour of gills, both of which are probably subject to some variation in individuals.

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PLATE 4.

Fig. 1. *Ephoron leukon;* last instar male nymph.
1a. First gill of right side; 1b, fourth gill of right side; 1c, right foreleg; 1d, maxilla; 1e, mandible; 1f, labium.
Fig. 2. Head of female of same.
Fig. 3. Egg of same.
Fig. 4. *Potamanthus flaveola;* head of last instar female.
4a. posterior segments of abdomen of same.
Fig. 5 *Potamanthus walkeri;* head of last instar female.
5a, posterior segments of abdomen of same.
Fig. 6 *Potamanthus rufous;* head of last instar female.
6a, posterior segments of abdomen of same; 6b, Egg of same.

PLATE 5.

Fig. 1. First instar nymph of *E. leukon.*
1a, maxilla; 1b, labium; 1c, ventral portion of nerve cord; 1d, heart; 1e, right posterior

limb, ventral aspect first instar nymphs; 1f, alimentary tract of second instar nymph.
Fig. 2. Gills of second, third and fourth segments of second instar nymph of above species; 2a, antenna of same; 2b, caudal filaments of same.
Fig. 3. First instar nymph of *Potamanthus rufous;*
3a, posterior limb of same.
Fig. 4. Caudal filaments of first instar nymph of *P. flaveola.*
Figs. 5 and 5a. Fourth and seventh gills of right side of last instar nymph of *Blasturus nebulosus.*
Figs. 6, 6a and 6b. Fourth, seventh and first gills of right side of last instar nymph of *Leptophlebia johnsoni;*
6c, maxilla; 6d, labium of same.

AMERICAN SPECIES OF LUDIUS; THE AERIPENNIS GROUP*

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In the preparation of the following notes, I have become indebted to Professor E. H. Strickland and Mr. C. A. Frost for the loan of specimens and to Mr. P. J. Darlington Jr., and the Museum of Comparative Zoology for the loan of much material and for permission to study the aedeagus of the type specimen of *carbo* Lec. Mr. K. G. Blair, by comparisons with types, has made it possible for me to identify *semimetallicus* Walk. and *aeripennis* Kby.

The *aeripennis* group, as here defined, includes species with the body three times as long as wide, with the antennae short and not attaining the apices of the posterior pronotal angles, with the elytra black or metallic and almost glabrous except in *pruininus,* and with secondary sexual characters not evident except in the antennae of *pruininus.*. The characters of the group are as follows:

Body about three times as long as wide; the vestiture consisting of very fine silvery hairs, evident on the venter but not distinct on the dorsum except in *pruininus;* the vestiture longer and distinct but not dense on the scutellum. Antenna not attaining the apex of the posterior pronotal angle; the third segment about twice as long as and subequal in width to the second, two-fifth or one-half as wide as long, narrower than and equal in length to or a trifle longer than the fourth; the fifth segment seven-tenths as long as the fourth; segments five to ten triangular, subequal in length, scarcely decreasing in width apically. Head about half as wide as the pronotum; the front flattened or feebly depressed, closely and moderately coarsely punctate. Pronotum with its greatest width equal to or a trifle greater than the length of its median line; the sides moderately to rather strongly arcuate; the punctures of the disk moderately coarse at middle, closer and somewhat coarser on the sides. Elytra subparallel or feebly widened to apical two-fifths; the striae well impressed, not coarsely punctate. Prosternal sutures not excavated. Punctures of the propleura similar in form to those of the pronotal sides. Metasternum and abdomen finely, not closely punctate at middle, the punctures closer and somewhat coarser on the sides. Secondary sexual characters not evident except in the antennae of *pruininus.*

In addition to the species discussed below, two others which are unknown to me should be considered. *Elater confluens* Gebl. (1830, Ledeb. Reis II, 80), described from the Altai Mountains of Asia, is certainly a member of the group and has been recorded from the Kenai peninsula of Alaska by Mannerheim. *Athous quadrivittatus* Walk. (1866, Lord's Naturalist in Vanc. Ins. II, 325),

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