

NOTES ON THE EPHEMERID GENUS  
LEPTOPHLEBIA.

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These notes are based on a study of the species of *Leptophlebia* found in eastern United States, particularly in the region about Ithaca, New York. When this study was begun, scarcely an American species of the genus was known in all stages of its life cycle. My work on the group involved especially the association of the immature and mature forms of the local species and observations on their habits. The work of F. P. Ide, in Ontario, during the summers of 1928 and 1929, resulted in the publication (Can. Ent. 62: 204-213, 1930) of descriptions of the nymphs and notes concerning several of the species involved in my study. These notes, therefore, will supplement this previously published information.

The studies of Dr. Paul R. Needham at Cornell University indicate that the genus is of considerable importance as fish food. Quantitative studies of the insect life in selected areas of the hill streams about Ithaca showed that 14.63 per cent of the 5,201 Mayfly nymphs taken during two summers' work belong to the genus *Leptophlebia*. Only the genera *Ephemerella* and *Baetis* were more abundant. In rapid water bottoms Mayflies constituted the largest single food element taken, while in pool bottoms they were second only to Dipterous larvae and pupae (Needham, 1927, p. 197); in stream drift (defined as including all forms of available food, both plant and animal, carried by the current), Mayflies made up 28.94 per cent of the total, being second only to Diptera in abundance. Studies of trout stomachs, made by the same authority (Needham, 1928, p. 224, 225), showed that Mayflies formed 29.70 per cent of all food consumed, being the "most available food" and "consumed by trout more than any other food."

Nymphs of the genus *Leptophlebia* were found chiefly in shallow, moderately swift riffles, eight inches or less in depth, over a bottom of loose stones, with almost no vegetation of any considerable size, but with a slippery coating of algae usually present on the stones. They were found also in regions of quieter water where the more gravelly, sometimes somewhat muddy, bottom was covered thickly with leaf-drift; and in situations where the depth of water was as much as two feet. Grassy stream borders, where comparatively coarse vegetation grew partly

in the water were also populated by *Leptophlebias*; they were often found in tufts of moss and submerged vegetation on stream bottoms. They were taken from areas where the banks were low and the water almost unshaded, as well as from well-shaded woodland and gorge streams. Width of streams where collections were made ranged from four or five feet to twenty or more. No one of the species studied appeared to be restricted closely to any one type of environment.

Imagos of the species studied seem to emerge in a fairly definite succession, although the time of emergence of any given species varied in different streams and seasons, and the seasons for several species overlap. The length of the period of emergence apparently varies from a few days to several weeks. Mating swarms observed differed enormously in size, but without exception appeared between noon and early evening. The genus is diurnal. The height of the season of emergence apparently is passed by the first of August except in the case of *L. debilis*. The eggs of the local species are very similar, and all are of the type shown in figure 2, plate 3. The insects evidently winter either in the egg stage or as partly grown nymphs.

*Collecting and rearing*—Collections were made during 1929, 1930 and 1931, in streams within a radius of about twenty-five miles of Ithaca. In Fall Creek, which borders the Cornell University campus on the north, collections were made at various points between the campus and Freeville, about eight miles northeast of Ithaca. Collecting was done in Cascadilla Creek, to the south of the campus, over a distance of about three miles. Further collecting was done in Salmon Creek, ten miles northeast of Ithaca; in The Glen, a spring-fed Ithaca stream; near Harford, which is about thirteen miles east of Ithaca, in the East Branch of Owego Creek, a part of the Susquehanna drainage; in Six Mile Creek, south of Ithaca; in Slaterville Wild Flower Preserve, ten miles to the southeast; in North Spencer stream, fifteen miles to the south; in Enfield Glen, seven miles to the south; in Coy Glen, three miles southwest, and in Van Buskirk's Creek, twelve miles in the same direction; in Taughannock Creek, ten miles to the northwest; and in a small stream near Watkins, about twenty-five miles to the southwest.

The nymphs were collected by means of a small hand screen, separated according to species and locality, and placed in cages for rearing. Rearing was carried on first under nearly natural conditions in a small spring-fed pool and later in wooden troughs, set up in a pumphouse on the shore of Beebe Lake, and

supplied with running water pumped from Fall Creek. Cages of fine meshed wire netting were used for rearing many of the nymphs, although oval cylinders about fourteen inches long, and seven inches in their greater diameter, made of silk bolting cloth on a framework of aluminum wire, proved more satisfactory. The cages were placed obliquely in the water with their upper portions extending well above the water level, thus offering an easy slope up which the subimagos could crawl when they emerged. The cages were visited once and often twice a day so that subimagos might be removed as soon as possible. The subimagos were placed in paper bags, labelled with the place and date of collection, and the date and approximate time of emergence. These bags were hung up in a moist atmosphere and left until the subimaginal molt had been made. The rough surface of the bags provided a satisfactory support to which the insects could cling while they worked themselves out of the subimaginal skin. This method permitted specimens of nymphal and adult stages of the species reared to be secured, together with observations on the length of time required for the subimaginal molt. This ranged from twelve to seventy-two hours, but was most commonly about forty-eight hours.

Specimens were kept in 70 per cent alcohol or mounted in Canada balsam. Mouthparts of nymphs and genitalia of male adults were boiled for a minute in a ten per cent solution of caustic potash before being mounted. Wings were mounted dry, under a cover glass secured to a slide by two strips of gummed paper. In addition to personal collections, material for study was found in the Cornell University collection. I am indebted to Dr. J. McDunnough, of Toronto, for specimens of several species, of both eastern and western forms.

*The Species*—Twenty-one of the twenty-four known species in the genus *Leptophlebia* are found in North America. Ten of them are found in eastern North America: *L. adoptiva* McD., *L. debilis* Walk., *L. guttata* McD., *L. johnsoni* McD., *L. moerens* McD., *L. mollis* Hag., *L. praepedita* Etn., *L. volitans* McD., *L. ontario* McD., and *L. assimilis* Bks. The first eight of these are the major concern of this paper, since all of them have been recorded in northeastern United States. Six of these species have been reared by me during the past two years. Adults of *L. volitans*, *L. johnsoni*, and *L. ontario* have been available for examination. The specific differences among adults of these nine forms and of nymphs of seven of them are here summarized in keys and tables. The latter are based on study of the species

reared except in the case of *L. volitans*, characters of which were taken from the description by Ide (1930, p. 207).

KEY TO MALE IMAGOS OF NINE NORTHEASTERN AMERICAN SPECIES OF LEPTOPHLEBIA

- a. Middle segments of abdomen conspicuously pale whitish
- b. Basal segment of forceps conspicuously enlarged at base
  - c. Segments 3-6 pale whitish with narrow brown band posteriorly ..... *L. moerens*
  - c. Segments 2-7 pale whitish, grayish posteriorly ..... *L. debilis*
- b. Basal segment of forceps not conspicuously enlarged at base
  - c. Segments 2-7 pale
    - d. No black markings in spiracular area of pale segments ..... *L. mollis*
    - d. Distinct black dot in spiracular area of each pale segment
      - e. Legs pale, tinged with brownish, dark spot at junction of tibia and femur ..... *L. guttata*
      - e. Legs uniform brown, the foreleg deep brown, 2nd and 3rd pale golden ..... *L. johnsoni*
  - c. Segments 3-7 pale, with narrow brown posterior bands ..... *L. volitans*
- a. Middle segments of abdomen not conspicuously pale whitish
- b. Penial lobes distinctly shorter than basal segment of forceps
  - c. Penes with triangular, wing-like appendages; second segment of forceps enlarged on the inner side ..... *L. adoptiva*
  - c. Penes with cylindrical hook-like appendages; second segment of forceps not enlarged on the inner side ..... *L. ontario*
- b. Penial lobes as long or longer than the basal segment of the forceps; penes with slender, cylindrical appendages ..... *L. praepedita*

KEY TO FEMALE IMAGOS OF EIGHT NORTHEASTERN AMERICAN SPECIES OF LEPTOPHLEBIA<sup>1</sup>

- a. Seventh abdominal segment distinctly prolonged ventrally into an ovipositor ..... *L. praepedita*
- a. Seventh abdominal segment not distinctly prolonged ventrally into an ovipositor
  - b. Excavation of 9th sternite plainly more than 1/2 length of plate

<sup>1</sup> The female of *L. volitans* is undescribed.

- c. Legs whitish, tinged with brown
  - d. Femora distinctly brown, darker beyond the middle, lobes of 9th sternite broad and blunt . . . . *L. debilis*
  - d. Femora faintly brown, a distinct brown spot at junction of tibia and femur; lobes of 9th sternite narrow and pointed . . . . . *L. guttata*
  - c. Legs uniform light brown . . . . . *L. moerens*
- b. Excavation of 9th sternite not more than  $\frac{1}{2}$  length of plate
  - c. Legs pale whitish . . . . . *L. mollis*
  - c. Legs brown
    - d. Fore-wing less than 7 mm.; hind-wing about 1.5 mm. . . . . *L. ontario*
    - d. Fore-wing 7 mm. or more; hind-wing 2 mm. or more
      - e. Excavation of 9th sternite a shallow rounded notch, lobes pointed . . . . . *L. johnsoni*
      - e. Excavation of 9th sternite broadly U-shaped, well rounded at bottom, lobes rounded . . . *L. adoptiva*

KEY TO NYMPHS OF SEVEN NORTHEASTERN AMERICAN SPECIES OF LEPTOPHLEBIA

- a. Main tracheae of gills with conspicuous branches; lateral spines on segment 9 only
  - b. Color pale brown; canines of mandibles not strongly directed inward, a line along upper edge of molar surface passing through bases of canines . . . . . *L. adoptiva*
  - b. Color uniform dark brown; canines of mandibles strongly directed inward, a line along upper edge of molar surface passing well below bases of canines . . . . . *L. mollis*
- a. Main tracheae of gills without conspicuous branches
  - b. Well-developed lateral spines on segment 9 only; second and third joints of maxillary palp  $1\frac{1}{2}$  times the length of the first . . . . . *L. guttata*
  - b. Well-developed lateral spines on segments 8 and 9; second and third joints of maxillary palp about equal the length of the first
    - c. Legs pale, barred with darker brown . . . . . *L. debilis*
    - c. Legs uniform brown or nearly so
      - d. Gills hairy . . . . . *L. volitans*
      - d. Gills not hairy
        - e. Segments of abdomen nearly twice as wide as long; spines on 8 and 9 equal . . . . . *L. moerens*
        - e. Segments of abdomen nearly equal in length and width; spine on 9 longer than on 8  
*L. praepedita*

TABLE I  
*Characters of Male Imagos of Nine Northeastern American Species of Leptophlebia*

SPECIES	MEASUREMENTS					COLOR AND MARKINGS OF LEGS	PALE SEGMENTS OF ABDOMEN	SPIRACULAR MARKINGS
	BODY	TAILS	FORE-WING	HIND-WING	FORE-LEG			
<i>adoptiva</i> .....	7-9	9	7-8	2.2 -	7- 7.5	Uniform deep brown	None; anterior portions of 4-7 faintly pale	Trace of broken line on 4-7
<i>debilis</i> .....	8- 8.5	11	8	2.5 -	8.5 -	Light brown; uniform or with dark, proximal spot on tibia	2-7; tips of dorsal and sometimes ventral grayish	Faint broken brown line on 2-7
<i>guttata</i> .....	6	9	6.5	2.2 1.8	9.5 6.5	Pale, tinged with brownish; dark spot at junction of tibia and femur	2-7; slightly soiled with brownish	Distinct row of black dots posteriorly
<i>johnsoni</i> .....	7.5- 8.5	22	8.2	2.7	9- 10	1, deep brown; 2 and 3 pale golden brown	2-7; 2 tinged with pale brownish	Small black dots below faint brown shades
<i>moerens</i> .....	6	7	6	1.5	6	Light brown; tarsi whitish; often dark proximal spot on tibia	3-6; narrow brown band posteriorly	Broken brown line usually obsolescent
<i>mollis</i> .....	7	11	7	2	7- 7.3	Dirty-white; coxae brownish	2-7; joinings, especially dorsally, yellowish white	None
<i>ontario</i> .....	6	7	6	1.4	6	Light brown; tarsi paler	None; median segments very narrowly paler anteriorly	None
<i>praepedita</i> ....	6-7	11	6-7	1.6	6	Pitch-brown; fore femora darker	None; abdomen lighter brown than thorax	None
<i>volitans</i> .....	5-6	9	8.5	1.6	6	Dull whitish	3-7; 7 tinged with brown; narrow brown posterior bands	Short lateral longitudinal blackish dashes

TABLE II  
*Characters of Female Imagos of Eight Northeastern American Species of Leptophlebia*

SPECIES	MEASUREMENTS					COLOR AND MARKINGS OF LEGS	NINTH STERNITE
	BODY	TAILS	FORE-WING	HIND-WING	FORE-LEG		
<i>adoptiva</i> .....	8- 8.5	7	7-8	2.3 - 2.6	3.5	Deep amber brown; uniform	Excavation $\frac{1}{2}$ length of plate, broad, well-rounded at bottom; lobes round
<i>debilis</i> .....	8- 8.5	8	8	1.8 - 2.4	5- 6.2	Pale; femora distinctly brown, darker beyond middle	Excavation more than $\frac{1}{2}$ length of plate; deeply U-shaped; lobes broad and blunt
<i>guttata</i> .....	6	6- 7	6.5	1.8	3- 3.5	Pale whitish-brown, darker on femora	Deep, narrowly U-shaped excavation; lobes pointed
<i>johnsoni</i> .....	7	12	8- 8.5	2.7	5.5	Paler brown than body	Excavation less than $\frac{1}{2}$ length of plate, rounded; lobes pointed
<i>moerens</i> .....	7	7	7	1.8	5	Uniform light brown, or with dark spot proximally on tibia	Broadly triangular excavation, lobes and excavation equal
<i>mollis</i> .....	7	4	7.5 8	2	3.5	Whitish, faintly discolored at base of femora	Fairly broadly U-shaped excavation, less than $\frac{1}{2}$ length of plate; lobes bluntly pointed
<i>ontario</i> .....	6		6.5	1.4	4.2	Light brown, tarsi somewhat paler	Excavation not more than $\frac{1}{2}$ length of plate; rounded notch and lobes
<i>praepedita</i> .....	6-7	9	7	1.6	4.5	Uniform pitch brown	Broadly triangular excavation, not more than $\frac{1}{2}$ length of plate; lobes pointed

TABLE III  
*Characters of Nymphs of Seven Northeastern American Species of Leptophlebia*

SPECIES	SIZE	HEAD	ABDOMEN	LEGS	GILLS
<i>adoptiva</i>	Body, 8-10 tails, 8	Pale areas in front of median ocellus and lateral to lat- eral ocelli	Narrow median pale line nearly to posterior border; pair of anterior pale diverging submedian dashes; stout spine on 9	Pale brown	Main trachea dividing $\frac{3}{8}$ to $\frac{1}{2}$ distance from base; tracheal branches pres- ent; hairy
<i>debilis</i>	Body, 7-8 tails, 9-11	Uniformly brown	Numerous large, variable pale areas; spines on 8 and 9	Pale brown banded with dark	Main trachea dividing $\frac{1}{10}$ distance from base; no tracheal branches; not hairy
<i>guttata</i>	Body 6.5-7 tails, 7.5, median longer	Uniformly brown	Indistinct pale median line on 8-10; blackish dashes at bases of gills; spine on 9	Pale	Main trachea dividing $\frac{1}{10}$ distance from base; no tracheal branches; not hairy
<i>moerens</i>	Body 7.5-8, tails 5-6	Pale areas in front of median ocellus, lateral to lateral ocelli; pale median line	Small submedian and larger lateral pale areas on each segment; large U-shaped area on 7; spines on 8 and 9	Pale brown lighter at distal end of femur	Main trachea dividing $\frac{1}{7}$ to $\frac{1}{8}$ distance from base; no tracheal branches; not hairy
<i>mollis</i>	Body, 6.5- 7.5, tails, 4.0- 4.5	Pale area between ocelli, and one in front of each ocel- lus	Usually uniform brown; traces of pale median and submedian areas; spine on 9	Pale, some- times brownish	Main trachea dividing $\frac{2}{7}$ to $\frac{1}{3}$ distance from base; tracheal branches present; hairy
<i>praepedita</i>	Body, 6.5, tails, 6-7	Very narrow me- dian pale line	Lateral pale areas on 3- 9, median pale areas, larger in female than in male; short spine on 8, long on 9	Pale brownish, paler at sutures	Main trachea dividing $\frac{1}{10}$ distance from base; no tracheal branches; not hairy
<i>volitans</i>	Body, 6.5, tails, 3.5	Pale areas over ocelli, between eyes and on epicranial suture	Pale posterior median and anterior submedian areas on 3-7; spines on 8 and 9	Pale, pro- thoracic legs darker	Main trachea dividing $\frac{1}{7}$ distance from base; no tracheal branches; hairy



*Descriptions and notes.*—Herewith I offer descriptions of hitherto undescribed stages of the six species reared by me, and notes on ecology and life history.

*Leptophlebia adoptiva* McDunnough.

*Subimago:*

*Male.*—Head dark brown. Thorax brown with light tan median line and similar light submedian patches on the metathorax; wings pale smoky gray, plainly ciliate on the anal margin; legs deep brown. Abdomen nearly uniform dark brown, often showing traces of the median pale line and the pair of submedian pale dashes diverging from the median line at the anterior border of each segment which were evident in the nymph; tails, dull brown, hairy. Length of body 7 mm.; of fore-wing, 7 mm.; of hind-wing, 2.4 mm.; of tails, 7 mm.; of foreleg, 5 mm. The genitalia are similar in form to those of the adult; the forceps show the inwardly broadened second segment and the rather abrupt, distinct enlargement on the inner side at the base of the first segment.

*Female.*—Similar to the male in coloring, but of redder cast. Length of body, 8 mm.; of fore-wing, 7 mm.; of hind-wing, 2.4 mm.; of tails, 7 mm. The excavation of the subanal plate is like that of the adult.

This species reaches maturity earlier in the spring than any other taken in the Ithaca region. In 1930, well-grown nymphs were collected in Salmon Creek as early as March 16. The earliest collection in 1931 was April 11, the last, May 5. On the latter date only a very few nymphs were collected, where the species had been abundant on April 19. Both imagos and subimagos were taken in flight on May 5, 1931. On June 17, neither nymphs nor adults could be found. A number of nymphs of this species were reared in pans in the laboratory, being kept alive for more than a month in quiet water, on a diet of *Elodea*, rubbed to a pulp on a coarse file. The length of the subimaginal stage varied from 24 to 48 hours. Half-grown nymphs were collected in Salmon Creek, Nov. 23, 1930. There is probably only one brood a year.

*Leptophlebia debilis* Walker.

*Subimago:*

The very brief description of the subimago given by Eaton (1883-88, p. 97: *L. mollis*), which may pertain to either *L. debilis* or *L. mollis* may be amplified as follows:

*Male.*—General color dark reddish brown; mesothorax bordered with darker. Wings dull grayish white, margined

with very fine short hairs. Legs pale whitish, the foreleg about 5 mm. long. Abdomen lighter in the middle segments; genitalia and tails pale whitish; dilation of the forceps limb at the base very similar to that of the imago. Length of body, 6.5 mm.; of fore-wing, 7.5 mm.; of hind-wing, 2 mm.; of tails, 7 mm.

*Female*.—Similar in color to the male, but the abdomen uniform reddish brown. Excavation of the subanal plate narrow and deep, rounded at the bottom; apices of the divisions narrowly rounded.

During the seasons 1929 and 1930 this species was collected in only one locality, The Glen, Ithaca. The species matured late, well-grown nymphs having been collected on September 26, and adults taken in flight October 31 and November 1, 1929. The specimens taken slightly exceeded Eaton's measurements (which were of dried specimens), averaging about 7.5 mm. in body length; tails of the female, 8 mm. The species is widely distributed through North America. A study of the dates on which adults were taken, especially in the New York State region suggests a succession of life cycles similar to that discovered by Murphy for *Baetis posticus* (Murphy, 1922, p. 41, 42): a six-month's cycle, May to October; a nine month's cycle, October to August; a nine month's cycle, August to May. Recorded dates of emergence of adults of *L. debilis* include May 17-28; August 1-September 3, and October 31-November 1.

Taxonomic confusion involving *L. debilis* and *L. mollis* necessitates mention of the fact that the *L. mollis* of Needham (1907, p. 189), and of Morrison (1919, p. 143) is really *L. debilis*. The same may be true of other early published mention of the species. Eaton's Monograph gave the name *L. debilis* Walker to a species described from a female taken in Nova Scotia. McDunnough (1925-1, p. 169), reported the collection of a similar female "on the same day (August 22), at the same locality as a male which is evidently *separata* Ulmer," and regarded it "as without doubt the female of *L. separata*, which name will fall therefore as a synonym of *debilis*." The *L. mollis* described by Eaton in 1871 and in 1884 (1871, p. 88; 1883-88, p. 97) were shown by Ulmer (1921, pp. 254-256) to have been two different species, the two descriptions having been made from different specimens. Consequently he restricted the type of the species to the specimen described by Eaton in 1871, designating the *L. mollis* of the Monograph as *L. separata*. This last name yielded to *L. debilis* as a result of the work of McDunnough referred to above.

*Leptophlebia guttata* McDunnough.*Imago:*

To the descriptions of McDunnough (1924, p. 95; 1925-2, p. 209) may be added measurements of the imagos:

*Male*.—Length of body, 6 mm.; of fore-wing, 6.5 mm.; of hind-wing, 1.8 mm.; of tails, 9 mm.; of foreleg, 6.5 mm.

*Female*.—Length of body, 6 mm.; of fore-wing, 6.5 mm.; of hind-wing, 1.8 mm.

*Subimago:*

*Male*.—Very much like the adult in general color except for the abdomen, which is uniform reddish brown, and the wings, which are distinctly smoky gray. The penes appear as two imperfectly separated broad-tipped appendages.

*Female*.—Much like the male in coloring. Excavation of subanal plate more broadly U-shaped than in the imago.

Nymphs of this species were collected, though never abundantly, in many streams near Ithaca, and are represented in collections from West Virginia and Pennsylvania. In the Ithaca region they were almost always found associated with *L. mollis*, except in the latter part of the season, indicating that their period of emergence is somewhat later than that of *L. mollis*. Well-grown nymphs were collected in Fall Creek, at Watkins, and in Enfield Glen on dates ranging from May 30 to June 7, 1930, reared adults appearing about the middle of June. A number of adults were reared from a catch at Salmon Creek, July 6, 1930. The earliest, and largest, swarm of adults was observed over Taughannock Creek, June 16, 1931; adults were taken swarming over Cascadilla Creek, July 17, 1930; subimagos and imagos were collected at Slaterville, July 27, 1930. The period of emergence is therefore fairly long, although the fact that only a very few mature nymphs were collected after July 27 indicates that the end of that month probably marks its termination.

*Leptophlebia moerens* McDunnough.*Subimago:*

*Male*.—General color, light red-brown. Length of body, 6 mm.; of fore-wing, 6.5-7 mm.; of hind-wing, 1.6 mm.; of tails, 7 mm.; of foreleg, 5.8 mm. Head light brown. Thorax dark red brown; legs pale brown, darker at the proximal ends of the tibiae; wings gray-brown, with short, fine hairs on the anal margin. Abdomen, red-brown dorsally, darker at the joinings of the segments, the middle segments slightly lighter in color; paler ventrally. Adult characters of the

genitalia fairly well developed, especially the excavation between the penial lobes; tails pale gray-brown, with circlets of hairs at the joinings of the segments.

*Female*.—General color red-brown, slightly darker than the male. Length of body 6 mm.; of fore-wing, 7 mm.; of hind-wing, 1.6 mm.; of tails, 7 mm. The female is much like the male in color and markings except that the middle segments of the abdomen are not lighter in color. Subanal plate with a shallow broadly rounded excavation.

*Nymph*:

General color light brown. Length of body, 7.5–8 mm.; of tails, 5–6 mm. Head red-brown, the vertex paler and pale areas in front of the median ocellus and lateral to the lateral ocelli, also a median pale line; antennae pale brown, with a darker second joint; mouthparts pale brown, the labrum shallowly notched anteriorly. Pronotum with light margins; legs pale brown, slightly lighter at the distal ends of the femora. Abdomen light brown, each segment with a small pair of submedian pale areas and a larger pair of lateral pale areas; segment 7 with a large U-shaped postero-median pale area which is confluent with the submedian dashes; lateral spines present on segments 8 and 9; tails pale brown, with few short hairs. Gills with the main tracheae branching  $1/7$  to  $1/8$  of the distance from the base to the tip of the gill; main tracheae without conspicuous branches.

Near Ithaca, nymphs of this species were taken in greatest abundance at The Glen, but also from Cascadilla Creek, Six Mile Creek, and Gyrinophilus Spring near McLean. Since most of the rearing of this species was carried on under almost natural conditions the dates of emergence of reared adults probably are close to the normal for the species. The first subimago to emerge in 1929 appeared June 26, and adults continued to emerge throughout July. In 1930, the first collection of nymphs was made June 2, the adults transforming June 6–15. The recorded duration of the subimaginal stage varied from about fifteen hours to over 36 hours. No large swarms of the species were observed during either summer, and I was unable to verify McDunnough's suggestion (1925–2, p. 209) that the species may be double-brooded.

*Leptophlebia mollis* Hagen.

*Imago*:

*Female*.—Eaton (1871, p. 88) gave a very brief description of the female. A more complete description, from reared specimens taken at Etna, May 30, 1930, is included here: General color, red-brown with pale whitish appendages.

Length of body, 7 mm.; of fore-wing, 7.5 mm.; of hind-wing, 1.9 mm.; of tails, 4 mm. Head red-brown, darker than the remainder of the body. Thorax dark red-brown above, lighter below; legs pale whitish, faintly colored with brownish at the bases, especially on the forelegs, which are 3.5 mm. long; wings hyaline, with slight iridescence, the veins almost colorless. Abdomen nearly uniform red-brown, slightly lighter at the joinings; tails pale whitish; excavation of the subanal plate narrowly U-shaped, less deep than in the similar *L. guttata*; the apices of the lobes bluntly pointed.

*Subimago:*

A more complete description of both male and female than is given by Eaton (1871, p. 88), from specimens taken at Enfield Glen, June 7, 1930, and from Etna, May 30, 1930, follows:

*Male.*—General color red-brown. Length of body, 6.5 mm.; of fore-wing, 6.5–7 mm.; of hind-wing, 1.5–1.7 mm.; of tails, 6 mm.; of foreleg, 4 mm. Head red-brown, the eyes less brightly orange-brown than in the adult. Thorax red-brown; legs very pale brownish white; wings, pale brownish gray, the fringe of hairs on the anal margin short and fine. Abdomen red-brown, segments 2–7 somewhat paler; genitalia pale brownish white, much like those of the adult (see fig. 3, plate XIV), the second segment somewhat enlarged inwardly, but the base of the first segment less enlarged than in the imago; tails, whitish.

*Female.*—General color red-brown. Length of body, 6 mm.; of fore-wing, 6.5–7 mm.; of hind-wing, 1.5 mm.; of tails, 6 mm. The female is much like the male in color except that the abdomen is darker and uniform in color. The excavation of the subanal plate is much like that of the imago.

Thirteen localities are represented in my collections of this species, which is apparently the commonest member of the genus in this region. Well-grown nymphs were collected from the middle of May through the first week in June, both in 1930 and in 1931. Reared adults from collections made May 14, 15 and 16 appeared first May 29; subimagos were emerging in numbers in Fall Creek at Etna and in Enfield Glen, when collections were made May 30 and June 7, 1930. That the height of the transformation season, at least in some streams, occurs early in June is indicated by the fact that only a very few mature nymphs were taken from the brook at North Spencer on June 5, and from Cascadilla Creek southwest of Turkey Hill on June 8, although both localities had yielded abundant catches shortly before those dates.

Available dates of capture of imagos and dates of emergence of reared specimens all fall within the month of June, for the Ithaca region. The species seems to be single-brooded. Large swarms have been recorded as late as June 26, but the period of emergence seems to extend over most of that month. The length of the subimago period varied from 24 to 72 hours, but in the majority of cases observed was about 48 hours.

The taxonomic history of this species is bound up with that of *L. debilis*, which was discussed briefly in this paper.

*Leptophlebia praepedita* Eaton.

*Imago:*

*Male*.—Eaton's description (1883-88, p. 99) was made from a dried specimen. The general color, in fresh specimens, is red-brown, the head and thorax darker. Length of body, 6 mm. (instead of 5 mm., according to Eaton); of fore-wing, 6-7 mm.; of hind-wing, 1.6 mm.; of tails, 11 mm.; of foreleg, 6 mm.

*Female*.—General color like that of the male. Length of body, 6 mm.; of fore-wing, 7 mm.; of hind-wing, 1.6 mm.; of tails, 9 mm. Head and thorax dark red-brown; legs uniform red-brown, the fore femora slightly darker than the other segments and than the other legs; foreleg, 4.5 mm.; wings hyaline, with a faint bronzy tint. Abdomen uniform red-brown, lighter than the rest of the body; tails light red-brown; posterior margin of 7th sternite prolonged distinctly, serving as an ovipositor.

*Subimago:*

A dried specimen is described by Eaton (1883-88, p. 99) as "Wings sepia-grey, with pitch-brown neuration. Setae sepia-brown."

*Male*.—General color, dark sepia-brown. Length of body, 6 mm.; of fore-wing, 6.5-7 mm.; of hind-wing, 1.6 mm.; of tails, 8-9 mm.; of foreleg, 5 mm. Wings dull gray-brown, the hind margins distinctly hairy; legs, much like those of the adult, deep, uniform sepia-brown; genitalia distinctly like those of the imago in form and color, but clothed with hairs; tails, deep sepia-brown, hairy.

*Female*.—General color, wings, legs and tails like the male. Excavation of the subanal plate V-shaped, extending a little more than half the length of the sternite; caudad elongation of 7th sternite, the ovipositor, almost as in the imago. Length of body, 6 mm.; of fore-wing, 7 mm.; of hind-wing, 1.6 mm.; of tails, 8 mm.; of foreleg, 4.5 mm.

This species was taken from Six Mile Creek, from North Spencer stream, from Fall Creek, and from Owego Creek at Harford. Well-grown nymphs were collected between the dates May 14 and June 5, 1930, only a few individuals being found on the latter date, in the North Spencer stream, where shortly before they had been abundant. Since all recorded dates of capture of adults in the Ithaca region fall in late May or in early June, it is probable that the species is single-brooded. Reared specimens showed a variation between 24 and 48 hours for the subimago stage.

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EXPLANATION OF PLATES.

PLATE XII, WINGS AND GENITALIA OF IMAGOS.

- Figure 1. *Leptophlebia adoptiva*.  
Figure 2. *Leptophlebia debilis*.  
Figure 3. *Leptophlebia guttata*.  
Figure 4. *Leptophlebia johnsoni* (genitalia of male after Mc-Dunnough, 1924-2, p. 73).  
Figure 5. *Leptophlebia moerens*.  
Figure 6. *Leptophlebia mollis*.  
Figure 7. *Leptophlebia ontario*.  
Figure 8. *Leptophlebia praepedita*.  
Figure 9. *Leptophlebia volitans*.  
a. Wings of Male.  
b. Ninth Sternite of Female (except 9b).  
c and d. Genitalia of Male, lateral and ventral aspects (b and c in 9).  
8e. Segment 7 of female, *L. praepedita*, showing ovipositor.

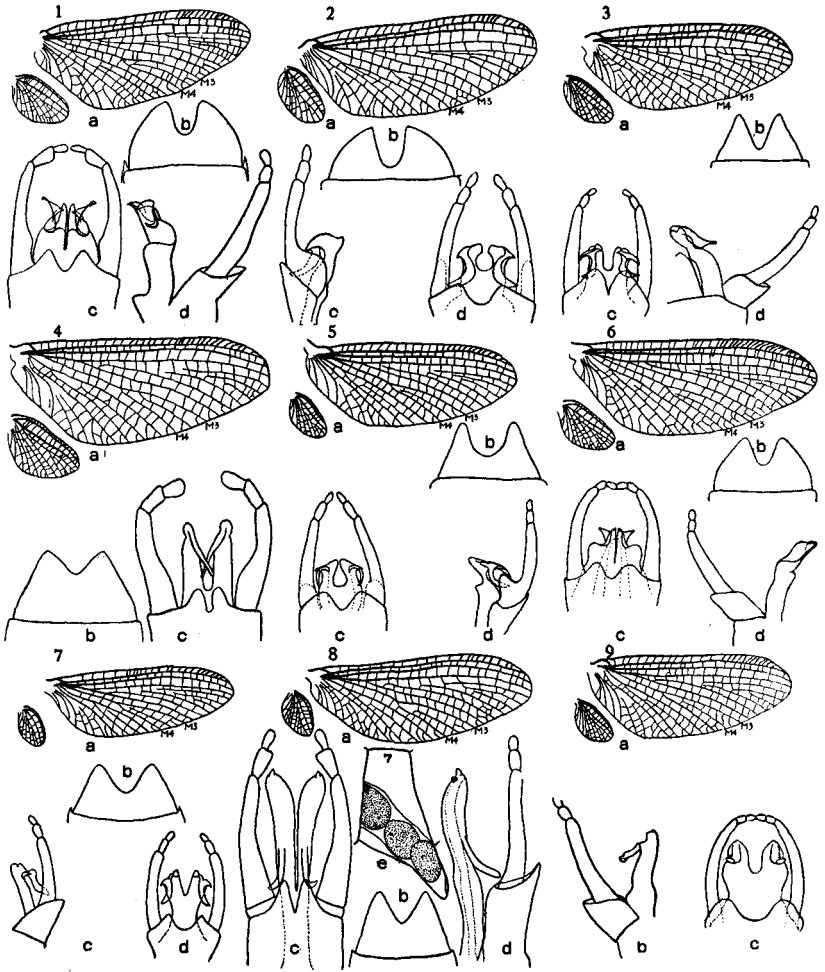
PLATE XIII, GILLS AND MOUTHPARTS OF NYMPHS.

- Figure 1. *Leptophlebia adoptiva*.  
Figure 2. *Leptophlebia debilis*.  
Figure 3. *Leptophlebia guttata*.  
Figure 4. *Leptophlebia moerens*.  
Figure 5. *Leptophlebia mollis*.  
Figure 6. *Leptophlebia praepedita*.  
a. Labrum.  
b. Hypopharynx.  
c. Maxilla.  
d. Left and Right Mandibles.  
e. Labium.  
f. Gills from Segments 1, 4, and 7.

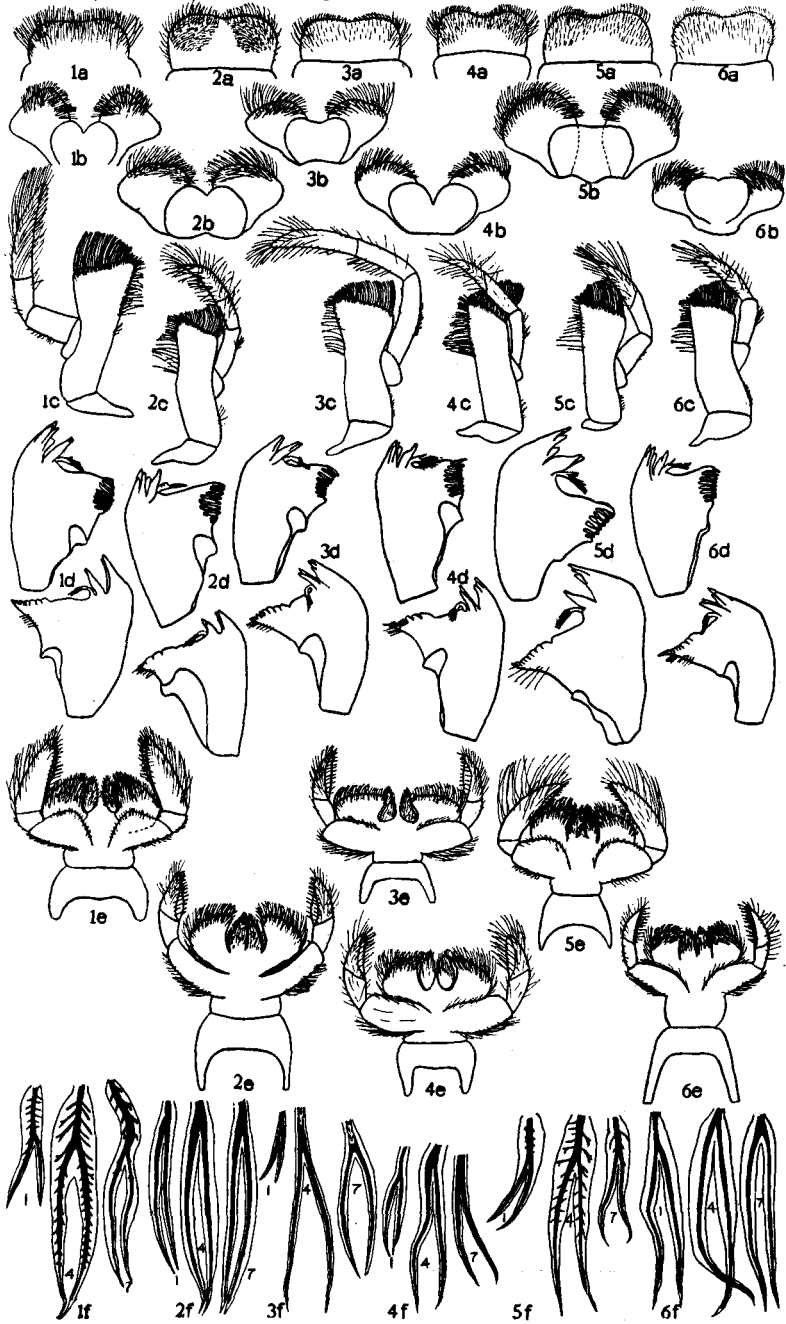
PLATE XIV.

- Figure 1. Head of Female Nymph of *Leptophlebia moerens*.  
Figure 2. Eggs of *Leptophlebia moerens*.  
Figure 3. Genitalia of Male Subimago, *Leptophlebia mollis*.





1 *adoptiva* 2 *debilis* 3 *guttata* 4 *moerens* 5 *mollis* 6 *praepedita*



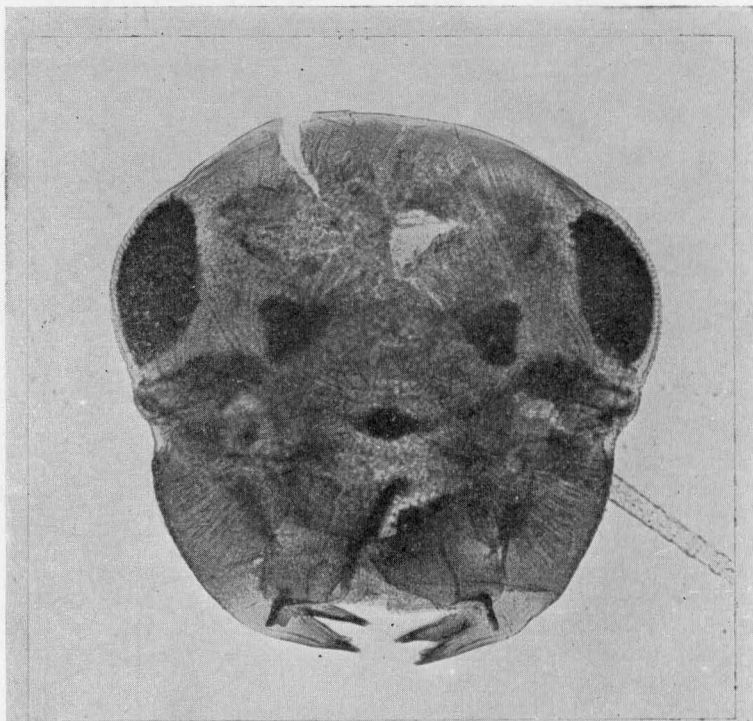


Figure 1

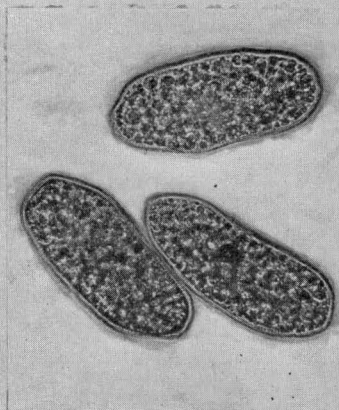


Figure 2

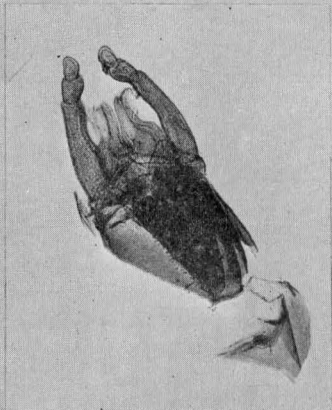


Figure 3