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TRANSACTIONS  
OF THE  
WISCONSIN ACADEMY  
OF  
SCIENCES, ARTS AND LETTERS

VOL. XVI, PART I, NO. 6

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EDITED BY THE SECRETARY.

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PRICE 50 CENTS.

## STUDIES ON THE TRICHOPTERA OF WISCONSIN.

CHARLES T. VORHIES.

The life-histories and habits of this interesting but somewhat neglected group have heretofore received but little attention in America. With the exception of a paper by Betten (1901), and one by Morton on the family Hydroptilidæ (1905), the metamorphosis of none of our species has been described. Since the imagoes are rather short-lived and inconspicuous, and since, if the group is of any economic importance whatever, it is as larvæ rather than as adults, it seems highly desirable that our knowledge of the life-histories should be extended. In Europe much of this work has been done in recent years, the admirable work of Klapalek having served, probably, as the initial stimulus. In this work (1888, 1893) very complete descriptions of the larvæ, pupæ, and cases of 53 species are given. At present, Morton (1905), Ris (1903), Silfvenius (1902, '03, '05), Struck (1903), Ulmer (1903, '05, '07), and others are carrying on the work. Thienemann has done important work on the biology of the pupæ (1904, '05), Silfvenius has produced a large paper on post-embryonal development (1907), and internal metamorphic changes have been treated by Lübben (1907), E. Russ (1907), and A. L. Russ (1908).

That the group may be of considerable economic importance in some localities is shown by Hudson (1903), from whose work may be noted the following summary. The contents of sixty trout stomachs consisted of a total of 4,804 Neuroptera, 662 other insects, and 28 animals not insects. Of the 4,804 Neuroptera, 4,241 were Trichoptera. The author is careful to point out that, owing to their easy identification when found in the stomach, their importance as food may be here slightly exag-

gerated. This ease of identification is due to the fact that the fish swallows the case as well as the larva. However, the figures show that nearly 78% of the food as identified was Trichopterous, and if we allow 28% for error from the above causes, we still have 50%, enough to prove the larval Trichoptera an important source of food for the trout of New Zealand. The trout examined were caught in the months from September to March inclusive. Prof. Forbes (1880) found in studying the food of fishes of Illinois that in a few species as much as 15% to 20% of the food consisted of the larvæ of Trichoptera.

The lack of descriptions of immature stages of American forms soon forces one who attempts work of any kind on the larvæ to turn first to systematic work. It is evident that until much more of this work shall have been done the solution of problems of other kinds will be handicapped. In Wisconsin an excellent opportunity for a study of local distribution is afforded by the Trichoptera, but one at once finds that it is desirable to be able to identify the larvæ without being compelled to tediously rear each one.

Rearing work, too, is sure to lead to a much fuller knowledge of our present species, and to the discovery of many new ones, as our Trichopteran fauna is comparatively poorly known in the imago stage. From the time of Walker (1852) (whose descriptions might better never have been written) and Hagen (1864, '73, '73 (2)) the worker in this group finds a notable gap in the systematic literature up to the time of Banks, who has described more than 150 of the total of 332 species listed in his recent catalog (1907).

The present paper, then, from stress of circumstances contains principally life-histories and habits. It was at first my intention to attempt a study along the line of local distribution, but the other work having taken up the major share of attention, I have no such observations to offer, aside from what may be contained in the notes on the habits and occurrence of each species.

Wisconsin, partly by reason of its many lakes and streams, affording a great variety of breeding places, and partly on account of its geographical position, affords excellent opportunities

for investigations on Trichoptera. Within a distance of thirty miles of Madison can be found very diverse conditions, and it is from within this limited territory that most of my material has been obtained, and its resources have by no means been exhausted. Within this area I have collected and learned to distinguish some 50 species of larvæ, and, from adults taken, I infer that there are no less than 100, probably more, to be had here. The Hydroptilidæ, the "micro-Trichoptera," have received practically no attention and are not included in the 50 mentioned above. I believe one has need of a few years of experience with the larger species, before attempting work on these minute forms.

An account of the conditions existing in the area mentioned will be given, so that precise locality references in the descriptions may need no detailed explanation. The city of Madison is situated on a narrow strip of land between two lakes; Mendota, with an area of about 15 sq. mi., and Monona, about 4 sq. mi. in area. The Yahara river, connecting these two lakes, flows through the eastern part of the city and at the point where it leaves Lake Mendota there is a short rapids with a fall of three or four feet. Here are the proper conditions for Hydropsychid larvæ, and they are present in great abundance. At this point Tenney Park stretches along the river for some distance and some forms may be advantageously collected in shallow, weedy lagoons of the park, as well as along the shore of the lake itself. Stretching into Lake Mendota like a long finger is Picnic Point, about one mile across the water from the western or University end of the city. Within the base of this promontory, west of the University, protected by a low, usually submerged bar from the open lake, is a shallow bay with muddy bottom,—University Bay. *Myriophyllum*, *Ceratophyllum*, *Elo-dea*, *Lemna* and other vegetation grows here in abundance. With the exception of this and similar bays not so conveniently located, the shores of these two lakes are sandy, gravelly, or stony, with corresponding differences of vegetation, thus affording a variety of conditions in the open lakes. At the western end of Lake Mendota is a large spring, or group of springs,

known as Merrill's Springs, from which a short, swift stream leads to the lake, a distance of not more than 75 feet.

A third small lake, with muddy bottom and many weeds, of which the principal one is *Potomageton*, lies south-west of the city, adjoining a suburb. This is Lake Wingra. It is surrounded by extensive marshes and fed by several large springs. The streams from these springs, except a very short distance at the head where they issue from the base of the higher ground, are rather sluggish as they flow thru the marsh, but quite cool in summer and unfrozen in winter. Some *Elodea* occurs in these streams, but the most plentiful form is *Nasturtium officinale*.

These, with numerous marshes and pools scattered about the country, form the chief collecting grounds in the immediate vicinity of the city. At a distance of 30 miles north-west lies the Devil's Lake region, which furnishes many species not found at Madison. The collecting grounds of this area worked by me consist of the Lake (not differing in its Trichopterous fauna from the Madison lakes) and some small streams issuing from the range of hills along the valley of the Wisconsin river, known as the Baraboo Mts. One spring-fed brook flowing into the lake has furnished its quota of material. At a distance of five or six miles north-east of the lake there is a small canyon in the side of the range, known as Parfrey's Glen. Rushing thru this Glen is a cold stream which, in the distance of less than a mile, has a fall of about 300 feet. Hydropsychid and Rhyacophilid larvæ are abundant here, as well as some other larvæ not obtainable near the city. The larvæ and pupæ for rearing were collected, carried four miles to the railway station at Merrimac, and thence by rail to Madison. Needless to say, the mortality was great, yet with care much can be thus accomplished. The Wisconsin River, accessible at Merrimac, between Madison and Devil's Lake, was not worked, but furnishes conditions suitable for some of the forms inhabiting large streams.

No forms have been reared from outside the region described, but a few adults and larvæ have been collected in other parts of the state, which may be referred to without further explanation.

In the rearing of imagos from larvæ much must depend on the wisdom and care of the individual worker. What may or may not be done with larvæ in the laboratory is to a great extent a matter of experience. Some forms, more particularly those from standing waters, may be rather easily managed in small aquaria, while others, as those from cold and swift-flowing waters, can only with the greatest difficulty be kept in the average laboratory, if at all. Ordinary crystallization or bacteria dishes, 7 or 8 inches in diameter, provided with glass or screen covers, proved very useful, and could be stacked up,—a great saving of space. In these the larvæ were kept carefully segregated, a strong lens being used for the separation of the smaller species. Bringing in the pupæ from outside is a plan much more certain of results, but this can only be done in most cases after a careful study of the larvæ, in order to be sure that not more than one species inhabits the same kind of case. In many instances, too, the pupæ are much more difficult to find than the larvæ. With species of *Rhyacophilidæ* and *Hydropsychidæ*; however, one may adopt this plan very successfully, as I finally learned after vain attempts at rearing from larvæ. The larval exuvia of the species of these families is retained in the pupal case and may be readily compared with the larvæ known to inhabit the same waters, or which are actually collected at the same time as the pupæ, since this is usually feasible.

As an example of what may be accomplished by the latter method, let me give an instance in my experience. On one of my trips to Devil's Lake, made at the end of June, I was collecting along the stream when my attention was attracted by some soft tubes of sand, projecting from a patch of sandy bottom. On carefully extricating some of these I recognized that I had cases resembling those figured by Betten (1901). (They proved to be the cases of a new species of *Phylocentropus*.) As I had not previously had any such larvæ, I made an examination and discovered that some cases contained larvæ, and some, pupæ, evidently nearly ready to transform. Collecting a number of these in a good-sized jar of water, I transported them to the laboratory, placed them in dishes of fresh water, and the next morning was rewarded by finding seven imagos,—some of them



helpless in the water with unexpanded wings, but valuable for preservation. I was able by means of the exuvia to positively connect the larval and pupal stages in this case.

It was my original intention in working up the life-histories in this paper, to give descriptions only of the immature stages, except in the case of new species. Before working long with McLachlan's excellent monograph, however, it became evident that many of our species needed more complete descriptions,—this being especially true of the species described by Walker. Particularly, the male genitalia should be described and figured. I have, therefore, for the sake of completeness, and, I hope, greater accuracy, written new descriptions of the imagos and made accompanying drawings. The drawings of the male genitalia, in the interests of accuracy, have been made from material preserved in alcohol or formalin, since with such specimens the parts may be moved about and carefully studied with a binocular dissecting microscope. I have not consciously copied from the old descriptions, nor have I, on the other hand, taken extreme pains to avoid the use of the same terms there employed. I at first attempted to use as much as possible of the old descriptions, giving proper credit, but this proved to be a cumbersome and tedious method, and it was therefore abandoned.

In the descriptions of adults, when the spur number is not given, it is the same as the number typical of the genus. Length of body is apt to be unsatisfactory, owing to shrinkage, yet it is worth more than length to tip of wings,—when expanse is also given,—since the latter is very nearly half the expanse in all cases, while the relative length of body and wings may be quite different.

On some of the dorsal abdominal segments of the pupæ are certain paired chitinous plates bearing spines or hooks. On all of the segments thus armed one pair near the anterior border of the segment bears backwardly directed hooks. On one segment (in a few genera, on two or three) there is in addition, on the posterior border of the segment, a pair of plates which bears hooks directed forward: this is in most cases the fifth segment. Although the number of these hooks to each

plate is apt to be somewhat variable for each species, yet it has some value in identification, and, for the sake of brevity, I have adopted Ulmer's plan of expressing this by a formula. It must be remembered, however, that the numbers represent only approximately what is actually to be found on individuals of a species. The following formula, III, 3-4. 3-4. 4-5 + 9-11. 6, 8, VII., indicates that plates with posteriorly directed hooks occur on the anterior border of each of the segments three to seven inclusive, each plate of the 3rd segment bearing 3-4 spines, of the 4th segment 3-4, of the 5th, 4-5, of the 6th, 6, and of the 7th, 8: also that each of the two plates on the posterior border of the 5th segment bears 9-11 anteriorly directed spines. The spur formula is the same as that of the adult, so it need not be given in the descriptions of pupæ. Each text figure represents by diagram the left side of the first 8 abdominal segments, the upper half being dorsal.

In all cases, whatever the stage under consideration, when reference is made to a segment of a certain number, the abdominal segment of that number is referred to unless otherwise explicitly stated.

None of the species herein described have been previously reported from Wisconsin. Indeed, in Ulmer's work on Trichoptera in the *Genera Insectorum* (1907), not a single species is listed from this state, and I have no knowledge of any having been reported from here which he has failed to note. In the work cited are listed 3 species from Minnesota, none from Iowa, 9 from Illinois, and 4 from Michigan. From widely separated localities in Canada 63 species are noted, and probably a majority of these may be found in Wisconsin.

I wish here to express my thanks to Prof. Wm. S. Marshall for his aid and encouragement, the major portion of the work having been done under his direction. It was thru his suggestions that I first became interested in work on this group. I wish to thank Prof. S. J. Holmes also, for many valuable suggestions. I am also greatly indebted to Mr. Nathan Banks and to Dr. C. Betten for aid in determining doubtful species and for exchange material, and to Mr. Georg Ulmer for similar aid.

## PHRYGANEIDÆ.

*Phryganea interrupta* Say.

*Phryganea interrupta* Say, Amer. Ent., III, 1838, 98, Pl. 44; Complete Writings, I, 1859, 98. Hagen, Verh. zool.-bot. Ges. Wien, 1873, 411; Proc. Bost. Soc. Nat. Hist., 1873, 293. Banks, Proc. Ent. Soc. Wash., VI, 1904, 211; Cat. Neur. Ins., 1907, 35. Ulmer, Gen. Insectorum, Fasc. 60, 1907, 26.

*Limnophilus interruptus* Hagen, Syn. Neur. N. Am., 1861, 256.

*Imago*.—Length of body, 15–18 mm. Expanse, 40–48 mm. Antennæ black, the basal joint clothed with pale hair above. Palpi fuscous. Head brown, with fuscous hair on the face and pale or hoary pubescence above: a black area behind the eye. Prothorax with long pale hair medially, and black hair laterally. Mesothorax with short gray pubescence on the impressed median portion; longer black and gray hair on the wing callosities; a conspicuous black band on either side. Abdomen fulvo-fuscous above, fulvous hair on the terminal segments, paler beneath. Legs fuscous, except posterior coxa, trochanter, and femur paler brown; tarsal joints marked with pale: spurs brown, spines black: on the anterior coxa a brush of white hairs. Anterior wings grayish-fuscous with hoary irrorations: a round white spot on the base of the third apical cell, from which extends outward a more or less conspicuous line of black: a black band along the middle of the wing, interrupted at the anastomosis by a clear space and more or less conspicuous white spots, terminated at its outer end by a white spot in the 6th apical cell: posterior border hoary in some specimens, in others not conspicuously so. As noted by Ulmer (1907, 2) the venation of the anterior wing of the female of this species differs from the typical venation of the genus in that vein  $M_4$  is fused with  $Cu_1$  before the margin. This is not invariable, however. Posterior wings grayish-fulvous, the apical third dark gray.

In the male the superior appendages are broad, short, directed slightly downward, with several teeth at the truncate apex; within, each bears a small club-shaped appendage, ending in a pencil of yellow hairs. A pair of penis sheaths projects from between them above the penis, curving abruptly outward, their points extending laterally beyond the superior appendages: these sheaths may be retracted so as to point backward rather than outward. The inferior appendages are short, broad, nearly meeting medially beneath, clothed with yellow hair.

*Larva*.—Length, 30–35 mm. Width, 6 mm. Body in life dark green with fine colorless markings on the meso- and meta-thorax, which become *more distinct* in alcoholic specimens, owing to the extraction of the green color, leaving the dark purplish of the thoracic region as a contrasting color. Head yellow: a medium longitudinal band of black on clypeus, somewhat arrow shaped at point of same; on either side of clypeus a black band extends from base of mandible to median suture on top of head, forming a V narrowly open at the apex; a lateral black band extends from the occipital foramen toward, but not to, the eye. Gula dark brown, some color extending beyond its

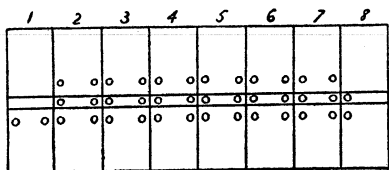
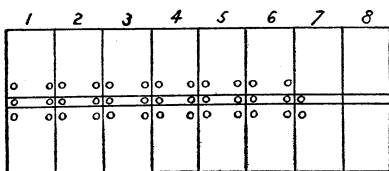


Fig. 1.

lateral sutures. Pronotum black-bordered anteriorly and posteriorly, with the two bands slightly connected along either side of the white median suture. Legs yellow with dark outer border on coxæ and femora: trochanter and femur of each leg with inner fringe of bristles; femur of second and third leg pectinate with short spines alternating with the bristles; tibia and tarsus of second and third leg pectinate with longer spines; inner side of coxa of first and second leg beset with linear groups of small spines. Dragging hooks consist of one large and two small claws. Gill formula, Fig. 1.

*Pupa*.—Length, 25–28 mm. Width, 6 mm. Antennæ extending to the fifth segment. Body in life green, a fuscous band extending along the dorsal wall of the abdomen on either side. Dorsal spines, IV, 4–5. 6–8 + 12–15. 6–9. 6–12, VII. Lateral line of soft black hairs begins on the fifth, and forms a loop under the eighth segment. Labrum about as broad as long; mandible longer than the labrum, toothed on inner edge at distal end, a projection on outer side near base bearing two long hairs. Gill filaments, Fig. 2.



*Fig. 2.*

*Eggs*.—An egg mass taken from vegetation in the water of Lake Wingra on July 21, proved to be of this species. It consisted of a cylindrical mass of clear jelly six mm. in diameter, in which the eggs were imbedded: the ends of this mass were bent around and united so as to form a perfect circle with a diameter of 3 cm.

*Case*.—Length, 50–70 mm. Width, 7 mm. A straight tube open at both ends, tapering slightly toward the posterior end except just before pupation, when it is equi-diametric, formed of rectangular pieces of leaves arranged spirally. The length is very variable, but it is usually much longer than the larva inhabiting it. When brought into the laboratory, the larva very soon cuts off a portion of the case so as to leave it but little longer than the body, seeming to find it inconvenient in the restricted area of an aquarium. The pupal case, 35–40 mm. in length, is closed at both ends by a sieve-membrane. Often when drawn deep into some hole or crevice an elbow bend is added at one end to afford better communication with the water outside.

*Habits and Occurrence*.—The larvæ of this species may usually be rather easily obtained in the fall and early spring, in

lakes or smaller bodies of standing water, where *Elodea* is abundant. A little time after the ice melts in the spring it seems almost impossible to find them by the ordinary scoop net method. However, if one pulls out of the water fragments of dead wood, a careful examination of the cracks will disclose the fact that the larvæ have wedged themselves with their cases into crevices and holes where they fit so tightly as to be difficult to dislodge. In such places the cases are tightly anchored with silk, and pupation takes place. The actual transformation takes place in May. When the imago emerges it leaves the pupal skin upon the surface of the water. The larvæ may be easily reared from the eggs if given plenty of *Elodea*. They are rapacious feeders, and if vegetable food runs short they resort to cannibalism. Unless disturbed the larvæ are usually quiescent during the daytime, and an examination will often prove the case to be attached to the dish at the anterior end by a thread of silk. I reared one brood from the eggs to a considerable size. My notes show the following order of events: hatching and working out of the jelly, July 23: building cases, July 27-28. The first cases were very irregular, of an average length not exceeding 2.5 mm. July 30, a spiral construction was evident in many of the cases. Aug. 2, the cases were from 3 to 4 mm. in length and distinctly spiral. The last one of these died the following January, having reached a length of 30 mm.

The larvæ have been taken in Devil's Lake, Lake Wingra, University Bay, and Tenney Park, in practically every month from September to June. Although I have several specimens of imagos, they have all been obtained by rearing, not a single specimen having been taken with the net or by means of the trap lantern. In the laboratory they appear in June and early July.

(Pl. LII, Fig. 2. Pl. LIV, Figs. 1-6.)



*Neuronia postica* Walker.

*Neuronia postica* Walker, Brit. Mus. Cat. Neur., 1852, 9. Hagen, Syn. Neur. N. Am., 1861, 251; Proc. Bost. Soc. Nat. Hist., 1873, 294; Verh. zool.-bot. Ges. Wien, 1873, 398. Banks, Proc. Ent. Soc. Wash., VI, 1904, 211; Cat. Neur. Ins. U. S., 1907, 35. Ulmer, Gen. Insectorum, Fasc. 60, 1907, 24.

*Imago*.—Length of body 14–16 mm. Expanse, male, 40 mm.; female, 47 mm. Antennæ fuscous with tawny annulations at base, luteous at tip. Palpi yellowish brown, darker distally. Face pale yellow, with darker hair; the median ocellus large, white, conspicuous. Head above brown; a pair of small warts behind the median ocellus, another posterior to the paired ocelli, and a long transverse pair posteriorly, clothed with white pubescence and longer brown hair. A pair of large warts on the prothorax, similarly clothed. On the mesothorax, the wing callosities, a longitudinal ridge on either side of an impressed median line, and a posterior median area, are clothed like the head and prothorax. Abdomen yellowish-brown above, with a median blackish line; a lateral blackish line on either side; paler beneath. Legs fulvous, with fulvous spines and spurs. Anterior wings fulvous with fuscous reticulations, more numerous near the tip; the apex distinctly margined with fuscous, interrupted in each apical cell, except the last, by a fulvous spot. A fuscous squarish spot of larger size at the arculus. Posterior wings fulvous with an angulated, sub-apical, fuscous band, and, in the males, slight indistinct fuscous spots on the apical margin.

In the male the ninth dorsal segment is produced into what McLachlan considers the penis cover, with a sheath on either side, springing from the base. The cover is excised at the apex, with two spine-like fulvous hairs on either side of the excision: it is hollowed medially beneath and slightly upturned at the tip. The last segment beneath ends in a thickened piece with a large concavity in the end, the ventral and dorsal rims of the cup being strongly toothed. From this on either side springs

an inferior appendage consisting of two portions: the basal portion is broad, concave within; the distal portion is in the form of a strong inturned hook, the points curved backward along the penis. The broad dorsal plate of the female is covered with rufous hairs: the ventral plate is dark brown, the apex acute, the median portion shining.

*Larva*.—Length, 30–38 mm. Width, 5 mm. Body in life dark green, reddish on the dorsal side, filaments reddish. Head and prothorax yellow with black markings as follows: a broad band on either side of the clypeus, the two nearly meeting in the median line posteriorly; a short branch on the inner side of this line extending over the edge of the clypeus, but fading out to yellow before meeting its fellow from the opposite side. Parallel to above band on either side of the head, is another reaching from a point just posterior to and below the eye, to posterior border of head. A black band on either side of the pronotum near the anterior border extending from near the median line outward and forward toward the antero-lateral angle, but not to it: band on posterior border narrow in middle

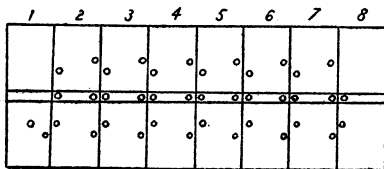


Fig. 3.

portion, wider on postero-lateral margin. Meso- and metanotum in living specimen dark green with small white markings, which are absent in alcoholic material. Legs yellow, the external edge of the femur bordered with brown. Tibial spur of the first leg situated on a distinct projection: from the supporting plate of the coxa a spine points forward. The soft prosternal "horn" arises from the anterior point of a tri-radiate piece of chitin. Dragging hooks with three large and two very small hooks on the dorsal side. The lateral margin of the eighth segment has a posterior lobe extending back over part of the ninth segment. Gills, Fig. 3.

*Pupa.*—Length, 23–30 mm. Width, 4–5 mm. Antennæ extending to the fourth or fifth segment. Body in life green in young pupæ, later becoming somewhat fuscous above. Dorsal hooks, III, 4–5. 5–6. 5–6 + 12–15. 6–8. 7–9, VII. Lateral line extends from the 5th segment to the 8th, forming a loop under the latter. Gill formula as in the larva, except there are no gills on the first segment. Labrum and mandibles not strongly chitinized, the length of the labrum 1.5 times its width: mandibles short, length and breadth sub-equal, with a projection on the outer side, bearing two long hairs.

*Case.*—Length, 40–47 mm. Width, 6–7 mm. A slightly curved tube, open at both ends, composed of rectangular pieces of leaves or thin bark, not arranged spirally, but formed of successive rings of material, usually three to five of these rings forming a single case. The pupal case is almost straight, closed at the anterior end by a loose mass of silk and vegetable debris, thru which the pupa with its weak mandibles may make its way out. The posterior membrane is sieve-like, but not very strong.

*Habits and Occurrence.*—The larvæ of this species are to be found in the streams flowing into Lake Wingra, where they live among the water cress, and also from the pools of the swifter stream at Parfrey's Glen, where their food appears to consist mostly of dead leaves, at least in the winter and spring. They are most abundant in the former habitat. For some time I was at a loss to account for the disappearance in the spring-time of this species from these streams. The beds of the Wingra streams are composed of lumps of peaty material worn into fantastic shapes by the flowing water. These lumps are honey-combed with larger or smaller openings, formed, in at least some cases, by decaying roots. The larvæ, as the time for pupation draws near, in May, draw their cases tightly into these holes, where they may only be found by tearing apart the lumps of peat. They are entirely invisible from the exterior. As most of these are blind holes, there can be no flow of water thru the case. The length of pupal life is apparently from two to four weeks. The pupa emerges from its skin on the surface of the water, leaving the cast skin floating. This stage

is abundant in May. I have not succeeded in capturing the adults in the open, but have reared a large number in the laboratory in June. Several were kept in a cage for some time in an attempt to obtain the eggs, but without results.

(Pl. LII, Fig. 1. Pl. LIV, Figs. 7-17.)

### LIMNEPHILIDÆ.

#### *Limnephilus rhombicus* Linn.

*Phryganea rhombica* Linnaeus, Faun. Suec., Ed. 1, 1746, 224; Syst. Nat., Ed. xii, 1767, 909. Pictet, Recherch., 1834, 148.

*Chaetotaulius rhombicus* Kolenati, Gen. et Sp. Trich., Pt. 1, 1848, 45. Hagen, Ent. Ann., 1859, 76.

*Limnephilus rhombicus* Leach, Ed. Encyclopedia, IX, 1815, 136. Walker, Cat. Neur. Brit. Mus., Pt. 1, 1852, 22. Hagen, Syn. Neur. N. Am., 1861, 255; Verh. zool.-bot. Ges. Wien, Vol. 14, 1864, 839. McLachlan, Rev. and Syn., 1875, 48. Wallengren, Kongl. Svenska Vet. Ak. Handl., Vol. 24, 1891, 41. Struck, Ill. Ztschr. f. Ent., IV, 1899, Fig. 33; Das Museum zu Lübeck, Festschrift, 1900, 265; Mitt. Geogr. Ges. u. Nat. Mus., Heft 17, 1903, 36. Silfvenius, Acta Soc. pro Fauna et Flora Fennica, 21, No. 4, 43. Ulmer, Allg. Ztschr. f. Ent., VI, 1901, 224; Stett. Ent. Zeit., 1903, 197; Coll. Selys, Fasc. VI, 1907, 17; Gen. Insectorum, Fasc. 60, 1907, 41.

*Imago*.—"Head and thorax reddish, antennæ and palpi paler; hairs golden, sparse. Legs reddish-testaceous, spines black. Abdomen above fuscous or fusco-ochreous, beneath paler, and in life somewhat greenish. Anterior wings rather broad, considerably dilated in the apical portion, the margin of which is truncate; somewhat shining; the ground-color varies from straw-yellow to testaceous, the dorsal portion often darker; the fenestrate spot broad, oblique, varying from irregularly oval to rhomboidal, on each side of it there is usually (but not always) a dark brown or fuscous mark, that internally being longitudinally cuneiform, that externally more regular and

broader, often with one or two pale dots at the thyridium, and frequently (in strongly marked individuals) connected with a brown space (more or less broken up into irrorations) at the angle, sometimes occupying nearly all the apical portion, and limiting externally the anastomosal space, which is usually not very distinct, and sometimes has darker irrorations in it (in pale individuals the wings have no dark markings, and the fenestrate spot in them is less distinct, and the anastomosal space obsolete): no pterostigma: membrane with very sparse and short grey pubescence: neuration scarcely darker, with short grayish hairs. Posterior-wings whitish hyaline, the apical portion tinged with yellow; neuration pale, yellowish in the apical portion: the first apical sector in the male with a dense fringe of brown hairs (the 'beard') occupying only a short space: upper branch of the cubitus furcating slightly beyond the level of the commencement of the discoidal cell.

"In the male the terminal margin of the last (eighth) dorsal segment is much produced in the middle into an obtuse lobe which is somewhat rolled under and densely covered with short black setæ. Superior appendages very large, elongately oval, yellow, very convex externally, and with the upper and lower margins considerably rolled inward; the lower margin is black and coarsely but obtusely toothed, and in the middle of this margin (or rather nearer the apex than the middle) is a very large black triangular projection turned inwards, and coarsely toothed in a very irregular manner, fringed with long pale hairs (the form of this projection varies in individuals): internally these appendages are deeply concave. Intermediate appendages lying deep in the cavity of the abdomen, short, obtuse, laterally broad, the apex obtuse and black. Side-pieces of the last (ninth) ventral segment broad, fringed with long pale hairs. Inferior appendages short, sub-triangular, with long dark hairs at the apex. Penis elongate, reddish. A minute acute triangular tooth in the middle of the 6th and 7th ventral segments.

"In the female the 9th dorsal segment forms a triangle, fringed with pale hairs. Appendages long, drawn out into a slender point, with long pale hairs, the basal portion broader

and often dilated on its lower margin, forming an angle (but the form varies somewhat, probably partly naturally and partly from the effect of desiccation). Tubular piece as long as, or slightly longer than, the appendages, open in the middle, above, nearly to the base, reddish, obtuse if viewed from the side, hairy. Side-pieces of 9th ventral segment conical. Vulvar scale with the median lobe longer than the lateral. A short broad triangular tooth on the middle of the 6th ventral segment, and an indication of a similar tooth on the 5th.

"Length of body, 10-17 mm. Expanse, 31-42 mm. The smallest and the largest individuals I have seen are both females."

The above is McLachlan's description. In examining an alcoholic individual of our own form I noted that from the inner side of the base of the inferior appendages of the male, there arises a short flattened branch, the distal end of which is rounded off on the outer side, and bears an acute point on the inner; this distal part is toothed with sharp brown spines. An examination of a European specimen, however, disclosed that the same structure is there present also. It is usually drawn deeply within the abdomen in dried specimens.

This species was formerly given a place in our fauna, but Mr. Banks does not list it in his latest catalogue (1907). My specimens agreed so closely with the above description, however, that I wished to test the matter by comparison. I therefore sent specimens (all stages) to Mr. Ulmer with a request for some European specimens in exchange, and also asked his opinion. He very kindly furnished me with exchange specimens and stated that they appeared to be specifically identical. I can find no differences comparable to those usually considered as specific in the group and therefore list this as a Wisconsin species which has been reared. I include full descriptions of all stages, not claiming them as original, though those of the pupa and larva are not copied. This course seemed advisable for the sake of completeness, and for the convenience of American workers who might not find the scattered literature available. The drawings are original.



*Larva.*—Length, 16–20 mm. Width, 4 mm. Body yellowish. Head and thorax yellow with many black and brown markings. A median longitudinal band on clypeus, broad at the anterior end, and on either side a broad band, the pair not quite uniting above; the posterior half of each band is not solid black, but composed of black patches connected by brown, though a variation to almost solid black may be noted (in the latter respect the European forms examined differ, the bands being more uniformly black): outside of these bands are a number of small spots, irregularly placed, these being replaced by darker beneath, where the color varies (in both forms) from light brown to black: around the occipital foramen a darker border. Anterior third of pronotum and posterior border black, the limits of the color more or less distinctly marked: a short diagonal line in the anterior outer corner of the lighter area across the middle of the segment; a group of spots on the posterior outer angle, a small longitudinal bar on either side of the median line posteriorly, and a pair of spots before the bars, but more widely separated. Mesonotum often quite dark, with markings indistinct, but in the most favorable specimens (especially in preserved material) the posterior border is seen to be black, the band wide at the posterior outer angle: an indistinct and more or less broken “V” on outer anterior corner: some small spots on the outer portion, and, near the median line, there can usually be distinguished a pair of small spots lying anterior to a pair of small transverse bars. In the specimens at hand the bands of the prothorax appear rather more distinct on the European individuals, while the markings on the mesonotum are less distinct, the whole segment being darker. However, the individual variation is considerable in any set of specimens. Legs yellow with brownish spots on the outer side. No gill-filaments appear on the eighth segment, as shown in the diagrams of Silfvenius (1902) and Ulmer (1901): these may occur on our forms perhaps, but certainly not often. In only one of four individuals from Europe did I find a single filament on this segment.

*Pupa.*—Length, 18–20 mm. Width, 4 mm. Antennæ extending to the 7th segment. Body yellowish. Dorsal hooks,

III, 3. 4. 3-4 + 12-15. 3-4. 3-4, VII. The lateral line begins on the posterior part of the 5th segment and forms a loop beneath the 8th. The gills seem to be as in the larva, perhaps averaging fewer branches in a place. The last segment ends in a pair of lobes, each bearing a slender, slightly upturned process, with rounded ends turning outward, terminated by two black hairs. Labrum broader than long; a group of five long hooked hairs on either side in front, and two smaller ones, not hooked, on each side posteriorly. Mandibles straight, finely toothed within.

*Case.*—Length, 20-25 mm. Width, inside, 4.5-5 mm. The external measurement is so variable that the internal diameter is given. It is a straight tube, with a small central opening at the posterior end. The case is extremely variable as to the kind of material of which it is composed, the larva using bits of wood, pieces of plant stem and leaves, seeds, or shells, though I have found none of the latter kind in Wisconsin. These materials are built up very irregularly, and the case often has a very bulky appearance. The cases in the streams at Lake Wingra show a seasonal variation, the cases of the younger larvæ, in the autumn, being often nearly or quite as broad as they are long, composed of pieces of leaves placed with their edges transverse to the long axis of the tube. The anterior view of such a case presents the appearance of a very thick-walled tube with a small lumen. The pupal case is closed with a sieve-like membrane. This case is mentioned more frequently than any other in the literature.

*Habits and Occurrence.*—These larvæ are very common in the small streams, where not too swift, and are probably more frequently encountered by the amateur than any other. They are quite plentiful among the watercress in the streams about Lake Wingra, and are also found in Merrill's Springs and in the stream at Devil's Lake, as well as in the lower portion of the stream from Parfrey's Glen. At the end of July very small larvæ may be collected by using care, though they are not large enough to be conspicuous until late autumn and winter. They may be kept in the laboratory rather easily, where they will feed on *Elodea*, *N. officinale*, or, vegetable food failing, on dead

fish. I have had two small fish skeletons beautifully cleaned by these larvæ.

The pupal cases are usually found attached to logs and sticks, especially such as are rough and uneven, in May and June. Pupal life in the laboratory lasts about two weeks. The imagos appear in June and July.

(Pl. LII, Fig. 7. Pl. LV, Figs. 3-8.)

*Limnephilus submonilifer* Walker.

*Limnephilus submonilifer* Walker, Cat. Neur. Brit. Mus., 1852, 33. Hagen, Syn. Neur. N. Am., 1861, 260. McLachlan, Ent. Ann, 1863, 157. Banks, Cat. Neur. Ins. U. S., 1907, 37. Ulmer, Gen. Insectorum, Fasc. 60, 1907, 44.

*Limnephilus pudicus* Hagen, Syn. Neur. N. Am., 1861, 262; Proc. Bost. Soc. Nat. Hist., XV, 1861, 295. Ulmer, Gen. Insectorum, Fasc. 60, 1907, 44.

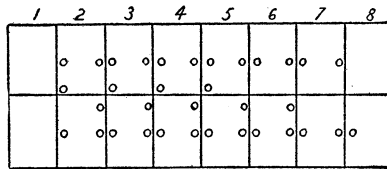
*Imago*.—Length of body, 8-11 mm. Expanse, 21-27 mm. The two specimens giving the extreme measurements are both females. Antennæ black, the basal portion narrowly annulated with fuscous, basal joint with a little gray hair. Palpi fuscous. Head and thorax fuscous, the head clothed with sparse, gray pubescence, and long, coarse, black hairs; a pair of transverse warts posteriorly. A pair of large warts on the pronotum similarly clothed. On the mesonotum, a longitudinal ridge on either side of an impressed median line, a median posterior area, and the wing callosities, all with black hair; a minute pencil of gray or white hair at the posterior median point of the segment. Abdomen fuscous. Legs brownish-testaceous, the feet darker, spotted with black. Spurs brown, spines black. Anterior wings brownish-gray with numerous small irrorations: a much broken fuscous line along the radius, ending in a large irregular spot at the pterostigma: a less broken, fuscous band along the cubitus, another along the inner margin to the arculus: a light, semi-hyaline, rhomboidal area near the middle of the wing, extending obliquely forward and outward: veins fuscous, often with lighter interruptions. Posterior wings grayish-hyaline, iridescent, darker at the tips.

In the male the superior appendages are small, rounded, the apex very slightly excised beneath, fringed with hair. The intermediate appendages are slender, turned outward, hook-like, inconspicuous. The inferior appendages are wide apart, the obtuse apex slightly upturned, hairy.

*Larva.*—Length, 12–15 mm. Width, 2.5 mm. Abdomen in life clear white. Head and thorax varying considerably in general shade of color, from gray specimens on which darker markings show plainly, to almost black ones on which the markings are barely visible. In light specimens the head darker than the pro- and mesothorax. Mandibles black. On the dark head a light band may be distinguished bordering the clypeus and extending along the posterior median suture: on the dark background on either side of this Y-shaped light band may be distinguished a row of darker spots consisting of short transverse bars anteriorly, and small round spots posteriorly: outside of these are several small irregularly placed spots. The prothorax has on the posterior half near the medial line a pair of diagonally placed elongated blotches, apparently formed by the fusion of two spots: parallel to, but within and posterior to these lies another pair composed of three fused spots: on the posterior lateral corner of the segment are several small spots; the posterior edge bordered with black. On the mesothorax a pair of small round spots lies near the median line at about the junction of the first and middle thirds of the segment, and at the middle of the segment lies a pair of short transverse bars: a number of other spots on this segment show a general tendency to an arrangement on a double row extending from the outer anterior angle to the posterior border near the median line: others on the posterior outer corner in general lie parallel to these rows: posterior border black. Metanotum with three pairs of chitinous spots. Legs gray with black at joints of femora and tibiæ. Small chitinous points along lateral line on segments 3–8. The gills are in groups of two or three, except toward the posterior end, where they are simple, Fig. 4.

*Pupa.*—Length, 9 mm. Width, 2 mm. Antennæ extending to the 9th segment. Color whitish. Dorsal spines, IV, 2. 3 + 6–7. 3–4, 4, VII. Lateral line of gray hairs begins on

the posterior half of the 6th segment and forms a loop under the 8th. In my single specimen the gills appear to be the same as in the larva. Posterior end of the abdomen ending in two long projections with three hairs on the distal portion. Mandibles long, length and breadth sub-equal, provided with a brush of five long hooked hairs on either side.



*Fig. 4.*

*Case.*—Length, 20–30 mm. Width, anterior, 3 mm.; posterior, 2 mm. Composed of flat pieces of plant material, irregularly placed, not with a spiral arrangement. Usually with one or two pieces projecting at the anterior end as a dorsal hood.

*Habits and Occurrence.*—The larva of this species is found only in the more shallow pools, which are subject to drying out so as to contain but little water in the fall, and, one would suppose, to freezing solid in the winter. Two specimens were secured in spring from a small pool scarcely six inches deep. Pools in which the phyllopod crustacean, *Branchipus*, may be taken, are of the right kind for this species. Early in April many larvæ of various sizes, most of them quite small, may be obtained by sweeping lightly over the vegetation with a small meshed net.

Though a most careful search was made at intervals during the time between the finding of the larvæ in abundance and the appearance of the adults, the pupæ could not be located in their natural habitat. In the laboratory, pupal cases were closed May 9, and the first adult appeared on May 23. Previous to this, on May 13, two specimens taken with a trap lantern, proved to belong to this species. These must have come some distance, as it is at least a mile from Science Hall, where the trap was operated, to any pool suitable for the larvæ. On two different occasions I discovered imagos in the house, equally dis-

tant from the larval habitat. Strange to say, on Oct. 14, Prof. Marshall brought in a specimen picked up on the street. This late date suggests the possibility of there being two broods.

(Pl. LII, Fig. 4. Pl. LIV, Figs. 18-21. Pl. LV, Figs. 1, 2.)

*Neophylax autumnus* nov. sp.

*Imago*.—Length of body, 5-7 mm. Expanse, male, 15-17 mm.; female, 16-18 mm. Antennæ, 8-9 mm. in length, the basal portion fulvous, more fuscous at the apex, the basal joint clothed with gray hairs. Palpi fulvous. Head fulvous, clothed with gray hair: a pair of large warts between the bases of the antennæ just above the median ocellus; a smaller, transverse pair just posterior to the paired ocelli, and a larger transverse pair posterior to these, all hairy. Thorax fulvous, gray hairs on the warts, of which there are on the pronotum, a small median pair, and a larger, lateral, transverse pair: on the mesonotum, a small longitudinal pair separated by a median impressed line, and a large median one on the posterior half of the segment. Abdomen short, robust, brown above, paler beneath; not hairy, except on terga of 7th and 8th segments: a conspicuous tooth on the 7th ventral segment of the male, *not* on both penultimate and antipenultimate segments, as given for the genus. Legs fulvous, tibiæ and tarsi with black spines; spurs fulvous, 1, 3, 4. Anterior wings fuscous, guttate with yellow, rather densely pubescent with black and golden hair: veins brown: on the inner margin a long yellow spot extending out from the body, another on the middle of the margin, fuscous between the two and without the latter at the arculus; a smaller yellow spot in the last apical cell: a transparent V-shaped spot in the darker region at thyridium and arculus. A dorsal view of the insect with wings folded shows a characteristic yellow median figure, consisting of a double spindle followed by a small dot, the whole on a fuscous background. A group of long black hairs near base of wing in unrubbed specimens; outer margin with fringe of black and golden hairs. Posterior wings sub-hyaline, sparsely clothed with hairs which are darker



toward the apex: fringed with black hair at the apex, shading into light golden along the inner margin.

In the male the 9th dorsal segment is produced into a long plate, deeply cleft in the middle, its sides curving downward so that it is quite broad in lateral view: in the latter view the basal portion is large, separated from the smaller, oblong, distal portion by a constriction. Beneath the dorsal plate are the superior appendages, directed downward. Arising from the lateral portion of the 9th ventral segment is an appendage, narrowing toward the tip, directed upward, and curving inward, the apex obtuse: this probably represents the intermediate appendage. The inferior appendages are short, rounded, pointing somewhat downward and curved inward: within, each bears a heavy brown piece, arising from the inner dorsal edge of the appendage near its base, and curving downward, its apical margin toothed. The end of the latter piece nearly meets with a small chitinous projection arising from the ventral margin of the segment on either side of a median excision. A few very long hairs are present on dorsal segments 7 and 8.

The spur number of the genus does not seem to be uniform. Only two other species are known. McLachlan, who described the genus and the first species (1873) gives the number as 1, 2, 4. *N. fuscus* Banks (1903) has 1, 2, 2. The number is quite variable among the individuals of *autumnus*, but an examination of a large number proved that 1, 3, 4, as given, best represented the average condition.

*Larva*.—Length, 8–10 mm. Width, 2 mm. Body yellowish, reddish on the dorsal surface. Head small, very dark, with a few lighter spots forming an irregular group on the clypeus, near the point: a row of four spots on either side of the clypeus. In a dorsal view of the larva little of the head is visible, the pronotum projecting forward over it. Pronotum lighter in color, especially anteriorly, beset with short hairs; indistinct spots on the posterior half; anterior edge pectinate with short spines. No "horn" on the prosternum. Mesonotum very dark with black border on outer posterior corner, within which is a small lighter area; there is a white median line on this segment. First pair of chitinous shields on the metanotum very

small, represented by the bases of a pair of hairs; second pair larger, irregular, dark; third pair long, black. Legs dark brown. An elliptical ring of chitin lies transversely on the ventral side of the 3rd, 4th, and 5th segments. Lateral line on segments 3-7. Gill filaments small, simple, as in Fig. 5.

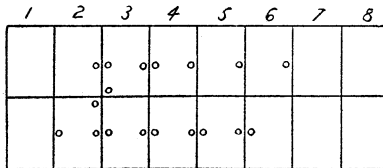


Fig. 5.

*Pupa*.—Length, 6-9 mm. Width, 2 mm. Antennæ as long as, or slightly longer than, the body. Body white or reddish-brown. Dorsal spines, III, 2-3. 3-4. 4-5+50-60. 4-6. 4-5, VII. Lateral line, gray, begins on the posterior half of the 5th segment, and forms a loop under the 8th. Above and below the lateral line, on segments 2-7, is a somewhat sinuous line of chitin, conspicuous on even the very young pupæ. A tuft of black hairs on the ventral side of the coxæ of the 1st and 2nd pairs of legs. No gill-filaments present. Posterior border of the first segment chitinous, with short black spines, directed backward. A pair of slender appendages, like stout hairs, hooked at their ends, arise from the posterior end of the abdomen. Labrum small, with long hairs hooked at the apex; length and breadth sub-equal, two thirds the length of the mandibles, which are slender, knife-like, with two large hairs on the outer side of the base.

*Eggs*.—The eggs are enclosed in small clear masses of jelly, not very firm, 3-5 mm. in diameter. These are deposited in well protected places beneath overhanging banks, or under sticks, where they are so near the water as to be kept moist and warm, since the time of egg-laying is late October and the first half of November.

*Case*.—Length, 8-11 mm. Width, 3-4 mm. The case is of sand, slightly curved, somewhat flattened dorsi-ventrally, lateral rows of larger stones adding to the flattened appearance. The

case closely resembles that of the genus *Silo*. The pupal case is like that of the larva, except that it is closed at both ends by a single stone, beneath the lower edge of which a narrow space is left, guarded with a grate-like structure of silk.

*Habits and Occurrence.*—These larvæ are found in the short stream at Merrill's Springs, and in Parfrey's Glen. At Merrill's Springs they are very abundant, but peculiarly, except in this restricted habitat, none are to be found in the vicinity of Madison. When pupation time approaches, the larvæ cluster densely in crevices of rocks or logs. Apparently they lie within the closed case for a rather long period before transforming to pupæ.

The imagos were most abundant at the springs in October and November. They are sluggish, showing little disposition to fly when disturbed, perhaps on account of the coolness of the atmosphere at that time of the year. They may be easily picked up with the forceps at the water's edge, where they hide under the vegetation, and in crevices. In cages in the laboratory, they were observed to be very active at dusk.

(Pl. LII, Fig. 3. Pl. LV, Figs. 9-20.)

*Platyphylax designatus* Walker.

*Limnephilus designatus* Walker, Brit. Mus. Cat. Neur., Pt. I, 1852, 24.

*Enoicyla designata* Hagen, Syn. Neur. N. Am., 1861, 269.

*Platyphylax designatus* McLachlan, Jour. Linn. Soc. Lond. Zool., XI, 1871, 110. Banks, Cat. Neur. Ins. U. S., 1907, 39. Ulmer, Notes Leyden Mus., XXVIII, 1906, 20; Gen. Insectorum, Fasc. 60, 1907.

*Imago.*—Length of body, 9-11 mm. Expanse, 26-30 mm. Antennæ luteo-fulvous, fuscous at tips, basal joint above with luteous hair, beneath darker. Body fuscous above, luteo-fulvous beneath. A pair of small warts (inconspicuous in dry specimens) just above the median ocellus, a large diagonal posterior pair on head, a transverse pair on the pronotum, a linear pair and a posterior median one on the mesonotum, all clothed with

luteous hair; a pair along the posterior side of the eyes, the wing callosities, and the outer ends of the pronotal warts, with black hairs; a small group of fuscous hairs beneath the antennæ anterior to the eyes. Legs brownish-yellow with black spines; coxæ of the posterior two pairs fuscous, tarsi fuscous, spurs luteous. Anterior wings longitudinally vittate with fuscous, yellowish, and white stripes, "with a silky white discal stripe which is interrupted beyond the middle, dilated and irregular towards the tip." (Walker, 1852.) This stripe, if analyzed, is seen to consist of a narrow whitish stripe between the sector and media, and, separated from this by a fuscous anastomosis, five whitish stripes in the apical cellules as follows: in the bases of the 3rd and 4th, a stripe 1-3 to 1-2 the length of the cells; in the 2nd and 5th, a stripe the full length; in the base of the 6th cell, a short stripe or spot; the whole margined with darker. There is a small whitish spot at the thyridium, and a trace of one at the arculus. Between the lower branch of the media and the anal vein is a lighter area, the latter vein conspicuously darker. Anterior edge of the wing to radius lighter; discoidal cell usually somewhat lighter, with a dark median stripe. There is a cross-vein between the subcosta and radius near the end of the former, which appears to turn up to the costal margin rather abruptly after the cross-vein, but is weak and difficult to see in that part. Cross-veins on the basal cells are absent in this species. Discoidal cell in each wing more than 1.5 times as long as its stalk. Posterior wings nearly hyaline, grayish-luteous at the apex.

The last dorsal segment of the male is beset with short black setæ, thicker on either side of the median line. Superior appendages large, sloping down from above, straight beneath, the intermediate appendages lying between them, curving strongly upward. Inferior appendages pointing strongly upward, narrow but not pointed at the tips, widely separated throughout. Penis bifid, as seen from the rear; sheaths very complex, consisting of a group of heavy bristles, part of which lie alongside the penis, the others turning upward and outward. The figure (Fig. 23, Pl. LV) offers the best description here.

Dr. Betten, who made the first determination of this species for me for use in another paper (1905), pointed out at that time that it did not entirely agree with Walker's description. It perhaps agrees as well as the average of Walker's species, but my specimens are somewhat smaller than the measurements given. I have been recently informed by Dr. Betten, however, that he has specimens of the genus from N. York which agree as well but are as much too large for Walker's measurements as mine are too small, but a distinct species. As he suggests, the question may be properly settled only by reference to the type, if it still exists. In the meantime, it may be here placed as *designatus*.\*

*Larva*.—Length, 15–17 mm. Width, 3–5 mm. Body in life, yellowish or greenish-white, slightly reddish on the dorsal side. Head dark brown, shading to black anteriorly and laterally. Ground color of pro- and mesonotum grayish-yellow. A black Y-shaped band lying along suture of clypeus and median dorsal suture of head; the anterior ends of the branches become broad and indistinct in the dark background. Clypeus marked with median triangle of black dots, and with double row of same extending forward into the black portion. A somewhat irregular row of larger black spots outside of and parallel to the Y-shaped band. Smaller black spots irregularly placed on sides of head, becoming indistinct in the black border. Pronotum with a dark anterior, and a narrow black posterior border, the latter broken in the medial line; two pairs of small oblong spots, nearly parallel, on either side of the median line on the posterior half of the segment. A darker band, in which are many irregular black dots and blotches, extending diagonally across the posterior outer corner of the pronotum, and continuing across mesonotum toward the median posterior border. The anterior half of the border of the metanotum not distinctly outlined: posterior half bordered widely on sides with black, which is continued as a narrower band along the posterior edge, but interrupted in the median line. A dark patch between the lat-

\* Banks, in a paper appearing after this was in type, (*Tr. Am. Ent. Soc.*, XXXIV, Sept. 1908), distinguishes three varieties of this species, of which he considers my specimens to be of the typical form (as he has kindly informed me by letter).

eral black border and the dark diagonal band. On either side of a light median line, is a small transverse oblong spot posterior to a black dot. Metanotum with chitinous patches well developed. Thoracic segments and first abdominal segment beset with short brown hairs. Legs yellowish-brown; femora and tibiae spotted with dark brown. Lateral line on segments 2-8. Gills complex, from one to seven branches in a place, the simpler ones near the lateral line. Fig. 6.

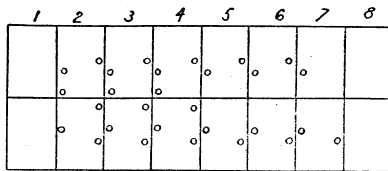


Fig. 6.

Through an error in making the diagram of the gill formula in a former paper (1905), gills were located on the eighth segment, which is entirely without them.

*Pupa.*—Length, 12-16 mm. Width, 3 mm. Antennæ extending to the 7th segment, or as long as the body. Body white or greenish-white. Dorsal spines, III, 2. 2-3. 2-4+10-12. 3. 3-4, VII. Lateral line begins on anterior edge of 6th segment, and forms a loop under the 8th. Gills complex, each with 4-12 branches, in the same positions as in the larva. Abdomen ending in two long processes. Mandibles sharp, knife-like, slightly serrate on cutting edge, a little longer than the labrum, which bears five long hooked hairs on either side.

*Eggs.*—The eggs of this species are light greenish, contained in a grayish translucent mass of gelatinous material, possessing considerable rigidity. These masses appear to be made up of a continuous string of material laid in a regular manner, with somewhat the appearance of an irregular coil 6-9 mm. in diameter. None have been found actually beneath the water, but always in moist, warm situations, *i. e.*, beneath the larger stones, where they would not be subjected to extremes of heat or cold, or to sudden changes.

*Case.*—Length, 18–22 mm. Width, 4–5 mm. at anterior end, a little narrower posteriorly; cylindrical, beautifully constructed of rather evenly sized sand grains, curved; open at both ends, but the posterior edge usually turned in so as to narrow the opening. A dorsal hood at the anterior end.

The anterior end of the pupal case is composed of larger, irregular stones, sometimes a few being added to the posterior end also when it is closed. It is fastened at both ends to the lower surface of a stone, large clusters being formed in a favorable location.

*Habits and Occurrence.*—The habits of this larva have been described in an earlier paper (1905). To the observations made at that time may be added the following. The food of the newly hatched larvæ differs somewhat from that of the older ones. Immediately after building a case, they begin to feed and for some time their food seems to consist almost entirely of simple algæ, diatoms, etc., which they gather from the rocks in the spring or stream.

After several unsuccessful attempts, a full-grown larva was successfully transferred to a glass tube of the proper size, and by this means what took place after the closing of the pupal case could be observed. Indeed, the process of closing was watched, but nothing worthy of note was seen. The closing of the case was completed Mar. 11. On Mar. 12 the first abdominal segment of the larva was much constricted, and the thoracic segments were stretched apart and immobile, evidence of the pupa taking shape within. The legs were thrown into positions unnatural for the active larva, which if taken from the case at this time is of course helpless. On Mar. 15 the hairs of the lateral line of the pupa were just discernible through the larval skin, and on the morning of Mar. 16 the line showed plainly, very black, and the larval skin could be seen free from the pupa at the posterior end. At 9 a. m. strong contractions and crawling movements were forcing the pupa forward in the larval skin, causing it to split. At 12:30 p. m. a split had appeared along the median line of the pro- and mesonotum, extending partly across the metanotum. A distinct, very white line could be seen along the sides of the body beneath the old

lateral line of the larva. The split next involved the head. The pupa continued the contractile movements, and, partly by means of the spines on the dorsal side, worked the skin backward over the body so that a larger and larger amount of free skin could be seen posteriorly. Within ten minutes the head and thorax were free, except the antennæ and long appendages. The process then went on steadily until the skin, without further splitting, was worked off at the posterior end. As a result of the crawling movements, the pupa had its head tightly jammed against the anterior end of the case during the molting process. Twenty-three minutes after the split was first noticed, the pupa was entirely free. Probably an average of twenty-five minutes is sufficient for the molt after splitting of the larval skin, but some hours seem to be necessary to produce the rupture. The splitting of the head occurs along the sutures of the clypeus. Two days later a considerable portion of the cast skin of the abdomen had been forced out through the posterior aperture. In three days some of the legs had passed out. Unfortunately this pupa died before transforming, so no further observation could be made upon it.

Larvæ have been taken from springs flowing into Lake Geneva, Walworth County, from Merrill's Springs, from the springs at Devil's Lake, the stream in Parfrey's Glen and a neighboring stream, and from the large springs at Lake Wingra previously reported (1905).

While the statement previously made as to the time of appearance of the adults is correct, so far as what may be called the maximum appearance is concerned, a few stragglers may be found during the summer and autumn. They may be easily captured from beneath the sticks and stones near the water, but, if once they start to run or fly, they are very active and difficult to catch. As late as Oct. 12 four egg masses were taken, after diligent search, where perhaps as many dozen might have been obtained in April or May. On Nov. 2, one egg mass was found, but the eggs were unfertilized. Eggs deposited in the laboratory hatched in eleven days.

(Pl. LII, Fig. 9. Pl. LV, Figs. 21-26. Pl. LVI, Figs. 1-4.)



*Platyphylax subfasciatus* Say.

*Phryganea subfasciata* Say, Long's Exped., II, 1824, 308; *Am. Ent.*, III, 1828, Pl. 44; Complete Writings, I, 1859, 97.

*Neuronia ? subfasciata* Walker, *Cat. Neur. Brit. Mus.*, I, 1852, 11.

*Enoicyla subfasciata* Hagen, *Syn. Neur. N. Am.*, 1861, 269; *Proc. Bost. Soc. Nat. Hist.*, XV, 1873, 296.

? *circularis* Provancher, *Nat. Can.*, IX, 1877, 260.

*Platyphylax subfasciatus* McLachlan, *Jour. Linn. Soc. Lond. Zool.*, XI, 1871, 110. Banks, *Proc. Ent. Soc. Wash.*, VI, 1904, 211; *Cat. Neur. Ins. U. S.*, 1907, 39. Ulmer, *Cat. Coll. Selys*, Fasc. 6, 1907, 25; *Gen. Insectorum*, Fasc. 60, 1907, 54.

*Imago*.—Length of body, 15–17 mm. Expanse, 35–40 mm. Antennæ blackish, annulated with rufous, tips light rufous, basal article rufous within and beneath. Palpi and face yellow. Body yellowish beneath, head and thorax rufous, and abdomen fuscous above. Two small warts between the median and paired ocelli, a larger transverse pair occupying nearly the whole of the pronotum, two small linear pairs on mesonotum, and the wing callosities, all clothed with rufous hair. Legs yellow with black spines, spurs rufous. Fore wings dull ochreous, bullate, scarcely pubescent, a broad smoky band along the outer margin, two transverse, irregular, fuscous bands on the disk, broken up into rounded spots by the veins; the outer of these nearly without the anastomosis, which it follows; the inner at the middle of the wing, neither extending across. A smoky band fills the space between the lower branch of the media and the inner margin to the anastomosis. Posterior wings sub-hyaline, ochreous at the tips. The third apical cell is the narrowest at the base on both fore and hind wings. In the fore wing, a cross-vein connects the media and the cubitus at the fork of the former, and cross-veins are present on both the basal cells. Discoidal cell of each wing about the length of its stalk.

In the male, the superior appendages are small flat lobes, concave on the inner surface; between these lie the very small intermediate appendages, the tips of which meet in the middle. Extending somewhat above the superior appendages are the inferior ones, each consisting of a spine-like piece, rising almost directly upward from the inner surface of a buttock-like swelling, on which is a heavy row of hairs. In the cleft between these swellings, lies the small penis and its sheaths. The penis is small, simple, with a simple spine-like sheath on either side.

*Larva.*—Length, 20–23 mm. Width, 4–5 mm. Greenish-white in life, slightly reddish on dorsal side. Head, pro- and mesothorax very dark. The markings are in general much like those of *P. designatus*, but more obscure on account of the dark color of the whole. Legs dark brown; a small chitinous “horn” on prosternum. The shield on the dorsum of the 9th segment is light colored, with black hairs. The lobes on this segment bearing the prolegs are pressed closely together in the middle, and are light brown, giving the appearance of a rounded 10th segment. Two very long black hairs stand just above the bases of the hooks. Lateral line of black hairs, not very conspicuous, on segments 3–8. *Gill-filaments simple*, Fig. 7.

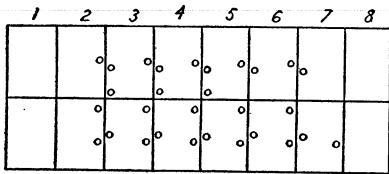
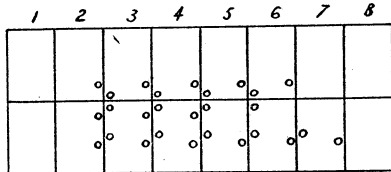


Fig. 7.

*Pupa.*—Length, 18–23 mm. Antennæ extending to the 6th segment. Whitish or yellowish. Dorsal spines, III, 2–3. 2–3+7–8. 2–4. 2–3, VII. Lateral line of dark hairs begins on the posterior border of the 5th segment and forms a loop under the 8th. Posterior border of the 1st segment strongly chitinous with a median indentation. A few scattered black hairs on the posterior edge of the 6th, 7th, and 8th segments above. A pair of long appendages on posterior end of abdomen, the prominences from which they arise beset with short spines,

the ends of the appendages with several upturned hooks. Mandibles knife-like, with serrate edges, longer than the labrum; the latter with a pair of whitish patches, each bearing five long, hooked hairs. Gills simple, as in the larva, with which the gill formula is almost identical, Fig. 8.



*Fig. 8.*

*Case.*—Length, 21–28 mm. Width, 6 mm. A nearly straight tube of even diameter, strongly built, composed of coarse sand and gravel irregularly placed; often with the peculiar seeds of *Potamogeton*, and occasionally a mollusc shell, used in its construction. A dorsal hood at the anterior end. The posterior end is rounded and partly closed by a membrane, leaving only a small circular or lobed aperture. A stick of greater or less length, usually a section of a stem of *Potamogeton*, is fastened to the dorsal side of many cases, projecting beyond the posterior end. One of these measured had a stick 46 mm. long projecting 35 mm. beyond the case, making a total length of 62 mm. for case and stick.

The pupal case is shortened somewhat, its length being 22–24 mm. The anterior end is closed by a sieve-membrane, while the posterior end is closed by a membrane with (usually) a single opening, showing in most instances, a tendency to a four-lobed shape.

*Habits and Occurrence.*—These larvæ live along gravelly bottoms in the lakes, in a depth of from two to four feet of water. They seem difficult to get by the ordinary dredging with a net, and as long as this means alone was used only a few empty cases were found. But, at least in the spring, numbers may be found attached to submerged sticks and logs, particularly if these have an irregular or roughened surface. The cases are nearly always attached at the anterior end as though

pupation time were near. However, they invariably fastened their cases thus in the aquaria and remained for days in the same position, though they did not pupate until late in the summer, the adults appearing in August and September. The larvæ have been obtained from Lake Mendota, along the south shore of Picnic Point, and in Devil's Lake. One adult was taken with a beating net from the shrubbery along the lake shore on October 5.

(Pl. LII, Fig. 5. Pl. LVI, Figs. 5-11.)

### SERICOSTOMATIDÆ.

#### *Helicopsyche borealis* Hagen.

*Notidobia borealis* Hagen, Syn. Neur. N. Am., 1861, 271.

*H. glabra* Hagen, Stett. Ent. Zeit., 1864, 130. (Case)

*Helicopsyche borealis* Hagen, Ent. Mo. Mag., II, 1866, 253.

McLachlan, Rev. and Syn. Trich., 1876, 238. Banks, Tr.

Am. Ent. Soc., XIX, 1892, 365; Proc. Ent. Soc. Wash.,

VI, 1904, 212; Cat. Neur. Ins. U. S., 1907, 43. Ulmer,

Gen. Insectorum, Fasc. 60, 1907, 94.

*Imago*.—Length of body, 5-6 mm. Expanse, male, 12-13 mm., female, 16-17 mm. Antennæ yellow, darker at the tips; the basal article darker, particularly in the males; as seen from above in the resting position of the insect they present the form of a long Y, as they lie close together through most of their length, but curve apart at the tips. Palpi of females dark, of males almost black, densely pubescent. Head and thorax brownish-black. A pair of large warts above eyes, a large transverse pair on prothorax, a small linear pair and a median posterior one on mesothorax, and the wing callosities, all with luteous hair. Abdomen not so dark as head and thorax, densely covered with long luteous hair. Legs luteous, luteous spurs and spines. Anterior wings grayish-fuscous in general color, with black and luteous hair, ciliated with black. Posterior wings grayish, pubescent, ciliated with grayish-black. In the male the superior appendages are represented only by small rounded lobes; the intermediate pair appear to be absent (un-

less represented by the penis cover) : inferior appendages very large, consisting of two parts, as seen from beneath; the inner, ventral part is a short lobe terminating in a group of heavy, closely set spines: separated from this by a deep excision is the outer, dorsal portion, which is directed strongly upward and consists of a large lobe bordered on the larger terminal part by strong projections, each bearing a spine-like hair; the inner, concave surface is studded with similar projections and hairs. The outer surface is quite hairy, especially the ventral surface. Projecting between these is the broad penis cover, with a slight median indentation terminally, and with a few short hairs on the border. From beneath, the penis may be seen lying within the hollow of the ventral surface of the cover. The posterior margin of the 9th ventral segment of the male has a median rounded excision. A brown lobe or tooth is present on the 6th ventral segment, not on the 7th, as MacLachlan and Ulmer state for the genus. McLachlan's figures of *H. sperata* appear to indicate it on the 6th, and of *revelieri* on the 7th.

*Larva*.—Length, 7–8 mm. Width, 1.5 mm. Body in life yellowish-green. Head and thorax very dark. Clypeus outlined with white, and eyes situated in a light area. Five small spots located on upper part of clypeus, and two on either side of same. Head white ventrally, nearly hidden under the pronotum normally. Gula not well marked or chitinized. Prothorax evenly dark, except fine white median line. Distinct fringe of hairs on sides and anterior edge, the latter pectinate with short spines. McLachlan says for the genus that the succeeding segments are all soft, but this is not true for *borealis*. Mesonotum with a bunch of hairs at the anterior lateral angle. General color a little lighter than that of the prothorax. On this segment there is a white median line crossed at its middle by a transverse line which curves forward, meeting the anterior edge at a right angle: situated in this transverse band on either side of the median line, are three black dots. A white oblong spot on either side of the posterior part of the median line, and another near the posterior lateral border. Metanotum only partly chitinized. Legs brownish, more yellow on tibiae and tarsi, with scattered, slender hairs. No gills and no lateral

line. Lateral humps thickly beset with small spines, set in pairs. Dragging hooks composed of a series of small hooks disposed in a fan shape, the largest hook on the outer side. The piece bearing this series of hooks is concave and well adapted to fit the curved interior of the case. A sharp spur on the supporting plate of the first leg extends forward, ending in a spine.

*Pupa*.—Length, 6-7 mm. Antennæ extending to the 7th segment. Body yellow to greenish. Dorsal spines, III, 3. 3. 3+3-4. 3, VI. No gills and no lateral line. Posterior end of body terminated by a pair of stout, club-like projections, each bearing 11-12 long, black, terminal hairs. Mandibles long, slender, finely serrate within, crossed at the tips, which are slightly turned outward; much longer than the labrum which is very small, a little broader than long, with two anterior groups of three hairs each, and two posterior pairs of hairs.

*Eggs*.—Hundreds of clusters of the eggs of this species might easily be collected from the posts of piers which stand in the waters of the lakes in the latter part of June and early July. They are contained in clear or slightly yellowish hemispherical masses of soft jelly, 3-5 mm. in diameter, which are deposited several inches below the surface of the water.

*Case*.—The larva of this species builds the famous case characteristic of the genus,—a spiral like a common snail shell, and several times described as such. As an example of such a mistake may be given the description of *arenifera*, by Lea (1834). He says it "has the remarkable property of strengthening its whirls by agglutinations of particles of sand, by which it is entirely covered."

The case is very strongly built of evenly sized sand grains accurately placed. Diameter of tube at mouth, 2 mm. Height of coil, 3 mm. Whole width of coil, measured across the mouth, 5 mm., and at a right angle to this 4 mm. Usually about two whorls to the posterior opening. Larvæ killed in the case are found to extend around more than an entire whorl, the average perhaps 1 1-4.

The pupal case is identical with that of the larva, and is found fastened upon stones, particularly rough or irregular

ones, almost anywhere along the lake shore where stones abound. The pupa lies with its ventral side toward the axis of the whorls of the case, the slit in the anterior closing membrane being so placed that it lies at about the level of the labrum, and across it from side to side. The body extends around somewhat less than one whorl, and at its posterior end a sieve-membrane is formed, leaving thus more than an entire whorl empty. This surplus cannot be cut off as would be done by larvæ with straight cases.

*Habits and Occurrence.*—This larvæ is easily obtainable along the rocky shores of the lakes, where it is often in such shallow water that it may be taken from rocks reached from shore. It ranges out to a considerable depth also, specimens having been taken from a depth of eight or ten feet. All other larvæ of this genus whose habitat I have been able to determine from the literature, live in (or near) flowing streams. Thus, *H. sperata* has been taken from "mossy rocks exposed to the sun, not in the stream itself, but kept constantly humid by dropping water," McLachlan, (1880). *H. zealandica* is reported by Hudson (1904) from streams containing trout, and *revelieri* from shallow streams and (probably the same) from torrents. Our American *H. arenifera* is known only from a case description from the Cumberland River, Lea (1834). I have collected *borealis* from Lakes Mendota and Monona and Devil's Lake.

The imagos are very common in late June and early July, when they may be taken in large numbers from vegetation near the lakes. Specimens were also obtained at Trout Lake, in Vilas County. I was unable to observe the method of oviposition, probably because it takes place after nightfall. Certainly the females must descend beneath the water to place the eggs where they are found. Furthermore, I should expect the insect to come up quite unwetted, owing to its excessive hairiness. It is certain that many Trichoptera fall upon the water and rise again at will.

(Pl. LII, Fig. 6. Pl. LVI, Figs. 12-22.)

*Lepidostoma wisconsinensis* nov. sp.

*Imago*.—Length of body, 4–5 mm. Expanse, 13–15 mm. Antennæ grayish-black above, fulvous beneath with a blackish process near the middle of each segment: this process consists of an annulation of black scales such as cover the upper surface completely. Head and thorax brown. On the head, a pair of warts within and at the bases of the antennæ, another larger pair above the eyes extending diagonally back across the head, and a third pair on the sides of the head behind the eyes; these, and two pairs of warts on the prothorax and the wing callosities, all clothed with long grayish hair. The face of the male is deeply concave to receive the maxillary palpi, and the basal joints of the antennæ are somewhat flattened within. Viewed from above, the disk projects somewhat forward between the bases of the antennæ, and bears a dark longitudinal keel; a similar keel on the posterior half of the head of the female, the face convex. Abdomen brownish, the body paler beneath. Legs yellow, except the first pair more brown. Wings dark gray; anterior pair indistinctly and sparsely guttate with yellowish, both pairs fringed with dark gray, except lighter near the body on the posterior pair.

In the male only a portion of the 9th dorsal segment is visible. A pair of appendages (intermediates?) short, broad, directed downward, with a concave outer face, on which are four short spines; ending below in a stout spine directed backward and upward. The inferior appendages are long, very hairy, nearly straight, directed slightly upward, ending in a beak-like point; in lateral view a small, club-shaped, ciliate appendage arises from within, near the base; viewed from above when dissected off, this inferior appendage is seen to bear three such supplementary appendages on its inner concave surface, the distal two being invisible from the side. The largest of the three corresponds to what McLachlan in *L. hirtum* says "by a stretch of the imagination may be called penis sheaths," but in this species a pair of small pointed pieces lying alongside the penis on the dorsal side would certainly better be called the penis sheaths. The penis is bifid. at the tip.



*Larva*.—Length, 9–10 mm. Width, 1.5 mm. Body yellowish. Head dark brown, almost black to naked eye, with two indistinct lighter spots on the upper part of the clypeus, which is outlined with a lighter suture; on either side of upper part of clypeus a double row of small indistinct lighter spots. Prothorax same color as head, uniform, except light median suture, and double line of black on posterior edge: a fringe of black hairs on anterior border. Mesonotum with a uniformly lighter brown shield of chitin and white median suture: black hairs anteriorly and posteriorly. Metanotum soft, four black hairs on middle portion, and a light colored strip of chitin on anterior lateral corner bearing a few black hairs. A soft light colored “horn” on prosternum. Legs light golden yellow, with black hairs and yellow spines, the second longer and placed further dorsal on the body than the first and third. The rudimentary antennæ are placed quite near the eyes. On the chitinous plate of the 9th dorsal segment are four long black hairs: also a group of hairs, three or four of them long, at the base of the draggers. No lateral line. Gills simple, Fig. 9.

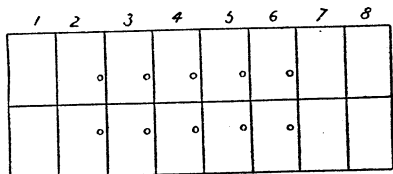


Fig. 9.

*Pupa*.—Length, 7.5–8 mm. Antennæ as long as the body. Body yellowish. Dorsal spines, III, 5. 4–5. 5 + 9–12. 5. 4–5, VII. The first abdominal tergum is produced posteriorly at the outer angles, the processes being slightly serrate when viewed laterally with a high power. Lateral line of dark hairs begins on the 2nd segment, forming a loop under the 8th. Gills as in the larva. The body of the female is terminated by a pair of processes, bearing many light-colored hairs laterally, and four black ones at the tips. Similar processes on the body of the male, but with fewer lateral hairs, and those at the tips less conspicuous, only one being comparable in size and blackness to

those of the female: beneath the bases of these processes, the male has also a pair of shorter processes or lobes. Mandibles longer than the labrum, straight, sharply pointed, slightly serrate within, two short black hairs on the outer side of the base. Labrum a little broader than long, a pair of long, black, hooked hairs on either side beyond the middle, a shorter black one, not hooked, near the latter, and some short colorless ones on the anterior portion.

*Case.*—The larvæ of this species, (and of the genus) build at first a cylindrical case of sand, slightly curved, tapering decidedly in some instances, while in others the diameter is almost uniform. The sand cases measure up to 10 mm. long, one of the maximum length measuring 2 mm. in width at the anterior end, and 1 mm. at the posterior. These are the cases commonly found in the autumn. In the spring a quite different case is formed, and enough intermediate stages to prove the change, even if the identity of the larva were not established, may be easily found. The later case is square in cross-section, formed of thin flat pieces of bark and leaves; the component pieces are rectangular, or sometimes slightly hexagonal in form. The case is straight and equi-diametric. Length, 10–12 mm. Width, 2 mm. This case, cut to the proper length to fit the body snugly (8.5–10 mm.), and fastened by strong cords of silk at both ends, is used for pupation. The anterior and posterior closing membranes are the same, being sieve-like.

*Habits and Occurrence.*—These larvæ are quite plentiful in the streams at Devil's Lake and Parfrey's Glen, where they inhabit the pools. The pupæ were abundant at the Glen on June 1. They could be found only among roots and grasses where these hung in the stream, as, for example, in a bit of overhanging sod. I have not taken the imagos in their natural habitat. Those reared in the laboratory appeared in the first days of June.

(Pl. LII, Fig. 8. Pl. LVII, Figs. 1–10.)

## LEPTOCERIDÆ.

*Leptocerus dilutus* Hagen.

*Leptocerus dilutus* Hagen, Syn. Neur. N. Am., 1861, 277.

Banks, Cat. Neur. Ins. U. S., 1907, 45. Ulmer, Coll. Selys, Fasc. VI, 1907, 45; Gen. Insectorum, Fasc. 60, 1907, 136.

*Imago*.—Length of body, 5–6 mm. Expanse, male, 18–20 mm.; female, 16–17 mm. Antennæ, male, 18 mm.; female, 10 mm. Antennæ brown, the basal joints, to about the 16th, annulated with snow-white on the proximal half. Head and thorax dark brown, nearly black. On the head a pair of warts (or a single median one) between the concavities which are found posterior to the antennæ; a second pair just outside the first and posterior to the concavities; a third just within and behind the eyes, and a fourth in front of the eyes, beneath the bases of the antennæ, all clothed with snow-white hairs, intermingled with which are a few black ones. A pair of prominent warts on the pronotum, and the wing callosities, also clothed with snow-white and black hair. On the mesonotum short white hair is parted by a shallow impressed median line, and on either side of this is a ridge on which short white and black hairs lie parallel to the long axis of the body. Abdomen green to brown. Legs grayish-yellow, except fuscous coxæ, clothed with silvery pubescence: brown spines on the tarsi. Anterior wings grayish-brown, with dense luteous and fuscous pubescence, fringed with dark gray or brown; a whitish-yellow spot at the arculus. Posterior wings grayish-hyaline, iridescent, with sparse gray pubescence, ciliated with same.

In the male the 9th dorsal segment is extended medially, ending in a bifid tip. The superior appendages (appendices praeanales of Ulmer) are plate-like, rounded at the extremities, with a border of long hairs. The large penis cover (Dorsalschuppe, Ruckenschuppe, or X segment of Ulmer) is rounded with a slight notch at the end, the border with a ring-like thickening: penis large, projecting downward from beneath the cover. The inferior appendages (Genitalfüsse of Ulmer) are long, directed

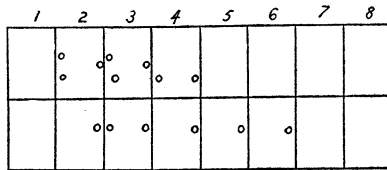
strongly upward, and curve backward between the levels of the penis cover and the superior appendages; the ventral portion is dark brown and at the junction of this with the lighter portion above there is a small lobe on the posterior edge.

In every particular, except the genitalia of the male, my specimens agree with the descriptions of Hagen and Ulmer, and, unless this be a new species, the difference here shown between my specimens and the type, as seen in my figures and Ulmer's must be due to the drawings being made, in the one case, from material preserved in alcohol and in the other from a dried and old specimen.

Considerable variation in general coloration from luteofuscous to nearly black, and from bright green to fuscous in the abdomen, appears to be correlated with the age of the insect, the lighter colors belonging to those most recently transformed. Variation in the conspicuousness of the anal spot is also noticeable. This species is common in the latter part of June.

*Larva.*—Length, 6–7 mm. Width, 1.5 mm. Head small as compared with the width of the abdomen. Body in life light green. Head and thorax yellow. Antennæ large, yellow; mandibles brown. Light brown spots on head as follows: on upper portion of clypeus a transverse spot lying in the base line of an arch formed above it by four other spots, their ends more or less closely approximated; on either side of the clypeus extends a row of four or five rounded spots lying in the direction of a line extending from either side of the posterior median suture toward the antennæ. Pronotum plain, except posterior half of lateral border, and posterior edge near median line, black. Fringe of hairs on anterior portion of pronotum. Mesanotum slightly chitinized in central portion, but almost colorless; a pair of crescentic black bars, with concavities outward, on posterior half of segment; a group of dark hairs on anterior lateral corner. Metanotum without chitin except black bars on anterior lateral portion for the attachment of legs. Legs yellow. Lateral line absent. Gills simple, Fig. 10. Lateral tubercles with a black bar of chitin and a group of spines which are arranged in pairs, all pointing forward. Dragging hooks small, with an acute curve.

*Pupa.*—Length, 7-8 mm. Width, 1.5 mm. The antennæ are much longer than the body and are wrapped about the posterior portion of the same. Color in life light green. Dorsal spines, III, 2-4. 3. 4 + 16-20. 3-4. 3-4, VII. Each side of the first abdominal tergum bordered by a line of chitin ending posteriorly in a knob studded with short blunt spines: a pair



*Fig. 10.*

of roughened or spiny patches on the posterior edge of the segment may be seen within these knobs, when a cast skin is placed beneath a microscope. Two lines of chitin extend down both the dorsal and ventral sides of the abdomen. Lateral line almost invisible. The gills could not be made out well in the cast skins on which I was forced to depend. They are small, as in the larva. The posterior end of the body is terminated by two chitinous appendages, with inturning hooked extremities; viewed laterally, the distal portion is seen to curve upward, as shown in the figure for the next species. Two small groups of hairs on the dorsal side of the last segment, point forward, evidently holding the coils of the antennæ in place. The mandibles are moderately long, curved inward, serrate within: labrum very small, shorter than broad.

*Case.*—Length, 7-9 mm. Width, anterior, 2 mm.; posterior, 1 mm. A strongly curved conical case of rather fine sand, smooth in construction. There is a forward projection dorsally, forming a hood, so that when the oblique opening is closely applied to the surface of a rock, the case meets the plane of the surface at an angle of about 45°. The posterior end is closed by a membrane with a single round or slightly elliptical opening at the dorsal edge.

At the time of pupation the hood is extended forward and downward and the end of the case assumes a neatly rounded

appearance. The whole case now lies close to the stone when the opening, which is now ventral, is applied to the surface; this opening is entirely closed by a membrane, the outer surface of which adheres to the stone. A small transverse slit is left open low down in the anterior rounded end.

*Habits and Occurrence.*—These larvæ are very plentiful in Lakes Mendota and Monona, in rather shallow water, where there is some *Potamogeton*. From the rocky promontory at Tenney Park, they may usually be taken without the use of a boat, by collecting from the stones along the shore.

The pupal stage lasted 12 days in the laboratory. I have not been able to observe the transformation from pupa to adult, but have some reason to believe that it takes place in an exceedingly short time. The pupal skins are left floating on the surface of the water. Adults are common in the latter part of June, when they may be taken with a trap lantern, or, along the lake shore, with a net.

(Pl. LIII, Fig. 3. Pl. LVII, Figs. 20–22. Pl. LVIII, Figs. 1–7.)

*Leptocerus ancylus* nov. sp.

*Imago.*—Length of body, 5–6 mm. Expanse, male, 20–21 mm.; female, 16–17 mm. Antennæ, male, 20 mm.; female, 10 mm. Antennæ dark brown, the basal half annulated with snow-white on the proximal part of each segment, annulations more distinct than in *dilutus*. Head and thorax brown, with warts and pubescence as in *dilutus*, except the admixed dark hairs are brown rather than black. Abdomen green to brown. Legs silvery gray, brown coxæ, brown spines on the tarsi, the latter flecked with brown on the distal ends of the joints. Anterior wings brown, with more luteous hair than in the preceding species; fringed with brown, a yellowish spot at the arculus, not conspicuous. Posterior wings grayish-hyaline, iridescent, with sparse gray pubescence, fringed with same.

In the male the 9th dorsal segment is extended medially, ending in a rounded tip. The superior appendages are plate-like, rounded at the extremities, without the long hairs on the border. Penis cover much as in *dilutus*, the ring-like thickening

of the edge not so prominent in lateral view, the tip not indented: penis as in the preceding species. Inferior appendages of the same general form as in *dilutus*, but the posterior lobe is larger, ending in a hooked tip, and the portion below is not thickened and dark brown. An additional pair of appendages is here present. They are long, tapering, nearly straight in lateral view; in ventral view they are strongly curved, or sickle-shaped, their points directed toward each other. These appendages may be thrown up so as to lie alongside the inferior (?) appendages, in which position they are much less conspicuous.

*Larva*.—Length, 6-7 mm. Width, 1.5 mm. Head small. Body in life green. Head very dark, the eyes in light spaces, which are situated at the anterior extremities of a horse-shoe-shaped light area, the middle of the curve of this area lying around the apex of the clypeus. On either side of the apex, in this area, are two black spots, the smaller one external. The clypeus shows a lateral border of white almost to the anterior edge. Mandibles and labrum black. Beneath may be seen a black semi-lunar gula, with white on either side. The prothorax is dark brown, darker on the posterior border, a small irregular light patch on either side above the legs. On the mesothorax is a squarish patch of light brown, bisected by a fine

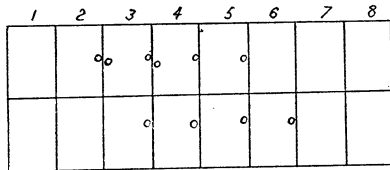


Fig. 11.

median line, posterior to which is a pair of small elongated spots; outside of these on the posterior half of the segment, a pair of curved black bars, with the concavities outward. Metathorax unchitinized, except a bar for the attachment of legs on either side. Legs light brown. A microscopical examination of the various parts shows their form to be almost identical with the parts of *dilutus*. The drawings of the respective clypei show some slight difference there. The two species could not

possibly be confounded, however, as *dilutus* is very light with a few slightly darker markings, while *ancylus* is nearly black on the head and prothorax with the markings in white.

*Pupa*.—Length, 7–8 mm. Width, 1.5 mm. Antennæ coiled about the posterior end of the abdomen. Body in life light green. Dorsal spines, III, 2. 3. 3–4 + 15–18. 3. 2, VII. First abdominal tergum with lateral borders of chitin, ending posteriorly in knobs studded with short blunt spines: within these knobs, on the posterior edge of the segment, a pair of spiny patches, a little more conspicuous than in *dilutus*. Lateral line inconspicuous, beginning on the 3rd segment and extending over the 8th. The gills are branched, each with 2–5 branches, but are quite small and their position difficult to determine exactly. The formula appears to be as in Fig. 11.

It will be noticed that this pupa is almost identical with the one preceding, but peculiarly, the case is here an unfailing specific character, so far as these two species is concerned. One can also make certain of the identity of a pupa if a fairly mature male specimen is at hand. After preserving such an individual, the genitalia may be seen thru the skin, or, better yet, the posterior end of the pupal skin may be dissected away and the organs be thus clearly exposed.

*Case*.—Length, 7–9 mm. Width, anterior, 4–5 mm.; posterior, 1 mm. This case, remarkable for a *Leptocerus*, has the form of a *Molanna* case or, better, that of a *Thremma*, *i. e.*, the tube proper is concealed by a dorsal shield formed by anterior and lateral extensions, giving it the appearance of a shell of the snail *Ancylus*. The larva is well protected and clings closely to the rocks on which it is found, usually on the lower surface. The structure is of fine sand grains, neatly fitted. The round opening of the posterior end is situated on a small projection of silk on the dorsal side.

At the time of pupation, the space beneath the anterior end is floored with silk, and a small transverse slit is made in the anterior end on the dorsal side. The upturned appendages of the posterior end of the pupa may usually be seen projecting out of the posterior opening as in *dilutus*. Though this case appears at first so remarkably different from that of the preceding



species, a lateral view, or a sagittal section of a pupal case, would be almost identical.

*Habits and Occurrence.*—These larvæ are quite common in Lakes Mendota and Monona in very shallow water, where stones abound. They are by no means to be found everywhere that the conditions are apparently right, however. Thus, for a short distance along the South shore of Picnic Point, near the end of the same, they are plentiful, but a similar stretch of shore continuous with this and apparently exactly like it, will yield none.

Several of the pupæ of this species were found to be infested with a small mite. On a single individual 44 of the parasites were counted, the pupa having the appearance of having been dead at the time it was placed in the preservative. I know of no such instance having been previously recorded.

Imagos appeared in the laboratory late in June. Specimens were taken with the trap lantern early in July.

(Pl. LIII, Fig. 2. Pl. LVIII, Figs. 8-15.)

*Leptocerus tarsi-punctatus* nov. sp.

*Imago.*—Length of body, 6 mm. Expanse, 18-20 mm. Antennæ fuscous, annulated with snow-white, the annulations less distinct toward the tip. Maxillary palpi brown, with brown hairs, the distal two joints with admixed white hairs. Head and thorax dark rufous, the warts and pubescence much as in *dilutus*, but the admixed dark hairs are lighter than in *dilutus* or *ancylus*, being golden or reddish-brown, and the warts in front of the eyes are clothed with all brown hairs. Abdomen green to brown. Legs rufescent with silvery pubescence; feet white, but *all* the tarsal joints are flecked distally with brown. Anterior wings with luteous and brown pubescence (the whole lighter than *dilutus*), a luteous spot at the arculus. Posterior wings grayish-hyaline, a little more reddish than in *dilutus*.

A lateral view of the male genitalia shows the relationship of this with the other species of the genus herein described, as well as its specific distinction. The superior appendages are long, narrowed at the tips, with a distal cluster of long hairs. The penis cover is very long and narrow, much more of it being vis-

ible in dorsal view than in the other species. The penis projects downward from beneath the cover, and a very slender intermediate appendage (or penis sheath) with a long spine near the tip lies on the other side. The distal portion of the inferior appendages curves backward rather abruptly, a stout, brown, spine-like branch lying in the curve of the posterior edge; ventrally each appendage is prolonged into a straight posteriorly directed portion ending in a short spine. Tips of inferior appendages fulvous; superior appendages gray.

The other stages of this species are wholly unknown to me.

(Plate LVIII, Figs. 16, 17.)

*Leptocella uwarowii* Kolenati.

*Mystacides uwarowii* Kolenati, Gen. et. Sp. Trich., 1859, 249, Tab. II, Fig. 24.

*Setodes candida* Hagen, Syn. Neur. N. Am., 1861, 280. Kolbe, Arch. f. Naturg., 1888, 174.

*Leptocella uwarowii*, Banks, Proc. Ent. Soc. Wash., VI, 1904, 213; Cat. Neur. Ins. U. S., 1907, 46; Ulmer, Cat. Coll. Selys, Fasc. VI, 1907, 45; Gen. Insectorum, Fasc. 60, 1907, 138.

*Imago*.—Length of body, 8–10 mm. Expanse, male, 27–28 mm.; female, 23–26 mm. Antennæ, male, 32 mm.; female, 16–18 mm. Basal portion of antennæ white with narrow brown or fuscous annulations, becoming wholly brown on the distal portion. Basal joint bulbous, a concavity on the head just posterior to it, into which it fits when folded back. Palpi yellow. Head and thorax fuscous, or, in fresh specimens shortly after transformation, green to yellow. The warts on head, pro- and mesothorax, and the wing callosities, all clothed with long snow-white hair; snow-white pile in the interspaces which, with a high power, is seen to consist of a clothing of scales. A Y-shaped wart on the head lies with the stem between the antennæ, the forks extending backward and outward; a large oblong transverse pair posterior to the branches of the first; a smaller pair at the outer posterior side of the larger pair, just behind the

eyes; on the very short pronotum a small prominent pair; on the mesothorax a shallow impressed median line, with a long wart on either side; at the posterior extremity of this segment is a small lighter colored area, greenish or yellow. Abdomen bright green, or, in older specimens, yellow. Legs yellow, except fuscous coxæ. Anterior wings snow-white, ciliated with light and dark brownish, with brownish scattered spots, due to the pubescence of that color on the veins, these spots tending, at the apex, to be arranged in transverse rows. In the older individuals, the neuration is distinctly brownish, and, as the pubescence is often almost entirely gone, the appearance of the wings is quite different. Posterior wings niveo-hyaline, ciliated with white.

In the male the 9th dorsal segment is much elongated, with two small lobes projecting from beneath the tip. The superior appendages are long, broader at the distal end, where they are thickly clothed with yellow hairs. A pair of appendages, which may represent the intermediates, curve upward, backward, and finally downward, ending in a broad, rounded portion, convex above. A penis cover, or penis sheaths, since there are two parts, extends straight out behind from the base of the intermediate appendages, each piece thin, almost transparent, flattened, with a pointed end. Beneath these the large penis may be seen, somewhat obscured by large hairs beneath. The inferior appendages point upward at an angle of about 45°. They are broader at the distal end, with a rounded lobe extending inward, long stiff hairs standing upright on the outer border, the lower outer surface clothed with yellow hairs.

As suggested by Ulmer (1907), this may be only a variety of *L. exquisita* Walker. I have carefully examined the males of the latter and do not find even the differences in the genitalia mentioned by Ulmer. The wing venation varies somewhat, the stalk of the 4th apical cell being shorter in *exquisita*, and the cross-vein between the upper branch of apical fork 5 and the vein above, being farther from the tip than in *uwarowii*. The thorax is yellow, and the antennæ a trifle longer also. I have taken only five specimens of *exquisita*, all males, and these at the same time of the year that the others appear. The inter-

esting possibility is here suggested that perhaps we have in this case an instance of dimorphism among the males of the species. If only one species, *exquisita* has precedence.

*Larva*.—Length, 13 mm. Width, 2 mm. Body green in life, with double row of bright yellow spots of fat showing on sides of body thru the integument. Head yellowish-gray with black forked line lying along suture of clypeus; posterior portion of sides grayish, irregularly punctate with white; black in the middle beneath. Antennæ conspicuous, light colored; mandibles black. Labrum yellow. Pronotum not darkly colored, with a median white line; on either side a white sigmoid line extending diagonally so as to separate each lateral half of the segment into an anterior outer third, and a posterior inner two-thirds; bordered posteriorly with a double black line, except a wide middle portion; a three-lobed patch of very light color next to the posterior border, the outer lobe the longest. Mesonotum not chitinized except strong black bar of chitin on sides for the attachment of the third pair of legs, which are much farther dorsal on the body than the others. First legs white, the others black, lighter at the joints. No gills and no lateral line. Lateral humps furnished with a paddle-shaped piece of chitin, of which the handle is strongly chitinous and the broader part thickly set with bristles pointing forward. A row of short stout spines or pieces of chitin along either side of the 8th segment.

*Pupa*.—Length, 12–13.5 mm. Antennæ as in the adult. The extremely long antennæ of the males are coiled about the bases of the posterior appendages, both being wrapped the same way in any individual, but either from left to right or from right to left. A small group of hairs on the base of each appendage points forward, acting as a guard to prevent the coils of the antennæ from slipping over the posterior extremity. Abdomen in life bright green. Dorsal spines, III, 2–3. 2. 2 + 7. 3–4, VI. Two lines of chitin on the dorsal side of the abdomen, black on the anterior part of each segment, lighter on the posterior part; same on the ventral side. The tergum of the 1st segment is bordered laterally by a line of chitin ending posteriorly in a spiny knob, and along the posterior border of

each side is a narrow area of short blunt spines. The lateral line, consisting of white hairs not very long or abundant, is very inconspicuous; it begins on the 3rd segment, forming a loop under the 8th. No gill-filaments. Mandibles long, slender, a little curved, serrate, crossed in front of the labrum, which is very short, almost semi-circular, with three long black hairs on each side near the base, and five short ones near the anterior margin. The posterior end of the body is terminated by two slender chitinous processes about 2 mm. in length, ending in sharp points, and with a few short spines within, before the distal end.

*Case.*—Length, 16–21 mm. Width, anterior, 2.5 mm.; posterior, 1.5 mm. Composed of very fine sand grains and much silk, forming a smooth and very tough case, slightly curved, open at both ends. At the anterior end there is a distinct hood.

In preparation for pupation the case is shortened to about 15 mm., the anterior end is made of even length, *i. e.*, the hood is cut off, and a flaring, bell-like rim is added. Each closing membrane has but a single opening, an oblong one placed horizontally at the center. It is fastened firmly at each end by a cord of silk, expanding into a circular anchor where it is attached.

*Habits and Occurrence.*—These larvæ are plentiful on stones, sticks, and the shells of live mussels, usually slightly attached, in water up to 8 or 10 feet in depth. Their distribution is quite general, as they occur in the muddy bays, as well as in the sandy or stony portions of the lakes,—Mendota, Monona, and Devil's Lake. After capturing imagos of both *exquisita* and *uwarowii*, and before I suspected that they might be only varieties, I anticipated that their larvæ might be very similar, and accordingly examined many specimens of what I knew to be the larvæ of one or the other of them, to determine whether I could detect two species in this stage. I was unable to do so, and have not yet reared a specimen of *exquisita* in the laboratory.

The pupal stage is of short duration,—two weeks or less. Pupæ are plentiful in June, but by the first of July have nearly disappeared. The adults are very common late in June, when

they may be taken in large numbers with a net, from shrubbery near the lakes, or flying over the water at dusk.

(Pl. LIII, Fig. 1. Pl. LVIII, Figs. 18-22. Pl. LIX, Figs. 1-9.)

*Setodes grandis* Banks.

*Setodes grandis* Banks, Proc. Ent. Soc. Wash., VIII, 1907, 128; Cat. Neur. Ins. U. S., 1907, 46.

*Imago*.—"Head and thorax dark brown, clothed with mostly white hair; palpi brown, with brown hair; basal joints of antennæ brown, beyond yellowish, narrowly annulate with brown at tips of joints; legs pale yellowish, first pair darker. Abdomen pale, sometimes darker on tip. Wings dusky, with sparse black hair; radius and cubitus dark brown; hind wings faintly dusky, with gray fringe. Both pairs are long, and acute at tips; fork 3 much longer than fork 1, the latter very short pedicellate; lower branch of radial sector ending slightly before tip of wing.

Expanse, 16 mm."

The above is the description of Banks. In the male the superior(?) appendages are slender, pointed, a little curved downward and inward, their tips nearly meeting. The dorsal portion of the last segment extends posteriorly beyond the ventral portion. Beneath the superior appendages the penis projects downward. The inferior appendages are very large, directed upward, the parts described above lying concealed between them. The basal portion of each is stout, in lateral view narrow; the distal portion is broadly expanded, oval, very hairy; in ventral view the inner edge of the basal portion is pectinate with spines and the last segment is excised medially.

*Larva*.—Length, 7-8 mm. Width, barely 1 mm. at the 1st segment of the abdomen, 1/2 mm. at the 8th. Body in life bright green. Antennæ distinct, yellowish. Head and thorax yellowish with markings of dark brown. A median T-shaped mark on the upper part of the clypeus, the stem anterior; surrounding this in a long oval are six pairs of spots, all round except the posterior pair, which vary considerably in distinctness; on the anterior end of the clypeus are two pairs of short

transverse spots, one pair immediately anterior to the other; laterad may be seen two oblong dark spots ventral to each eye, with two more arranged parallel to these. A narrow bar along edge of occipital foramen on either side below. Prothorax nearly clear with short narrow bar along anterior edge on either side of the median line; a pair of oblong spots parallel to median line about the middle of the segment; a group of 10 or 12 dark spots on the outer posterior portion of this segment, the two inner ones of the group being elongated in the direction of a slightly diagonal line, the others forming a more or less perfect circle about one of the number as a center. Mesothorax with dorsal chitinous shield not distinctly delimited; near the anterior edge a pair of transverse spots; at juncture of middle and posterior thirds a smaller pair of longitudinally oblong spots, and near the posterior edge another pair of transverse spots, slightly nearer the median line than the first pair; six smaller spots lie outside these marks on either side. Metathorax not chitinous. Legs yellowish, with two or three brown spots on each coxa; the second leg is peculiar, being modified apparently for grasping; the third leg is a typical swimming leg. No gills or lateral line. No median dorsal plate on the 9th segment.

*Pupa.*—Length, 7–8 mm. Width, 1 mm. Body bright green in life. The long antennæ are coiled about the posterior end of the body, passing about twice around in the female and six times in the male; a few hairs pointing forward to hold them in place. Dorsal spines, III, 2. 2. 2 + 2. 2, VI. No gills and no lateral line. A double line of chitin on both dorsal and ventral sides of the abdomen. On the tergum of the 1st segment, a lateral border of yellow chitin, ending in a knob studded with a few blunt spines. The 9th segment is long and slender, and in somewhat advanced stages the genitalia of the imago may be seen some distance forward of the extremity; this posterior part, which is thus left empty, is more strongly chitinized so as not to become useless in the later stages. The segment is terminated distally by a pair of long spiniform processes, bearing bristles and small spines on the proximal portions, slightly upturned at the extremities; viewed laterally these are seen to arise from the ventral portion of the extremity of the

segment, the dorsal portion of it bearing two small chitinous processes just before the end. Labrum very small; mandibles long and slender, with broad base and incurved distal portion bearing small teeth within and at the base of the curve.

*Case*.—Length, 10–11.5 mm. Width, anterior, 1 mm.; posterior, less than  $\frac{1}{2}$  mm. Cylindrical, slightly curved, formed entirely of clear secretion.

At time of pupation a bell-like rim is formed at the anterior end, and the case is attached to *Ceratophyllum* by a band of silk. The posterior closing membrane, placed some distance from the end, is funnel-shaped, pointing backward, and the anterior membrane is a disk, slightly concave interiorly, with a central perforation. The cases fit the larvæ and pupæ very closely.

*Habits and Occurrence*.—In the autumn, if plant material be brought in from certain localities and placed in large aquaria, immense numbers of the young larvæ of this species will in a few hours collect on the lighted side. They often form a drift in the angle along the bottom, from which some are continually swimming up and dropping back. The case being transparent, the bright green body of the larva or pupa shows thru it and is thus well protected in its natural habitat. Especially is this true at pupation time, about July 1, when the pupal cases are fastened among the spine-like leaves of *Ceratophyllum*, the resemblance of cases and leaves being quite remarkable. I have the larvæ and pupæ from a stretch of the Yahara River where it leaves Lake Monona, and from University Bay.

The adults were observed on July 9, in the bushes and trees along the above mentioned stretch of river, literally by thousands. The number present can only be compared to the hordes of May-flies so often observable.

(Pl. LIII, Fig. 5. Pl. LIX, Figs. 10–18.)



*Triænodes flavescens* Banks.

*Triænodes flavescens* Banks, Tr. Am. Ent. Soc., XXVI, 1900, 257; Cat. Neur. Ins. U. S. 1907, 45. Ulmer, Gen. Insectorum, Fasc. 60, 1907, 141.

*Imago*.—Length of body, 7–8 mm. Expanse, male, 21–22 mm.; female, 18–20 mm. Antennæ very pale luteous with narrow brown annulations, less distinct distally. On the inner dorsal side of the basal joint of the antennæ of the male, is a groove filled with long hairs which arise from its proximal end; it is covered with a long flap, attached along its lower edge. This may be a generic character, but I am not aware that it has been noted before in the literature. Palpi clothed with luteous, and a few black hairs. Body luteous. A pair of small warts in front of, and another posterior to, the eyes, with brown hair; disk clothed with light luteous hair directed forward; on either side of the disk, a large wart with light luteous hair except a little brown on the outer portion. A pair of prominent warts on the pronotum clothed with light hair, and mesothorax, medially, similarly clothed; wing callosities with light and dark hair. Legs light luteous. Anterior wings brownish, indistinctly marmorate with luteous; in some individuals there is a luteous band in each apical cell. Often two black dots on the posterior margin; occasionally a darker spot at the pterostigma; fringe golden. Posterior wings hyaline, with sparse pubescence, the fringe very pale.

In the male there is a lanceolate median piece between the small, finger-like, up-directed superior appendages. The penis is large, curving downward, bifid in lateral view. Normally, a spine-like piece lies alongside the penis like a sheath on either side, but this may be thrown out in the position shown in Pl. LX, Fig. 1, when it is seen to be a part of the inferior appendages, its strongly curved proximal portion being normally hidden within the abdomen; rising from the base of this piece is a small chitinous part, its expanded distal portion beset with short spines; also a small, hairy, pointed appendage directed slightly upward (normally) is attached by a broad basal portion

to the lower part of the foregoing parts of the inferior appendage.

*Larva*.—Length, 10–11 mm. Width, 1.5 mm. Abdomen green in life. Head, thorax, and legs light straw yellow. The head is conspicuously spotted with dark brown; four rows of spots occupy the posterior median portion; anterior to these, lie three others, the middle one a little in front of the other two, and just anterior to the latter a very small fourth one; the outer two form the posterior ends of two semicircles, each of which is composed of four spots, the convexity of the curve outward; the two small spots forming the anterior ends of these semicircles have a similar pair anterior to them, the four forming a square; anterior to these, and a little wider apart, are two pairs of slightly elongated spots. On either side of the head, back of the eye, is a triple row of 4–5 spots each, two of which may be seen in dorsal view, and beneath these are two more small spots. Extending caudad from the base of the first maxilla is a brownish blotch, followed by five or six brown spots. Mandibles

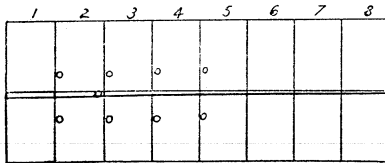
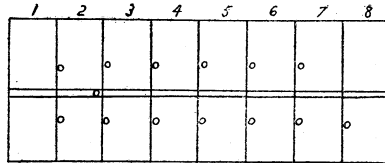


Fig. 12.

stout, the distal portions brown. Antennæ rather long, straw yellow. Clypeus small, and not readily distinguishable. The prothorax has a distinct elongated spot on each side near the border, a lighter curved pair near the median line on the posterior edge, and six more light ones lying along this edge may be seen in dorsal view; one or two small ones may be seen farther down if the larva be turned somewhat; the outer part of the posterior edge is bordered with dark brown. The mesothorax is but little chitinized and only a few pale spots are visible. The third pair of legs are swimming legs, the larva being an active swimmer. The lateral line is present, but is composed of almost microscopic white hairs. Gills simple; those given in the diagram (Fig. 12) as being above the lateral line are so

close that it is difficult to say that they are not upon it. The same is true of those given as above for the pupa. Within the bases of the prolegs are humps bearing many bristles.

*Pupa.*—Length, 10 mm. Width, 1.5 mm. Body in life green. Dorsal spines, III, 2. 2. 1-2 + 5-6. 1-2, VI. Two lines of chitin, not very conspicuous, on both dorsal and ventral sides of the abdomen. The tergum of the 1st segment bordered by chitin, the posterior lateral angles extended laterally into an acute point, studded with small spines, within which, on the posterior edge, is a narrow area of small, sharp spines. Lateral line inconspicuous, but extending the length of the abdomen. Gills simple, Fig. 13. Abdomen terminated by a pair of long spiniform processes, the distal third slightly curved, and the distal two-thirds studded with brown bristles. On the dorsal side of the last segment are two groups of 3-4 hairs each to hold the coils of the antennæ in place. Labrum rounded, slightly longer than wide.



*Fig. 13.*

*Case.*—Length, 17-19 mm. Width, anterior, 2 mm.; posterior, 1.3 mm. Cylindrical, straight, formed of small rectangular pieces of leaves, spirally arranged. As it is most frequently of green leaves it presents a very beautiful appearance. At pupation time it is shortened to the length of the body, about 11 mm.: the posterior end is closed with a funnel-shaped membrane, much like that of *Setodes*, but with a smaller opening and a more acute central part. The anterior closing membrane is a disk with a central perforation. The case is attached to plants and usually has a few bits of leaves gathered about the ends.

*Habits and Occurrence.*—Though the number of adults which may be obtained shows that this is a fairly common

species, the larvæ are not obtainable in numbers. It was rather thru good fortune in keeping alive those secured, than in getting large numbers that they were reared successfully. As they are relatively small until spring, near pupation time, and the cases usually green, they may be easily over-looked when handling material in the field. Plant material may be brought into the laboratory and put in large jars with much water, when the larvæ will in a few hours come out where they may be seen. I have them from Lakes Mendota, Monona, and Wingra.

Adults were taken with trap and net in the latter part of June.

(Pl. LIII, Fig. 4. Pl. LX, Figs. 1-6.)

#### MOLANNIDÆ.

##### *Molanna uniophila* nov. sp.

*Imago*.—Length of body, 7-8 mm. Expanse, 22-23 mm. Antennæ grayish-black. Palpi thickly clothed with gray and black hair. Head black, with a median anterior wart, a small pair above the antennæ close to the eyes, and, on either side, near the posterior part of the eye, two closely approximated warts, all clothed with black and grayish hair. Pro- and mesothorax ferruginous to blackish, a pair of transverse warts on the former, and the wing callosities of the latter, clothed as those of the head; sparse, grayish pubescence medially on the mesothorax. Metathorax lighter brown. Abdomen grayish-fuscous. Anterior legs grayish-black, the posterior two pairs gray; tibiæ and tarsi with black spines. Anterior wings dark gray, with about three large, irregular spots of lighter gray, more or less distinct, on the distal two-thirds. Posterior wings gray.

In the male the 9th dorsal segment is medially produced into a small lobe. The superior appendages are long, concave within, slightly curved, the convex edge upward in lateral view; a ventral expansion near the base, hairy. Between these lie the broad penis covers, the tips pointing downward between the inferior appendages; the latter are long, forcipate, curving upward and inward, narrow at the tips, hairy.

As mentioned by McLachlan for the genus, the wing venation varies greatly as between species, and is quite variable in a single species, or, *even in individuals*, the two sides being often unlike. I have given what appears to be the typical venation of the species.

*Larva*.—Length, 13–14 mm. Width, 2.5 mm. Body in life green. Head yellow, with a band of black along the sutures of the clypeus and the median dorsal suture of the head; the stem of this “Y” does *not* extend over the prothorax as in *M. cinerea*, but may have that appearance if the head is strongly retracted. The occipital foramen is bordered with brown; gula dark brown. Prothorax with a broad dark brown border posteriorly and laterally. Anterior portion of the mesothorax separated from the posterior part by a transverse white line, which curves forward and outward; the darker brown anterior portion thus delimited is divided by a median line of white; the posterior part is irregularly clouded with lighter brown. Metathorax not chitinous. Legs yellow, the anterior femur bordered with brown. Lateral line on segments 2–8, the short, close-set hairs being replaced on the 8th by chitinous points followed by several long hairs distinctly separated. Labrum not heavily chitinized, yellow. Antennæ yellow, placed very close to bases of mandibles. Gills branched, Fig. 14.

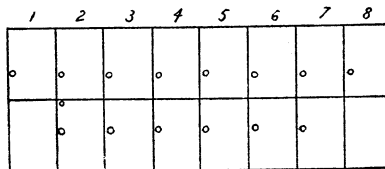


Fig 14.

*Pupa*.—Length, 13 mm. Width, 2.5 mm. Antennæ extending to the 8th segment. Body in life light green. Dorsal spines, III, 3. 4. 4 + 4–5. 4–5, VI. Lateral line begins on 3rd segment and forms a loop under the 8th. Gills appear to be as in the larva. Body terminated posteriorly by two straight finger-like projections studded thruout their length with short spines and ending in two long hairs. Mandibles long, serrate within, the tips incurved, hook-like.

*Case.*—Length, 15–20 mm. Width, 8–10 mm. at the anterior end. This case, typical of the genus, is formed of sand with lateral extensions of coarser particles of stone, and with a large anterior dorsal hood, completely protecting the larva as it feeds.

The pupa (in the laboratory) lies in a case formed by the closure of the ventral opening at the anterior end, a vertical slit being left at the posterior end. My specimens, unfortunately, do not show the nature of the opening at the anterior end, the few at hand being such as the pupa have cut in making their escape. The cases in aquaria were slightly buried in the sand.

*Habits and Occurrence.*—These larvæ are rather common and yet often difficult to get, owing to the form of their cases and their bottom habits. On a sandy bottom they are very difficult to see unless they chance to be moving. One spring they were found in numbers, in May, on mussels which were being dredged up for class use, but so many have never been obtained at one time since. Betten (1901) reports *M. cinerea* from flowing water only; all of my specimens of *uniophila* are from the lakes, some from a depth of 10–12 feet. I have them from Lakes Mendota and Monona, and from a small lake near Minocqua, in Oneida County, Wis.

The pupal stage is of two weeks, or less duration. Adults are common in June and July. Their peculiar resting position is well shown by Betten's illustration of *cinera*, (1901) Pl. 13, Fig. 4. I have specimens from Madison and from Trout Lake, Vilas County, Wis.

(Pl. LIII, Fig. 6. Pl. LVII, Figs. 11–19.)

## HYDROPSYCHIDÆ.

### *Hydropsyche alternans* Walker.

*Philopotamus alternans* Walker, Brit. Mus. Cat. Neur., 1852, 104.

*Philopotamus indecisa* Walker, Brit. Mus. Cat. Neur., 1852, 104.

*Hydropsyche indecisa* Hagen, Syn. Neur. N. Am., 1861, 288; Verh. zool.-bot. Ges. Wien, XIV, 1864, 822.

*Hydropsyche morosa* Hagen, Syn. Neur. N. Am., 1861, 287.

*Hydropsyche alternans* Hagen, Syn. Neur. N. Am., 1861, 288.

McLachlan, Ent. Annual, 1863, 139. Banks, Proc. Ent. Soc. Wash., VI, 1904, 214. Ulmer, Gen. Insectorum, Fasc. 60, 1907, 170.

*Imago*.—Length of body, 6–7 mm. Expanse, male, 18 mm.; female, 20–22 mm. Antennæ fuscous, the base broadly annulated with luteous. Eyes jet black. Head, thorax, and abdomen fuscous above, paler, approaching luteous, beneath. Face clothed with luteous and fuscous hair. Top of head densely clothed with luteous hair on disk, with dark brown on outer posterior portion; when denuded, three pairs of warts are visible, the smallest pair in front and nearest the median line, the others progressively larger and farther apart, posteriorly. On the prothorax is a large pair of transverse warts, with brown hair, and outside of these, a smaller pair with fuscous hair. Wing callosities with fuscous hair; a broad median band of luteous hair on the mesothorax, including that borne on a median posterior wart. Palpi luteo-fuscous. Feet and genitalia luteous. Wings densely pubescent, fuscous, densely spotted with bright luteous or golden. More conspicuous patches of fuscous at middle of inner margin, at the arculus, and at the anal angle, with golden between. On a rubbed specimen, luteous describes the color of the pubescence better than golden, but not so on a perfect example. Posterior wings grayish-hyaline, darker at the tips, ciliated with same, except luteous at base.

In the male the 9th dorsal segment is produced into a long lobe, notched at the apex, with a pair of small appendages arising from it near the tip, and with a thickened part at the base, above, bearing long hairs. Two rounded lateral plates bearing long hairs are said by McLachlan (doubtfully) to represent the superior appendages. The inferior appendages are long, club-shaped, directed upward and backward, hairy, ending in narrow incurved portions which almost or quite meet at the tips; between these projects the long penis, its distal end turned upward; in dorsal view it is seen to be expanded at the end, with

a median excision, and just back of the expanded portion on either side is a rounded hump of chitin.

*Larva.*—Length, 14–15 mm. Width, 3 mm. Body yellowish or greenish. Head yellow beneath, dark brown above, each succeeding segment a little lighter than the one before, the legs yellow. The light yellow posterior part of the head is naturally retracted within the pronotum so that only the darker portion is visible. On this darker portion are six light spots, two median, with two on either side. Eyes situated in a light area. The mesothorax has a black lateral border, and a heavy black semi-circular mark in the middle of the posterior edge. Metanotum similar, but with only a median black spot posteriorly. The clypeus is flattened, almost concave, giving the larva a peculiar appearance in lateral view. No lateral line of hairs, but short, pointed protuberances directed backward occur on the posterior edge of each segment at about the position usually occupied by the lateral line. Gills present only on the ventral side; the mesothorax and 7th segment each with two stalks, and the intervening segments each with four, the stalks sometimes double. Each proleg terminated by a tuft of heavy hairs above the hook. The prothorax has a chitinous sternum back of the legs.

*Pupa.*—Length, 11 mm. Width, 2.5–3 mm. Yellowish, a little reddish on the dorsal side; short dark brown or black pubescence beneath and on sides of abdomen, denser at the posterior end. A transverse row of longer hairs on the posterior part of the 4th to 7th segments above, less dense posteriorly. The hooks and plates on the dorsal segments are quite different in appearance on different segments: the anteriorly directed hooks are on the 3rd and 4th segments and none are present on the 5th. Dorsal spines, II, 9. 14 + 72. 9 + 10. 8. 6. 5. 4, VIII. The posterior end of the body is terminated by a pair of stout processes, flattened distally, the flat face looking outward and upward, a strong spine at the inner, dorsal extremity, and another at the outer ventral angle. A group of heavy black hairs is borne on the outer side just anterior to the latter spine, with lighter ones on the flattened face and posterior to the heavy ones. The labrum is rounded, shorter than wide,



with rounded protuberances at the outer posterior angles, the whole densely hairy with black bristles; two brushes of these black bristles extend up on the face. Mandibles long, incurved, with a cluster of black bristles near the base on the under surface. The left bears five strong teeth, the right four. No lateral line of hairs, but, as in the larva, on each of the segments 3-7, a pointed protuberance having the appearance of a short simple gill-filament projects backward from the posterior edge; sometimes one or two smaller ones are present in front of the large one. Gills occur in two rows on the ventral part of each of the segments 2-7; each is very complex, consisting of one or sometimes two stalks, bearing 6-12 branches.

*Case.*—The larva protects itself with a large, loose mass of vegetable debris and silk fibers, in front of which is erected a net for the capture of prey. When time for pupation arrives, it surrounds itself with a more firm structure of sand or fine gravel, measuring about 10-13 mm. in length, by 4-6 mm. in width. This is closed anteriorly and posteriorly by a sieve-membrane.

*Habits and Occurrence.*—These larvæ are quite plentiful in the swift water of the Yahara where it leaves Lake Mendota, a stone taken from the swiftest water being thickly covered with them and other Hydropsychid larvæ. Indeed, the number may be said to vary somewhat as the swiftness of the water. As this water is at the temperature of the lake, it is here very well demonstrated that it is the swiftness of the stream and not the coldness, that determines their presence. One wonders how they are able to cling to the smooth stones of their habitat, until, after a collecting trip, one observes them climbing up the smooth, perpendicular sides of a glass jar. Then they may be seen to be spinning industriously as they climb, building thus a net or ladder by means of which the ascent is made. No doubt this method of making a firm foothold as they go, is directly correlated with their habitat.

Adults were taken with the trap and from the shrubbery in Tenny Park in late June and early July.

(Pl. LIII, Fig. 7. Pl. LX, Figs. 7-19.)

*Phylocentropus maximus* nov. sp.

*Imago*.—Length of body, male, 7 mm.; female, 10 mm. Expanse, male, 21 mm.; female, 28 mm. Antennæ of males longer than of females. Antennæ yellowish, obsoletely annulated with brown in the middle of each joint at the base, darker toward the tips, basal joint bulbous, clothed with brown hair beneath and yellow hair above. Face brown, palpi brownish-yellow. Head, thorax and abdomen dark brown above, the latter paler beneath. A large transverse wart between, and back of, the bases of the antennæ, a large pair on the posterior outer portion of the head, a small pair anteriorly and a large median one posteriorly on the mesothorax, and the wing callosities, all clothed with yellow hair. Legs luteo-fulvous, the coxæ browner. Anterior wings with blackish hair, guttate with yellow, a larger obsolete spot of yellow above the 5th apical fork; darker spots at arculus, at tips of branches of 5th fork, at cross-vein between radius and discoidal cell, and diagonally across the middle of the lower branch of the media. Veins brown. Posterior wings gray with gray hair, except a little yellow hair along the costal margin.

In the male the superior appendages are yellow and the inferior dark brown. The 9th dorsal segment is represented by a median plate excised in the middle, and bearing upturned hooks at the outer angles. What appear to be the superior appendages are leaf-like, arising at the base of the dorsal plate, low down, and pointing upward so as to hide the plate in lateral view. The penis projects from beneath the dorsal plate, curving downward. No intermediate appendages seem to be present. The inferior appendages are stout, strongly hairy, appearing leaf-like from the side, but from beneath they are seen to be thick and fleshy, nearly meeting along their median surfaces, which are black and thickly set with black spines.

The measurements given are from a single pair of expanded specimens. Alcoholic material shows that this is rather an extreme range of sex difference, though the females average larger than the males.

*Larva*.—Length, 15–16 mm. Width 2 mm. Head and prothorax very small, about .6 mm. in width. Body whitish,

head, prothorax and legs straw yellow, no markings except the posterior half of the lateral border, and all the posterior border, black. Meso- and metathorax unchitinized, except lateral black bars for attachment of legs. No gills, the lateral line almost indistinguishable. The 9th abdominal segment is small, the prolegs long and slender, with a strongly curved hook. The labium is extremely elongated, the silk duct opening at the tip, however. Mandibles unlike as to teeth, each with a very dense brush of black hairs within, rounded teeth on the outer sides.

*Pupa.*—Length, 12–15 mm. Width, 2 mm. Antennæ extend slightly beyond the 4th abdominal segment in the female; as long as the body in the male. Color in life yellowish. Well developed spines pointing backward occur on segments 3–8, the number in each place being 3–5. On the posterior part of the 5th segment is a pair of plates bearing 3–6 forwardly directed spines. The 9th segment ends in a pair of stout processes with brushes of dark hairs distally, and on either side of this segment occurs a short, stout process also bearing a brush of dark hairs. Labrum small, with 12 long black hairs. Mandibles with broad base, the distal portion slender, cylindrical, curved, without teeth.

*Case.*—The larva lives in a non-portable abode, in this respect resembling other Hydropsychidæ. It burrows into the sand of the bottom of the stream and forms a long, often complexly branched case of sand, scarcely firm enough to keep its shape when it is extracted from its position. This case, about 5 mm. in diameter, excepting some smaller branches, is often as much as 65 mm. in length, the greater portion buried, only 10–20 mm. projecting from the stream bed. When the whole case is taken out carefully (a difficult task) a more or less distinct swelling, usually nearer the submerged end, is visible, in which the pupa is found. Anteriorly this part is closed by a membrane of peculiar weave, the openings being very small and irregular, the thread dark, so that it has somewhat the appearance of cocoanut fiber. At the posterior end is a bag of similar appearance, slightly tapering, and about 5 mm. in length, in the end of which the exuviae are retained. Since the lower part of the case is embedded in the sand the outward flow of water must be

into the sand. The great size of the discharging surface, the posterior membrane, may be due to this fact. One of these larvæ lived for some time in a dish in the laboratory, where it burrowed in the sand supplied for it and rapidly constructed an elaborately branched case, which then was easily exposed by washing away the sand with a gentle stream of water.

A case similar to this is described and figured by Miss Clarke (1891) but ascribed to the larva of *Plectrocnemia*. That it belongs to this genus, however, there can be little doubt, as she mentions the long "spinneret" of the larva.

*Habits and Occurrence.*—Beyond what observations on habits it seems necessary to include with the account of the case, I have nothing to give. I have taken the larvæ and pupæ only in the stream at Devil's Lake (both on June 29) and the imagos were reared from these. The other two species of the genus measure only 13 and 14 mm. in wing expanse, hence the name given to this one.

(Pl. LIII, Fig. 8. Pl. LXI, Figs. 1-13.)

## RHYACOPHILIDÆ

### *Rhyacophila torva* Hagen.

*Rhyacophila torva* Hagen, Syn. Neur. N. Am., 1861, 296.

Banks, Cat. Neur. Ins. U. S., 1907, 41. Ulmer, Gen. Insectorum, Fasc. 60, 1907, 210.

*Imago.*—"Rufo-fuscous; antennæ and palpi rufo-fuscous; head and thorax brownish-black; feet testaceous; abdomen luteous; wings fusco-hyaline, with fuscous veins; anterior ones with dense luteous guttæ. Male.

Length to tip of wings, 10 mm. Alar expanse 19 mm." (Hagen)

*Larva.*—Length, 14-16 mm. Width, 2.3 mm. The greatest width is about at the middle of the body,—the third or fourth abdominal segment, the head and the last segment being much smaller. Abdomen yellowish, reddish-brown above, a double line of yellowish extending along the dorsal side. This reddish coloration does not dissolve in preserving fluid. Head, prothorax,

and legs clear yellow, the head clouded with dark brown in the central portion above, with inconspicuous lighter spots and a black posterior border. Pronotum with a black posterior border. Meso- and metanotum unchitinized. No tubercles on the first abdominal segment, no gills, and no lateral line. Draggers long, down-curved. Mandibles unlike. McLachlan ascribes gills to the larvæ of this genus, but, as noted by Ulmer (1903), there are exceptions in the European species, while here we have at least one exception in the American species. The larva of no other species of the genus has been described in America.

*Pupa.*—Length, (in cocoon) 11 mm. Width, 2.5 mm. Antennæ reaching to the 5th segment. White or reddish-brown. On segments 3-7 are very small plates with almost microscopic spines pointing backward, and on the posterior parts of segments 3, 4, and 5 are similar ones, the spines pointing forward. Labrum shorter than long, rounded, three hairs on either side near the base and four near the tip. The mandibles are strong, each with three large teeth bearing smaller ones. In my single well preserved specimen, there were no special anal appendages, that end of the abdomen showing the general shape of the genitalia beneath. As there is no opening of the case to be kept clean, there is no need for special structures.

*Case.*—The larva lives in a loosely built case of gravel, which can scarcely be measured accurately. At time of pupation this becomes a strong, irregular hemi-ellipsoid, measuring about 10 mm. wide by 15 mm. long. Within this is a strong brown cocoon, the dimensions of which are given above.

*Habits and Occurrence.*—These larvæ are common in the moderately swift parts of the stream in Parfrey's Glen, where, early in June, the pupal cases may readily be obtained from the stones. As my few specimens (all reared) happen to be females, a complete description including male genitalia could not be attempted. June 10 is the date of the appearance of the adults in the laboratory.

(Pl. LIII, Fig. 9. Pl. LXI, Figs. 14-21.)

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May, 1908.

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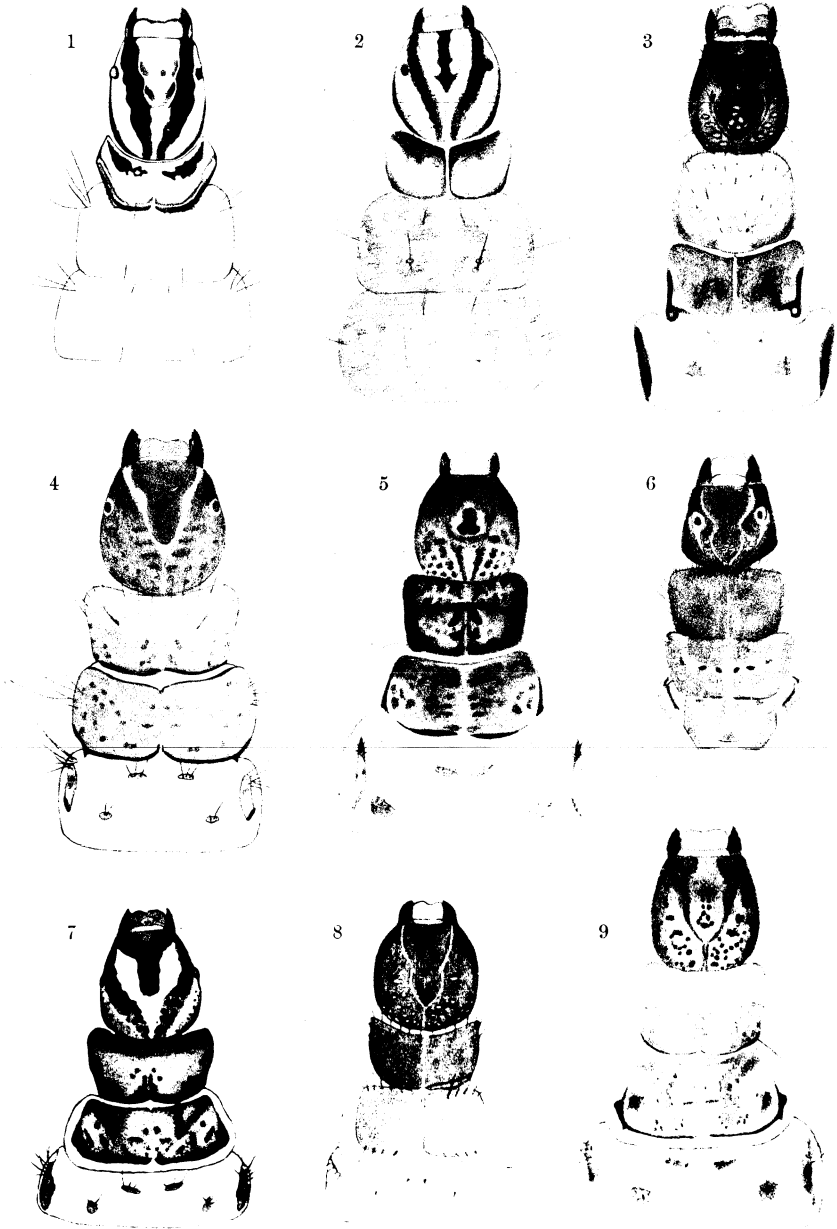


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PLATE LII.

PLATE LII (Larvæ, head and thoracic segments of.)

- Fig. 1. *Neuronia postica*, × 4.
- Fig. 2. *Phryganea interrupta*, × 4.
- Fig. 3. *Neophylax autumnus*, × 13.
- Fig. 4. *Limnephilus submonilifer*, × 10.
- Fig. 5. *Platyphylax subfasciatus*, × 5.
- Fig. 6. *Helicopsyche borealis*, × 13.
- Fig. 7. *Limnephilus rhombicus*, × 5.
- Fig. 8. *Lepidostoma wisconsinensis*, × 8.
- Fig. 9. *Platyphylax designatus*, × 7.



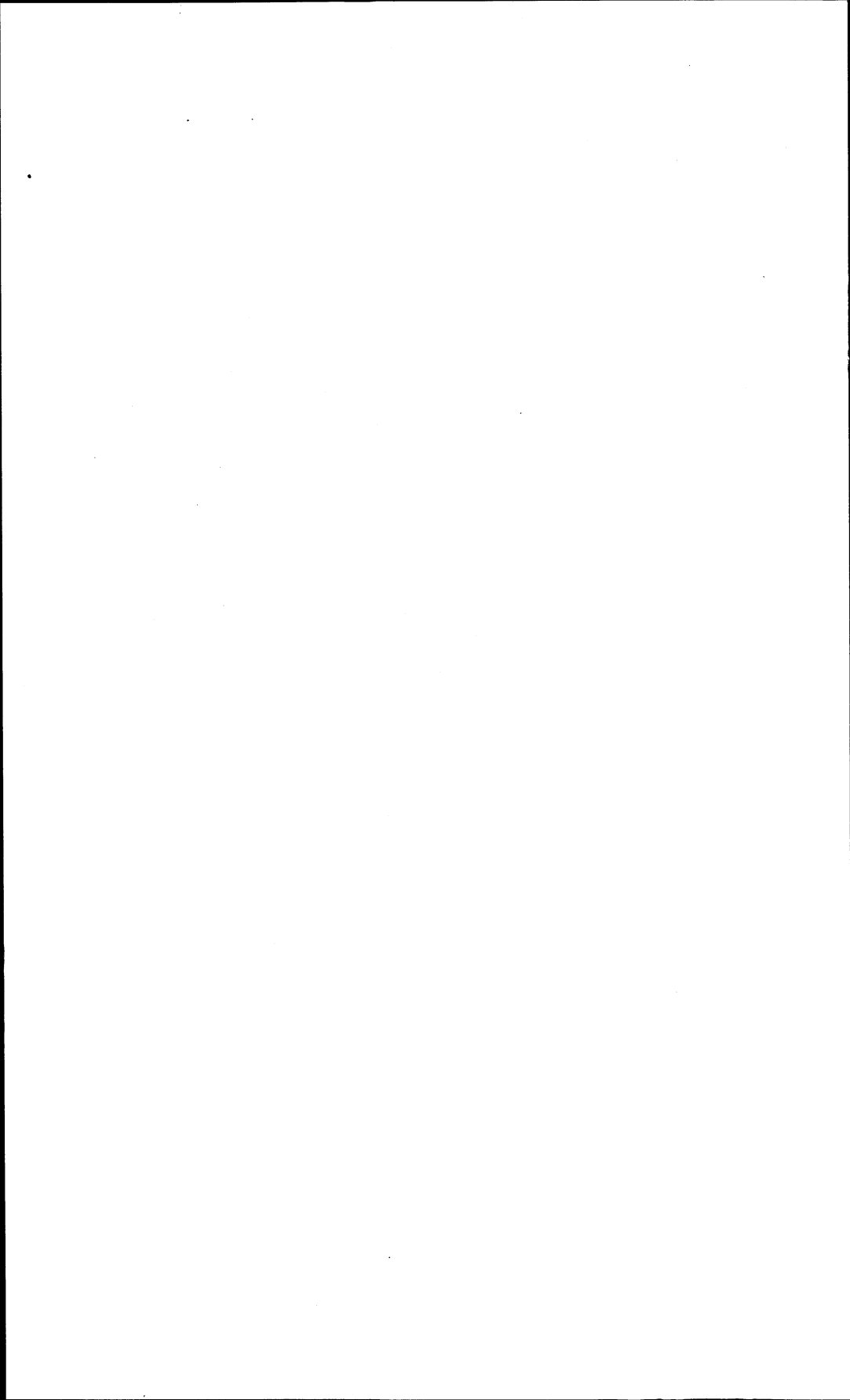
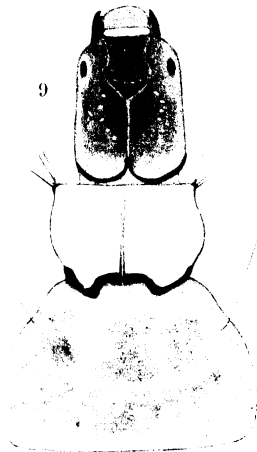
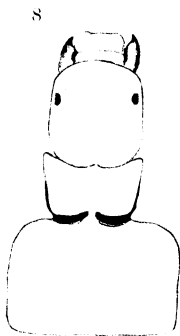
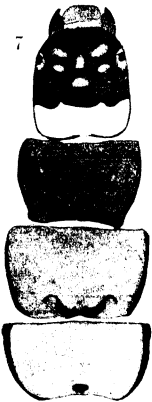
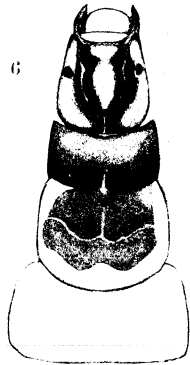
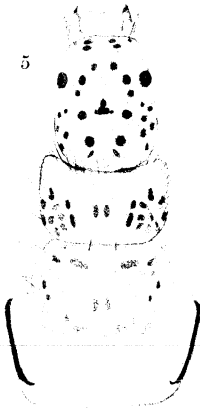
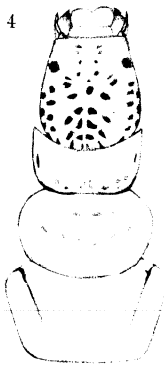
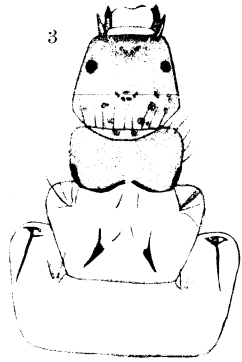
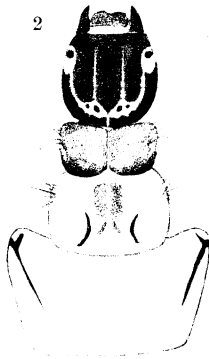


PLATE LIII.

PLATE LIII (Larvæ, head and thoracic segments of.)

- Fig. 1. *Leptocella uwarowii*, × 13.
- Fig. 2. *Leptocerus ancylus*, × 13
- Fig. 3. *Leptocerus dilutus*, × 13
- Fig. 4. *Triænodes flavescens*, × 13
- Fig. 5. *Setodes grandis*, × 24.
- Fig. 6. *Molanna uniophila*, × 10.
- Fig. 7. *Hydropsyche alternans*, × 7.
- Fig. 8. *Phylocentropus maximus*, × 10.
- Fig. 9. *Rhyacophila torva*, × 10.





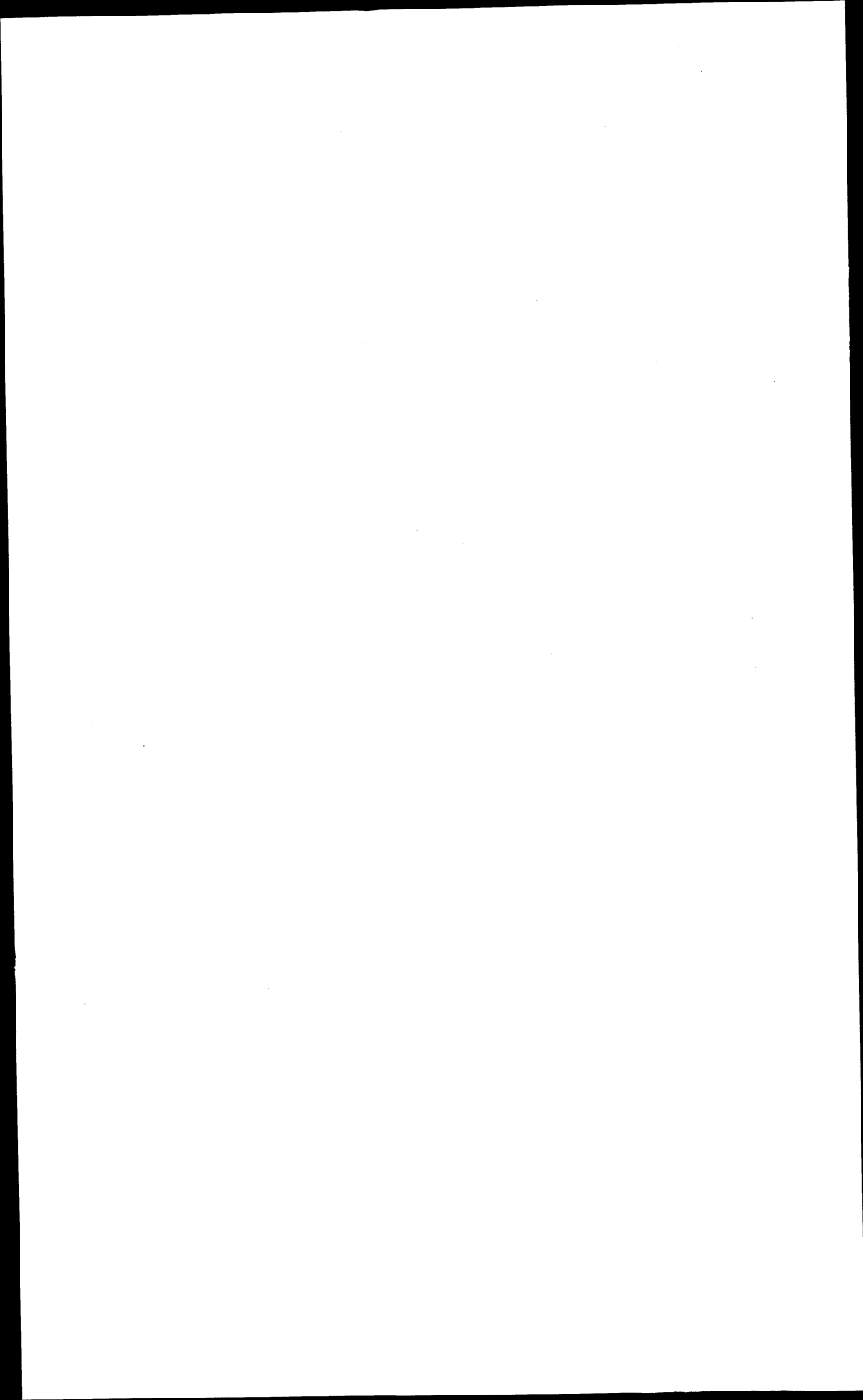


PLATE LIV.

PLATE LIV.

*Phryganea interrupta.*

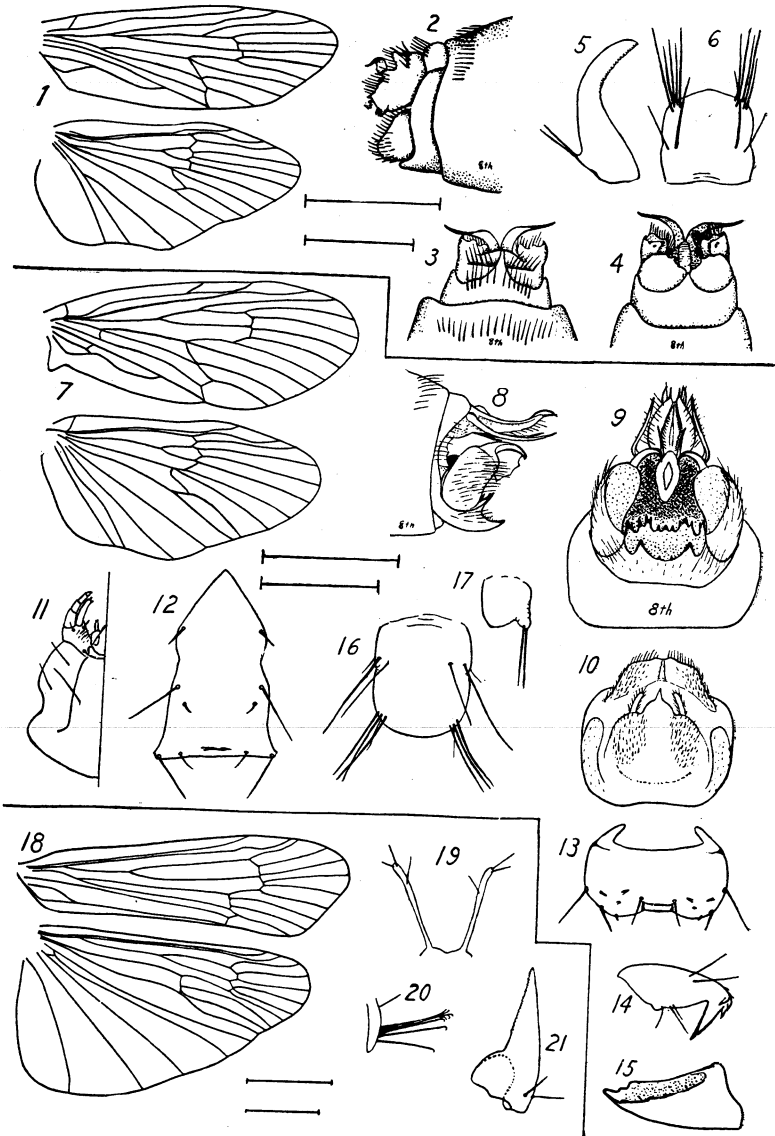
- Fig. 1. Wings, male.
- Fig. 2. Male genitalia, lateral,  $\times 7$ .
- Fig. 3. Male genitalia, dorsal,  $\times 7$ .
- Fig. 4. Male genitalia, ventral,  $\times 7$ .
- Fig. 5. Mandible, pupa,  $\times 16$ .
- Fig. 6. Labrum, pupa,  $\times 16$ .

*Neuronia postica.*

- Fig. 7. Wings of male.
- Fig. 8. Male genitalia, lateral,  $\times 7$ .
- Fig. 9. Male genitalia, ventro-posterior,  $\times 8$ .
- Fig. 10. Male genitalia, ventral,  $\times 7$ .
- Fig. 11. Maxillæ, larva,  $\times 16$ .
- Fig. 12. Clypeus, larva,  $\times 16$ .
- Fig. 13. Labrum, larva,  $\times 20$ .
- Fig. 14. Dragging hook, larva,  $\times 20$ .
- Fig. 15. Mandible, larva,  $\times 20$ .
- Fig. 16. Labrum, pupa,  $\times 20$ .
- Fig. 17. Mandible, pupa,  $\times 20$ .

*Limnephilus submonilifer.*

- Fig. 18. Wings.
- Fig. 19. Posterior end of abdomen, pupa,  $\times 15$ .
- Fig. 20. Labrum, lateral view, pupa,  $\times 20$ .
- Fig. 21. Mandible, pupa,  $\times 20$ .



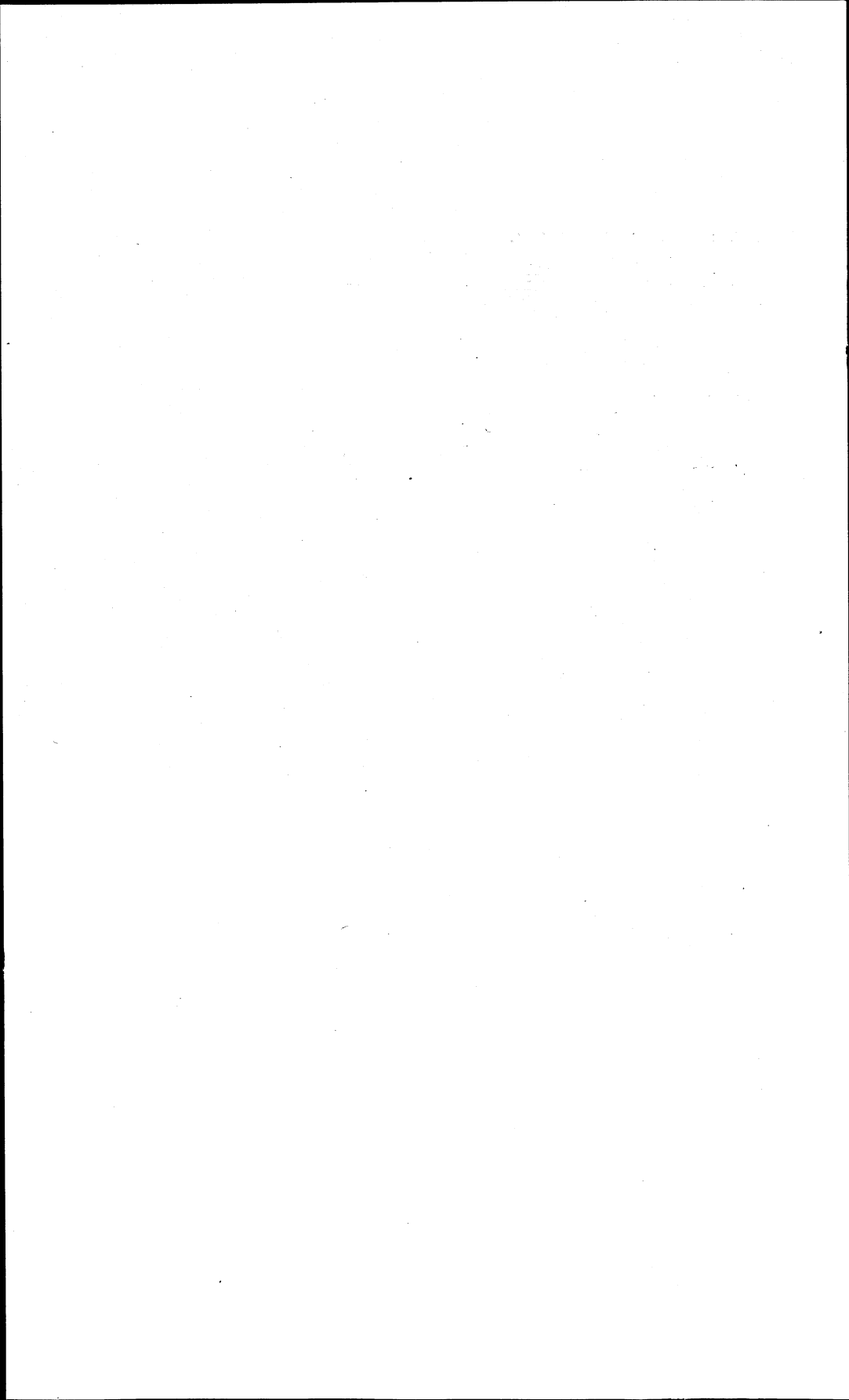


PLATE LV.

PLATE LV.

*Limnephilus submonilifer.*

- Fig. 1. Male genitalia, lateral,  $\times 20$ .  
Fig. 2. Male genitalia, ventral,  $\times 12$ .

*Limnephilus rhombicus.*

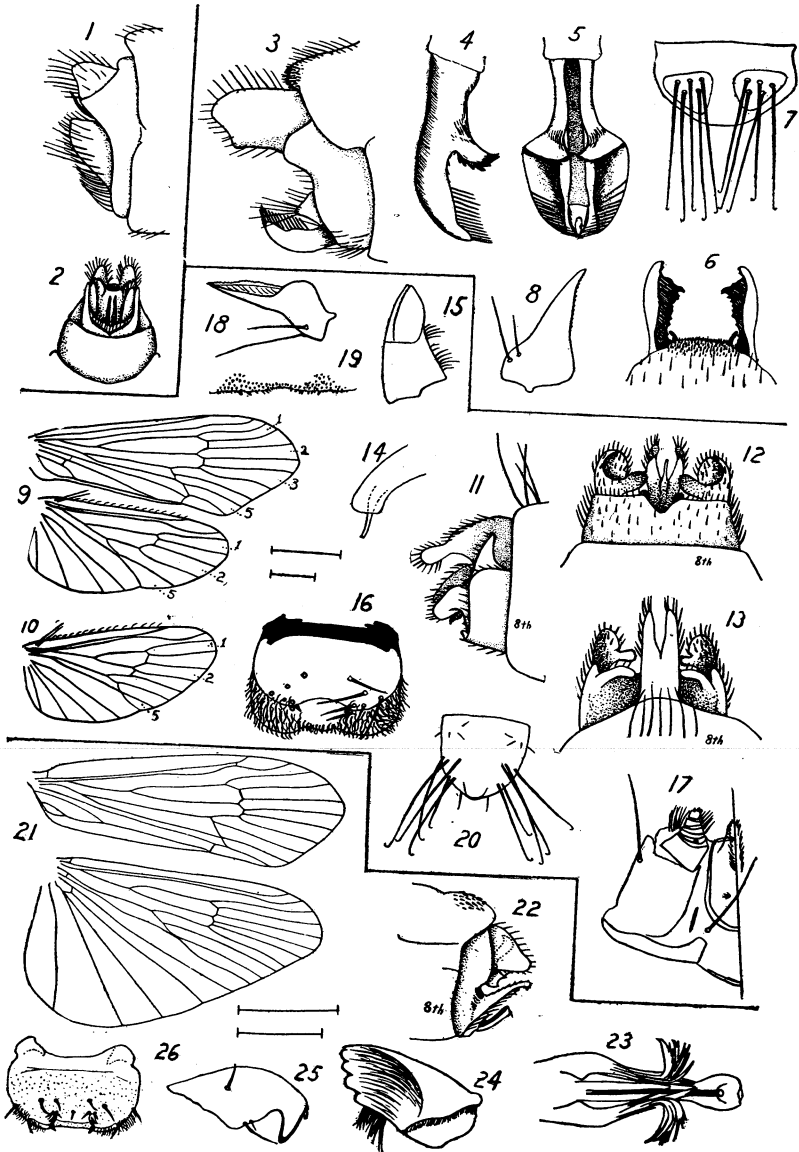
- Fig. 3. Male genitalia, lateral,  $\times 15$ .  
Fig. 4. Inferior appendages, male, lateral,  $\times 20$ .  
Fig. 5. Inferior appendages, male, dorsal,  $\times 20$ .  
Fig. 6. Superior appendages, male, dorsal,  $\times 15$ .  
Fig. 7. Labrum, pupa,  $\times 20$ .  
Fig. 8. Mandible, pupa,  $\times 20$ .

*Neophylax autumnus.*

- Fig. 9. Wings of male.  
Fig. 10. Posterior wing of female.  
Fig. 11. Male genitalia, lateral,  $\times 34$ .  
Fig. 12. Male genitalia, ventral,  $\times 34$ .  
Fig. 13. Male genitalia, dorsal,  $\times 34$ .  
Fig. 14. Penis, lateral view,  $\times 34$ .  
Fig. 15. Mandible, larva,  $\times 47$ .  
Fig. 16. Labrum, larva,  $\times 47$ .  
Fig. 17. Maxillæ, larva,  $\times 60$ .  
Fig. 18. Mandible, pupa,  $\times 34$ .  
Fig. 19. Posterior border of first abdominal segment, pupa, dorsal,  $\times 34$ .  
Fig. 20. Labrum, pupa,  $\times 34$ .

*Platyphylax designatus.*

- Fig. 21. Wings.  
Fig. 22. Male genitalia, lateral,  $\times 12$ .  
Fig. 23. Penis and sheaths, dorsal,  $\times 34$ .  
Fig. 24. Mandible, larva,  $\times 47$ .  
Fig. 25. Dragging hook, larva,  $\times 47$ .  
Fig. 26. Labrum, larva,  $\times 34$ .





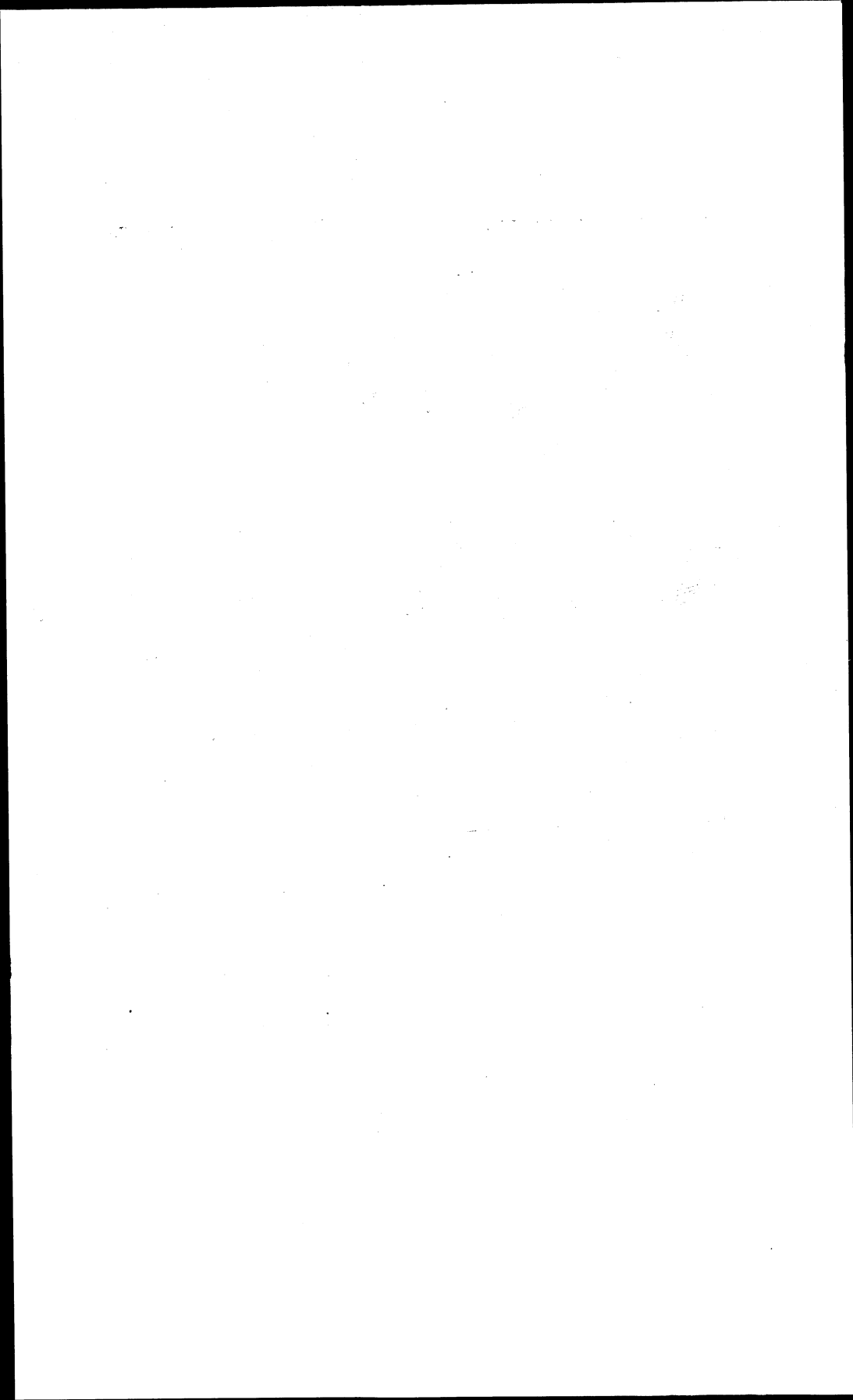


PLATE LVI.

PLATE LVI.

*Platyphylax designatus.*

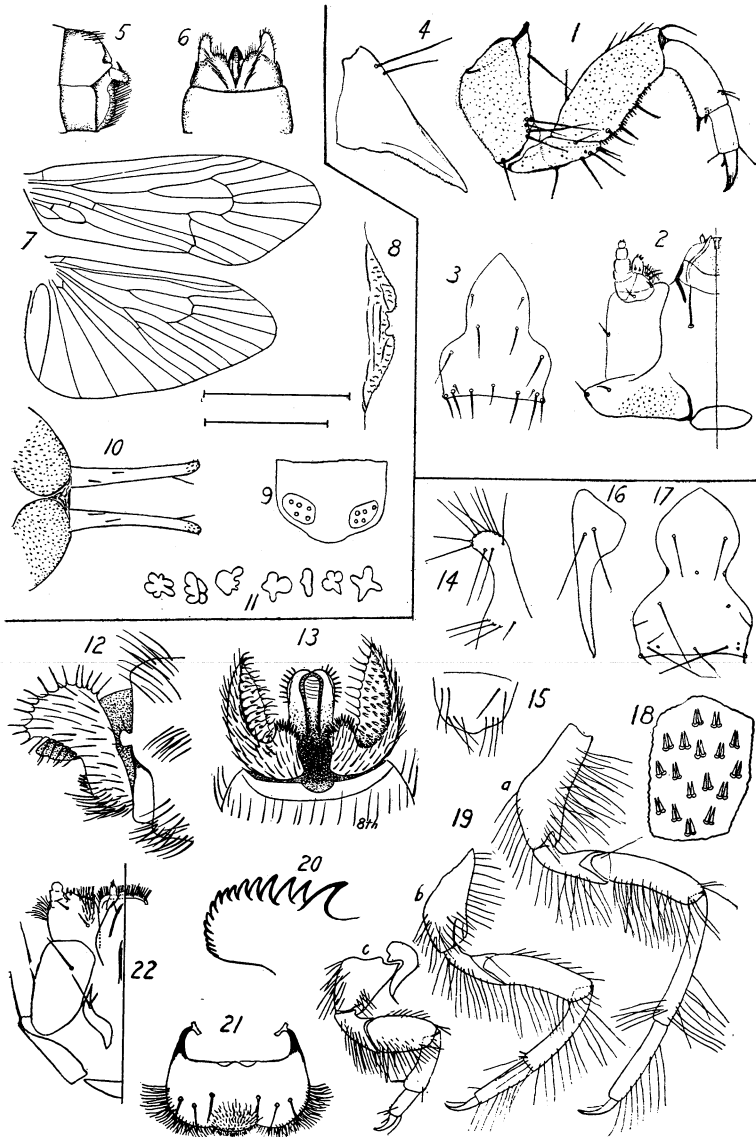
- Fig. 1. First leg, larva,  $\times 34$ .
- Fig. 2. Maxillæ, larva,  $\times 34$ .
- Fig. 3. Clypeus, larva,  $\times 15$ .
- Fig. 4. Mandible, pupa,  $\times 34$ .

*Platyphylax subfasciatus.*

- Fig. 5. Male genitalia, lateral,  $\times 7$ .
- Fig. 6. Male genitalia, ventral,  $\times 8$ .
- Fig. 7. Wings.
- Fig. 8. Posterior border of first abdominal segment, pupa,  $\times 15$ .
- Fig. 9. Labrum, (circles indicate position of hairs) pupa,  $\times 20$ .
- Fig. 10. Posterior end of abdomen,  $\times 15$ .
- Fig. 11. Outline shapes of openings in posterior ends of cases.

*Helicopsyche borealis.*

- Fig. 12. Male genitalia, lateral,  $\times 47$ .
- Fig. 13. Male genitalia, ventral,  $\times 47$ .
- Fig. 14. Anal appendage, pupa,  $\times 47$ .
- Fig. 15. Labrum, pupa,  $\times 47$ .
- Fig. 16. Mandible, pupa,  $\times 47$ .
- Fig. 17. Clypeus, larva,  $\times 34$ .
- Fig. 18. Portion of lateral hump of larva. The spines point forward  
 $\times 144$ .
- Fig. 19. a, b, c. 3rd, 2nd, and 1st legs,  $\times 20$ .
- Fig. 20. Dragging hook, larva,  $\times 47$ .
- Fig. 21. Labrum, larva,  $\times 60$ .
- Fig. 22. Maxillæ, larva,  $\times 60$ .



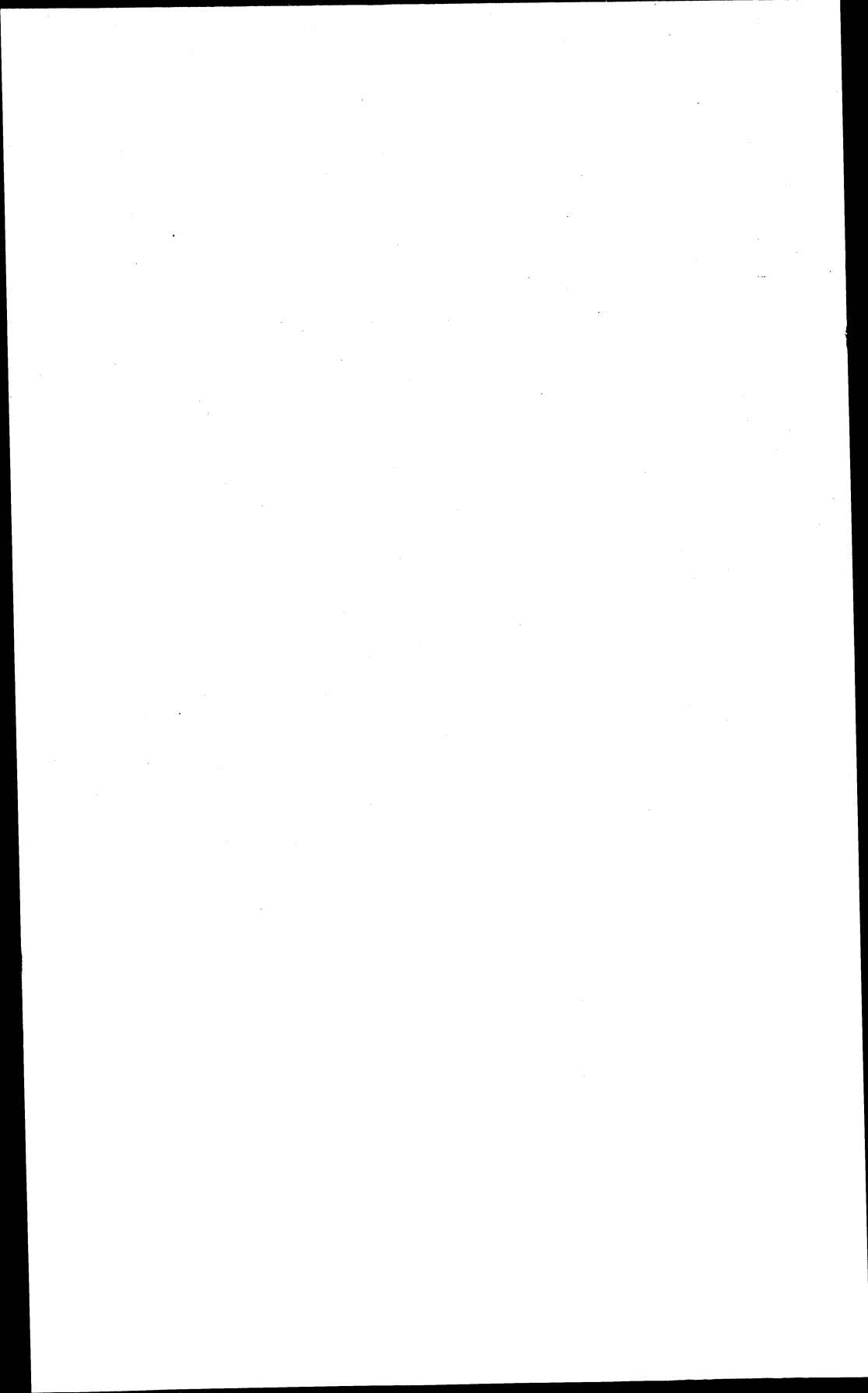


PLATE LVII.

PLATE LVII

*Lepidostoma wisconsinensis.*

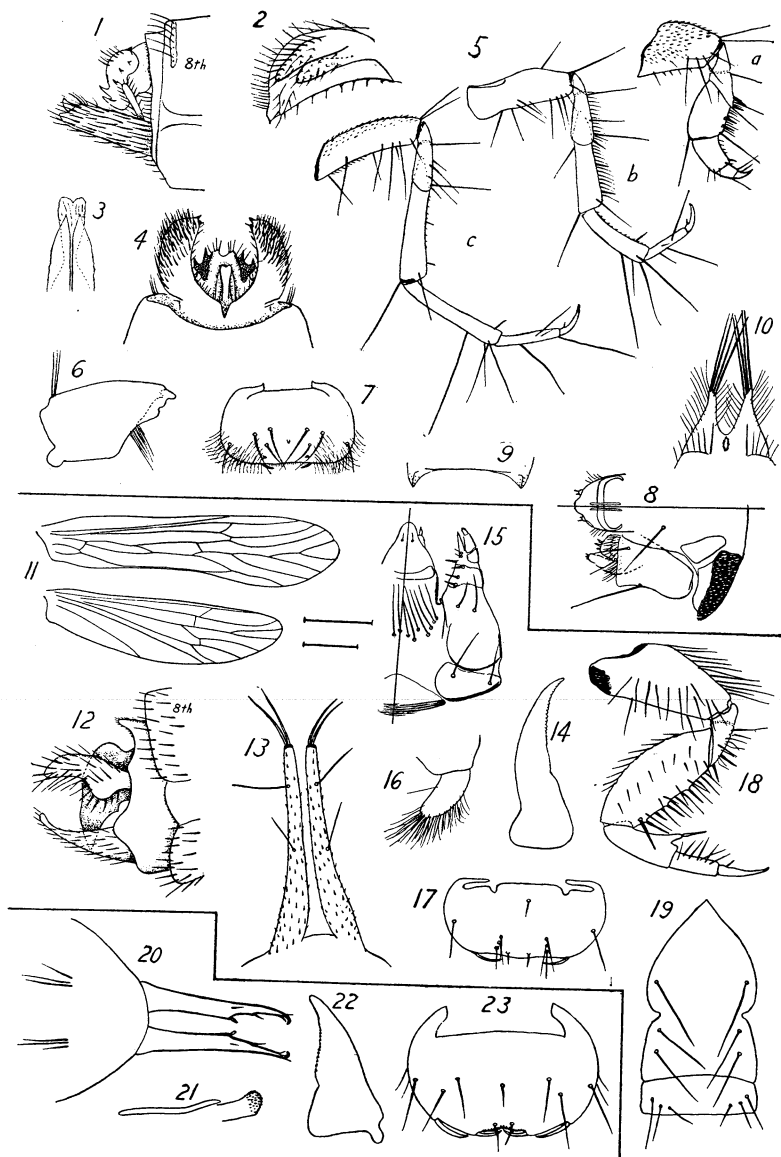
- Fig. 1. Male genitalia, lateral,  $\times 34$ .
- Fig. 2. Inferior appendages, male, dorsal view,  $\times 47$ .
- Fig. 3. Penis and sheaths,  $\times 47$ .
- Fig. 4. Male genitalia, ventral,  $\times 34$ .
- Fig. 5. a, b, c. 1st, 2nd, and 3rd legs, larva,  $\times 20$ .
- Fig. 6. Mandible, larva,  $\times 60$ .
- Fig. 7. Labrum, larva,  $\times 60$ .
- Fig. 8. Maxillæ,  $\times 60$ .
- Fig. 9. Posterior border of first abdominal tergum, pupa,  $\times 15$ .
- Fig. 10. Anal appendage, pupa,  $\times 15$ .

*Molanna uniophila.*

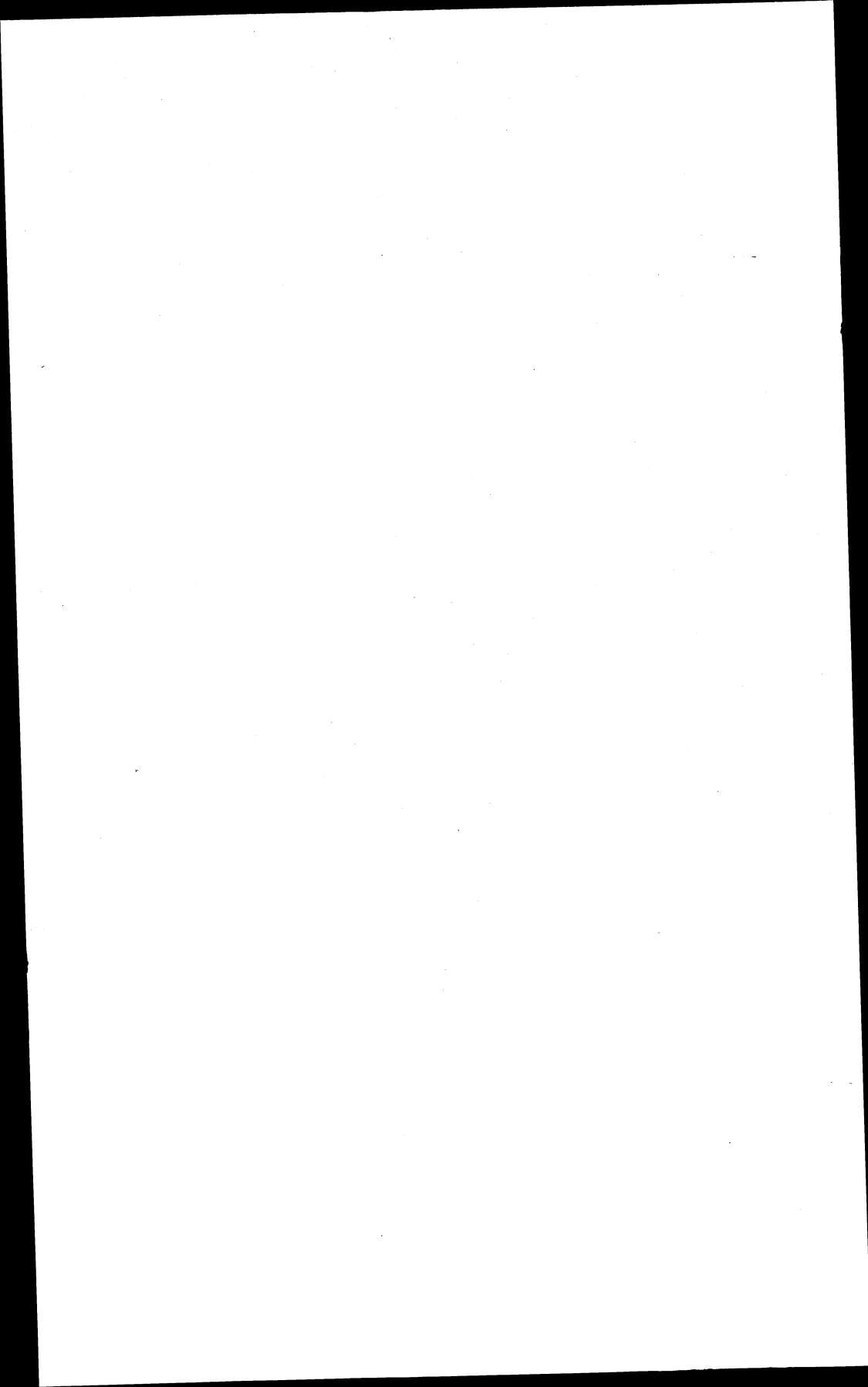
- Fig. 11. Wings of male.
- Fig. 12. Male genitalia, lateral,  $\times 20$ .
- Fig. 13. Anal appendages, pupa,  $\times 34$ .
- Fig. 14. Mandible, pupa,  $\times 34$ .
- Fig. 15. Maxillæ, larva,  $\times 47$ .
- Fig. 16. End of tarsus of third leg, larva,  $\times 144$ .
- Fig. 17. Labrum, larva,  $\times 47$ .
- Fig. 18. First leg, larva,  $\times 20$ .
- Fig. 19. Clypeus, larva,  $\times 34$ .

*Leptocerus dilutus.*

- Fig. 20. Anal appendage and hairs to hold antennæ in place,  $\times 34$ .
- Fig. 21. Lateral border of first abdominal tergum (knob posterior), pupa,  $\times 47$ .
- Fig. 22. Mandible, pupa,  $\times 60$ .
- Fig. 23. Labrum, larva,  $\times 108$ .







**PLATE LVIII.**

PLATE LVIII.

*Leptocerus dilutus.*

- Fig. 1. Wings of male.
- Fig. 2. Male genitalia, lateral,  $\times 47$ .
- Fig. 3. Male genitalia, dorsal,  $\times 47$ .
- Fig. 4. a, b. 1st and 3rd legs, larva,  $\times 20$ .
- Fig. 5. Maxillæ, larva,  $\times 60$ .
- Fig. 6. Clypeus, larva,  $\times 47$ .
- Fig. 7. Dragging hook, larva,  $\times 144$ .

*Leptocerus ancylus.*

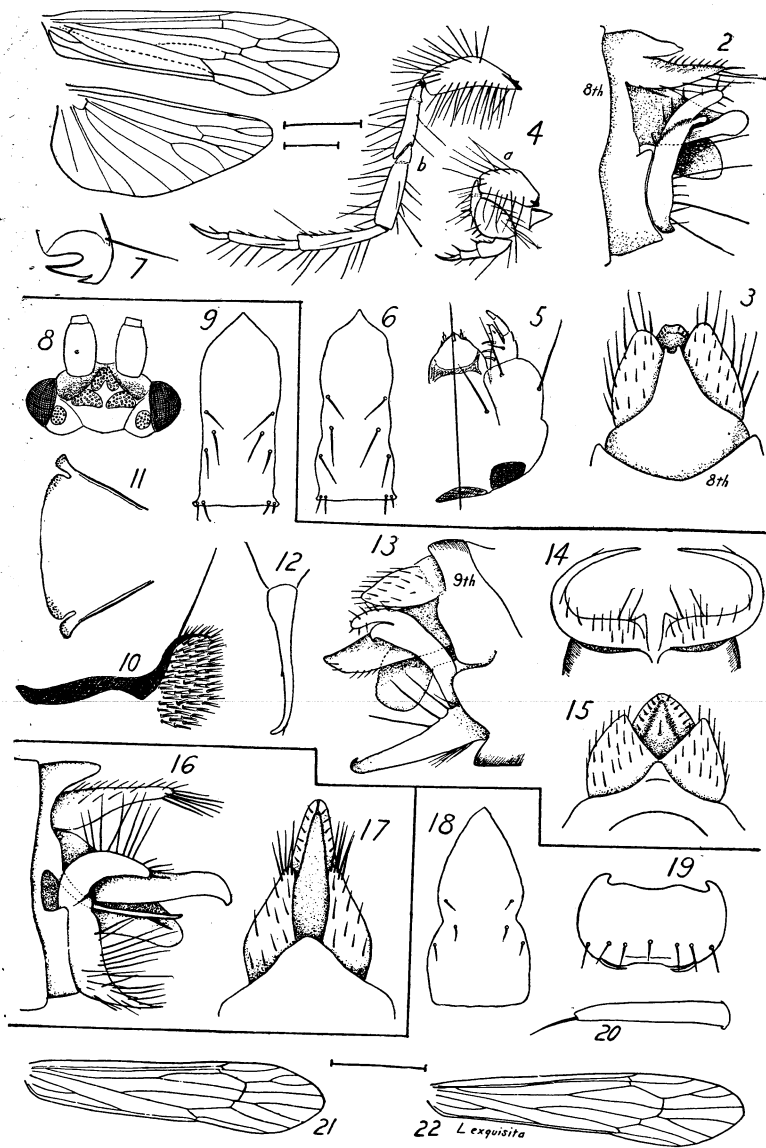
- Fig. 8. Head of imago, dorsal,  $\times 15$ .
- Fig. 9. Clypeus, larva,  $\times 15$ .
- Fig. 10. Portion of lateral tubercle, paired spines pointing forward, larva,  $\times 60$ .
- Fig. 11. Border of first abdominal tergum, pupa,  $\times 20$ .
- Fig. 12. Anal appendage, pupa, lateral view,  $\times 34$ .
- Fig. 13. Male genitalia, lateral,  $\times 47$ .
- Fig. 14. Male genitalia, ventral,  $\times 24$ .
- Fig. 15. Male genitalia, dorsal,  $\times 47$ .

*Leptocerus tarsi-punctatus.*

- Fig. 16. Male genitalia, lateral,  $\times 47$ .
- Fig. 17. Male genitalia, dorsal,  $\times 47$ .

*Leptocella uwarowii.*

- Fig. 18. Clypeus, larva,  $\times 34$ .
- Fig. 19. Labrum, larva,  $\times 47$ .
- Fig. 20. Antenna, larva,  $\times 108$ .
- Fig. 21. Fore wing of *uwarowii*.
- Fig. 22. Fore wing of *exquisita*.



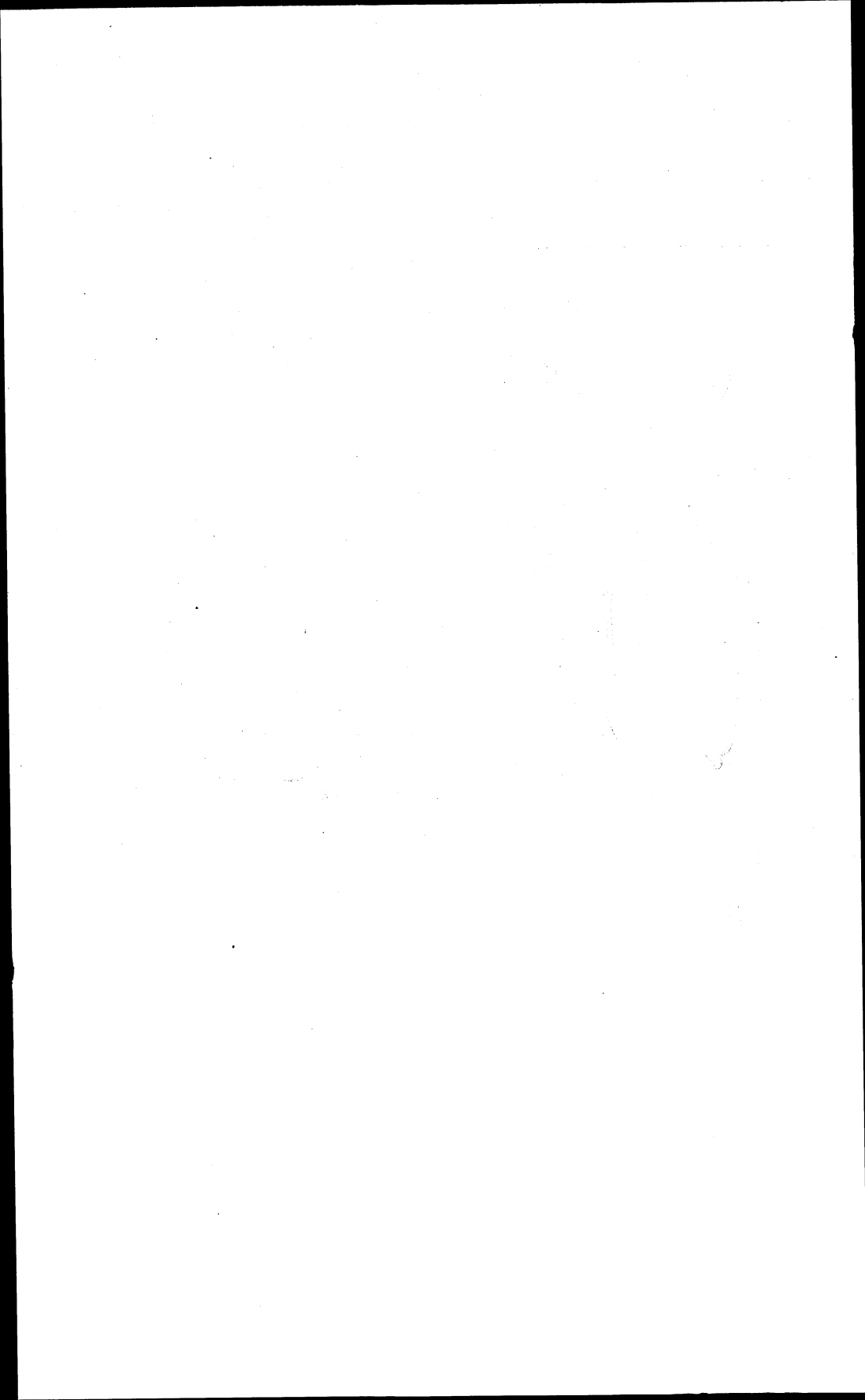


PLATE LIX.

PLATE LIX.

*Leptocella uwarowii.*

- Fig. 1. Male genitalia, lateral,  $\times 27$ .  
Fig. 2. Ventro-posterior view of inferior and intermediate appendages,  
 $\times 34$ .  
Fig. 3. Maxillæ, larva,  $\times 47$ .  
Fig. 4. Chitin and hairs from lateral tubercle, larva,  $\times 47$ .  
Fig. 5, a, b, c. 1st, 2nd, and 3rd legs, larva,  $\times 15$ .  
Fig. 6. Mandible, pupa,  $\times 47$ .  
Fig. 7. Anal appendages, pupa,  $\times 15$ .  
Fig. 8. Border of half of 1st abdominal tergum, pupa,  $\times 24$ .  
Fig. 9. Labrum, pupa,  $\times 47$ .

*Setodes grandis.*

- Fig. 10. Wings of male.  
Fig. 11. Male genitalia, lateral,  $\times 47$ .  
Fig. 12. Male genitalia, ventral,  $\times 47$ .  
Fig. 13. Mandible, pupa,  $\times 108$ .  
Fig. 14. Anal appendages, pupa,  $\times 60$ .  
Fig. 15, a, b, c, 1st, 2nd, and 3rd legs, larva,  $\times 34$ .  
Fig. 16. Clypeus, larva,  $\times 47$ .  
Fig. 17. Maxillæ,  $\times 78$ .  
Fig. 18. Posterior end of body, dorsal view, larva,  $\times 47$ .

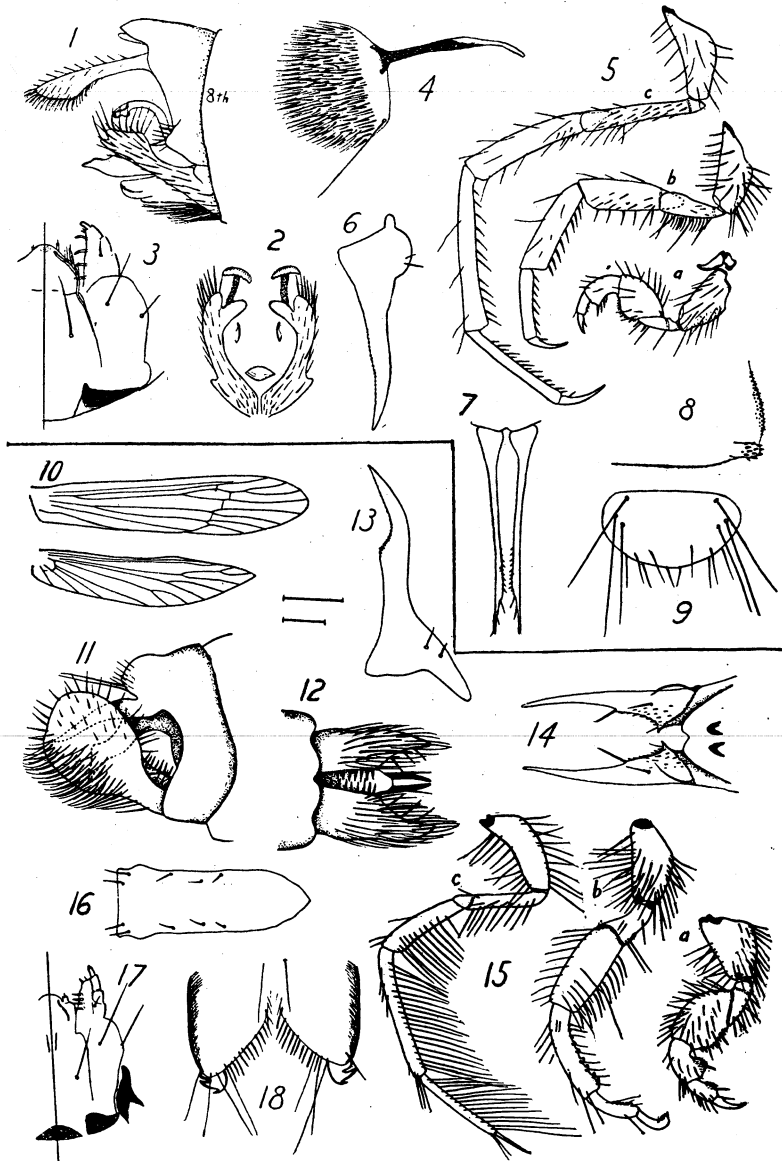






PLATE LX.

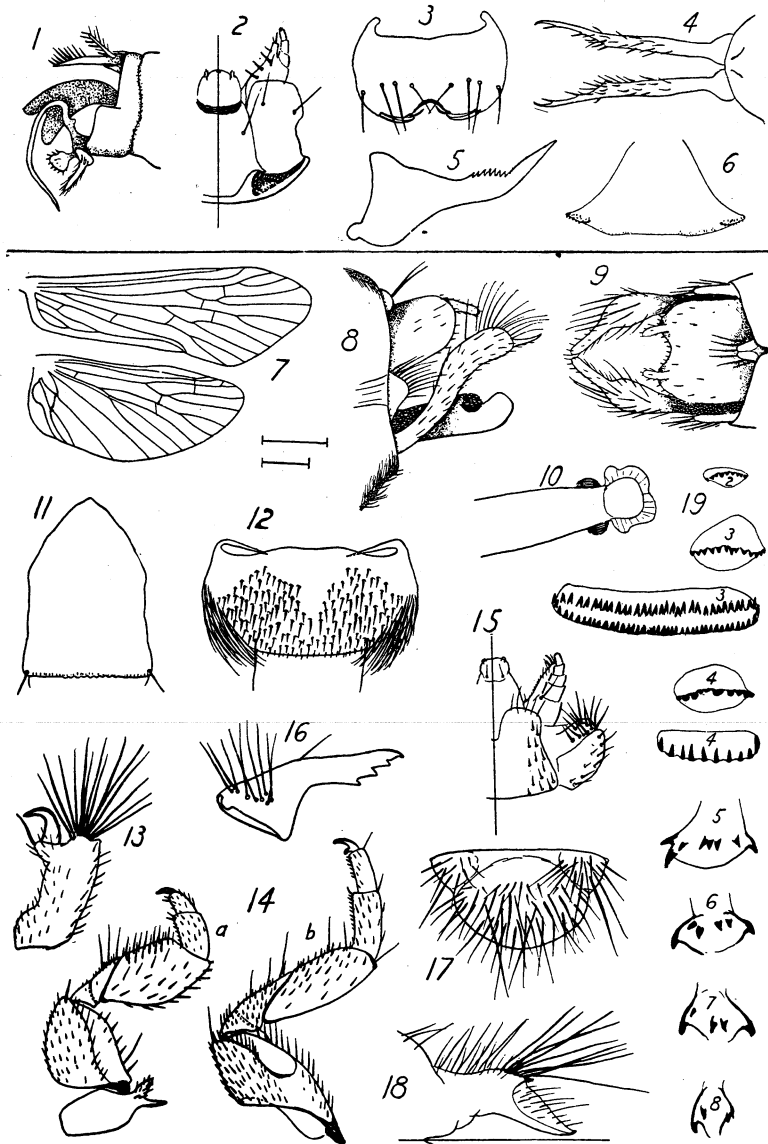
PLATE LX.

*Triaxnodes flavescens.*

- Fig. 1. Male genitalia, lateral. Inferior appendages extended,  $\times 27$ .
- Fig. 2. Maxillæ, larva,  $\times 47$ .
- Fig. 3. Labrum, larva,  $\times 60$ .
- Fig. 4. Anal appendages, pupa, dorsal view,  $\times 20$ .
- Fig. 5. Mandible, pupa,  $\times 60$ .
- Fig. 6. Border of first abdominal tergum, pupa,  $\times 20$ .

*Hydropsyche alternans.*

- Fig. 7. Wings of male.
- Fig. 8. Male genitalia, lateral,  $\times 34$ .
- Fig. 9. Male genitalia, dorsal,  $\times 34$ .
- Fig. 10. Penis, dorsal view,  $\times 47$ .
- Fig. 11. Clypeus, larva,  $\times 20$ .
- Fig. 12. Labrum, larva,  $\times 47$ .
- Fig. 13. Dragging hook, larva, lateral view,  $\times 20$ .
- Fig. 14, a, b. 1st and 3rd legs, larva,  $\times 20$ .
- Fig. 15. Maxillæ, larva,  $\times 47$ .
- Fig. 16. Mandible, pupa,  $\times 27$ .
- Fig. 17. Labrum, pupa,  $\times 47$ .
- Fig. 18. Anal appendage, pupa, dorsal view,  $\times 34$ .
- Fig. 19. Dorsal plates of pupa numbered according to the segments on which they are found,  $\times 47$ .



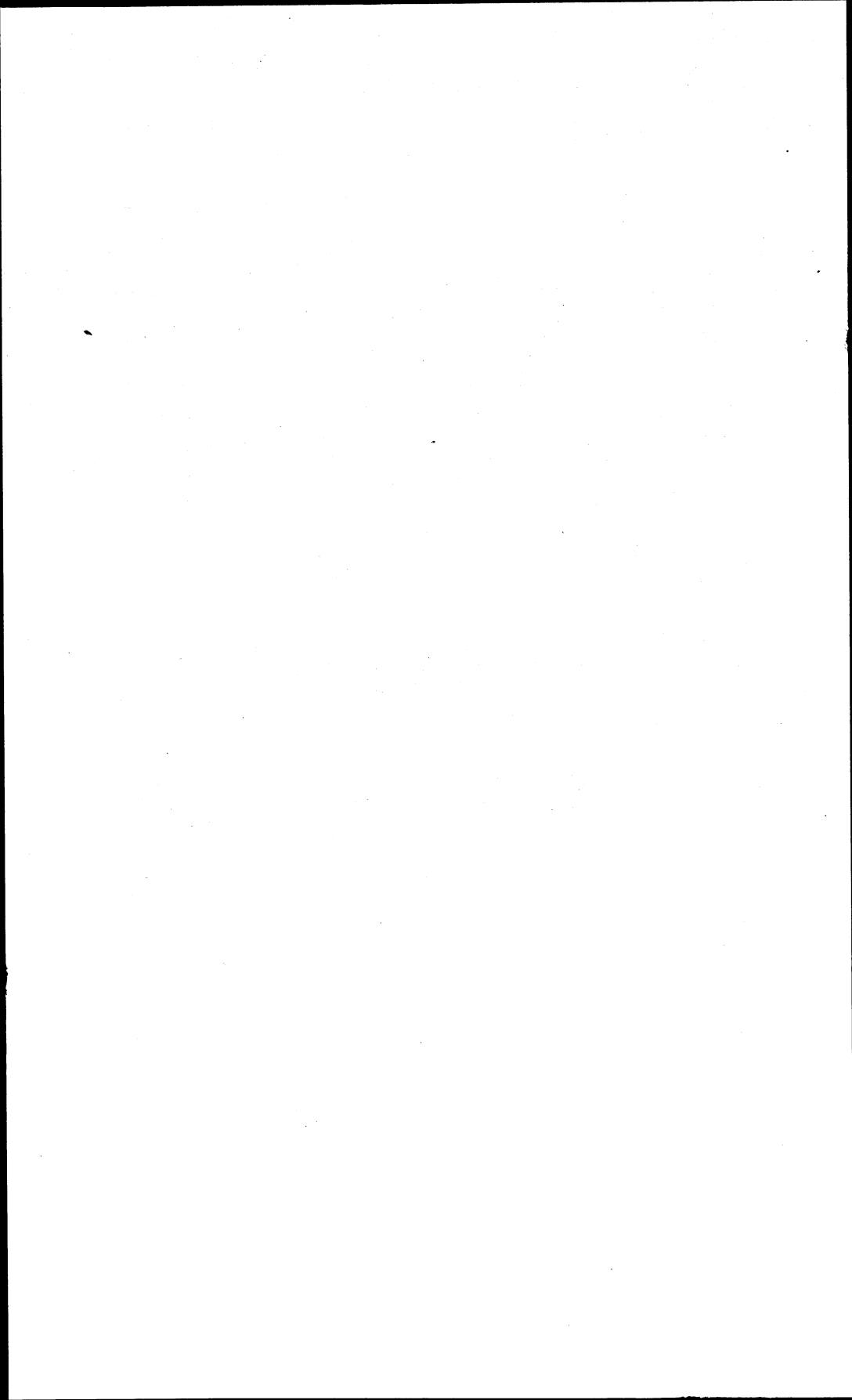


PLATE LXI.

PLATE LXI.

*Phylocentropus maximus.*

- Fig. 1. Wings.
- Fig. 2. Male genitalia, dorsal,  $\times 27$ .
- Fig. 3. Male genitalia, lateral,  $\times 27$ .
- Fig. 4. Mandible, pupa,  $\times 47$ .
- Fig. 5. Labrum, pupa,  $\times 47$ .
- Fig. 6. Anal appendage, dorsal, pupa,  $\times 20$ .
- Fig. 7. Dragging hook, larva,  $\times 34$ .
- Fig. 8. Labrum, larva,  $\times 47$ .
- Fig. 9. Maxillæ, larva,  $\times 34$ .
- Fig. 10. Right and left mandibles, larva,  $\times 47$ .
- Fig. 11. Clypeus, larva,  $\times 20$ .
- Fig. 12. First leg, larva,  $\times 34$ .
- Fig. 13. Pupal case, natural size.

*Rhyacophila torva.*

- Fig. 14. Labrum, pupa,  $\times 47$ .
- Fig. 15. Mandible, pupa,  $\times 47$ .
- Fig. 16. Labrum, larva,  $\times 47$ .
- Fig. 17. Right and left mandibles, larva,  $\times 47$ .
- Fig. 18. Clypeus, larva,  $\times 34$ .
- Fig. 19. Maxillæ, larva,  $\times 47$ .
- Fig. 20, a, b. 1st and 2nd leg, larva,  $\times 20$ .
- Fig. 21. Dragging hook, larva,  $\times 34$ .





