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# New York State Museum Bulletin

Published by The University of the State of New York

No. 292

ALBANY, N. Y.

December 1934

NEW YORK STATE MUSEUM  
CHARLES C. ADAMS, *Director*

## THE CADDIS FLIES OR TRICHOPTERA OF NEW YORK STATE

BY CORNELIUS BETTEN PH.D.

*Temporary Entomologist, New York State Museum*

WITH SPECIAL CHAPTERS BY

BLENDA L. KJELLGREN, ALFRED W. ORCUTT and

MRS MARION B. DAVIS

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## PREFATORY NOTE

The New York State Museum began, in 1900, a comprehensive study of the aquatic insects of the State under the direction of Dr E. P. Felt, then State Entomologist, of the Museum staff. The *first* report in this series formed Museum Bulletin 47, Aquatic Insects in the Adirondacks, and was prepared by Professor James G. Needham and Dr Cornelius Betten of Lake Forest College, Lake Forest, Ill. The *second* formed Bulletin 68, Aquatic Insects in New York State, by Professor James G. Needham, Lake Forest College; A. D. MacGillivray, Cornell University; O. A. Johannsen, Cornell University; and Professor K. C. Davis, West Virginia University; and the *third*, Bulletin 86, May Flies and Midges of New York, by Professor James G. Needham, Lake Forest College; Kenneth J. Morton, Edinburgh, Scotland; and O. A. Johannsen, Cornell University. The *fourth*, by Professor James G. Needham, was published in Museum Bulletin 124, Report of the Entomologic Field Station Conducted at Old Forge, N. Y., in the Summer of 1905, and the *fifth* is the present contribution by Dr Cornelius Betten, of the New York State College of Agriculture, Cornell University. The *sixth* member of the series is Museum Bulletin 289, by Dr C. L. Metcalf and W. E. Sanderson, on Black Flies and Other Biting Flies of the Adirondacks. Another paper, not of this series, but intimately related to it, was prepared by Dr E. P. Felt on Mosquitoes or Culicidae of New York State, and issued as Bulletin 79. These publications as a whole constitute one of the most important contributions to our knowledge of these insects which have been published in America.

The present report by Doctor Betten calls for a special apology on account of the long delay in its publication. The report was originally written in 1906-17, and has since been revised and brought up to date several times. After this prolonged delay it was considered that, in justice to the author, the report should be published, even at the sacrifice of delaying reports from other fields which have so long been given precedence.

The long delay in publishing this report has been a serious handicap to all students of aquatic natural history, particularly those studying the food of fishes or other aquatic animals. Its relation to fish

culture is of much importance also. Its publication now will be welcomed by a large number of teachers, entomologists, zoologists and students of fish culture, as it will materially aid them in modernizing their studies of these insects.

Since this manuscript was for the most part prepared 25 years ago, it has been thought best to adhere to the form of publication of the earlier Museum reports, for example Bulletin 86, on May Flies and Midges, although not uniform with the Museum's present editorial practice.

*January 1934.*

CHAS. C. ADAMS, *Director*

# THE CADDIS FLIES OR TRICHOPTERA OF NEW YORK STATE

BY CORNELIUS BETTEN PH.D.

*Temporary Entomologist, New York State Museum*

## INTRODUCTION

This report, dealing primarily with the Trichoptera, or caddis flies, of New York, is an attempt to render available to American students what is at present known of this important and interesting order of insects. A general account of the life history and the habits of all stages is included and a description of the external anatomy with particular reference to those features that are of most interest to the systematist. There are here included generic descriptions, with keys, of all North American genera, and specific descriptions of all North American species east of the Mississippi and north of Mexico. All other North and Central American species are listed with complete references so that the report may serve as a catalog for this continent. The total number of genera reported for the North American continent including Greenland and the West Indies is 123, and the number of species, as listed in this report, 568. Of these species, 261 are from the United States and Canada east of the Mississippi river, and 271 from the western parts of those countries, from Greenland, Central America, and the West Indies. Thirty-six additional species have so far been listed as common to the areas east and west of the Mississippi river but that number will doubtless be very greatly increased as further studies are made. Of the total of 568 species, 303 are described by Banks, 63 by Hagen, 59 by Walker, 14 by McLachlan, 15 by Navás, 12 by Ulmer, 12 by Morton, 18 are new in this report, and the remaining 72 are credited to 23 other authors. As originally written the report included the immature stages. While the specific descriptions of these are now omitted, a general account of the larvae and the pupae is included and the bibliographic references to the specific descriptions are retained, as are some figures that were included in the plates with those of adult structures. Descriptions of the immature stages of 55 species have been published in greater or less detail.

## ECONOMIC IMPORTANCE OF THE TRICHOPTERA

Of the economic importance of the Trichoptera in their relation as fish food there can be no doubt. The studies so far made are perhaps not extensive enough to be conclusive as to the proportions in which different insects serve as food for fish; these proportions will doubtless vary enormously with the habits and adaptations of the species of fish and with the relative abundance of the species of insects in the situations studied. Forbes (1888) has reported larvae of Trichoptera in the food of some fifteen genera of fishes, including sunfish, bass, perch, carp, sturgeons, minnows and catfish. In his summary (Bul. Ill. State Lab. Nat. Hist., 2, p. 485) he says, "Case-worms (Phryganeidae) were somewhat rarely found, rising to fifteen per cent in the rock bass and twelve per cent in the minnows of the Hybopsis group, but otherwise averaging from one to six per cent, in less than half of the species."

Needham in his study of the food of brook trout (Bul. 68 (1903), N. Y. State Mus., p. 204-17) found, in 25 stomachs, in addition to some three thousand midge larvae, 14 specimens of Trichoptera and 77 empty cases. In his later studies (Bul. 124 (1905), N. Y. State Mus., p. 172-88) Needham found no caddis flies in the food of the bullheads of Old Forge pond, but few in the food of the sunfish of the same locality, and none in that of the red-bellied minnow.

Another interesting series of fish food studies is given by G. V. Hudson (1904) in the appendix to his work on the New Zealand Neuroptera. Separate tables are given for the stomach contents of trout taken from various New Zealand streams and rivers. The general summary of the contents of 60 trout stomachs gives 4241 caddis flies, 1225 other insects of eight different orders, and 28 animals other than insects. It is probably to be assumed that no account is taken, in these latter tables, of the smaller insects like the midges; at least it seems improbable that they should be lacking.

Muttkowski (1925), in speaking of the feeding habits of the trout, says that in mountain streams stone flies and May flies constitute the major portion of the food and that fish eggs, fry and fingerlings must be ranked with these. Caddis flies he places in a second category so far as directly serving as fish food is concerned, but he adds that they "are used extensively as food by stone flies and May flies, and in this respect become as important, though indirectly so, as their enemies."

Altogether these studies show that while Trichoptera are not so important an item of fish diet as the May flies or as the midges, they are far from being negligible, and intelligent cultivation of fish demands a knowledge of the species.

Except in their important relation as fish food these usually unobtrusive insects are likely to arouse general interest only in certain localities where their enormous numbers make them a veritable pest. Thus at Buffalo, N. Y., it is well understood that it is useless to do any outside painting during the earlier summer months because freshly painted surfaces, at least if at all near the river, are literally covered with caddis flies. It is said also that it was largely on account of these insects that the Pan-American Exposition of 1901 was not located in the place which on other accounts was deemed the most desirable. On Squaw island, opposite Buffalo, in the Niagara river, almost 500 specimens were taken in ten random strokes of an ordinary insect net through the grass. At Ogdensburg, N. Y., on the evening of my arrival I saw a very large picnic of several hundred persons utterly routed by caddis flies. The air of the well-lighted park was filled with these insects and the consumption of ice cream and cake unadulterated was impossible. The species occurring in such numbers at both of these places belong to the genus *Hydropsyche*, whose larvae live on rocks in swift water. The Niagara river at Buffalo is not favorable for collecting and I was unable to locate the exact habitat of the most common species. The pupae were caught as they were coming up for emergence alongside the government breakwater, but these specimens had doubtless been carried some distance by the swift current since they left the rocks. The only place where I was able to get even a perilous footing was in a shallow riffle adjoining the breakwater and almost opposite what was at that time (1906) the site of the Buffalo Yacht Club. Here I found the larvae of *Macronema zebratum* Hag. and of *Hydropsyche alternans* Walker, both prominent in this region as adults; I did not find the larvae of the species whose adults were most common during my stay, namely, *Hydropsyche chlorotica* Hagen. I could reach over but little area, however, and I have no doubt that the larvae of this species, also, live on the rocks in the shallow riffles. The nature of the current precluded investigation of the depth to which they might be found; I did visit a dredge which was bringing up rock from a depth of 25 feet, and on these rocks there certainly was no sign of insect life.

It has very recently been discovered that caddis flies are probably of considerable importance as the cause of coryza and asthma. Dr Salvatore J. Parlato of Buffalo has reported (1929, 1930) that out of 192 cases examined 14 were found to react positively to skin and eye tests with extracts made from the bodies of caddis flies. In six of the cases the reaction was to caddis fly material only, and in the other eight to a combination of this with other factors. The trouble is presumably caused by the hairs and scales which are likely to be carried in the air where these insects are common. The high percentage shows that caddis flies are to be considered as probable causative agents in hay fever and asthma in places like Buffalo where the insects abound.

Siltala (1903a) and Wiesmann (1926) cite instances in which larvae of *Hydropsyche* did some damage in attacking the wood of bridges, and the former records the fact that Aristotle and Pliny referred to Trichopterous larvae as wood-destroyers (*Xylophthoros, ligniperda*). Injury to fish nets has also been reported. Van Hasselt (1867) records an instance of larvae killing a mussel by attacking the gills. Kolenati (1848a) mentions the use of the egg masses as bird food.

#### COLLECTIONS

This report embodies the results of several seasons' work. A beginning was made in the summer of 1900 when the author assisted Dr James G. Needham in the conduct of the New York Entomologic Field Station at Saranac Inn. The results of that season's collecting were included in Bulletin 47 of the New York State Museum. The field station was located at Ithaca, N. Y., during the summer of 1901 and at Old Forge, N. Y., in 1905, and during both of these seasons I gave my attention largely to the collection and rearing of caddis flies. The operations of the field station and the localities in which it operated have been adequately described by Doctor Needham in Bulletins 47, 68, 86, and 124 of the New York State Museum, and nothing further need be added here. During the summer of 1906 my own work was continued at Buffalo, N. Y., from July 20th to August 6th, and at Ogdensburg, N. Y., during the remainder of August. At Buffalo the collections were limited practically to the neighborhood of the Niagara river and the Erie canal. The river is here narrower than for some miles below and its rocky channel and swift current furnish ideal breeding places chiefly for *Hydropsychidae*. A number of trips were taken to Niagara Falls and the Niagara gorge, and one to streams near Lancaster and Hamburg.

N. Y. As stated above, there is little opportunity for collecting larvae in the Niagara river at Buffalo and very little of this was done. Adults were taken most commonly at the lights of the ferry landing at the foot of Ferry street, and at those along the entrance to the Buffalo Yacht Club of that time.

My stay in Ogdensburg was too late in the season for the best collecting but the results obtained indicate that the trichopterous fauna of the St Lawrence region is exceedingly rich. I have already mentioned the swarms of caddis flies that were to be seen along the river on the evening of my arrival. At that time I collected as many specimens as could well be taken care of in the receptacles I happened to have with me, not realizing how suddenly the possibilities of good collecting might fall off. As a matter of fact, the specimens collected that evening constitute at least half of my catch during the three weeks I spent at Ogdensburg. Some collecting of larvae was done in the Oswegatchie river, which here pours its water, red with some organic sediment, into the St Lawrence. The short duration of my stay and the lateness of the season, made the rearing of specimens impossible. Most of the adults were collected within the city of Ogdensburg and on the grounds of the New York State Hospital north of the city. Near the latter location the *Gallop Rapids* begin and this region is sure to furnish most excellent collecting earlier in the season.

To the above-mentioned localities where the collections have been made, should be added the vicinity of Lake Forest, Ill., particularly the south branch of Pettibone's creek, the latter a ravine stream running into Lake Michigan. The mouth of this ravine has more recently been deepened and widened so as to form a harbor, and this is now the site of the Naval Training Station of the Great Lakes. The south branch of this little stream contains but little water at any time and it goes dry toward the middle of summer. A number of species were collected at Diamond lake, a small lake near the village of Area, Ill.

Besides the material collected by myself there have been at my disposal specimens already in the New York State Museum, those in the museum of Cornell University, and smaller collections from the state museums of Maine, New Hampshire and Michigan. Professor J. H. Comstock, Dr J. C. Bradley and Dr C. P. Alexander have given me specimens which are referred to in the text. I have also had the privilege of examining Doctor Hagen's types in the Museum of Comparative Zoology at Cambridge, and those of Nathan Banks in his own collection and in the National Museum. I make grateful

acknowledgment to all those who have courteously extended to me the use of material in their charge. I am under lasting obligations for the patient and sympathetic interest taken in the work by Dr E. P. Felt, under whose direction, as State Entomologist of the New York State Museum, it was done. I wish to make special acknowledgment to Dr James G. Needham of the New York State College of Agriculture at Cornell University not only because I am indebted to him for a very great amount of material but because it was in his inspiring companionship that my interest in natural history and in the Trichoptera in particular was first stimulated.

Certain features of this report, which it seems not absolutely essential to change, may find their explanation in the fact that the manuscript was largely written before 1910 and that all of it was in its present form by 1915. Since the latter date virtually no changes have been made except such as were necessary to include the genera and species described in the later literature. It is not without trepidation that the author presents the results of work discontinued so long ago. Particularly distressing is the lack of opportunity to incorporate the generic rearrangements which would doubtless result from a consideration of the work done on European and Asiatic forms during the past 17 years.

#### PRESENT STATUS OF OUR KNOWLEDGE OF THE TRICHOPTERA

Our knowledge of the Trichoptera has in recent years received many notable additions. Fortunately the foundations were made by Hagen's work and by McLachlan's great monograph of the European fauna. This latter monumental work at once placed the systematic knowledge of the order into a condition immeasurably superior to that into which it had been brought by Kolenati and the other pioneers in this field. The work of Brauer and that of Eaton during this period also deserve particular mention. More recently McLachlan's work has been followed by that of Morton, Klapálek, Ulmer, Thienemann, Ris and Martynov, until now the adult Trichoptera of Europe are well known. Ulmer has also made large contributions to the knowledge of extra-European genera and species. His catalogs for various regions (see bibliography) are models in careful preparation and are of greatest service to students of the order. He has published also (1907) an admirable synopsis of the genera of the world, cataloging all the species, and fully illustrated. More recently a large number of extra-European species have been described by Martynov, Navás, Lestage and Banks.

Until the appearance of Ulmer's characteristically thorough monograph (1912e) the work on the adult fossil Trichoptera was not very extensive nor very recent. Complete references to it have not been included in the bibliography appended to this bulletin but these can readily be found in the principal works, namely, those of Hagen (1856), Handlirsch (1906), Ulmer (1912e), and Tillyard (1917-19), and in the lists by Scudder (1890, 1891). The only contributions regarding American material are in papers by Cockerell (1907-27) and by Berry (1927). Ulmer's study of the Trichoptera in Baltic amber is most interesting and serves to throw some light on the problems of phylogeny in the order. Reference to some of the details of his results will be found in a number of the ensuing pages; the following summary of his work may be here included. (1) The Trichopterous fauna in amber includes 56 genera and 152 species. Of these genera, 26 are restricted to amber and 30 are found in recent forms. (2) The greatest number of genera are in the Sericostomatidae, the next highest in the Polycentropidae (the latter family furnishing by far the greatest number of all specimens). (3) The most frequent genus is *Plectrocnemia*, followed by *Holocentropus*. (4) The most numerous species are, in order: *Plectrocnemia lata* Pict., *Holocentropus incertus* Pict., *Lype sericea* Pict., and *Plectrocnemia barbata* Pict.; these four are the typical amber-Trichoptera. (5) The family Limnephilidae, and the subfamilies Hydrobiosinae, Macronematinae and Sericostomatinae are the only ones lacking in the amber fauna. (6) The absence of the Limnephilidae (forming more than 25 per cent of the recent fauna) is most striking and is to be explained mostly by the subtropical distribution of the amber fauna. (7) The passing of the amber forests marked also the passing of the dominance of the Polycentropidae; in recent forms this family includes a little less than 7 per cent of the total as compared with nearly 45 per cent in amber. (8) The Trichopterous fauna in amber is not middle-European, European or Eurasiatic, but consists rather of Eurasiatic and Nearctic elements with an admixture of South American and South Asiatic forms. It is of subtropical character, with a very great preponderance of Polycentropidae and a total lack of Limnephilidae. (9) The Trichoptera found in amber are not the ancestors of present-day forms, but are as highly developed as the latter. (10) The Ecnominae do not belong to the Polycentropidae (or Hydropsychidae). The Beraeinae should be separated from the Molanninae and placed nearer the Sericostomatidae. The present family Sericostomatidae is not monophyletic (see p. 114 of this report). (11) The

amber forests were well supplied with streams, both rapid and quiet. (12) The larvae and pupae were wholly aquatic with no terrestrial forms.

The immature stages of the Trichoptera, also, have been receiving a share of attention. Their natural history was the subject of some of Reaumur's researches, and of some, also, of those of Pictet and De Geer. A good account is given in Miall's *Natural History of Aquatic Insects*, consisting largely of quotations from the work of Reaumur. A large proportion of the European species have now been described, mostly by Ulmer, Klapálek, Struck, Siltala and Thienemann. Some South American larvae have been studied by Fritz Müller and by Thienemann. Siltala, besides describing many life histories, has produced masterly studies on the postembryological development, on the eggs and oviposition, and on the food of Trichoptera. Thienemann has contributed a valuable study of the pupal stage, and Wesenberg-Lund has added another on the habits of the more generalized larvae. Ulmer, besides describing a very great number of species in shorter papers, has provided keys to the known European forms (1909*a*). Lestage's work brings this down to a later date (1921). The cases and case-building are mentioned in many of the above papers and are the subject of several shorter studies. As the bibliography indicates, the Trichoptera are beginning to find a considerable place in embryological, morphological and ecological researches. Of fossil larvae and cases there are few records (Berry, 1927, 1928). Ulmer, (1912*e*) in reviewing the instances of supposed Trichopterous cases in amber, concludes that these are all more than doubtful and adds that he himself has found none in his recent extensive study.

There is, therefore, a great deal of information available concerning this order of insects. And fortunately for those who would now undertake the study of the group, almost all of the work has been done with care and skill.

Except in the description of species, American entomologists have had an inconsiderable share in this work and the American forms also remain inadequately known. Fifty-nine species are described by Walker from material in the British Museum. In spite of reexamination of some of these old types, by Hagen, McLachlan and others, it seems likely that a number of these species will not again be recognized with any degree of certainty. Sixty-three species were added by Hagen, whose monograph of the family Phryganeidae is a piece of very careful work. For the description of 303 species we are indebted to Nathan Banks, who has also published very

useful catalogs of this order (1892, 1907). Vorhies (1909) has described and figured several Wisconsin species very carefully, including the entire life history in each case. Lloyd (1921) has made a fine contribution on the life histories and on the larval feeding habits of species occurring in the Ithaca region, and has published other detailed descriptions and notes in a series of shorter papers. Sibley (1926) has studied and described the species of a restricted area (the Lloyd-Cornell Reservation near McLean, N. Y.) with accompanying records and keys. Krafka (1915), while a student in the author's laboratory, prepared a key to the larvae which appears to have proved serviceable, and he has since (1923, 1924, 1926) contributed data bearing on the phylogeny of the families of the order.

The purpose of the present paper is primarily to make more readily available to American students the more important results of the truly noteworthy researches to which reference has been made above and thus to give those who have not the scattered literature at hand a starting point for their work on the Trichoptera. At present it is practically impossible to determine North American species and this is particularly unfortunate for those whose interests are not primarily systematic, but for whose biological studies the Trichoptera should furnish excellent material. Until the appearance of Ulmer's key given by Brues and Melander (1915), the only key to the families of Trichoptera available in an American publication was one which indicates (properly enough for the time when the key was made) but seven of the present 13 families, and one of these (Hydroptilidae) is erroneously differentiated by the presence of three segments in the maxillary palpi of the male. Banks has published a number of keys to the genera of various groups, the most important of these being a classification of the Limnephilidae (1916).

It is wholly impossible for me to indicate the degree of my indebtedness to those whose work appearing prior to 1915 I have mentioned above. The published material has been freely used and whenever it was possible it has been done by direct quotation so that its source might be known. For the generic descriptions I have drawn most heavily upon the works of Ulmer, McLachlan and Siltala. The completeness of the bibliography is due to the fact that I am able to supplement my own list with many additions from the very extended ones found in the works of Ulmer, Siltala and Thienemann.

I am indebted to my former students, Blenda Louise Kjellgren, A. W. Orcutt (both now deceased), and Dr Joseph Krafka jr for

the preparation of the parts of the text with which they have been credited. I am also under peculiar obligation to Mrs Nelson F. Davis of Lewisburg, Pa. Mrs Davis had for some time been independently engaged in the study of the life histories of caddis flies, and at the suggestion of Dr E. P. Felt, she very kindly offered to forego separate publication and to merge her results in the present report. At my suggestion, the scope of her work was broadened so as to include an abstract of the work done by others on the habits of the Trichoptera. This part, including her own observations in this field, will be found under her name in the text, but it is impossible to make amends to her for the unforeseen delay in its publication. Since these various contributions were completed many years ago, I have taken the liberty of changing them to the extent of including the results of some of the later investigations.

My own contribution to the subject consists largely in additions to the descriptions of the species that have come under my observation, particularly by figures of the male genitalia. I had hoped also to have done something in adding to our knowledge of the external anatomy of these insects, especially in drawing attention to the nature of the jugum and in elucidating some features of the wing venation. The most important of these items have now appeared in other papers, particularly those of Comstock and Tillyard, beginning with 1918.

In the following pages there will be found descriptions of 18 new species. In a large number of cases the species have been partially described without name because of the incompleteness of the material. These descriptions are added simply because they may serve to indicate what may be found in the localities cited; they should of course receive no other consideration whatsoever. The types described in this report, pinned or in alcohol, are in the New York State Museum.

It is very apparent that the Trichopterous fauna of America is but little known. There are doubtless a great number of undescribed species in the eastern United States and Canada, and the rich western fauna has hardly been touched. It is hoped that the compilation of the work so far completed, into more available form, may stimulate interest in a neglected group.

It has not been possible for me to examine all the types of the known species and the condition of my own material has often left much to be desired. The fragility of these insects and the ease with which the generally somber coloration is affected by rubbing are

difficulties of more than ordinary importance. The adult females have been wholly disregarded in the following pages. The keys will apply in full only to the males, but I have tried to arrange them so as to carry the females so far as possible; it may be assumed that the characters used will apply to both sexes unless the reverse is clearly indicated by the wording.

#### COLLECTION, PRESERVATION AND PREPARATION OF MATERIAL<sup>1</sup>

The adults, being nocturnal or crepuscular, can best be captured at lights on warm dark nights. Several species swarm at dusk, mostly near water. Adults should preferably be studied in the fresh condition as the genitalia are likely to dry in different positions or in positions unfavorable for observation. If possible the specimens should be spread so that the genitalia and the wing venation may be observed. It is of course highly desirable to have duplicate material in alcohol and such material is for most purposes the more important. The larvae, with the exception of one or, at most, a few European species, are aquatic and some may be found in almost any variety of aquatic habitat. They may be picked up by hand or swept from aquatic vegetation with a stout net; for bottom collecting a sieve net is desirable. The larvae and pupae may be preserved in alcohol or in a combination of alcohol and formalin. If one wishes to rear them, it is best done in breeding cages set in the natural habitat of the species collected.<sup>2</sup> If they are to be transported it should be done with expedition and with utmost precaution to aerate the water and to keep it cool. They will be much more likely to survive in air in a receptacle containing wet plant material than in water that is not aerated or that is allowed to get much warmer than that from which the specimens were collected. Similar precautions should, of course, also be taken with the aquaria.

Special care is needed in the rearing of specimens, not only in the handling of the material but also in making sure that species are not confused. The larvae of related forms are very similar and there is danger of faulty records of rearings. It should be remembered that in many groups it is possible to recover the hard parts of the larval body from the pupal cases; full grown pupae also have the adult genitalia formed beneath the pupal skin. It is therefore often

<sup>1</sup> See Ulmer, *Allg. Zeitschr. f. Ent.*, Bd. 7, No. 7, 8, p. 143-47. 1902.

<sup>2</sup> For descriptions of such cages see N. Y. State Mus. Bul. 47, p. 397-99, also Professor Needham's earlier descriptions in Part O of U. S. Nat. Mus. Bul. 39, p. 4.

possible to get the essentials of an entire life history from a single specimen.

For an adequate knowledge of any species it is necessary that duplicate material be used so that the structures may be dissected and studied separately. It is highly desirable to have balsam mounts of the various parts; almost all the parts used in systematic work may be so treated with advantage. The wings and the abdomen are the main exceptions to this rule. With the wings this procedure may be followed: remove them with care so as to keep the basal region whole; after immersion in alcohol place them upon hot water to soften; again immerse them in alcohol and place them on the slide, the end of which is held in the fluid while the wing is slowly drawn upon it; the wing being now completely flattened, a cover glass may be placed over it and securely held while the alcohol is evaporated over a flame; it will now be possible to remove the cover glass and to denude the wing with a stiff camel's hair brush; finally, replace the cover and apply a minute drop of hard balsam to each corner, the cover being held securely while the balsam is slightly heated so as to run under the corners. A little experience will enable one thus to make a secure mount with considerable balsam but with none of the latter in contact with the wings. It is perhaps as effective and certainly much easier to fasten the cover to the slide with strips of *passe partout*. If the wings thus mounted are examined with a small opening in the diaphragm of the microscope, the veins will be seen very clearly. If the wings are placed upon the slide directly from ordinary tap water, they will generally adhere to the slide and it will not be possible to denude them or even to remove the cover glass. The procedure here detailed may of course be shortened with those wings which do not need to be denuded. For many forms it is safer, more rapid, and as effective to denude the wings in alcohol rather than dry. The genitalia may be heated in caustic soda or potash until the parts stand out full and clear. This method doubtless gives the best approach to the condition of fresh material and in the extension of some of the parts may surpass it. The sodium hydroxide is removed with water and the specimen is then ready for study. It is convenient to insert the point of a pin in the open anterior end of the abdomen so that the specimen may be held in any desired position, the head end of the pin being flattened to prevent rolling. Even after treatment with hot caustic soda, certain invaginated parts like the appendages of the penis in some genera are only rarely extruded (pl. 5, fig. 2; pl. 18, figs. 3, 10). The penis of the *Limnephilidae* is deeply telescoped within its own

base and this structure has not often been fully shown in figures. After the treatment with caustic soda, it is often possible by cautious manipulation to draw out this organ to full length (pl. 50, fig. 7).

#### GEOGRAPHICAL DISTRIBUTION OF THE TRICHOPTERA

The facts concerning the distribution of the Trichoptera have been put into available form by Ulmer. This author has published a paper (1905a) in which are indicated the ranges of all the families and genera and in which the great faunal regions are characterized. In a more recent work (1912e) he has added a valuable discussion on the basis of his study of the Trichoptera found in amber. In this later treatise he calls attention to the following facts: (1) Trichoptera are found in all parts of the earth with the exception of the Hawaiian Islands. (2) With some exceptions (*Chimarra*) it is the large genera such as *Hydropsyche*, *Limnephilus* etc., that are the most widely distributed. (3) The number of small genera of restricted distribution is very large. Ulmer is doubtless right in attributing this, in part at least, to the slight development of the function of flight in this order of insects. (4) A most striking feature is the entire absence of Phryganeidae and of Limnephilidae (the latter with a few exceptions in Chile) south of the Equator. So far as the Limnephilidae are concerned, Ulmer points out that the larvae of these are always found in cold water and that they are relatively more numerous as one goes northward. The Phryganeidae are at best relatively scarce and while they are not found south of the Equator, they approach the tropics more generally than do the Limnephilidae.

With respect to the distribution of forms within the Nearctic region nothing can be said while the fauna is so little known. As a whole this fauna seems to show close relationship to that of Europe and Asia, largely the same families and genera being found. *Agraylea multipunctata* C., *Neureclipsis bimaculata* L., *Arctopsyche ladogensis* K., *Neuronina lapponica* McL., *Limnephilus nebulosus* Kirby, *Limnephilus miser* McL., *Limnephilus despectus* Walk., *Limnephilus rhombicus* L., *Chilostigma praeteritum* Walk., *Apantania stigmatella* Zett. and *Mystacides longicornis* L. are among those that have been reported from both continents. Our common *Mystacides* has also been identified with that of Europe, but this is probably an error (see p. 281). In Hagen's collection is a specimen from British Columbia which is identified as *Astratus asiaticus* McL. a species described from Turkestan.

## MORPHOLOGY OF THE TRICHOPTERA

## ADULTS

Trichoptera are insects of small or of moderate size; the adults have threadlike, often very long antennae; the mouthparts, while all represented, are more or less reduced so that the two pairs of palpi alone are readily seen; the labium does not form a long sucking tube but it or the hypopharynx appears as an haustellum which in some cases at least may be used for lapping up food; the legs are rather long and slender, they each have five tarsal segments and are terminated by a pair of claws; there are with only the rarest exceptions four membranous wings which are roofed over the body in repose and which are either hairy or nearly naked, much more rarely with scales; the venation is of a simple type, with few cross veins and tending in general rather to reduction than to multiplication of the typical veins; in contrast to the condition in the Lepidoptera, there is never any covering of scales on the body itself, exclusive of the head.

*Head*

The head is small and transverse, its dorsal surface either flat or somewhat rounded; there are almost always a number of tubercles, or warts as they have been designated, of different sizes, covered with dense and sometimes coarse pubescence. In the genus *Hydroptila* there are two large posterior lobes in the males, recognized and described as scent organs by Mosely (1920b). Heretofore authors have also described enormous lobes on the head of the males of Sericostomatinae; these are really the basal segments of the antennae. The compound eyes are small, generally well separated. In the genus *Ascalophomerus* (China) as described by Walker (1852a, p. 79), and McLachlan (1871a, p. 121) the eyes of the males are closely approximated. The same is more or less the case in *Marilia* Fritz Müller and in *Mystacides* Latr. Ulmer (1906b, p. 60) has described one species (*Polymorphanisus ocularis*, Java) in which the eyes of the male actually touch each other on the ventral side of the head. The ocelli are three in number when they are present. The posterior pair are found near the median sides of the eyes, the third a little farther forward and in the median line between the antennae (text fig. 5a). All are generally much obscured by the pubescence of the head. McLachlan (Ent. Mon. Mag., 1875, p. 65) records the abnormal absence of one lateral ocellus in a specimen of *Acrophylax zerberus* (Europe). Ocelli occur in Hydroptilidae (in part), Rhyacophilidae, Philopotamidae, Phryganeidae, Limnephilidae,

and in two exotic genera of Sericostomatidae (*Thremma* and *Plectrotarsus*).

The adult mouth parts (Lucas 1892, Kellogg, 1895*b*, Döhler, 1914, Ulmer 1904*e*, Cummings 1913, 1914*b*) include the usual members but they are all much modified. The mandibles are sometimes wholly absent, as Lucas has demonstrated for *Anabolia furcata* (Europe); in other cases they are said to be large enough to be seen with the naked eye, but they are probably not often functional. Lucas has



Fig. 1 Head of *Phryganea cinerea* Walker. a Side view. b Front view of mouth parts

called attention to more lateral projections on the skeleton of the head which sometimes resemble mandibles. They are highly developed in *Carborius punctatissimus* (text fig. 2*a*). In dried specimens the mandibles may be very difficult to find; in such specimens of *Phryganea cinerea*, even when these are boiled in caustic soda, the mandibles are well-nigh indistinguishable, but in freshly emerged specimens they appear as rather prominent turgid tubercles (text fig. 1). The maxillae are reduced to a basal lobe and a palp; in the basal lobe, according to Kellogg, cardo and stipes may sometimes be distinguished and there may be one or two free lobes. The labium is composed of submentum, mentum, an haustellum and a palp. The haustellum is ordinarily a large lapping organ with a chitinized groove on the upper surface over which the labrum lies; more rarely this organ is not greatly developed. According to Cummings (1914) the haustellum is probably developed from the hypopharynx. All the parts are shown in the accompanying figure

of *Macronema zebratum* (text fig. 2b). The labium is here short, not extending over the haustellum; the latter organ is overlapped at the base by the free lobes of the maxillae and beneath it lies the basal part of the labium with labial palp attached (separately shown in text fig. 2b). The same relations may be observed in the figure of *Phryganea* (text fig. 1a, b).

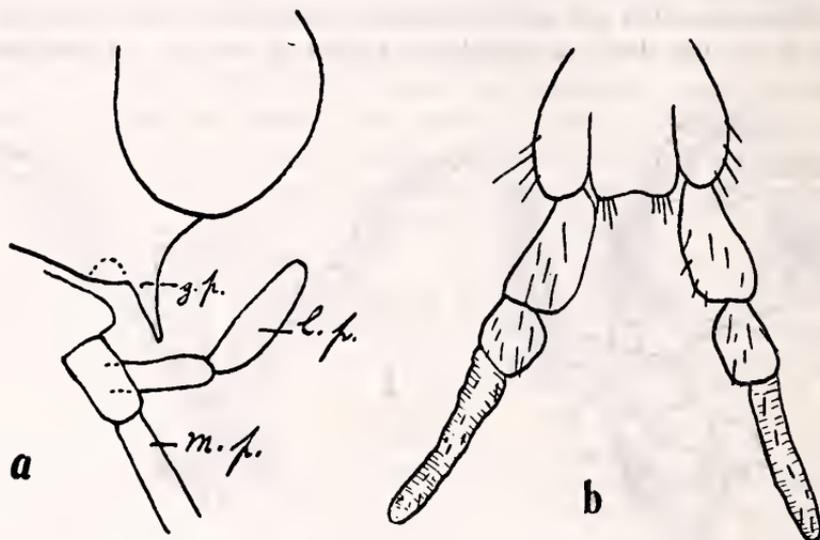


Fig. 2 a Genal process on the head of *Carborius punctatissimus* Walker.  
b Labium of *Macronema zebratum* Hagen

The palpi show considerable diversity of structure and are of importance in defining the groups within the order. The maxillary palpi have five segments in all females except those of certain Psychomyiidae and of the exotic genus *Thamastes* Hagen which is peculiar in other respects also. In the males the maxillary palpi are 5-segmented in all except certain Psychomyiidae, the Phryganeidae, Limnephilidae and Sericostomatidae. In an exotic sub-family of Psychomyiidae the maxillary palpi are 6-segmented and the labial palpi 4-segmented (Martynov 1914d, Lestage 1926a). In the Phryganeidae the males have four segments in the maxillary palpi, in the Limnephilidae and the Sericostomatidae the number is reduced to three or less. The labial palpi are 3-segmented in both sexes. To these statements regarding the number of the palpal segments a number of other exceptions must be made. The genus *Philanisus* Walker (Sericostomatidae) has maxillary palpi 5-segmented in males as well as in females. In many Macronematinae (family Hydropsychidae) the mouthparts are wholly lacking. In *Hyalo-*

*psyche* Ulmer, an Indian and African Polycentropid, the labial palpi are absent while the others are present.

The segments of the palpi are ordinarily cylindrical, the terminal ones often slightly elliptical, sometimes produced into a slender point (text fig. 3). In the Philopotamidae, Hydropsychidae, Polycentropidae and Psychomyidae, the terminal segments of both pairs of palpi are multiarticulate (not very plainly so in the Philopotamidae). In the Leptoceridae the terminal segments seem to be flexible although there is no trace of articulation within the segments. The Sericostomatidae (p. 381) present the greatest differences in the structure of the maxillary palpi; here the terminal segments are often much enlarged and the whole organ may be held up so as to mask the face. In *Nosopus* McLachlan (California) the labial palp

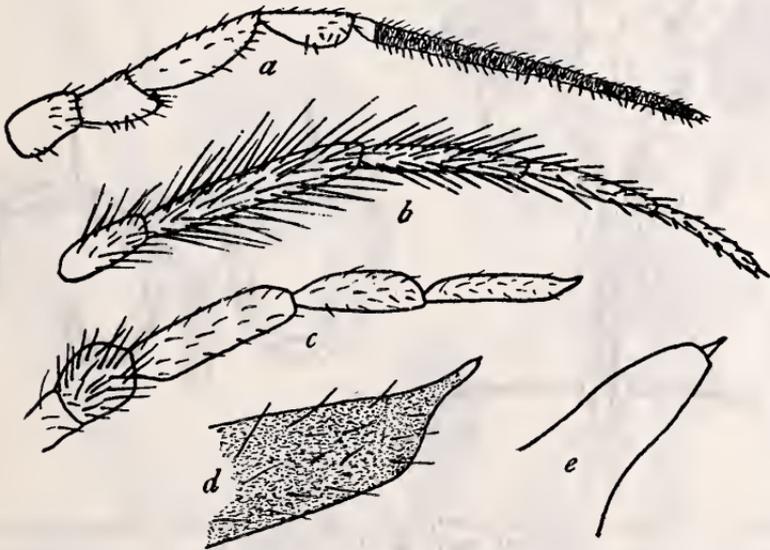


Fig. 3 Palpi of adult *Trichoptera*. *a* Maxillary palpus of *Macro-nema zebratum* Hagen. *b* Same of *Leptocerus submacula* Walker. *c* Same of *Rhyacophila fuscula* Walker. *d* Tip of *c* enlarged. *e* Tip of *d* enlarged

is abnormally large. Ordinarily the palpi are closely covered with short pubescence; in the Lepidostomatinae there are often large scales. In a few genera, parts other than the haustellum are apparently developed for taking food. In *Plectrotarsus Kolenati* (Australia), commented on by Hagen (1881) and McLachlan (Rev. and Syn., p. 4), and described by Ulmer (1904e), there is a long tube which appears to be an appendage of the labrum. In *Dipseu-dopsis* Walker (China, India, Africa) described by Ulmer (1904e)

and by Cummings (1913) there are two long tubelike organs which may be the greatly elongated lobes of the maxillae; in an Indian species of this genus I find the usual small lobes as well as the elongated ones (text fig. 4*b*). Döhler (1914, 1915) has described a most interesting form from Chile in which the labial palpi are carried far out on the greatly elongated stipites to which they are joined by the palpigers; the anterior part, which is therefore the haustellum, is divided into four points (text fig. 4*a*). The elongated stipites together form a groove over which the elongated external lobes of the maxillae are placed so that a sucking tube is formed. The entire tube is retractile so that ordinarily the palpi appear to lie close to the head.

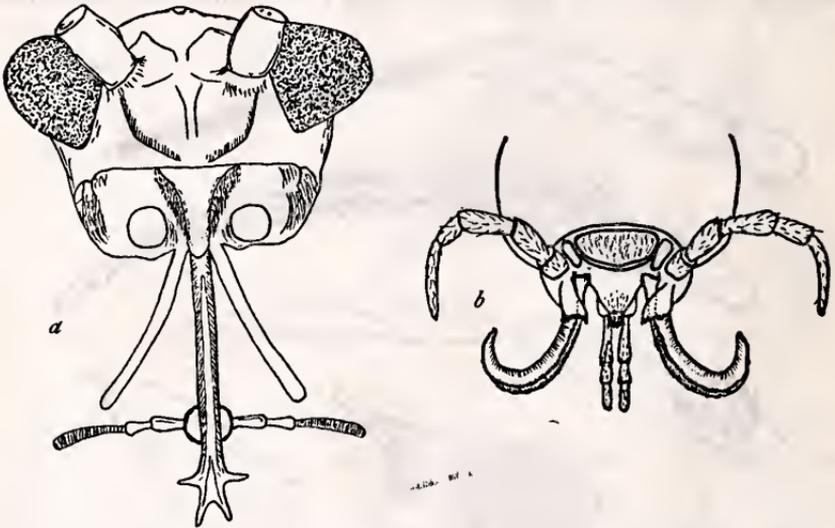


Fig. 4 *a* Head of *Pseudostenopsyche sugens* Döhler (after Döhler).  
*b* Mouth parts of *Dipseudopsis* sp.

### THE ANTENNAE OF ADULT TRICHOPTERA<sup>3</sup>

By BLENDA LOUISE KJELLGREN

The antennae of caddis flies are situated on the front of the head, between the eyes, usually set well apart, with the bases of the first segments almost touching the inner margins of the eyes (text fig. 5*a*). In *Brachycentrus* and other genera they are separated more widely because of the great width of the head. In flight, the

<sup>3</sup> Miss Kjellgren, who as a gifted and promising young college student, prepared this description of the antennae in 1912, spent some subsequent years in biological work. During the war she and her sister volunteered as nurses at Camp Grant, where both died on the same day, victims of influenza.

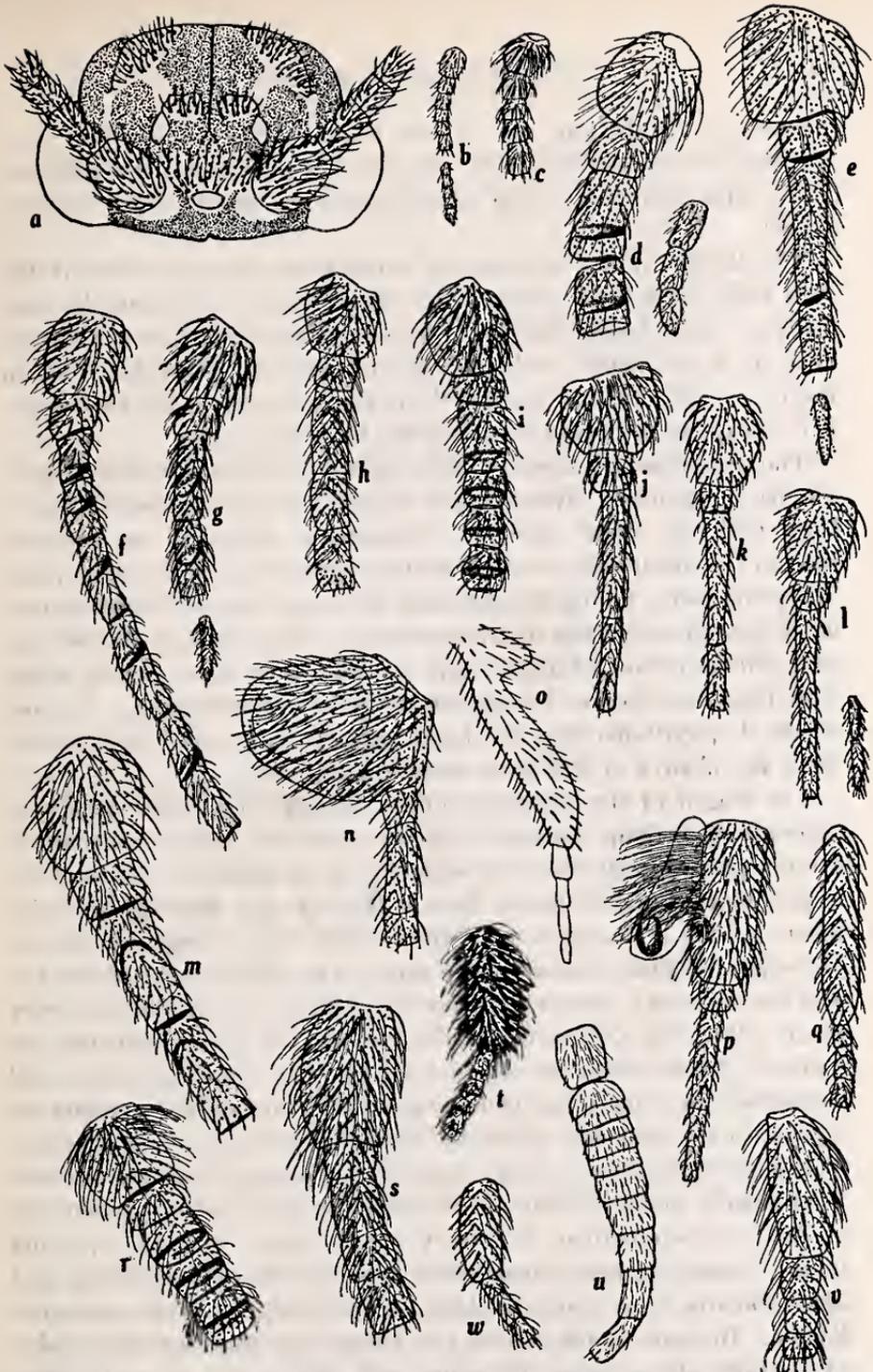


Fig. 5. Antennae of adult Trichoptera. *a* Dorsal view of head of *Rhyacophila* sp. showing bases of antennae, the ocelli, and the so-called warts. *b* *Protophila maculata* Hagen (base and tip). *c* *Agraylea multipunctata* Curtis. *d* *Limnephilus tersus* n. sp. (base and tip). *e* *Macronema zebratum* Hagen (base and tip). *f* *Diplectrona modesta* Banks. *g* *Hydropsyche alternans* Walker. *h* *Plectrocnemia* sp. *i* *Phylocentropus placidus* Banks. *j* *Potamyia flava* Hagen. *k* *Oecetis incerta* Walker. *l* *Leptocerus* sp. (base and tip). *m* *Hydromanicus truncatus* Betten. *n* *Agarodes grisea* Banks. *o* *Dinarthrella* sp. *p* *Triaenodes injusta* Hagen. *q* *Lepidostoma togatum* Hagen (female). *r* *Neuronia concatenata* Walker. *s* *Platycentropus maculipennis* Kolenati. *t* *Lepidostoma togatum* Hagen (male). *u* *Orthotrichia* (?) *pictipes* Banks. *v* *Goera* sp. *w* *Helicopsyche borealis* Hagen

antennae, even the long ones of the Leptoceridae and the Macrone-matinae, are directed forward. At rest, the position of the antennae is the same, commonly lying upon the surface on which the insect is found.

The length of the antennae is often about equal to that of the fore wings or a little shorter; less often, but not uncommonly, they are very much longer than the fore wings, sometimes three times as long, as in the males of *Leptocella* and other Leptoceridae. When there is a difference in the length of the antennae in the two sexes, it is always in the males that they are more developed.

The antennae are covered with hairs through the entire length, the basal segments always more thickly covered and with stouter hairs than the other segments. Sometimes the hairs are grouped toward the distal ends of the antennal segments so as to form spine-like projections, giving the antennae the appearance of being serrate or at least accentuating that appearance. This seems to be the case with *Odontocerum* (Europe) and possibly with other genera which have been described as having serrate or dentate antennae. In some of the Lepidostomatinae the basal segment is covered with scales, these not always of the same shape throughout.

The length of the segments differs considerably. The very long antennae have long segments but of course the two measurements are not proportional; thus the segments in the antennae of the Polycentropidae are much shorter than in *Hydropsyche* although the total length of the antennae is not greatly different. Except in *Ascalophomerus* (China), the antennae taper very slightly toward the tip, and the segments, except the basal two and the apical one, are very much alike. In *Orthotrichia* (?) *pictipes* the basal segments are markedly thicker than the others (text fig. 5u). In *Diplectronea*, and very likely in some other genera, there is a noticeable convexity of outline in the first few segments beyond the second (text fig. 5f). The basal segment is always broader and longer than the second. It is usually about as long as the head; in many cases, particularly in the Lepidostomatinae, it is very much longer (text fig. 5q), and in the Asiatic genera *Dinarthrum*, *Dinarthrella*, *Dinarthrodes* and *Maniconeura*, it is about as long as the body or even somewhat longer. In some of the genera just named the basal segment is also of peculiar shape, being thickened and having one or more large spurs. Ordinarily, the shape of this segment varies from cylindrical to spherical. The basal segment of the antennae of the males of certain species of *Triaenodes* is peculiar in having at its side a flap which is of almost the same length and width as the segment itself.

This flap is attached along about one-half of one of its edges and does not join the head. On the inner face of the large flap there is another smaller curved one as shown in text figure 5*p*. Along the angle between the segment and the larger flap there is a line of very long, thin hairs, and toward the apex of the segment there is a tuft of short bristlelike hairs, the structure of which seems to differ somewhat in different species. This tuft is covered by the larger flap when that is closed over the segment.

In the Sericostomatinae the basal segment of the antennae of the male forms a large lobe which is directed backward over the head. These peculiar segments have heretofore been described as horny processes on the head or as projections into which the basal segments of the antennae are inserted, but their true nature has not been generally suspected, Cumming's paper (1914) being the only one to indicate the correct relation. In at least some species there seems to be a narrow flap on the inner and under side of this segment; in *Agarodes* this is about as wide as the second segment and is directed posteriorly (text fig. 5*n*). The only species of the subfamily *Sericostomatinae* that has been available for investigating this structure is *Agarodes grisea* Banks but Doctor Ulmer has informed me by letter (1912) that the same structure appears in the other genera and adds that in the Brazilian genus *Grumicha* (sometimes regarded as belonging to this same subfamily) the antennae of the male are normal, like those of the female.

The second segment of the antennae is always shorter than the other segments. Very often the articulation of this with the succeeding segment is incomplete, sometimes wholly lacking, so that the two segments together appear as one very long one. The two antennae of the same individual may differ in this way. The apical segment is usually a trifle longer than those preceding it. Its apex is commonly rounded (text fig. 5*d*); in *Hydroptila*, *Protoptila* and probably in other Hydroptilidae there is a hairlike projection at the tip (text fig. 5*b*).

In some genera of Hydropsychidae, Sericostomatidae, Polycentropidae and Phryganeidae there is a peculiar ringlike thickening on many of the segments beginning with the third; this is distinct proximally, less so toward the apex. In *Hyalopsyche*, *Plectrocnemia*, *Polycentropus* and *Lepidostoma* these rings are complete circles parallel with the antennal joints. In *Hydropsyche* and in *Dipletrona* they are oblique, and instead of being of equal thickness, they run out at one side so as to form incomplete circles. In most cases these rings are dark in color, in others they are hardly recognizable, being then indicated in cleared specimens by the lack of pubescence.

*Thorax and appendages*

The prothorax is ordinarily very small, forming a narrow ring on the dorsal side of which there are generally two large tubercles covered with stiff hairs. In a few genera (*Grammotaulius* Kol., *Glyphotaelius* Kol., *Dipseudopsis* Walk.) the prothorax is relatively more developed. There is commonly a median furrow, deep in *Dipseudopsis* (exotic), but generally very shallow. The mesothorax is much larger, being the largest segment of the body; it is itself somewhat hairy and supports the hairy tegulae. The metathorax is smaller than the mesothorax and is nearly or quite naked. The sterna of all the segments of the thorax are hidden by the large coxae.

The legs are generally long and slender; the coxae are very large, those of the forelegs movable, the others more firmly united to the thoracic segments. The trochanters are small, the femora and tibiae long, the tarsi 5-segmented. The relative lengths of the segments of the legs differ somewhat but, except in the case of the tarsus, the segments of which sometimes differ in the sexes, no account has been taken of this in systematic work. The shape ordinarily presents no very extraordinary differences. The forelegs of the Californian *Nosopus* are described by McLachlan (Rev. and Syn., p. 6) as being "gouty and abbreviated." In the females of many species of Hydropsychidae and of Rhyacophilidae, in one genus of Phryganeidae (*Agrypnetes*, exotic), and in the males of some of the Macronematinae the tibiae and tarsi of the middle legs are very much dilated and flattened. Like other parts of the body, the legs are covered with short pubescence. In addition there are often numerous spines on the tibiae and on the under side of the tarsi; more rarely there are some on the femora. In a few genera of Limnephilidae there is in the case of the males a double row of very short heavy spines along one side of the femur and another row of still shorter ones on the adjacent side of the tibia (text fig. 6b). The spurs are easily distinguished from the spines by their large size and generally by a difference in color. They are movable and are covered with microscopically small, fine points. The greatest number of spurs to occur is 3-4-4, the figures in the formula indicating the number of spurs on the fore, middle and hind legs respectively. The spurs are said to be apical when they are at the distal end of the tibia, subapical when a little further toward the middle of the segment. There are never more than two spurs together and when the formula indicates the presence of three or two spurs on the

leg, it means that there are two apical spurs and one or none sub-apical. In very many genera the inner spur is somewhat longer than its mate. The inner spur of the hind legs of the males of *Dipseudopsis* (exotic), *Platycentropus* and *Mystrophora* (text fig. 6c, e) is variously modified; in the male of *Nesopsyche* (exotic) it is long and spirally twisted; in *Xiphocentron* (Brazilian) the male has the two apical spurs of the hind legs united into a sword-shaped blade; in *Colpotaulius* and *Rheophylax* the apical spur of the foreleg of the male appears as a long black spine (text fig. 6). In some genera the claws are of unequal size, the outer being the larger; this is said to be the case in *Chimarra* but I have not found it so in American species. In males of the genus *Hydropsyche* the outer claws of all

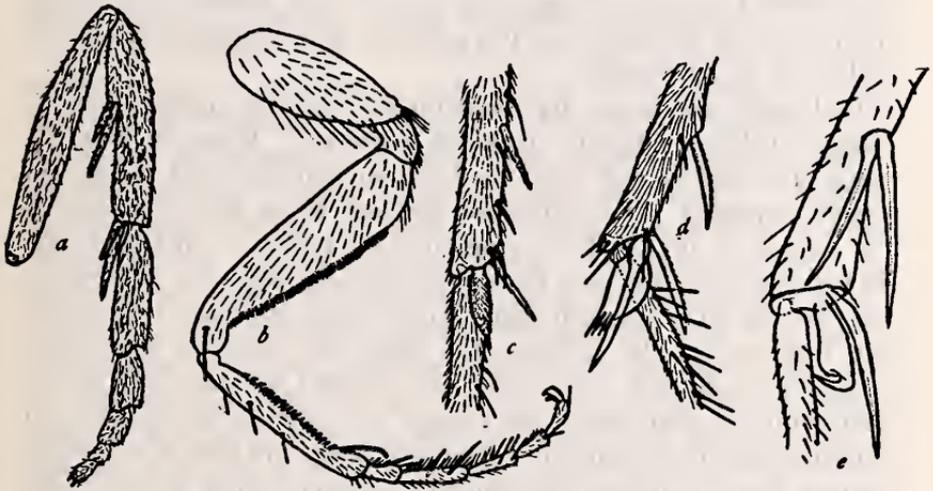


Fig. 6 Legs of adult Trichoptera. a Middle leg of *Macronema zebratum* Hagen (female). b Fore leg of *Rheophylax submonilifer* Walker (male). c Spurs on hind leg of *Platycentropus maculipennis* Kol. d Spurs on hind leg of *Neophylax consimilis* n. sp. (male). e Hind leg of *Mystrophora americana* Banks (male)

the legs have been described as malformed or as replaced by a bunch of black bristles. I have never been able to find this so in American species and have expressed doubt of the value of this character in differentiating the genera *Hydropsyche* and *Hydromanicus* (Betten 1909, p. 235). Ulmer has more recently arrived at a similar conclusion (Ulmer 1912, p. 207) and now describes the claw as covered by a bunch of black bristles.

The wings are practically always four in number. In the males of the exotic genera *Thamastes* and *Anomalopteryx* the hind wings are rudimentary; the females of *Enoicyla* (Europe) are apterous,

and this is also reported by Doubleday (1837) for a North American species of *Philopotamus*. Doubleday's notes (p. 279-80) written at Trenton Falls, New York, on the 31st of October, a frosty day with the spray of the falls frozen on the trees, are as follows: "Yet had the sun the power to awaken into life some little Philopotomi, which were running about on the rocks. I saw in one place there was a great bustle amongst them; eight or ten were huddled together, and were apparently very contentious and quarrelsome; the object of their strife I found to be an apterous female; I carefully searched for more, but found only four or five, there being at least ten males to one female."

Banks has described a western American species (*Psychoronia brevipennis*) in which the anterior wings of the female do not reach the tip of the abdomen and the posterior pair scarcely beyond the middle of the abdomen.

Both pairs of wings are membranous but the anterior pair is always of heavier texture than the posterior. When at rest the wings are held roofed over the body so that the hind wings are wholly concealed. In this position the fore wings overlap a little at the base if at all; the hind wings may be folded so that they also do not overlap, but in case there is a large anal angle the hind wings may overlap so as to reach nearly to the costal margins of the opposite fore wings. In *Molanna* the wings are more or less rolled around the body and in *Psilochorema* (exotic) they are held nearly horizontal; in both cases the change of position has resulted in abnormalities in the venation. The hind wings are always somewhat shorter than the others and generally broader, but in the Hydroptilidae and in a few species of other families the fore pair is broader. The tegulae are in general well developed and sometimes rather prominent.

The costal margin of the fore wing is sometimes nearly straight for much of its length (for example, *Molanna*), generally it is convex, rarely somewhat sinuous. The same may be said of the apical margin, but this is in addition sometimes concave, and in the Hydroptilidae it wholly disappears because the wings are sharply pointed. The posterior or inner margin is not parallel with the anterior, the two diverging somewhat from the base. In the hind wing, the anal area is generally greatly expanded. There is in some forms (for example, Rhyacophilidae) a lobe at the base (text fig. 18a) and in this there is a branched vein. In the larger wings there is no incision setting off such a lobe but it and its vein seem to be incorporated into the wing (text fig. 18e).

The wings of the Trichoptera are sometimes practically naked, as in the Macronematinae, and the hind wings are generally but sparsely covered. On the fore wings there occurs a variety of hairs. The entire wing is covered with small solid hairs, the "Stächlen" which Spuler<sup>4</sup> has shown to be common to the whole Ortho-Neuropteroid group. Kellogg<sup>5</sup> describes those found in the Trichoptera as, "very small, slightly curving, pointed hairs, firmly attached to the wing membrane and not inserted in a socket or cup." These hairs are more or less localized on the inner margin of the fore wings and particularly on the fibula as noted beyond (p. 33). Besides these there are long hairs often forming a cover so thick as to obscure the venation. The pubescence generally extends beyond the wing margins as a fringe. This is longest on the inner margin. In the Hydroptilidae the fringe is often longer than the width of the wing. On the anal veins there are sometimes bristlelike hairs; these may occur also on the other veins and even on the membrane, in which case (as in *Chaetopteryx*) they arise from small tubercles. The occurrence of the micro- and macrochaetae is discussed by Tillyard.<sup>6</sup> Besides the types already mentioned there are clublike and flatter striate scales. These are found in the Hydroptilidae, in many Sericostomatidae and Molannidae, and in a few Rhyacophilidae and Leptoceridae. Not infrequently these scales are localized in a groove or furrow extending longitudinally through the wing. Structures of this general type occur in certain Limnephilidae, Sericostomatidae and Molannidae (pls. 30, 54, 64). In *Olemira* Banks the entire anterior margin of the fore wing is folded over to form such a groove (pl. 64, fig. 1). Of course the venation is more or less disarranged by these folds. These peculiar structures are limited to the males and are in most cases in the fore wings. In the hind wings of certain Limnephilidae there is a pencil of very long hairs lying along the anal veins (pl. 52, fig. 5).

In this connection may be mentioned certain other structures which are perhaps of the same general nature as these scale grooves. In the males of some species of *Glossosoma*, McLachlan finds what he describes as "a large, nearly reniform, callosity connected on its exterior edge, but otherwise free (and probably capable of being

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<sup>4</sup> Spüler, Arnold. Beitrag zur Kenntnis der feineren Baues und der Phylogenie der Flügelbedeckung der Schmetterlinge. Zool. Jahrb. Anat., 8 (1895), p. 520-42.

<sup>5</sup> Kellogg, V. L. The Taxonomic Value of the Scales of the Lepidoptera. Kans. Univ. Quart., 3 (1894), No. 1, p. 45-89.

<sup>6</sup> Tillyard, R. J. Proc. Linn. Soc. N. S. W. 43 (1919) Pt 3, p. 626-57.

elevated); it is clothed with short inflated hairs" (text fig. 7a). In the genus *Homophylax* Banks, which was probably described from female specimens, I find that the male has not only a broad groove of scale hairs in the hind wing but a conspicuous flap on the fore wing. This structure is found on vein *M* and its free edge lies over the base of the radial sector (text fig. 7b). In this region there are a number of scales but in the single specimen that I have seen there did not appear to be many beneath the flap.

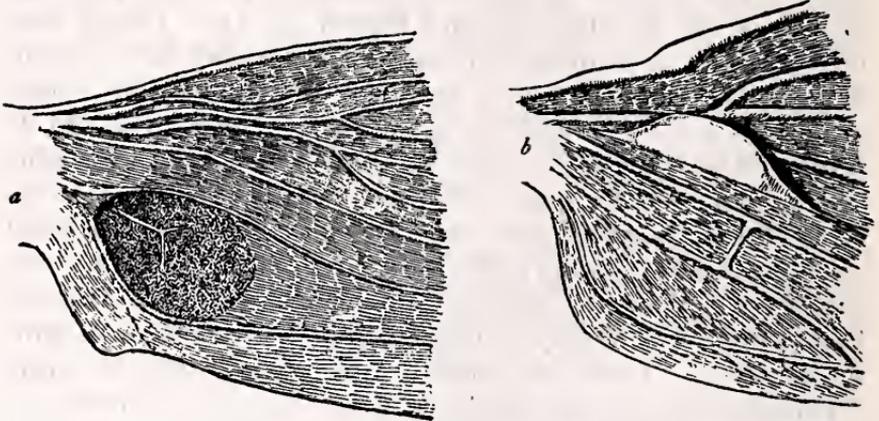


Fig. 7 a Base of fore wing of *Glossosoma* sp. (male). b Same of *Homophylax flavipennis* Banks (male)

In the discussion of the homology of certain of the wing veins in the following pages, it will be seen that I have given some weight to the position of what McLachlan has described as "corneous points" in the wing membrane. Navás (Assoc. Esp. para el Prog. Ci., 1917, p. 62) calls these points the internal and the external nigmata. These points are slightly different from the remainder of the wing membrane in color, they may be somewhat raised and finely tuberculated, and little spines radiate from these surfaces, making these spots not inconspicuous in wings which have been denuded. The presence of these points in the base of cell  $R_4$  of both wings has long been noted and is shown in many figures (text fig. 8). A similar point in cell *M* of the fore wing in certain genera has not received such general notice. Fritz Müller (1887a, p. 226) remarked upon it in showing the relationship of *Chimarrha* to the Hydropsychidae rather than to the Rhyacophilidae. He also comments upon its occurrence in *Grumicha* (Sericostomatid from Brazil) and in *Phylloicus* (Brazilian Calamoceratid), surmising that it might be common to all the genera of Calamoceratidae.

Ulmer (1907c, p. 16, 17) refers to it as generally present. So far as I know, Ulmer's more recent papers are the only ones in which this point in cell  $M$  is shown. On the basis of my own material the following generalizations may be made with regard to the occurrence of these three points, it being understood that many exotic genera are not represented in the collections at my disposal. The point in cell  $R_4$  of the fore wing and that in cell  $R_4$  in the hind wing appear to be universally present except in the genus *Helicopsyche*, most of the Hydroptilidae and a few Rhyacophilidae. The wings of the Hydroptilidae present some difficulty in examination in this regard; in the lower genera (*Agraylea*, *Ptilocolopus*, *Allotrichia* and *Protoptila*) these points appear. Ulmer (1912e, p. 20, footnote) says they are very evident in the wings of the Hydroptilidae in amber except in one genus. I find the point lacking in cell  $R_4$  of the hind wing of *Psilochorema* (New Zealand) and *Agapetus*—Rhyacophilid genera in which cell  $R_4$  is very short. The point in cell  $M$  of the fore wing is not so commonly present. It appears in the Philopotamidae, Hydroptilidae (in part), Hydropsychidae, Calamoceratidae, Psychomyidae, Phryganeidae, Limnephilidae, Goerinae and Brachycentrinae (at least in *Brachycentrus*

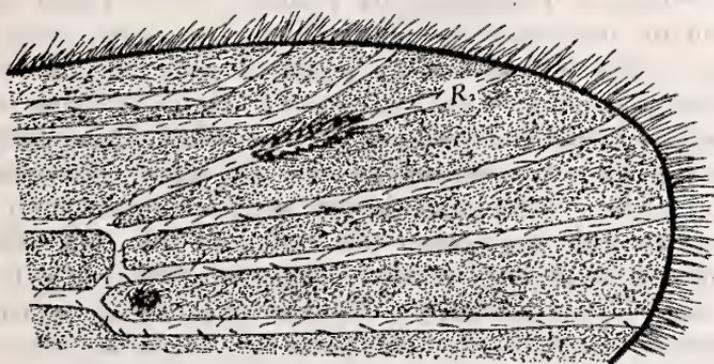


Fig. 8 Tip of wing of *Limnephilus indivisus* Walker (male) showing "beard" on  $R_2$  and the corneous spot in cell  $R_4$

and *Oligoptectrum*). It is lacking in the Rhyacophilidae, Hydroptilidae (in part), Molannidae, Odontoceridae, Leptoceridae, Lepidostomatinae and *Helicopsyche*.

The position of these points with reference to the veins (where the homology of these is unquestioned) is constant. To make their position a criterion of the homology of the veins in some cases where this is uncertain, as I have done (Betten 1913. See also p. 45) may be giving undue importance to an organ whose function is wholly

unknown, for it is still possible that the position of the corneous points is determined by factors which bear no relation whatever to the course of the veins. I have adopted this course, however, because it seemed to me to lead to no strained interpretations of the venation and because the conclusions thus arrived at are corroborated by other considerations (p. 45).

A pterostigma is well indicated in but few genera. It is best developed in *Chilostigma*, where it occupies the tips of cells *Sc* and *R*<sub>1</sub>.

The folding of the wings during repose results in the formation of definite furrows through the wings. Besides these there are furrows along which the wings fold during the upward stroke in flight. Some of the furrows doubtless serve both purposes. In the fore wing there are two furrows; the median furrow runs along *M* and the anal furrow generally along *Cu*<sub>2</sub>. In the hind wings furrows occur along the corresponding veins but there is considerable variation in their position. In addition there are a number of furrows in the expanded anal area. These may run parallel to the longitudinal veins or may cut across them. In general the effect of the furrows is to obliterate the parts of the veins which they cross.

<sup>7</sup> The wings of Trichoptera are probably always joined during flight but the mechanism for accomplishing this is not always the same and differs obviously in its degree of perfection. Reference has already been made to the localization of the small spines on the inner margin of the under side of the fore wing. These doubtless serve to hold on to the veins of the hind wing which are overlapped by the fore wing. Subcosta of the hind wing often seems to be well developed for this and perhaps the fusion of this vein with the costal margin, occurring in more than one group, is a further improvement of this mechanism. These small spines are particularly well developed on the fibula. This latter is a lobe at the base of the fore wing occurring in most caddis flies. In many forms it projects very definitely beyond the inner margin of the wing proper (text fig. 9a, b, c); in others (text fig. 9d) it is simply a small part of the rounded anal angle of the wing. In any case it is sharply folded against the under side of the wing in repose. While the fibula of Trichoptera is homologous with the jugum of the Lepidoptera, the organ can not be used in the same way in the two orders except that the Micropterygidae are like the Trichoptera in this as in many other characters. In the Lepidoptera the jugum is

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<sup>7</sup> Reference should be made to the papers anticipating the essentials of this paragraph in publication—Comstock 1918, Tillyard 1918a, Braun 1919, 1924.

long and slender and the hind wing is supposed to be held during flight between the overlapping fore wing and the jugum which extends beneath. In the Trichoptera the fibula is generally about half as broad as long and is broadly joined to the wing so that there is no possibility of its passing under the hind wing. Instead, it reaches over the latter for some distance so that the spines on the under surface can hold on to the bases of cubitus and the anal veins (text fig. 9e). The strong tendency of the fibula to fold under the

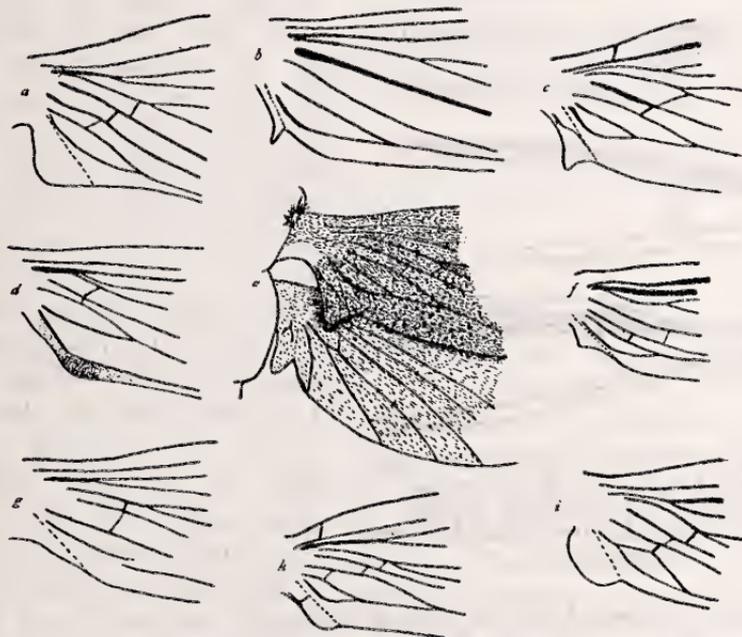


Fig. 9 Basal parts of fore wings showing the fibula variously developed. *a* *Lepidostoma* sp. *b* *Agraylea multipunctata* Curtis. *c* *Rhyacophila fuscula* Walker. *d* *Leptocella exquisita* Hagen. *e* *Rhyacophila* sp. *f* *Macronema fastosum* Walker. *g* *Psilotreta frontalis* Banks. *h* *Limnephilus tersus* n. sp. *i* *Oligophlebodes minuta* Banks

wing serves to keep it closely applied to the hind wing during flight. The costal margin of the hind wing is supplied with strong hairs which probably serve as holdfasts for the spines of the fore wing. This is the generalized condition. In practically all caddis flies these hairs are more strongly developed and more thickly set at the humeral angle. Sometimes there is found at this place a tuft of long fine hairs (text fig. 10a); in other species there is a definite group of a few very stout hairs (text fig. 10e). The wings overlap so that this frenulum is applied against the anal veins of the fore wing

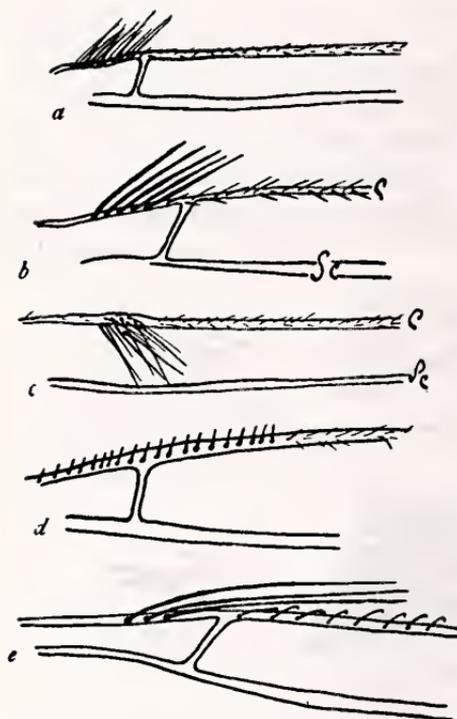


Fig. 10 Costal margins of hind wings showing frenula. *a* *Polycentropus* sp. *b* *Carborius punctatissimus* Walker. *c* *Chimarra* sp. *d* *Homophylax flavipennis* Banks. *e* *Neophylax* sp.

which are well adapted to receive the strain which such a connection of the wings would involve. In other forms there is a specialization of the hairs farther out on the wing margin. In the Leptoceridae these hairs are very stout and strongly curved (pl. 33, fig. 11). These hooks catch on to the compound anal vein of the fore wing, which is here fused with the hind margin of the wing for some distance. In some of the Hydroptychidae the hairs are almost as stout as those of the Leptoceridae, but are not so strongly curved. In *Hydropsyche*, *Hydropsychodes* (text fig. 11*b*) and *Potamyia*, there is a row of very stout blunt hairs on the under side of the compound anal vein of the fore wing, structures of which I have seen no notice in the literature. These hairs are curved backward, and possibly the front margin of the hind wing is held between them and the inner margin of the fore wing. In the Macronematinae, the hairs on the costal margin of the hind wing are very long and even more definitely hooked than those of the Leptoceridae and the hooks are themselves armed with small teeth (text fig. 11*c*, *d*). In this subfamily the hooks fit into a chitinous fold formed along the compound anal vein which is not drawn into the wing margin as is the case in the Leptoceridae. Of course when the wings are joined by a series of hooks the anal area of the fore wing does not overlap as far as is otherwise the case. In comparatively rare cases the humeral angle of the hind wing is strongly developed so as to project under the fore wing (text fig. 11*a*). In these cases there is a correspondingly small development of the fibula of the fore wing.

These various methods of uniting the wings in flight have doubtless resulted in modifying the course of the veins, as has been indicated above. The most striking adaptation is in the arrange-

ment of the crossveins and of parts of the longitudinal veins into a more or less complete transverse line to which the term, "line of anastomosis" had been applied, but which, following Needham's suggestive analogy to the bolt cord of a sail (N.Y. State Mus. Bul. 124, p. 222, 223) I shall designate as the "cord."

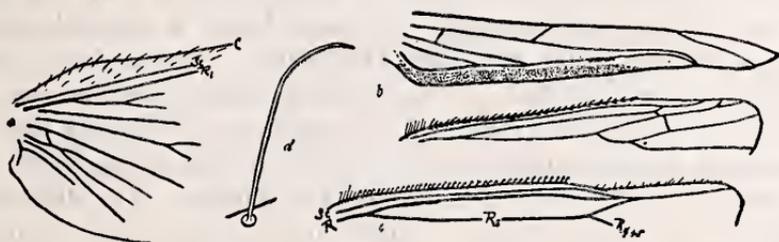


Fig. 11 a Hind wing of *Psilotreta frontalis* Banks with expanded humeral angle. b Wing-joining apparatus of *Hydropsyche* sp. c Same of *Macronema zebratum* Hagen. d One of the marginal hooks of *Macronema* enlarged

### Venation

The wing venation is worthy of particular attention because in this order as in so many others it has been used as the chief basis for systematic grouping, and rightly so, for the venation not infrequently gives the best and fullest indications of the phylogeny of a group. The wings of insects and the course of the venation have developed mainly in relation to the mechanical problem of flight and in contact with a constant medium—the atmosphere of the earth. It is reasonable to expect that under such circumstances the lines of specialization would not be so strongly divergent as in the case of those organs whose adaptations are toward various functions or in contact with various materials, as, for example, the mouthparts of adult insects.

The principles of phylogenetic study as applied to insect venation were clearly set forth in Comstock's essay on Evolution and Taxonomy<sup>8</sup> and were by him concretely illustrated in a genetic study of the venation of the Lepidoptera. Subsequently Comstock and Needham's work on The Wings of Insects<sup>9</sup> supplied a good basis for such study by establishing more completely, through the study of pupal tracheation, the homology of the veins in insect wings, by showing what the generalized type of insect venation is, and the methods by which the venation of the various groups has been

<sup>8</sup> Comstock, J. H. Wilder Quarter-Century Book, p. 37-113. 1893.

<sup>9</sup> Comstock, J. H. and Needham, J. G. American Naturalist, 32 (1898), p. 43-48, 81-89, 231-57, 335-424, 561-65, 769-77, 903-11; 33 (1899), p. 117-26, 573-82, 845-60.

derived. Comstock has more recently reviewed and extended his work in the field, the results appearing in his fine treatise—The Wings of Insects (1918). Upon the basis thus established by Comstock and Needham, the phylogeny of various groups of insects has been worked out in some detail. I confess that I have not been able to use the venation to any very large degree in establishing the lines of descent within the order Trichoptera. This is due in part, I think, to the fact that in this order of insects, the function of flight is not much exercised, and, in consequence, no strong type of venation is firmly established. Caddis flies are not strong fliers, but the males probably fly more than do the females. The difference between a moderate amount of flight and practically none probably results in far greater changes in venation than would result from a like increase in amount or difference in manner of flight, in insects which already had a highly developed type of venation. May we not on these grounds explain the large variation found in this order, where the difference in venation of male and female of the same species often exceeds the difference between members of different families? In all the families of Trichoptera one can readily recognize the primitive type of venation but this type is not fixed through

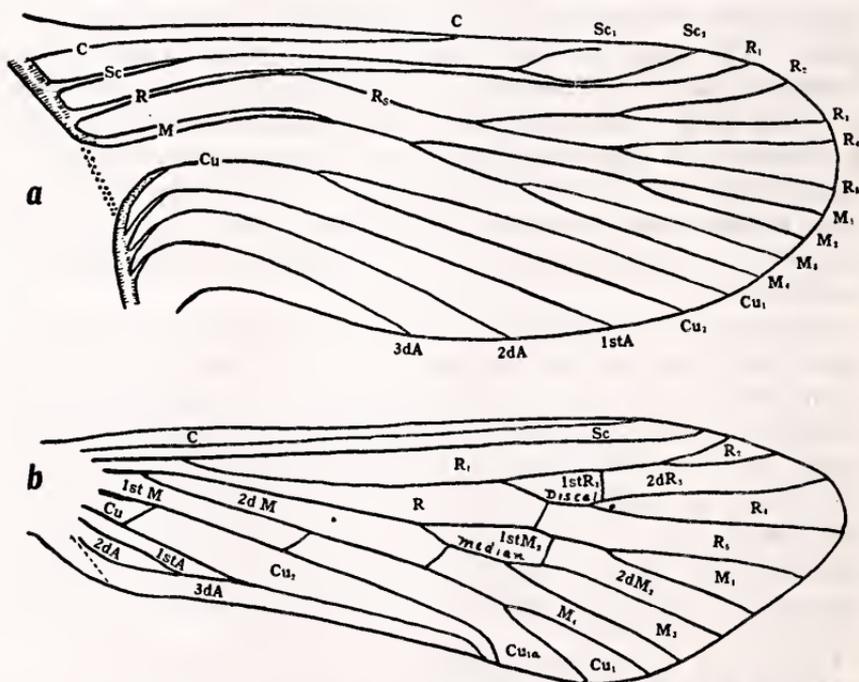


Fig. 12 *a* Hypothetical type of insect venation (after Comstock and Needham). *b* Venation of *Hydropsyche* sp. with cells labeled

use, and deviations from it are likely to be erratic. A further difficulty in interpretation lies in the fact that, as shown by Comstock and Needham (l. c.), the pupal tracheation in this order is much reduced and bears no relation to the adult venation.

The most primitive type of Trichopteroan venation is undoubtedly that exhibited by the genus *Rhyacophila*. That of the females of *Brachycentrus* is fully as generalized but the males of that genus show various specializations. To make the discussion clear, I have thought it worth while to place Comstock and Needham's figure of the typical insect venation in juxtaposition with that of *Rhyacophila* and with that of *Hydropsyche* (text figs. 12 and 13), labeling the

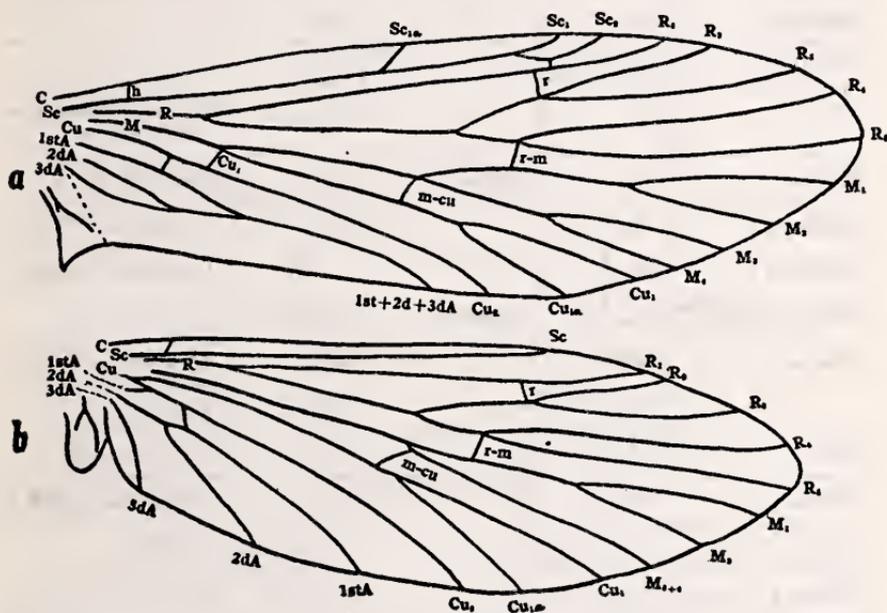


Fig. 13 Venation of *Rhyacophila* sp.

veins in the wing of *Rhyacophila* and the cells in that of *Hydropsyche*. According to the Comstock-Needham system, the typical branches of the main longitudinal veins are designated by subfigures ( $R_1, R_2$  etc.) and the accessory branches which may occur by added subletters ( $R_{1a}, R_{1b}$  etc.). The cells, or areas, of the wing are named after the veins or branches which are immediately anterior to them; thus the cells at the bases of the main stems are cells  $C, Sc, R$  etc.; the others  $R_1, R_2$  etc., as the figure shows. In case two veins have coalesced, the cell back of the compound vein retains the name of the more posterior vein (see cell  $M_4$  in the hind wing of *Hydropsyche*).

For the sake of easy comparison, there is here listed the Comstock-Needham notation together with that heretofore largely employed by students of the Trichoptera.

## NOMENCLATURE OF VEINS AND CELLS

Veins			Cells	
Comstock-Needham	Abbreviation	McLachlan and others	Comstock-Needham	McLachlan and others
Costa.....	C.....	Costa.....	C.....	Costal area
Subcosta.....	Sc.....	Subcosta.....	Sc.....	Subcostal area
Subcosta <sub>1</sub> .....	Sc <sub>1</sub> .....	.....	Sc <sub>1</sub> .....	
Subcosta <sub>2</sub> .....	Sc <sub>2</sub> .....	.....	Sc <sub>2</sub> .....	
Radius.....	R.....	.....	R.....	Subdiscoidal or subradial area
Radius <sub>1</sub> .....	R <sub>1</sub> .....	Radius.....	R <sub>1</sub> .....	Radial area
Radius <sub>2</sub> } Radius <sub>3</sub> } Radius <sub>4</sub> } Radius <sub>5</sub> }	R <sub>2</sub> } R <sub>3</sub> } R <sub>4</sub> } R <sub>5</sub> }	Sector.....	R <sub>2</sub> .....	1st apical or fork 1
			1st R <sub>3</sub> ...	Discoidal or discal
			2d R <sub>3</sub> ...	2d apical
			R <sub>4</sub> .....	3d apical or fork 2
			R <sub>5</sub> .....	4th apical
Media.....	M.....	.....	M <sup>9a</sup> .....	Thyridial cell
Media <sub>1</sub> .....	M <sub>1</sub> .....	Upper Cubitus	M <sub>1</sub> .....	5th apical or fork 3
Media <sub>2</sub> .....	M <sub>2</sub> .....		1st M <sub>2</sub> ...	Median
Media <sub>3</sub> .....	M <sub>3</sub> .....		2d M <sub>2</sub> ...	6th apical
Media <sub>4</sub> .....	M <sub>4</sub> .....		M <sub>3</sub> .....	7th apical or fork 4
			M <sub>4</sub> .....	8th apical
Cubitus.....	Cu.....		Cu.....	
Cubitus <sub>1</sub> .....	Cu <sub>1</sub> .....		Cu <sub>1</sub> .....	9th apical or fork 5
Cubitus <sub>1a</sub> .....	Cu <sub>1a</sub> .....		Cu <sub>1a</sub> ...	10th apical
Cubitus <sub>2</sub> .....	Cu <sub>2</sub> .....	Lower cubitus	Cu <sub>2</sub> .....	Anal area
1st Anal.....	1st A....	Postcosta....	1st A....	Basal cells
2d Anal.....	2d A....		2d A....	
3d Anal.....	3d A....		3d A....	Postcostal area

<sup>9a</sup> Strictly speaking there is a cell 1st *M* and a cell 2d *M*. These two cells are divided by *Cu* in a very puzzling way; reference to the discussion of the succeeding pages must here serve for explanation. Cell 1st *M* has sometimes been called the cubital area.

In the older notation the discal cell was said to be open when there was no crossvein to set off a cell 1st  $R_3$ ; the discal cell was said to be closed when such a vein was present. The terms "discoidal cell" and "median cell" are well established in the literature and have been used without confusion of homologies; I think they may therefore well be retained and I have made no attempt to use either these terms or their equivalents exclusively.

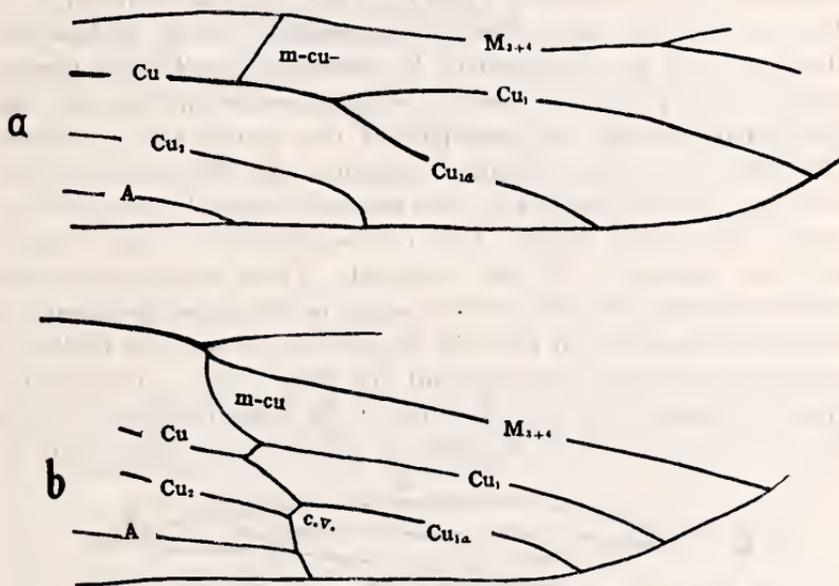


Fig 14 Tips of cubitus and the anal veins in fore wing of *a Nyctiophylax vestitus* Hagen. *b Phryganea vestita* Walker

A number of other terms in common use may be noted. Sometimes a distinction is made between apical and subapical cells, the first subapical being equivalent to cell  $M_1$ . At the first branching of  $M$ , there is frequently a semitransparent spot which has been called the thyridium; a similar bulla on the tips of the anal veins has sometimes been called the arculus.  $Cu_2$  and the anals of the hind wing have sometimes been designated the costulae.

In comparing the venation of *Rhyacophila* and that of *Hydropsyche* with the type, one realizes at once how generalized they are. There are, however, certain obvious differences; and there are also a few apparent resemblances that are very misleading. The latter, together with certain features of the venation that are common to the whole order, may be discussed before taking up the variations in venation that are found within the order.

In *Rhyacophila*,  $Sc$  of the fore wing often seems wholly typical, that is, it divides into two branches not far from its termination. Within this genus, however, there appears to be evidence that the anterior branch is probably an accessory. Reference to text figure 15 will make this clear. In *Rhyacophila fuscula* (text fig. 15a) it is apparent that the two branches of  $Sc$  are present and that there is in addition an anterior accessory branch.  $Sc_2$  is joined to  $R_1$  by a crossvein. In *R. obliterata* (text fig. 15b)  $Sc_2$  arches toward  $R_1$  so that the crossvein has well-nigh disappeared. In *R. septentrionis* (text fig. 15c) the distal part of  $Sc_2$  has disappeared either through fusion with  $R_1$  or as a result of atrophy *in situ*; in this case, one could easily mistake the basal part of this branch for a crossvein. The hind wing shows similar variations. In *Glossosoma boltoni* (text fig. 15e) the base of  $Sc_2$  has become atrophied while the distal part is still faintly shown; here one would likely assume that an accessory branch of  $R_1$  had occurred. These variations are not wholly constant even in the two wings of the same specimen. In perhaps the majority of cases  $Sc$  appears simple and it is labeled  $Sc$  except where there is evidence of the fate of  $Sc_2$ . The question might be raised as to why the first of the three branches of  $Sc$  of the fore wing should be regarded as the accessory rather than the

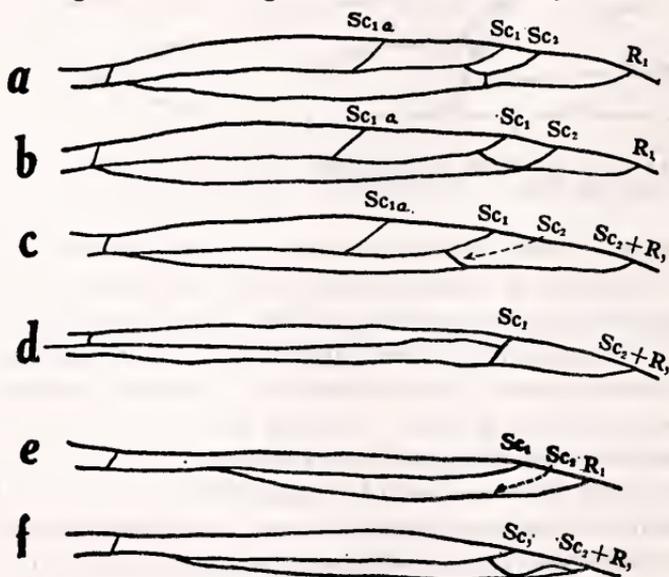


Fig. 15 a Subcosta and  $R_1$  in the fore wing of *Rhyacophila fuscula* Walker. b Same in *Rhyacophila obliterata* McL. c *Rhyacophila septentrionis* McL. d *Oligophlebodes minuta* Banks. e Same in hind wing of *Glossosoma boltoni* Curt. f *Rhyacophila* sp.

third. The reason is found in the fact that the anterior branch is never found in the hind wings, where the condition is otherwise similar, and because accessory branches from *Sc* to the costal margin are not unknown in other families of the order. In the Chinese genus *Perissoneura* and in two western American genera there are several such accessory branches (pls. 27 and 28).

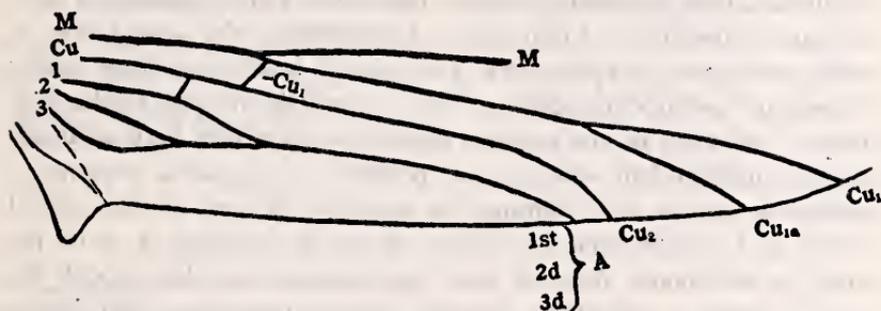


Fig. 16 Basal part of fore wing of *Rhyacophila* showing the relations of media, cubitus and the anals

Another general problem to be here considered is the interpretation of cubitus and the anal veins. In earlier figures (Comstock and Needham, Amer. Nat., 32, p. 257, Ulmer, 1907c, pl. 1) *Cu* is represented as branching near the wing margin. Because this interpretation leaves one to account for four anal veins in a region of the fore wing that is apparently subject to reduction of venation, I long ago (unpublished thesis in Cornell University Library, 1906) took the position that cubitus branches near the base of the wing, that its anterior branch arches into media, and that what Comstock and Needham and Ulmer called *Cu*<sub>2</sub> is an accessory branch. While the pupal tracheation can not be appealed to, I regarded the work of Comstock and Needham on the Sialidae as giving sufficient support for this view. My figure of *Rhyacophila* (1913, fig. 1) used this interpretation although the accompanying text is concerned with other questions. In 1917 I suggested to Professor Comstock that the Micropterygidae among Lepidoptera show absolutely the same relations of these veins, and that the pupal tracheation in these forms might solve the difficulty. Professor Comstock (see Wings of Insects, 1918) was able to confirm my interpretation of the arching of *Cu* into *M*, but he modified it by concluding that *Cu* and 1st *A* are fused at base, that it is *Cu*, not *Cu*<sub>1</sub> only, that bends into *M*, and that *Cu* branches near the wing margin instead of at base. Tillyard (1919) has championed the view I had taken, namely, that cubitus

branches near the wing base, and he maintains that this is true not only in the Micropterygidae but in other Lepidoptera as well. Forbes,<sup>10</sup> agreeing with Comstock's determination, remarks that the difficulty is one of nomenclature rather than of homology, that in early forms there is an independent vein between *Cu* and the veins of the anal fan, uniting with one or the other set in different groups of insects; that in holometabolous insects the vein is associated with cubitus; sometimes (Neuroptera, Trichoptera) the association is clear, sometimes (Lepidoptera, Diptera) it is inconspicuous either because of a secondary splitting back or through atrophy of the vein itself. Forbes is of the opinion that there may have been as many as three independent veins in this position. There is at present no conclusive reason for claiming the survivor as part of the cubital system as has been done by writers on the Neuroptera or as of the anals as commonly done in the Lepidoptera. In this report the former choice is adopted. Forbes' further contention that if the vein in question is considered as part of cubitus, it must then be called *Cu*<sub>3</sub>, is of course valid if the distal branch of *Cu* appeared before the basal fusion. Otherwise this distal branch may as well be regarded as an accessory to *Cu*, as was done by Comstock and Needham in the case of *Sialis* and its allies. Text figure 16 is labelled on this interpretation. *Cu*<sub>1</sub> is shown to turn sharply forward into media and again toward the wing margin so that its distal portion appears as a branch of media and its transverse part looks like a crossvein.

The base of *Cu*<sub>1</sub> as it leaves *Cu*<sub>2</sub> and crosses to media simulates a crossvein not only in appearance but in freedom of movement. In *Rhyacophila torva* Hagen (text fig. 17*a*) *Cu* has fused with media in a point, in *R. fuscula* (text fig. 17*b*) there is a slight migration and the transverse basal part is partly obliterated by the furrow which is found between *Cu*<sub>1</sub> and *Cu*<sub>2</sub> distally between *Cu* and *M* at base; in an Indian species (text fig. 17*c*) this transverse part of the vein has migrated a short distance basad from the original point of fusion; in *Philopotamus americanus* Banks (text fig. 17*d*) it has gone away from the base, and in the genus *Hydropsyche* (text fig. 12*b*) it is so far removed that one would not likely guess its true homology. This transverse part of the cubitus together with that part of its own stem along which it migrates is the posterior arculus. In general, the transverse part of cubitus goes back to its original

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<sup>10</sup> Forbes, William T. M. The Wing-Venation of the Coleoptera. *Annals Ent. Soc. America*, 15 (1922), p. 328-43, pls. 29-35.

position in those wings in which there has been established another more distal connection between  $Cu_{1a}$  and  $Cu_2$ . (c.v. of pl. 40, fig. 4). The relation of veins here described brings about the circumstance that in the Trichoptera cell  $M$  is divided into *1st M* and *2d M*.

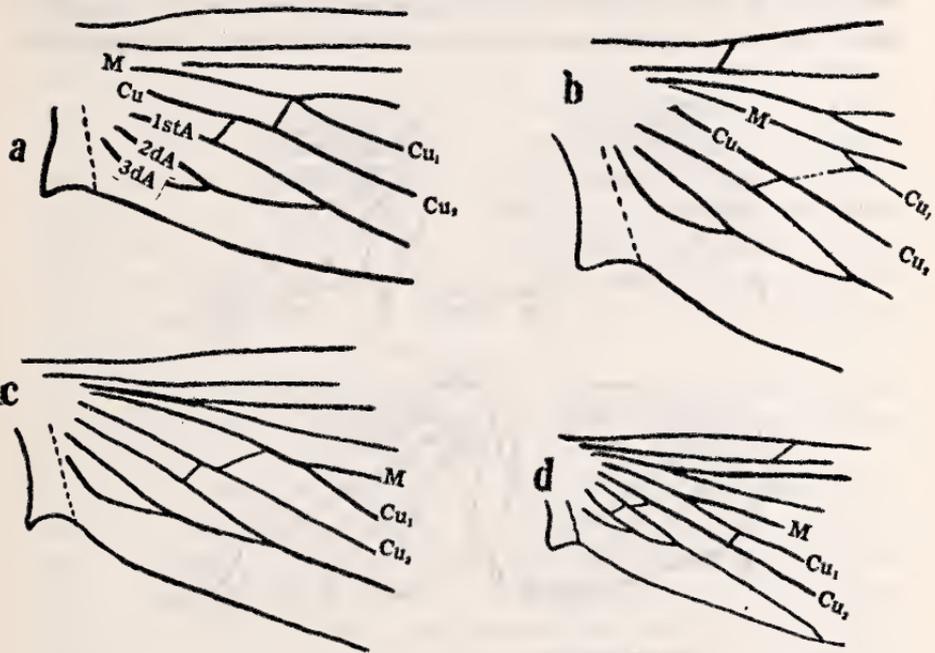


Fig. 17 Venation of the basal part of the fore wing of: *a Rhyacophila torva* Hagen. *b Rhyacophila fuscula* Walker. *c Rhyacophila*, undescribed Indian sp. *d Philopotamus americanus* Banks

In the hind wing, we meet the same problem with reference to cubitus and the anals. Here the difficulty of interpretation is increased somewhat by the fact that the branching of these veins is far toward the base of the wing and it is harder to follow their course. As in the case of the fore wing, Professor Comstock was able to confirm, from a study of the tracheae of the Micropterygidae, the interpretation I suggested to him for that family and for the Trichoptera, namely, that  $Cu$  branches near the base of the wing and that  $Cu_2$  has an accessory branch. The course of *1st A* is peculiar; its base is very faint and runs obliquely forward into  $Cu_2$  (text fig. 13*b*), after a short fusion it leaves this vein abruptly, and turns sharply once more and proceeds to the wing margin. *2d A* is more normal, and there is a crossvein from it to the last angle in *1st A*. *3d A* is simple. These relations may be followed in text figure 18*a* where the veins are diagrammatically differentiated.

In some of the more generalized forms such as *Rhyacophila* (text fig. 18*a*) there is at the base of the hind wing a small lobe in which there appears to be a branched vein. In the forms which have the anal area more developed (text fig. 18*c-e*) the incision setting off this lobe is lost and the vein is apparently incorporated into the wing; in the Limnephilidae the vein is three-branched. It is possible

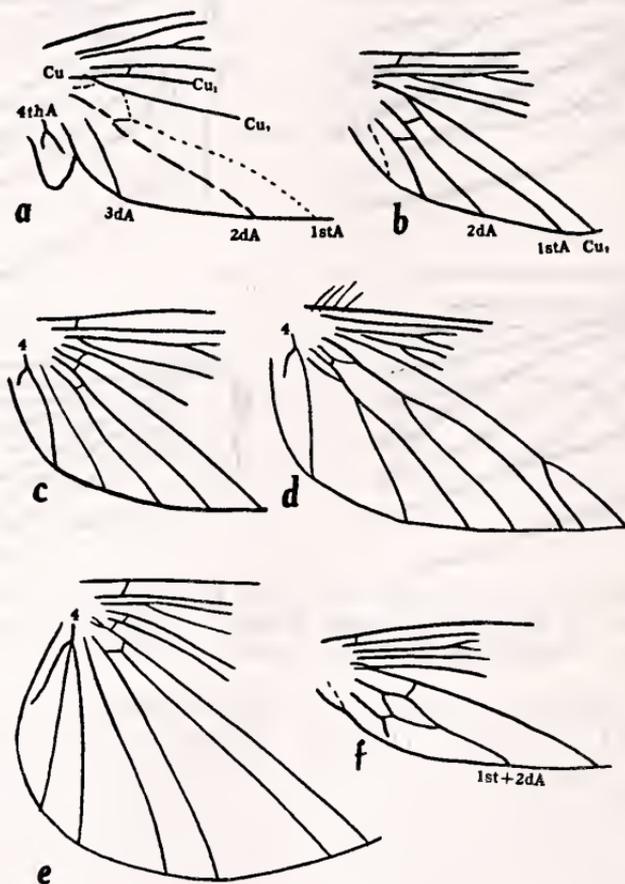


Fig. 18 Anal veins and anal lobes. *a* *Rhyacophila fuscula* Walker. *b* *Neureclipsis* sp. *c* *Brachycentrus fuliginosus* Walker. *d* *Goera* sp. *e* *Platyphylax subfasciatus* Say. *f* *Chimarra* sp.

that this vein is really a branch of the third anal but it is separate to the base of the wing, and, in the absence of further knowledge, it will be simplest to refer to it as *4th A*.

Comstock and Needham indicated several crossveins which may be regarded as fairly typical for all insect groups. As Needham

has shown,<sup>11</sup> they may not be strictly homologous and are "such merely as recur in like position in a large proportion of winged insects, and . . . it is convenient to designate them by the simple method that Professor Comstock devised." These crossveins (humeral, *h*, radial, *r*, radio-medial, *r-m*, medio-cubital, *m-cu*) occur in Trichoptera and there are in addition two others in the fore wing that are so common in this order that they deserve special names. One of these occurs between the two main branches of the radial sector, setting off the discal cell; this may be called the crossvein of the sector or the interrarial crossvein ( $r_3-r_4$ ). The other is between  $Cu_{1a}$  and  $Cu_2$  of the fore wing; it may be called the intercubital crossvein (text fig. 14*b*). This latter crossvein occurs almost universally in the more specialized families. There are other crossveins of frequent occurrence between the anal veins at the base but reference to them need not often be made.

There remain to be discussed the more striking variations in venation which are not common to the entire order. These may be taken up in order beginning with the anterior part of the fore wing.

Attention already has been called (p. 40) to the fact that the two branches of *Sc* rarely run free to the wing margin.  $Sc_2$  when present is often fused in part with  $R_1$ ; the tip may disappear so that the base of the free part looks like a crossvein from  $Sc_1$  to  $R_1$  (text fig. 15*c*), or the base may disappear so that the tip looks like a branch of  $R_1$  (text fig. 15*e*). In one subfamily of the Limnephilidae (Apataniinae) the former is the case and the tip of  $Sc_1$  and the base of  $Sc_2$  have diverged so strongly that they together appear as one straight vein from the costal margin to  $R_1$  (text fig. 15*d*). In very many cases *Sc* appears unbranched and there is no evidence whether this condition results from the fusion of its two branches or whether  $Sc_2$  has wholly disappeared after partial fusion with  $R_1$ .

Radius of the fore wing often appears with less than the five typical free branches. Reduction may take place through the fusion of the tips of  $R_1$  and  $R_2$ , as in many Calamoceratidae and Odonotoceridae (pl. 27, fig. 7); of  $R_2$  and  $R_3$  (pl. 25, fig. 2); or of  $R_1$ ,  $R_2$ , and  $R_3$  (pl. 29, fig. 15). Whether  $R_4$  and  $R_5$  are ever fused is a debatable question. It always has been considered to be the case in the Leptoceridae. It is in trying to come to some conclusion on this question that I have given considerable weight to the position of the corneous point (see p. 31). It has long been noted that this point is always in cell  $R_4$  when there is no doubt as to the identity of that

<sup>11</sup> Needham, J. G. Report of the Entomological Field Station, Old Forge, 1905. N. Y. State Mus. Bul. 124, p. 221. 1908.

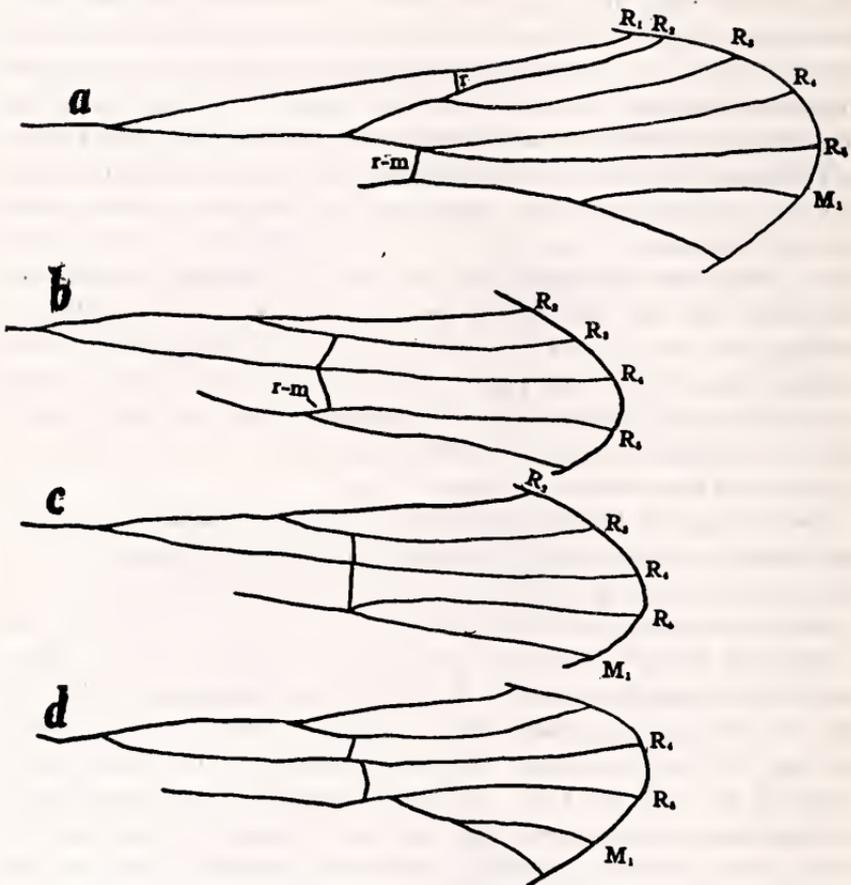


Fig. 19 Radius of the fore wing. *a* *Rhyacophila* sp. *b* *Helicopsyche borealis* Hagen. *c* *Helicopsyche minuscula* Mart. (after Martynov). *d* *Helicopsyche borealis* Hagen (after Ulmer)

cell. I have come to the conclusion that it always is in this cell, that is, that in the Leptoceridae, Molannidae and in *Helicopsyche* (the apparent exceptions),  $R_5$  is not fused with  $R_4$  as might be easily assumed, but has arched into the anterior branches of  $M$  and has partly or wholly fused with them.<sup>12</sup> In text figure 19*a* is represented the typical radius and its connections as seen in *Rhyacophila*; in *Helicopsyche* (*b*) the course of the veins is much the same but the crossvein  $r-m$  is oblique and is so placed that it is in line with the distal part of  $R_5$ , the result being that  $R_5$  appears to come from  $M$  and to be connected with  $R_4$  by a crossvein. In *Molannodes indubia*

<sup>12</sup> The interpretation here taken of the course of  $R$  has also been advocated by Martynov so far as it applies to the Helicopsychinae (1912*a*) and the Beraeinae (1913*a*). Martynov's later paper is in Russian and both were unknown to me at the time my paper on this subject was published (1913).

(fossil) the relations are much the same but the crossvein *r-m* is there much reduced and there is a further reduction by the fusion of  $R_2$  and  $R_3$ . *Molannodes zelleri* (Europe) is just the same except that the crossvein *r-m* is there obliterated (text fig. 20a). In *Molanna* (text fig. 20b) the fusion of  $R_5$  with  $M_1$  has gone further and  $R_{2+3}$ , already fused in *Molannodes*, has fused also with  $R_1$ . In *Leptocerus* (text fig. 21a), and the Leptoceridae in general, the fusion of  $R_5$  and  $M_{1+2}$  is total. The extreme in deceptive appearance is reached in *Oecetis* (text fig. 23a) where  $R_5$  and  $M_{1+2}$  are in a straight line with the base of *M*. Whether  $R_5$  is free at the tips in such forms as the females of *Leptocerus* is an open question (see below in the discussion of media).

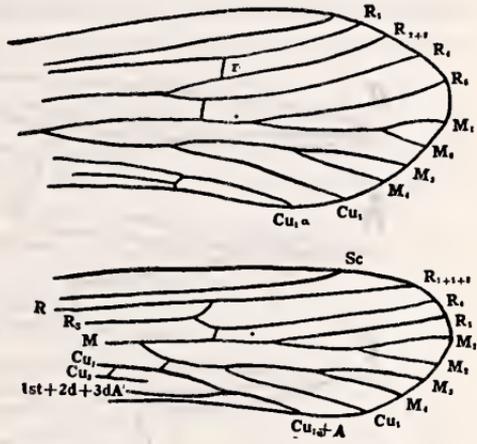


Fig. 20 Venation of fore wing. a *Molannodes zelleri* McL. b *Molanna cinerea* Hagen (female)

The Beraeinae present another series of modifications in the relations of branches of radius; these modifications are extreme and the interpretation here suggested is tentative because of scant material available for study. I have seen but few specimens of the family, and text figure 22 is made up from those of McLachlan (Rev. and Syn., pl. 52). In this figure subcosta and radius alone are shown; the latter vein is partly fused with media as in *Molannodes*, but to show this would confuse the figure. In *Beraeodes minuta*, male (text fig. 22a), every one of the typical branches is present;  $R_4$  has partly fused with  $R_3$  and  $R_2$ ;  $R_5$ , on the contrary, has split back rather far and has also fused partly with *M* (the latter feature is not included in the figure). In *Beraea articularis*, male

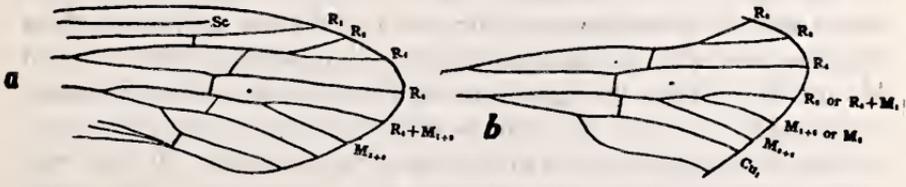


Fig. 21 Radius and media in fore wing of *Leptocerus*. a Male. b Female

(text fig. 22*b*),  $R_2$  has split from its old connection with  $R_3$  and has migrated upon  $R_1$ ;  $R_5$  has also retreated somewhat. In *Beraea maurus*, male (text fig. 22*c*),  $R_1$  has largely fused with  $Sc$ , and what one would surely take to be  $R_1$  had he not followed this series, is really  $R_2$ ; the base of  $R_5$  is again farther back. In *Beraea pullata* male (text fig. 22*d*), the base of  $R_5$  is near to the base of the wing; in respect to  $R_1$  and  $R_2$  there are two possibilities. The conditions here shown might be derived from (*b*), in which case  $R_1$  and  $R_2$  may have fused, or from (*c*) through the fusion of  $Sc$  and  $R_1$ .

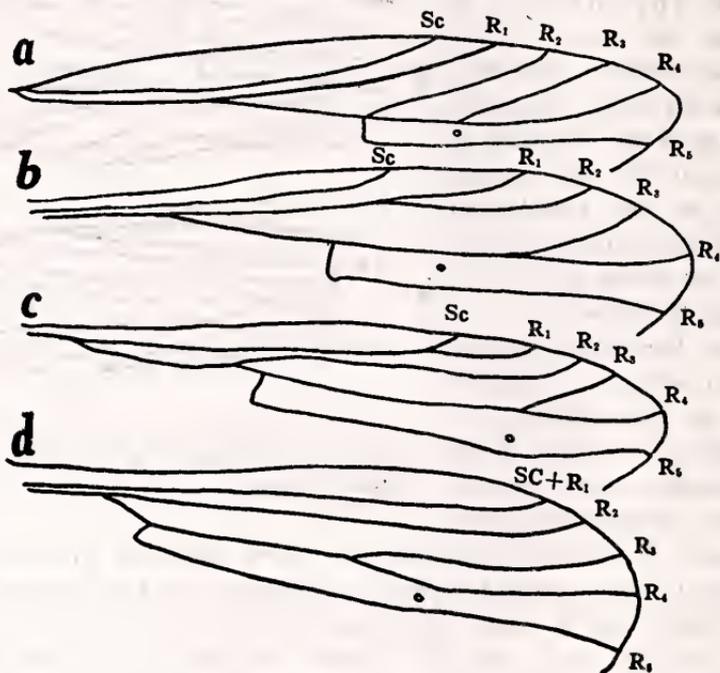


Fig. 22 Radius in the fore wing in *Beraeinae* (a possible interpretation). *a* *Bereodes minuta* Linn. (male). *b* *Beraea articularis* Pict. (male). *c* *Beraea maurus* Curt. (male). *d* *Beraea pullata* Curt. (male)

Media of the fore wing is generally reduced by the fusion of  $M_3$  and  $M_4$  (pl. 51, fig. 10); very frequently  $M_1$  and  $M_2$  are also fused (pl. 62, fig. 7). In the females of the Triplectidinae (exotic) and of the genus *Leptocerus* (text fig. 21*b*), there are apparently three branches in media, and in the males this is reduced by the fusion of  $M_1$  and  $M_2$ . While the figures are all labeled thus, another interpretation seems to me to be fully as likely to be true (text fig. 21*b*). As was shown above,  $R_5$  in this group arches upon  $M_1$ . It may very well be that the fusion of  $R_5$  with  $M_{1+2}$  is not complete in the females

and is complete in the males. It is simply a question as to which took place earlier in the evolutionary series—the fusion of  $R_5$  with  $M_1$  or the fusion of  $M_1$  and  $M_2$ —and on this I find no evidence. The identity of the additional cell, of course, varies according to the interpretation adopted. The condition of media in *Molanna* is most peculiar. In the females four branches are generally free, although  $M_1$  is fused for some distance with  $R_5$ , and  $M_{3+4}$  has fused with  $Cu_1$  after the same manner, but a little farther toward the base of the wing (text fig. 20*b*). In the males of this genus the fusion of  $R_5$  and  $M_1$  seems to be complete, while  $M_2$  has changed its basal connection from  $M_1$  to  $M_3$ . In the genus *Triaenodes* (pl. 39, fig. 7), there is no trace of the main stem of media and I find no hint of the manner of its disappearance. In the genus *Oecetis* (text fig. 23)  $M_{3+4}$  bends so sharply away from  $M_{1+2}$  that all the students of the

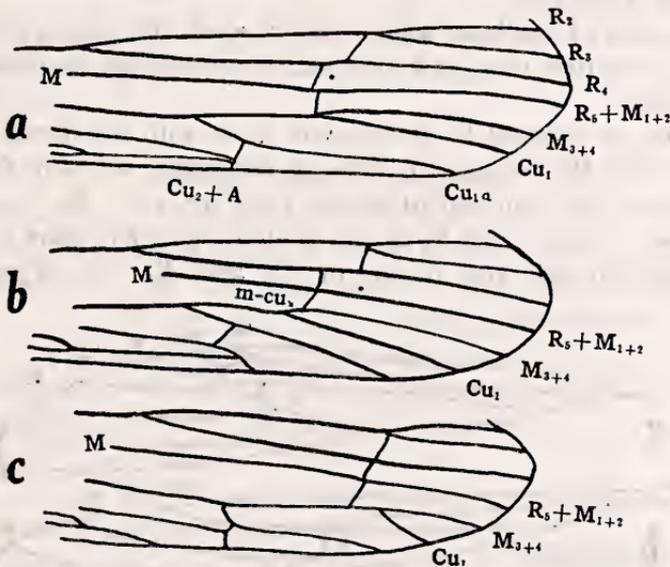


Fig. 23 Media in the fore wing of *Oecetis*. a *Oecetis resurgens* Walker. b *Oecetis incerta* Walker. c *Oecetis testacea* Curt. (after McLachlan)

group seem to have been led to the erroneous conclusion that it is lacking; thus McLachlan (Rev. and Syn., p. 329) and Ulmer (1907*c*, p. 143) agree in describing media as unbranched. It is clear, however, that this vein is present in this genus in practically normal relations. The position of the parts is subject to slight variation, but in general we find in *O. resurgens* (text fig. 23*b*) that  $M_{3+4}$  leaves  $R_5 + M_{1+2}$  at almost right angles; it then bends again at nearly a right angle and proceeds to the wing margin. At the latter angle it

is joined by the crossvein *m-cu*; this crossvein is in line with the distal end of  $M_{3+4}$  so that the resulting appearance is that of an extra branch on the anterior side of  $Cu_1$  joined to  $M$  by a crossvein. In *O. incerta* (text fig. 23a) the crossvein *m-cu* is very short, sometimes it is wholly lost. Finally, in such forms as *O. testacea* (text fig. 23c) the base of  $M_{3+4}$  has migrated backward on  $Cu_1$ ; in this position its true nature as a part of  $M_{3+4}$  is far from obvious.

The general relations of  $Cu$  already have been described. The fusion with  $M$  is practically the only source of confusion in its homology.  $Cu_2$  is sometimes atrophied at the tip as in *Molanna* (pl. 29, fig. 15) where this vein has disappeared back nearly as far as the base of cell  $Cu_1$ .

The anal veins of the fore wing present no difficulties. They are almost always fused distally, and there are generally crossveins in the cells at the base.

The veins of the hind wings present much the same problems as those of the fore wing and they need therefore not be discussed in great detail.

*Sc* may be reduced by fusion with  $R$  or with the dorsal margin. Some of the Rhyacophilidae show an interesting series in the modifications of this vein and of radius (text fig. 24). In *Catagapetus* (Europe) *Sc* has joined  $R_1$  at the tip (text fig. 24b); there is further reduction through the fusion of  $R_2$  and  $R_3$ . In *Synagapetus*

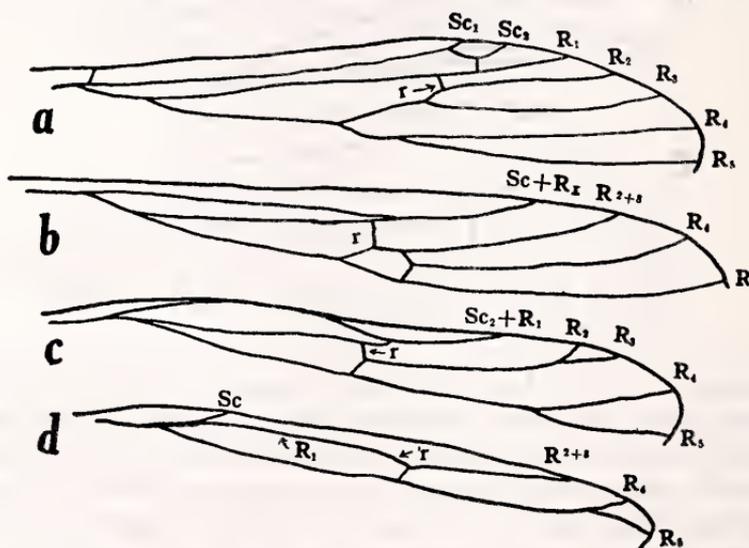


Fig. 24 *Sc* and  $R$  in *Rhyacophilinae*. a *Rhyacophila* sp. b *Catagapetus* (after McLachlan). c *Synagapetus* (after McLachlan). d *Agapetus* sp.

(exotic), although the condition is less specialized in that  $R_2$  and  $R_3$  are partly separate, there is a fusion of  $Sc$  with the costal margin (text fig. 24c). It is not wholly clear how the condition found in *Agapetus* (text fig. 24d) came about; the following interpretation, although it may seem rather fantastic, seems to me justified. We may derive the condition of these veins found in *Agapetus* from that of *Synagapetus* if we imagine the distal end of  $Sc$  to disappear through fusion with the costal margin—a process already begun in *Synagapetus*—and the part of  $R_1$  beyond the crossvein  $r$ , to disappear together with the tip of  $Sc$  with which it is fused. The only further modification necessary is a straightening of the angle where  $R_1$  and the crossvein  $r$  meet. Besides the ways already mentioned, radius may be reduced by the fusion of  $R_1$ ,  $R_2$  and  $R_3$  (pl. 27, fig. 7) or of  $R_5$  with  $M$  (pl. 34, fig. 1). With regard to the fusion of  $R_5$  with branches of  $M$  in the Leptoceridae the same interpretation is taken as in the case of the fore wings and for similar reasons. In *Neophylax* (pl. 56, fig. 1) some males have two branches of the radial sector separate back to the base.

#### *Abdomen and appendages*

The abdomen is of more or less spindle shape, the middle segments both thickest and longest. There are ten segments, of which the first seven (female) or eight (male) are of normal ring shape. The tergites of all except a few of the posterior segments are united to the sternites by membranous pleura which do not remain extended in dry specimens. There are commonly special ridges in the chitin which doubtless serve to preserve the shape of the body (text fig. 25). On the sterna there are often rather prominent transverse ridges which have been called false sutures; on these there may be projecting processes of various shapes. In certain forms there are flaps, aristate tubercles or slender filaments in a more lateral position, not in contact with the false sutures (text fig. 26); in some Hydroptychidae, Leptoceridae, Hydroptilidae and Polycentropidae there are structures which may be regarded as persisting tracheal gills

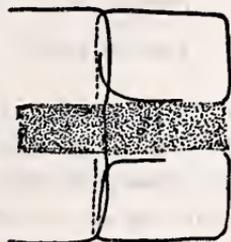


Fig. 25 Lateral view of abdominal segments of *Leptocella albida* Walker

(see Proc. Ent. Soc. Lon., 1879, p. 13, 14). In an undescribed species of *Phryganea*, specimens of which I have seen from Devil's Lake, North Dakota, there are groups of the latter structures along the margins of the first six segments. They are white in color and

so plump in form as certainly not to suggest degenerate organs. The eighth segment of the male is sometimes beset with short spines (pl. 49, figs. 9-11). On the dorsal side of a few segments in the males of certain species of *Oecetis*, there is a peculiar modification of the integument. This was noticed by McLachlan (Rev. and Syn., p. 330, 335-37), who describes these segments as "of a different texture to the rest of the abdomen, hardened, and under the microscope they are seen to be finely and closely punctured, the punctures arranged in rows." Ris (1904a, 1904b) has studied this structure with care

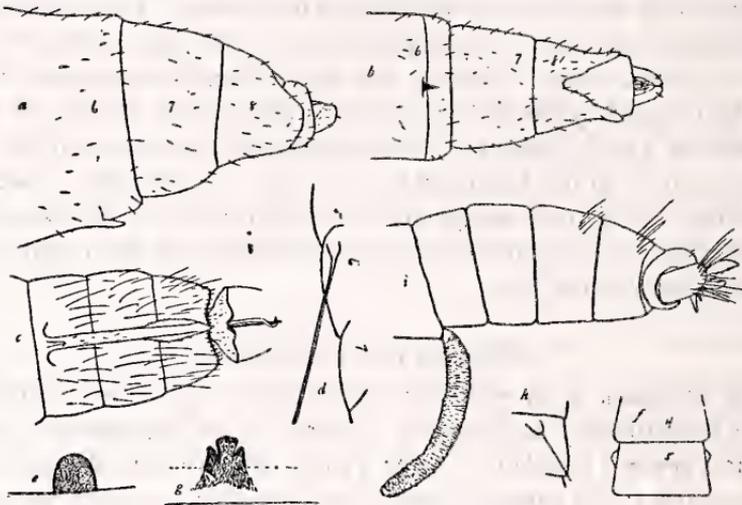


Fig. 26 Processes on abdominal segments of Trichoptera. a *Rhyacophila fuscula* Walker. b Same in ventral view. c *Hydroptila hamata* Morton. d *Smicridea divisa* Banks. e *Mystrophora americana* Banks. f *Rhyacophila lobata* n. sp. g *Neophylax consimilis* n. sp. h *Hydroptila hamata* Morton i *Allomyia tripunctata* Banks

and, while he finds it impossible to decide regarding its function, he thinks that it is most likely an organ of scent. McLachlan reported the presence of this organ in two European species of *Oecetis*; I find it also in two American species, *O. avara* and *O. resurgens*, and also in the genus *Helicopsyche*. In *Allomyia tripunctata* the males have a retractile appendage emerging between the fourth and fifth segments (text fig. 26i).

The sex organs have been studied by von Siebold (1848), by Stitz (1904, 1909), and by Cholodkovsky (1911, 1912, 1913a, b, c). The homologies of the external genitalia are discussed by Zander (1901), Klapálek (1903d), Crampton (1917, 1920a, b), and Eyre (1924). These appendages furnish the decisive characters in the

determination of most of the species and I have figured them for those that I have examined, but I have not made a study of the homology of the parts.

In the male the ninth segment is the first one to be modified in relation to the sex organs. It is heavily chitinized, generally beset with bristles, especially along the margins; it forms a complete body segment, the shape of which varies greatly. The tenth segment is, on the contrary, not a complete segment. It is dorsal in position, and may be variously divided, and bears no resemblance to a typical segment.

There are two pairs of appendages arising from the margin of the ninth segment; the dorsal pair (preanal appendages, superior appendages, socii, surgonopods) here referred to as anal appendages, and a ventral pair (harpes, gonopophyses, inferior appendages) here designated claspers. Between the tenth segment above, and the claspers and the ninth segment below, there emerges the penis, which is at base closely associated with the claspers. Authors have commonly referred to the family Limnephilidae as distinguished by the fact that the penis is retracted into a deep invagination. This contrast seems to me a little overstated for, as the figures will show, in species of several of the families, this structure can be considerably extruded.

The general features of the external genitalia are apparent in the figures here shown of a species of *Rhyacophila*. Here the tenth segment seen from the side (text fig. 27a) is slender, viewed from above (text fig. 27b) it is partly divided. There are no anal appendages. The parts are similar to this in *Macronema* sp. (text fig. 27d) but here the external margin of the tenth segment is thickened so as to give the appearance of a lateral appendage. In *Neuronia postica* (text fig. 27i) there are slender anal appendages inserted on the base of the tenth segment and the latter has itself a pair of ventral prongs. In *Dicosmoecus gilvipes* (text fig. 27m) the tenth segment is still more complex. It has a dorsal and a ventral part, the former divided in the median line as seen from above, and the latter divided into three parts, the middle one of which is more rounded than the others. The ventral division of the tenth segment are seen from the side (text fig. 27q) appears as a prolongation of the ninth segment. In *Anabolia* sp. (text fig. 27r), the tenth segment takes the form of two upturned prongs and the anal appendages are very broad. In *Leptocerus cancellatus* (text fig. 27g) the anal appendages are fused dorsally so as to have more of the appearance of a segment than has the tenth segment itself. A species of

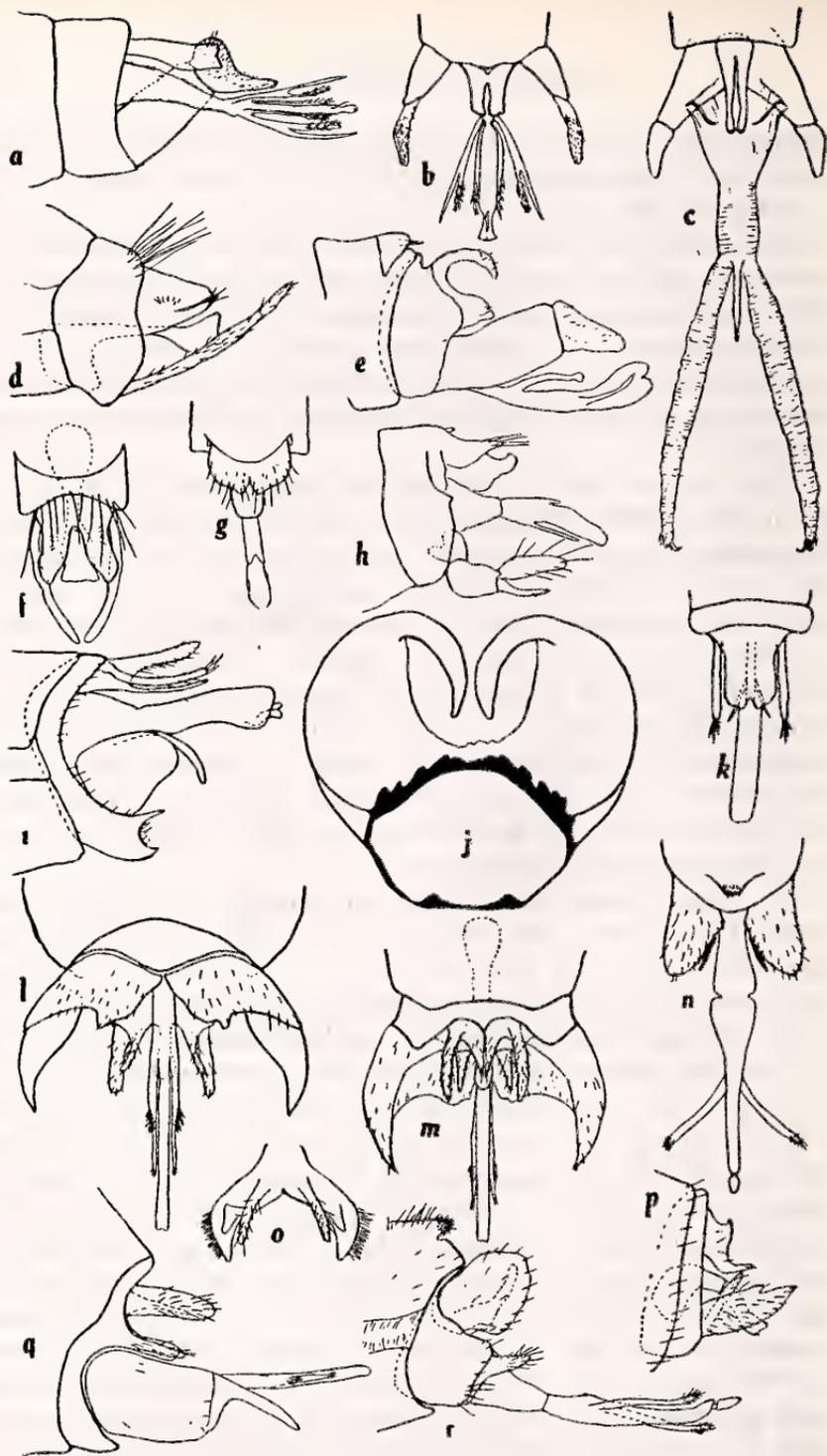


Fig. 27 Genitalia. *a* *Rhyacophila* sp., lateral view. *b* Same, dorsal view. *c* *Rhyacophila grandis* Banks. *d* *Macronema carolina* Banks. *e* *Rhyacophila* sp. *f* *Macronema carolina* Banks, dorsal view. *g* *Leptocerus cancellatus* n. sp., lateral view. *h* Same, lateral view. *i* *Neuronia postica* Walker, lateral view. *j* Same, ventral view of ninth segment. *k* Same, dorsal view. *l* *Dicosmoecus gilvipes* Hagen, ventral view. *m* Same, dorsal view. *n* *Anabolia* sp. *o* *Olemira costalis* Banks, dorsal view of claspers. *p* Same, side view. *q* *Dicosmoecus gilvipes* Hagen, lateral view. *r* *Anabolia* sp., lateral view

*Rhyacophila* (text fig. 27c) shows on the eighth segment structures like the anal appendages in the higher forms.

The claspers are generally readily recognized, although the shape varies a great deal. The tips are often divided (text fig. 27h) and there are sometimes slender appendages formed. In *Neuronia postica* (text fig. 27j) the ninth ventral segment is turned upward and inward between the claspers and is heavily chitinized.

The penis (text figs. 27, 28) is often retracted into a deep pouch; not infrequently it has slender appendages (titillators) at its base. The figures are drawn from specimens treated with caustic soda and the parts may, in some cases, be extended more than they ever are in life as the removal of the musculature allows them to be pulled out freely.

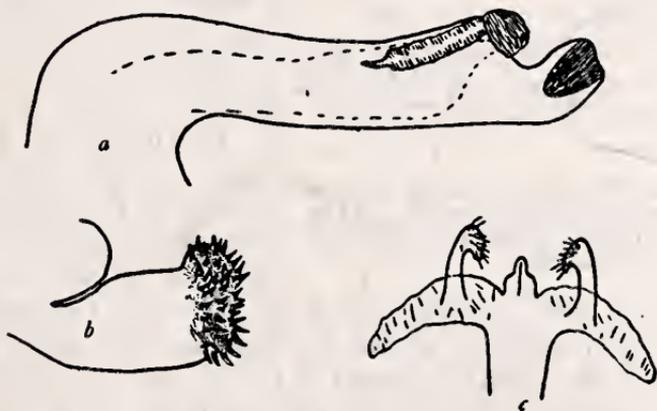


Fig. 28 a Penis of *Hydropsyche chlorotica* Hagen.  
b Tip of same expanded. c Same of *Drusus sparsus*  
Bks.

In the females the eighth segment may be more or less modified in form, having dorsal, lateral, or ventral incisions; part of its ventral side forms the subgenital plate. The ninth segment is often of normal shape or may bear a small subgenital plate ventrally. In some forms the rear segments of the body are retractile and form an ovipositor when extruded (text fig. 29). Cerci are present at least in some *Rhyacophilidae*.

#### *Sex differences*

In the foregoing account of the external anatomy of the adult Trichoptera, occasional reference has been made to differences between the sexes aside from those found in the genitalia. Ris (1904b) has made a list of these which, with some additions, may

be included here. The differences in size are not great; the female is larger in the majority of the forms but the reverse case is not infrequent. The males very often have a greater development of the antennae and the wings—organs used by the males in seeking

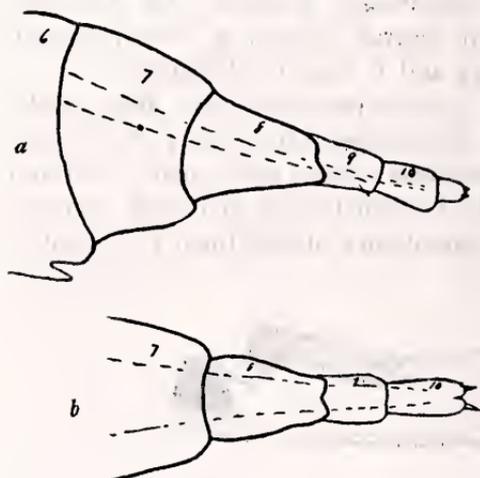


Fig. 29 Tip of abdomen of *Rhyacophila carolina* Banks (female). *a* Lateral. *b* Ventral. Segments 9 and 10 are ordinarily retracted.

their mates. In certain genera the females have rudimentary wings (*Psychoronia*, *Anomalopteryx*, *Enoicyla*); in very many genera the venation is greatly reduced in the males. Other striking differences are: unequal number of segments in the maxillary palpi (*Phryganeidae*, *Limnephilidae*, *Sericostomatidae*); unequal length of tarsal segments; unequal number of spurs; the presence in the males of abnormal spurs, larger eyes, scale grooves in the wings, exceptional development of scales on the head, antennae, and palpi, lobes on the head (*Hydroptila*) or on the wings (*Homophylax*), enlarged basal segments of the antennae, and the peculiar organ occurring in the dorsal integument of *Oecetis* and *Helicopsyche*. In several groups the females have the middle tarsi and tibiae very much enlarged and fitted with long hairs—an adaptation for going beneath the water for oviposition. A similar condition has been reported for some male Macronematinae. Gynandromorphism has been reported for at least two exotic species, *Limnephilus nigriceps* Zett. and *Brachycentrus subnubilus* Curt. Both records are by McLachlan (Proc. Ent. Soc. Lond., 1867, p. 99, and Ent. Mon. Mag., 7, p. 19).

#### The eggs

The eggs of Trichoptera are dealt with by Siltala in one of his thorough researches (1906*b*). I have availed myself of much of the material brought together by this author in the characterizations of the families and genera in the systematic part of this bulletin; much of it has also been incorporated into the account of the habits of the Trichoptera (p. 85).

Siltala distinguishes two types of egg-masses which are rather sharply differentiated. In the first of these, the eggs are laid in a mass of gelatinous material which swells when placed into the water, sometimes reaching several times the original size; an egg-mass of this type has a more or less definite shape, rarely flat. In a mass of the second type, the cementing substance is small in amount and does not swell in water; the mass is generally flat and the long axis of the eggs is parallel to the support on which they are laid. Such a mass, in contrast to one of the other type, does not change in form or color. The gelatinous egg-masses are characteristic of Leptoceridae, Molannidae, Phryganeidae, Limnephilidae and Sericostomatidae; in the lower families the other type regularly occurs.

Especially interesting are the egg-masses of the Phryganeidae and of the genus *Triaenodes*. The former are of the gelatinous type and the egg string commonly forms a complete circle (pl. 3, fig. 7). Those of *Triaenodes* are of the other type and the shape is that of a flat disk formed of egg strings spirally wound; more rarely the disk is slightly concave so that the mass can float.

The eggs themselves are elliptical or almost globular. Siltala gives the ordinary proportions of length to thickness as 1 or 1.5 to 1. In the Hydropsychidae the proportion may be 3.2 to 1. The ends of the eggs are rounded and alike; only in rare cases do we find eggs of a conical shape. Except in some Brazilian Hydropsychidae, described by Müller (1888a, p. 261), the chorion is thin, smooth, and transparent. In some cases, there is a slight coloration, generally reddish. The yolk is commonly green or yellow, or the color may change from green to yellow during development. Siltala cites as extremes in the observed number of eggs in a mass, 800 in a species of *Hydropsyche* and 15 in *Beraeodes minuta*.

### THE LARVAE OF TRICHOPTERA<sup>13</sup>

BY ALFRED WALTER ORCUTT

In the Trichoptera as in other orders of insects our knowledge of the immature stages has lagged far behind that of the adults, in this case in spite of the fact that the former perhaps exceed the latter in popular interest. During the years that have elapsed since McLachlan's great work (1874-84) placed the systematic study of

<sup>13</sup> Due to the long delay in the appearance of this report, two of those who furnished contributions to it have not lived to see their work published. The author of this section did this work as a graduate student in Lake Forest College. After completing his preparation he began his career as assistant professor of zoology in Denison University, but lived to complete only the work of one year, 1913-14.

the adults on a good footing, the study of the metamorphoses of the European forms has been done mainly by Klapálek, Morton, Thienemann, Siltala, Ulmer and Lestage. Extra-European forms, on the contrary, are still almost wholly unknown. Müller has described some South American species and Ulmer and Thienemann have added a number, and Hutton has done the same for New Zealand. In North America, aside from a few scattering notices, the descriptive work has been done by Vorhies, Lloyd and Sibley.

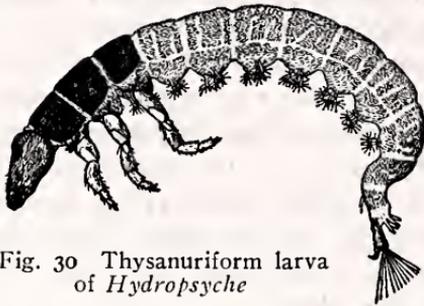


Fig. 30 Thysanuriform larva  
of *Hydropsyche*

The immature stages when studied will doubtless show the same phylogenetic divergences as the adults, but at present the work has not progressed far enough to admit of thorough classification even to genera. Separation of North American form to families has been made possible by Krafka's work.

The larvae of the Trichoptera may be distinguished as thysanuriform, eruciform or suberuciform. In the thysanuriform larvae (text fig. 30) the long axis of the head is in line with that of the body, the abdomen is somewhat flattened, the depressions between the segments are very deep, and the prolegs are often long. The larvae of the Rhyacophilidae, Hydroptilidae, Philopotamidae, Hydropsychidae, Polycentropidae, Calamoceratidae and Psychomyidae fall into this class. In eruciform larvae (text fig. 31) the head is more or less

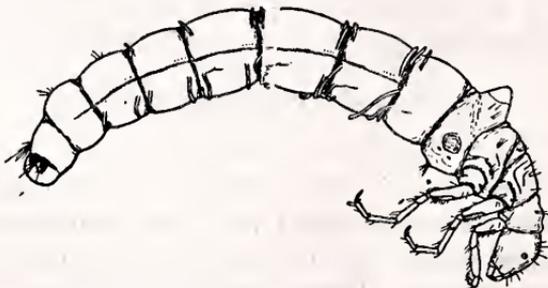


Fig. 31 Eruciform larva of *Arctoecia*

transverse to the long axis of the body, the abdomen is generally round and without deep constrictions between the segments, and the prolegs are short. To this group belong the Leptoceridae, Molannidae, Odontoceridae, Limnephilidae and Sericostomatidae.

The Phryganeidae are intermediate in this respect, and Klapálek (1888) has classed these larvae as suberuciform.

Siltala has rendered good service in beginning the work of describing all the stages of the larval life. Upon the basis of successive moultings, he distinguishes five stages exclusive of the full-grown stage and a short one which may in some cases be passed through within the egg. The first of these stages is the shortest one, varying from five to six days in *Agraylea* to two months, in an exceptional case, in *Neuronia clathrata*; the average time is about 15 days. In this stage the larva has a very simple form and shows the first indications of the hard parts which are smaller, more even in shape, and more alike in form, than in the adult larvae. In this stage there is upon the head a horny point which, in the opinion of Siltala, serves to open the egg so that the larvae may emerge. Patten (1884) describes

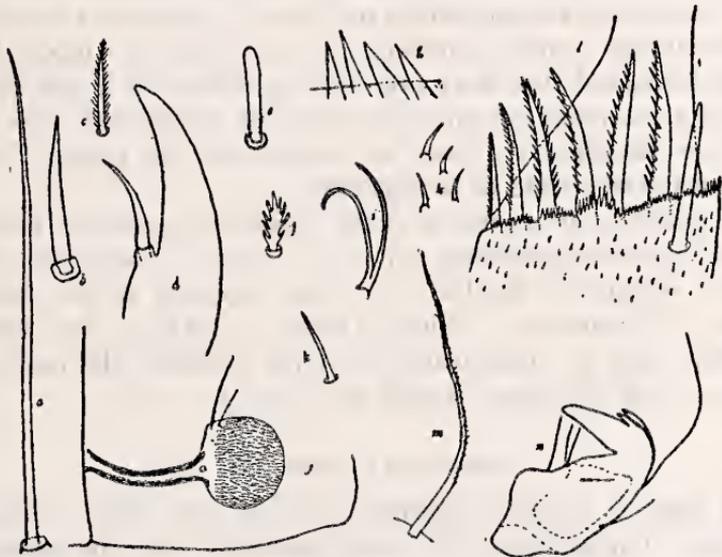


Fig. 32 Cuticular appendages of Trichopteroan larvae (referred to in Siltala's terminology). a *Börstchen* on femur of *Hydropsyche*. b *Sporn* on tibia of *Hydropsyche*. c *Fiederbörstchen* on anterior side of coxa of *Hydropsyche*. d Claw and basal *Sporn* on anterior leg of *Hydropsyche*. e *Spornchen* on mesothorax of *Hydropsyche*. f *Fiederspornchen* on posterior side of coxa of *Hydropsyche*. g *Dornchen* along anterior femur of a Phryganid. h Simple *Spitzen* on first abdominal segment of *Anabolia sororcula* (after Siltala). i Branched *Haardorn* on lateral tubercle of *Agrypnia pagetana* (after Siltala). j Chitinous shield on lateral tubercle of *Leptocella albida* covered with numerous *Börstchen*. k One of the *Börstchen* from j. l *Fiederdornen*, *Spitzenkämme*, and *Sporn* on distal end of tarsus of a Polycentropid. m *Haardorn* from anterior femur of *Notidobia ciliaris* L. (after Siltala). n Claw of the left proleg of *Neuronia* sp. with two *Dornen*

this as a rudiment of a simple eye and doubts its use as an egg-rupturing apparatus, holding that, at most, this is not its primary function, but is an adaptation from its primary function as a sense organ. The first molt subsequent to hatching brings about considerable change through growth and differentiation in the form of the parts; this second stage lasts from 10 to 20 days. The third and fourth stages are each from 10 to 25 days long. The fifth is ordinarily the final larval stage, and most larvae pass into this stage before winter, but others spend the winter in the fourth stage.

### *Cuticular appendages*

Siltala (1907c) has shown that the cuticular appendages are of particular importance in the description of the various stages of trichopterous larvae. This author has made a classification of the types of these appendages which may prove serviceable in rendering the descriptions more intelligible (see also Deisewitz, 1906), but it may be remarked that there are inherent difficulties in the attempt to apply a consistent terminology to a set of intergrading structures, and these difficulties are likely to increase with the range of forms to which the terms are to be applicable.

The primitive arrangement of the cuticular appendages found in the early postembryological stages is preserved unequally in the different regions of the body and also unequally in the different groups of Trichoptera. Siltala (1907c, p. 585-91) has made a searching study of these matters and has indicated the bearing of the facts upon phylogeny within the group (p. 110).

### *Head and appendages*

The head is usually cylindrical, longer than wide, somewhat depressed. On its surface are hairs and bristles, and in some cases (Limnephilidae, Hydropsychidae) it is rough with small chitinous points. The coloration of the head is often in a well-marked pattern but this is subject to some variation. In some species the chitin of the head is mostly clear so that one may see that the conspicuous colored spots correspond to the muscle attachments.

The sclerites of the head are four in number. On the upper side is the frons (often designated clypeus), on the sides the epicranium, and the hypostome or gula beneath. The frons is a large plate forming the roof of the head, of more or less triangular shape with the base of the triangle joining the labrum and the apex reaching one-half or three-fourths of the way to the back of the head. The

union with the labrum is by a flexible part not always visible. There is ordinarily an indentation in the middle of each side. In *Chimarrha* (text fig. 33g) and at least in some other Philopotamidae the sclerite is decidedly asymmetrical. There is, according to Ulmer, a more or less typical arrangement of thirteen bristles on this sclerite, somewhat as shown in text fig. 33b. Six are along each of the lateral margins and one is in the middle of the anterior margin. Of the six lateral bristles, three are in the anterior angles, one at the lateral constriction, one in the middle of the oral half, and one in the widest part of the aboral half. If more bristles are present they are commonly in close relation to these thirteen, or along the median line. In the forms studied, 15 is the more common number, there being four in the anterior angle on each side. The frons presents many variations in shape and in the arrangement of the bristles (text fig. 33); the sclerite is, however, the same in these respects in all stages.

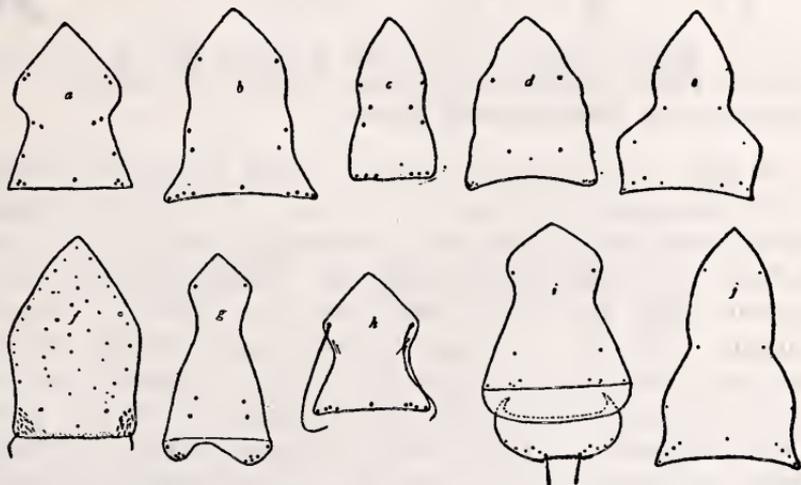


Fig. 33 Types of larval fronts. *a* *Rhyacophila* sp. *b* *Neuronia posticia* Walker. *c* *Leptocella albida* Walker. *d* *Macronema zebratum* Hagen. *e* *Anabolia bimaculata* Walker. *f* *Hydropsyche alternans* Walker. *g* *Chimarrha* sp., probably *aterrima* Hagen. *h* *Mystrophora* sp. *i* A *Polycentropid*. *j* A *Lepidostomatid*

The epicranium forms the side of the head. Dorsally, its halves meet in the posterior region, and anteriorly, they inclose the frons; on the ventral side they again meet in the median line except where they are separated by the gula. Posteriorly, the epicranium forms the margin of the head, and anteriorly, it serves for the attachments of the mandibles and of the maxillary cardines. As seen from the side, the epicranium is rectangular with the anterior angles rounded; in cross section it is semicircular. Sometimes the gula is so large that

the halves of the epicranium do not meet below (text fig. 34*d*). The number of bristles on each half varies from 20 to 26; of these there are nearly always from four to six at the bases of the mandibles and maxillae, the others in varying positions. In some cases (Hydropsychidae) the ventral side of the epicranium is strongly ribbed, the furrows running parallel to the anterior margin. Sometimes (Phryganeidae) there are many small depressions scattered over the surface. In eruciform larvae the length of the sclerite is great in proportion to the width and in cross section is sharply curved; in thysanuriform larvae the length and the width are about equal and the cross section is not so sharply curved.



Fig. 34 Types of gulae. *a* *Rhyacophila fuscula* Walker. *b* *Mystrophora americana* Banks. *c* *Hydropsyche alternans* Walker. *d* *Molanna* sp. *e* *A* Polycentropid. *f* *Neuronia postica* Walker

The gula, or hypostome, is found ventrally between the margins of the epicranium; sometimes it reaches to the occipital foramen, while in other cases it forms but a small anterior indentation between the halves of the epicranium (text fig. 34). Siltala (1907*c*, p. 554-57) maintains that the term "gula" has been used to designate structures which are not altogether homologous. He finds the simplest condition in the Hydropsychidae (s.l.); in these forms what has been called the gula is really the submentum. The same is true in the Hydroptilidae. In the other families this sclerite is extended farther back and is divided into two parts of which the posterior one only is the gula proper. I have not been able to find the suture designated by Siltala; that is, I find no suture between the two parts, although there is commonly a thickened ridge and a distinction in color.

It may be noted that in some forms there are ventral angles in the epicranium forming thick ridges not quite coincident with the margins of the sclerite. The flat area thus formed might be taken to be the gula but the latter may be only a small central part of it (text fig. 34*f*).

The eyes of trichopterous larvae are small, each appearing exteriorly as a group of very small pigment spots. They are each on a raised area surrounded by a clear space. Wesenberg-Lund

(1911c) finds a correlation between the position of the eyes and the feeding habits of the larvae; the more completely the animals are carnivorous the farther forward the eyes are placed (text fig. 35).

Siltala has shown that antennae are present in all the families of Trichoptera, best developed in earlier larval stages, and that two types of structure may be distinguished. In the first type, found in the Rhyacophilidae, Polycentropidae, Philopotamidae and Psychomyidae, there is a white raised portion of the epicranium which bears several sense rods and bristles, the number of these varying in the different groups. In the second type, found in the first stages of the other families, the basal elevated portion is higher and broader and on the distal end there is a long slender segment which normally bears one small bristle, and a short club-shaped sense rod. In the second and later stages of the larvae the antennae may be reduced or wholly lost.

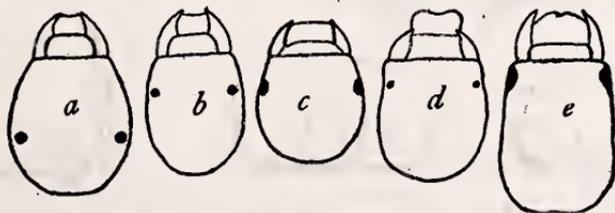


Fig. 35 (After Wesenberg-Lund) Illustrating the varying position of the larval eyes. *a* *Limnephilus* sp. *b* *Phryganea minor* Curtis. *c* *Molanna angustata* Curtis. *d* *Neureclipsis bimaculata* L. *e* *Rhyacophila nubila* Zett.

The larval mouth parts are mandibulate, with labrum, mandibles, maxillae and labium all well developed, the latter two fused at base. The labrum is joined to the frons by a connecting membrane which is sometimes conspicuous. The shape of this sclerite and the distribution of its bristles furnish good diagnostic characters. A number of examples are shown in text figure 36. As will be seen, the labrum is transversely elliptical, the anterior margin notched, the rear margin often with two hooklike processes; the upper surface has from three to seven bristles on each half, while along the anterior margin the hairs and long bristles are more numerous. In many cases there is a median bristle on the anterior half of the labrum and a small hook, or spinelike process, on either side of the notch. The under side of the labrum may also be more or less covered with hair.

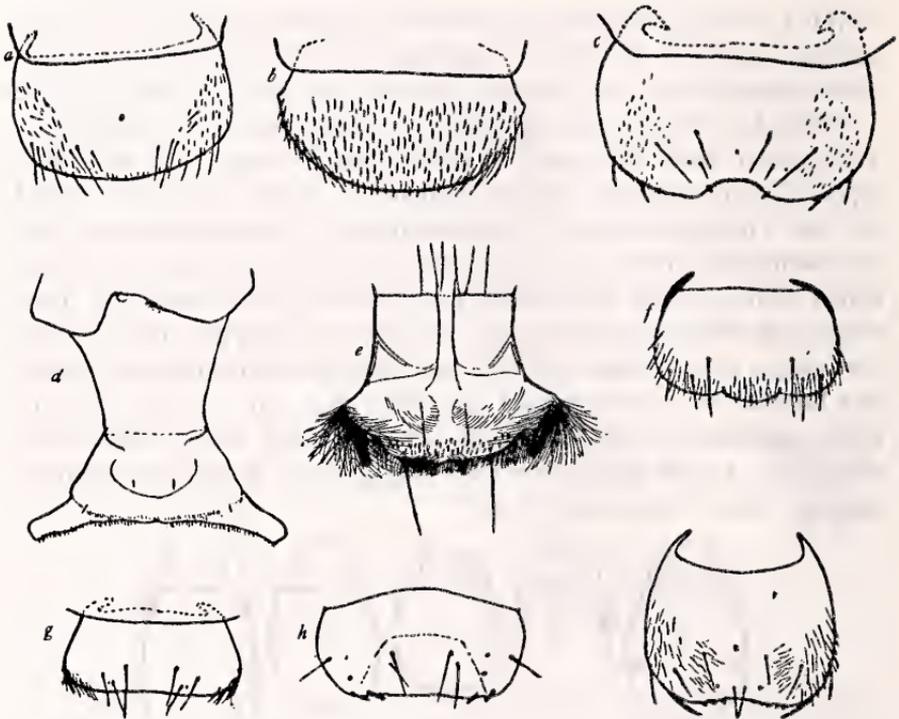


Fig. 36 Larval labra. *a* *Rhyacophila lobifera* n. sp. *b* *Hydropsyche alternans* Walker. *c* *Anabolia bimaculata* L. *d* *Chimarra* sp., (probably *ater-rima* Hagen). *e* *Macronema zebra-tum* Hagen. *f* *Helicopsyche borealis* Hagen. *g* A Lepidostomatini-d. *h* *Molanna* sp. *i* *Psilotreta frontalis* Banks

The mandibles (text fig. 37) are well developed, generally they are dark brown in color. In eruciform larvae the cutting edge is largely anterior and the mandibles may be described as chisellike. In the thysanuriform larvae, on the contrary, the cutting edge is largely internal, forming a blade. The mandibles usually have strong points or teeth on the cutting edge; in many cases the right and left mandibles differ in the number of these teeth. On the convex or outer surface of the mandible there are two stout bristles set close together; on the inner side there is often a bunch of smaller bristles.

The maxillae and the labium are united at base, the maxillae joining the epicranium, and the labium, lying between, being attached to the gula. Each maxilla is composed of a basal cardo, a stipes, an inner lobe and a palpus. The cardo and the stipes are easily recognizable, the homology of the other parts is often uncertain. Immediately beyond the stipes (*st*, text fig. 38*a*), there is a large transverse piece bearing medially an inner lobe, and exteriorly the palpus. The

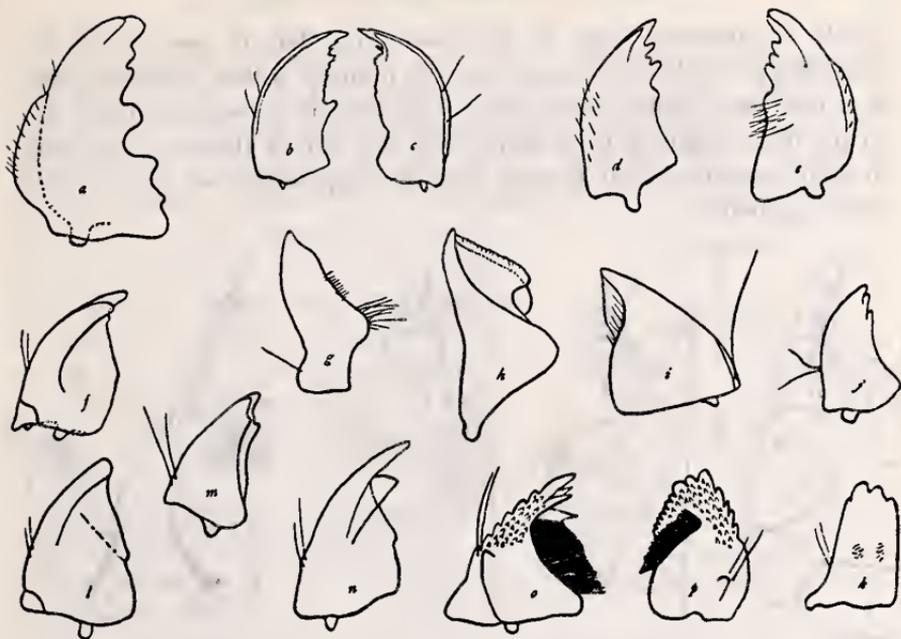


Fig. 37 Larval mandibles. *a* *Macronema zebratum* Hagen. *b* *Chimarra* sp. (left). *c* Same (right). *d* *Hydropsyche alternans* Walker (right). *e* same (left). *f* *Rhyacophila carolina* Banks. *g* *Helicopsyche borealis* Hagen. *h* *Agraylea multipunctata* Curtis. *i* *Mystrophora* sp. *j* *Leptocella albida* Walker (side view). *k* Same (inner view). *l* *Rhyacophila fuscata* Walker. *m* *Molanna cinerea*. *n* *Rhyacophila lobifera* n. sp. *o* Probably *Phylocentropus placidus* Banks. *p* Same

inner lobe may, perhaps, represent a fused galea and lacinia. It is sometimes apparently absent, its shape varies considerably, and not infrequently the transverse suture at the base separating it from the large transverse sclerite is not plainly indicated. The varying statements regarding the palpal segments are perhaps due to varying interpretations of the transverse sclerite next to the stipes. If this is regarded as the basal segment of the palpus then there are five segments (except in the Leptoceridae where the number is reduced by one) and this is the number given by the more recent authors. If the sclerite next to the stipes is the palpiger, then the palpal segments number four, except in the Leptoceridae.

The labium is composed of the submentum (fused cardines) at base, the mentum (fused stipites), the labial lobe and the palpi. The labial lobe is the short, conical, central tip representing, perhaps, the glossae and the paraglossae; it is sometimes retractile. The duct of the spinning glands opens at its distal end. Concerning the number of segments in the labial palpi there is a variety of statement.

Siltala is doubtless right in his contention that if one counts the dilatation at the base as a segment, the number is then normally two; in a few cases more, never less. This author shows that there are on the distal segment three sense rods and one of these is commonly so well developed that it may give the appearance of one or two extra segments.

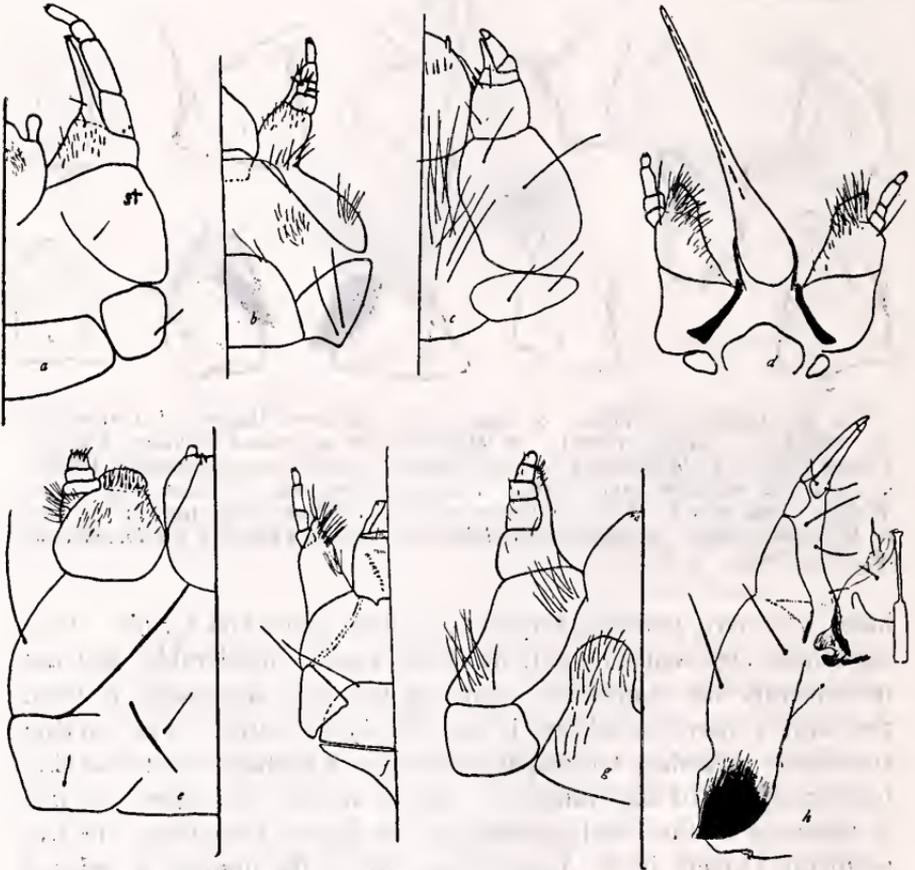


Fig. 38 Larval labia. *a* *Rhyacophila fuscula* Walker. *b* *Macronema zebratum* Hagen. *c* *Molanna cinerea* Hagen. *d* *Phylocentropus* sp. *e* *Mystrophora americana* Banks. *f* *Chimarra* sp. (probably *aterrima* Hagen). *g* *Hydropsyche alternans* Walker. *h* *Oecetis resurgens* Walker.

#### Thorax and appendages

The three segments of the thorax are very distinctly set off from each other, never fused. Each segment bears a pair of well-developed legs. In the thysanuriform larvae the segments are of about the same size, increasing a little in width toward the rear; in eruciform larvae the size differs more, the first segment being but about one-half as large as the second or the third.

The prothorax always has a chitinous sclerite on each side of the median line. On the ventral side of this segment there is in the larvae of Phryganeidae, Limnephilidae, Goerinae, and Lepidotomatinae a structure called the "horn" (text fig. 39). This is a small chitinous process, not always easy to see. The only reported exception to its appearance in the groups mentioned is in *Neophylax* and in that genus the structure is sometimes present. The prothorax is the only one of the three segments to be chitinized in the Rhyacophilidae, Philopotamidae, Polycentropidae, Phryganeidae, and in the genus *Tinodes* (Psychomyidae). The Hydroptilidae and Hydropsychidae have all three segments chitinized; in the remaining families the condition is various, sometimes highly distinctive. In the Goerinae the anterior margin of the prothorax is concave and the head may be drawn backward into the concavity (pl. 6I, fig. 7). A well-developed sternite is sometimes present (text fig. 40h).

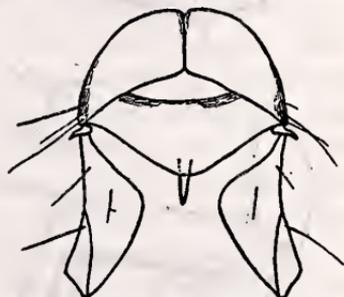


Fig. 39 The prosternal "horn" of *Neuronia postica* Walker

Each leg consists of five segments, or of six, if one counts, as do Ulmer and some other authors, the additional segment formed between the coxa and the body and bearing a chitinous plate (text fig. 40e). Ulmer describes the hind tibiae of Molanninae, *Mystacides* and *Anisocentropus* (?) sp. as divided. Siltala adds to this that in the Leptocerinae the trochanters and the middle and hind femora are divided. The larvae described in the present report indicate that all the trochanters are divided in all species; in some cases the second of its segments is relatively long (text fig. 40b) and, at least in *Mystacides*, and possibly in other Leptocerinae, there is a division into three segments. The middle and hind femora are divided not only in the Leptocerinae but also in some Odonoceridae (*Psilotreta*) and Calamoceratidae (*Ganonema*); in these forms the proximal segment is extended within the trochanter. The extreme of division is reached in *Mystacides*, where the middle legs have the trochanters and femora divided, while the hind legs have three segments in the trochanters, and two each in femora, tibiae and tarsi.

The first pair of legs is generally the stoutest and shortest. As indicated by Ulmer, this pair of legs is carried alongside of the head and is used not so much for locomotion as for holding prey and

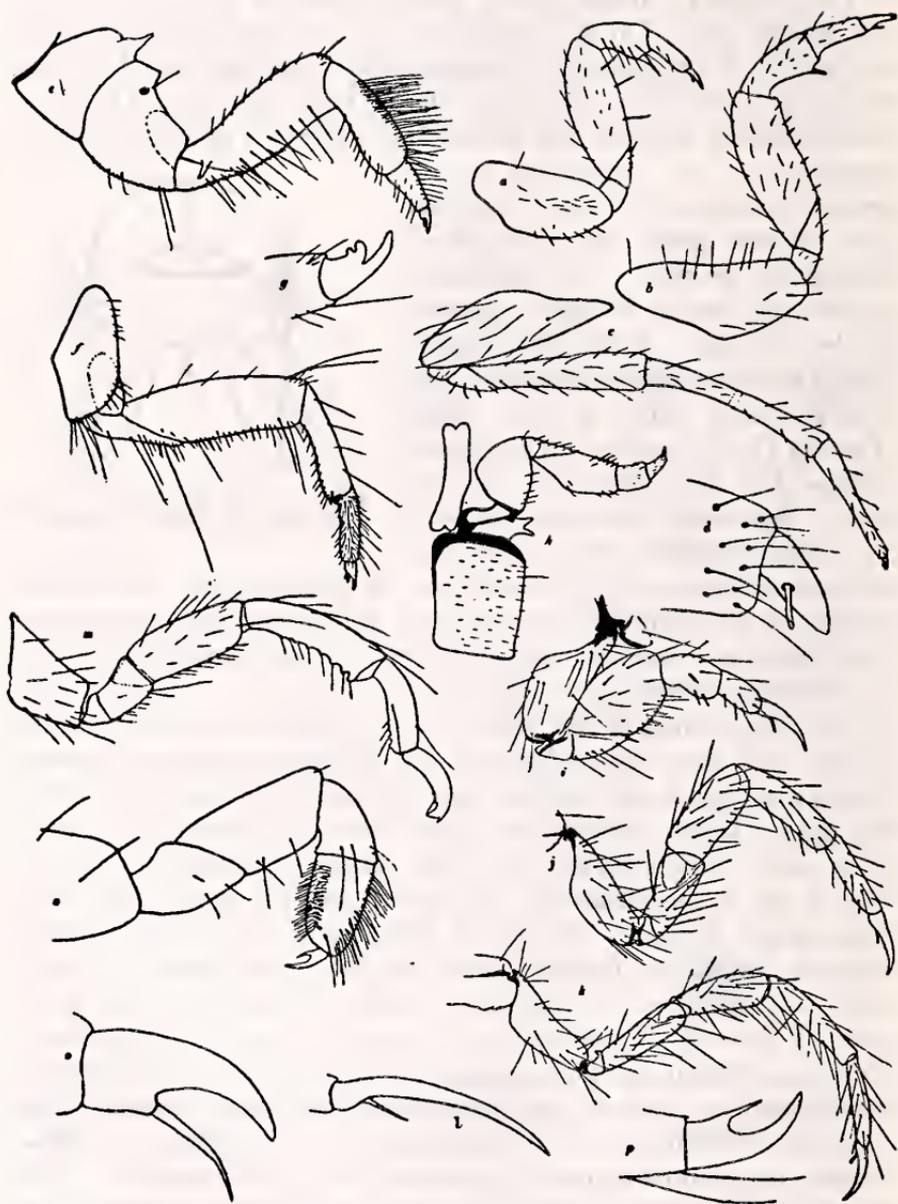


Fig. 40 Larval legs. *a, b, c* 1st, 2d and 3d legs of *Molanna cinerea* Hagen. *d* Claw of *c* enlarged. *e, f* 1st and 2d legs of *Macronema zebratum* Hagen. *g* Claw of *f* enlarged. *h* Left half of pronotum, fore leg and sternite of *Hydropsychodes analis* Banks. *i, j, k* 1st, 2d and 3d legs of *Oecetis resurgens* Walker. *l* Claw of *k*. *m* Middle leg of *Setodes grandis* Banks. *n* 2d leg of *Phylocentropus*. *o* Claw of *Neophylax consimilis* n. sp. *p* Claw of *Goera* sp.

for case-building. In most cases the legs are progressively longer, as in the Phryganeidae. In most Limnephilidae the second pair is hardly longer than the first and is shorter than the third; in the Goerinae and in most torrent-loving larvae the legs are of practically the same length. In the Leptoceridae and the Hydroptilidae (the latter with exceptions) occurs the greatest difference in the length of the legs; thus in the Leptoceridae the ratio of the lengths is often 1:2:3. In general the thysanuriform larvae have the three pairs of legs much alike; they are not much used in walking, the larvae generally creeping along silken threads. In these forms the fore tarsi generally have brushes which are used in taking food from the nets, in cleaning the nets, and sometimes in brushing together sand grains to be used in case building. In the eruciform larvae the legs are more diverse in structure, they may be inserted almost one above the other, and the hind pair is often so long as to extend from the case and to serve as an organ of feeling. The legs have strong claws, each of which commonly has a stout spur at its base (text fig. 40l,p). In the Macronematinae the spur may be divided (text fig. 40g) or there may be two spurs; in the Goerinae and in *Neophylax* (text fig. 40o) the spur is very long. In *Molanna* the spur of the claw of the hind leg is abnormal (text fig. 40d). For the stout spines or spurs of the legs Ulmer (1903c, p. 16) has suggested the use of a formula after the manner in common use for the adults; for example, he gives 2,2,2; 1,0,2; 1,0,2, as the formula for the Limnephilidae. This would mean that there are two spurs on the trochanter, two on the femur, and two on the tibia of the fore leg, etc. If the tibial spurs are far apart, as in *Phryganea*, it may be indicated thus: 1,2,1+1 (middle leg).

Lübber has shown that in certain species of *Plectrocnemia* and *Holocentropus* there are glands in the femora of the middle and hind legs; Lauterborn and Rimsky-Korsakow (1903) found the same condition in *Ithytrichia lamellaris*. These glands extend through the tibiae and tarsi and open at the distal ends of the tarsi; their function is unknown although Lübber suggests strongly that they are spinning glands.

In text figure 40 are illustrated various types of larval legs; the adaptations of some of these should prove an interesting study.

#### *Abdomen and appendages*

The abdomen of the larva is not heavily chitinized. Klapálek has described chitinous plates on the dorsal segments of *Stactobia*

*eatonella* (Europe) and Ulmer has called attention to the plates on the sternites in Limnephilidae.

There are either nine or ten body segments according to one's interpretation of what is apparently a tenth segment in some forms (p. 72); the constrictions between these segments are shallow in eruciform larvae, and deeper in the thysanuriform species. In the former the segments are, as a rule, cylindrical, and in the latter they are more often somewhat depressed. The eruciform larvae are of about equal diameter for most of their length, only the last one or two segments being narrower; Leptocerid and Sericostomatid larvae, however, are gradually narrowed. Thysanuriform larvae, on the contrary, are thickest in the middle, the Hydroptilidae markedly so.

The first abdominal segment differs from the others in being sometimes more heavily chitinized and in having, in most eruciform and suberuciform larvae, two or three tubercles of conspicuous size. When but two of these are present it is the dorsal one which is lacking. These tubercles are never smooth but always have fine chitinous points or bristles of some sort.

The lateral line is a fringe of hairs running from the third segment to the eighth; in some cases it does not begin before the fourth or fifth. This fringe is not found in thysanuriform larvae but is generally present in the other group. When most strongly developed it appears as a furrow or wrinkle bearing numerous long dark bristles. This structure is best shown in the Phryganeidae, and very well in the Limnephilidae; when present in the Sericostomatidae, Leptoceridae, Molannidae and Odontoceridae, it appears as a very fine line. Siltala and Ulmer have called attention to the fact that in some forms the lateral line is followed on the eighth segment by a narrow row of chitinous points from which hairs may arise (text fig. 4If).

Trichopterous larvae have a closed tracheal system, except in the case of *Enoicyla pusilla* (Europe) which is terrestrial in habit. Respiration takes place either directly through the body wall (sometimes localized, as in the subcoxal sacs of the Polycentropidae) or by means of tracheal or of blood gills. The tracheal gills are of several kinds (text fig. 4I). In *Ithytrichia* (text fig. 4Ie) they are slender, flat diverticula near the median lateral line of the third to the sixth segments. In other forms (*Hydropsyche*, Sericostomatidae) there are conical processes which Siltala found first appearing in the fifth larval stage. In the Sericostomatidae those on the anterior part of the segment are small and short, while those which

are postsegmental are triangular, sharp-pointed, and erect, being directed backward. The most common tracheal gills are of the filamentous type; these are found on the abdominal segments and sometimes on the meso- and metathorax. In some species the first abdominal segment has these gills even when the tubercles are present but this is generally not so. Tracheal gills commonly occur on the other segments except the ninth and the tenth, which have them

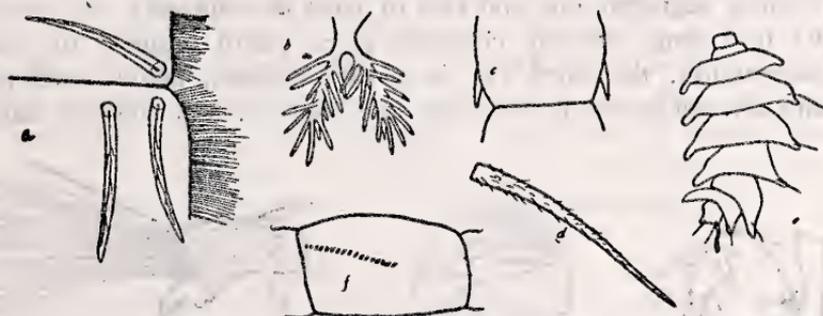


Fig. 41 Gills. *a* *Limnephilus* sp. *b* *Hydropsyche* sp. *c* *Hydropsyche alternans* Walker. *d* Hairy tracheal gill of a Phryganid. *e* Abdomen of *Ithytrichia* larva with respiratory processes (after Ulmer). *f* Eighth segment of *Setodes grandis* Banks

but rarely. Dorso-ventrally four rows may be counted, one dorsal, one ventral, one just above, and another just below the median lateral line. The gills may stand near either or both margins of the segments. In most cases they are simple but often (*Hydropsychidae*) they are branched (text fig. 41*b*). In some forms (*Phryganeidae*) the gills are covered with fine hairs (text fig. 41*d*).

Blood gills are of much less frequent occurrence and are limited to the anal region. These have been noticed and described by Palmén (1877), Müller (1888*b*), Klapálek (1888), Thienemann (1903), Siltala (1907*c*) and by Lübben (1907). Thienemann (l. c.) has shown that while there are true blood gills, there are also other anal gills which are tracheal (*Rhyacophilidae*). The number of the blood gills is generally three, four or six. In the *Rhyacophilidae* the number is six. Ordinarily the anal gills are above the prolegs (text fig. 42*c*) but in a species of *Brachycentrus* (pl. 59, figs. 2, 3) two processes apparently of this kind are ventral.

In all Trichoptera larvae the abdomen is terminated by two anal prolegs. These organs have been described as consisting of one, two or three segments. Siltala has more recently shown, however, that the parts described by various authors as first, second, and third segments are not at all homologous. While insisting that the question of the homology of these parts must wait for full solution on

embryological studies, Siltala makes a valuable contribution to the subject on the basis of his postembryological studies with reference especially to the arrangement of the bristles (1907c, p. 575-85); his conclusions may be briefly indicated here. Siltala takes the condition found in certain Polycentropidae as typical. Here there are nine segments in the abdomen. The prolegs consist of four segments each (text fig. 42e); of these the first (*a*) is distinctly divided (forming segments one and two of most descriptions), the second (*b*) is a long, strongly chitinous piece (third segment of most descriptions), the third (*c*) is a soft division, better developed ventrally, not generally described, and finally, a claw which is trans-

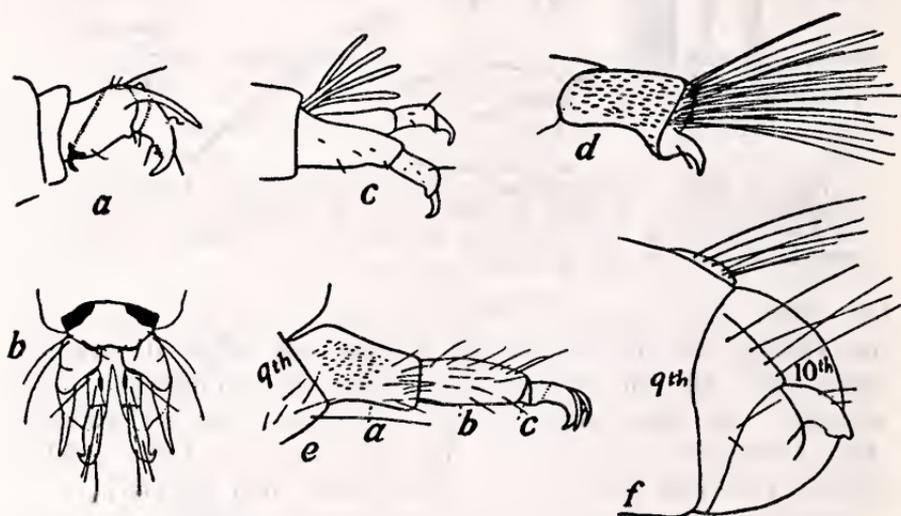


Fig. 42 Anal prolegs. *a* *Rhyacophila fuscula* Walker (side view). *b* Same (dorsal view). *c* *Chimarrha* sp. *d* *Hydropsyche* sp. *e* *Chimarrha* sp. (dorsal view). *f* A Limnephilid

versely divided and which has bristles on both divisions (*d* and *e*). The same condition holds in the Psychomyidae. In the Philopotamidae the relations are the same but here segment *b* has ordinarily been called the first and *c* the second. In the Hydropsychidae Siltala finds a similar condition in the early stages but it is later obscured by the presence of numerous bristles. Here there is also some change in that the basal segments (*a*) of the two prolegs have fused in part and the anal opening is on this newly formed segment; segment *c* is here chitimized both dorsally and ventrally. In the Rhyacophilidae the homologies are perhaps the same but the arrangement of the bristles throws doubt upon it, especially in the Glossosomatinae. In the Hydroptilidae the condition varies in dif-

ferent periods; in stages 1-3 the arrangement is like that described as typical with the exception that the basal segments (*a*) have coalesced so as to form a tenth segment. In the later stages the longitudinal division of the tenth segment remains less evident; on the ventral side there is a piece which corresponds to segments *b* and *c* of the prolegs and distally, there is a short hooklike claw composed of two segments (*d* and *e*) and bearing the usual number of bristles and pits. The case-bearing Trichoptera have a tenth abdominal segment composed of segment *b* (or *a* and *b*) of the prolegs; this segment bears the anal opening. On the ventral side there is a small chitinous plate (*c*) which bears a single bristle. To this plate there is attached a more strongly chitinized piece which is divided into two parts corresponding to segments *d* and *e*; these are the ones that are usually designated as the first and second segments.

#### *Larval nets and cases*

The case-bearing habit (see also. p. 110) is universal among Trichoptera though the period during which a case is inhabited varies. In the lowest family (Rhyacophilidae) there is in some species no case until near the time for pupation; in the Hydroptilidae the case is not made until relatively late. The Polycentropidae have no cases but live in nets, as has been well described by Wesenberg-Lund (1911*b*); these nets may be large, trumpet-shaped structures or they may be sacks shaped like a swallow's nest. Some species of Polycentropidae have passageways rather strongly built. The Philopotamidae also live in loose silken passageways, sometimes at least, in definite sack-shaped nets. The nets and cases of the Hydropsychidae have received considerable attention. They were first described by F. Müller (1881), by Clarke (1883), and by Howard (1886); Ussing (1909) and Esben-Petersen (1908*a*) have noted European species, and Alm (1914) and Wesenberg-Lund (1911*b*) have given the subject more detailed attention. The last two authors indicate that *Hydropsyche* has a larval case made mostly of vegetable matter and placed obliquely with reference to the direction of the flow of the water; in front of the case there is a vestibule in one side of which there is a strongly built net whose stout double threads cross, at least in the middle of the net, more or less at right angles.

Howard's description of the nets of American species has been often referred to by those to whom it was inaccessible; it is here quoted:

In the month of August on the larger stones in parts of Rock creek, District of Columbia, where the current was swiftest, and

particularly on such rocks as were tilted so as to bring a portion of the surface close to the surface of the water, were observed hundreds of peculiar funnel-shaped larval cases or webs of a species of this interesting Trichopterous genus (*Hydropsyche*). The case varied greatly in size. The mouth of the funnel in some instances was not more than 3 mm in diameter and in others reached fully 10 mm. The tube of the funnel was in every case bent nearly at right angles with the mouth and the larva, ensconced within it, waited for its prey to be caught in the broadened mouth. It was noticed that the cases were preferably placed at the edge of slight depressions in the rocky surface, so that the tubular portion was protected from the full force of the current. The broad funnel-shaped extension was woven in wide meshes with exceedingly strong silk, and was supported at the sides and top by bits of twigs and small portions of the stems of water plants. The central portion was so open as to allow the water to pass through readily. The tube was strong and tight and was covered with bits of leaves and twigs. It was open at either end. On the surface of a rock about 18 inches in diameter 166 of these nets were counted. At this portion of the stream the larvae of a *Simulium* (probably *S. venustum* Say) were very abundant. They occurred chiefly on the small water plants which grow in these rapid places, and were found in considerable numbers on the surface of the rocks on which the cases of *Hydropsyche* occurred. They must have been washed into the mouths of these nets in great numbers and probably furnished the principal food of the carnivorous larvae. The *Hydropsyche* larvae were very active and difficult to capture, unless the stones were removed entirely from the water. Placed in standing water they fought vigorously with each other and after a lapse of twenty-four hours did not seem appreciably affected by the want of fresh water. (Report of U. S. Entomologist, 1886, p. 510.)

It may be added that sometimes there are no supports of leaves or stems, the nets being held by lines of silk running obliquely downward and forward to the rock.

Alice A. Noyes has more recently described and figured the nets of *Hydropsychidae*, *Philopotamidae* and *Polycentropidae* found in Cascadilla creek, Ithaca, N. Y. This author indicates that the *Hydropsyche* case may enter the net from either the left or the right or it may extend back from the net in a straight line. Her most interesting contributions are descriptions of the nets of *Chimarra* and of two *Polycentropidae*. Her description of the net of *Chimarra* is largely quoted in the account of that genus (p. 172).

The larvae of the *Hydroptilidae* have cases made of silk, sometimes with algal threads included and often covered with very fine sand. In the *Glossosomatinae* the cases are dome-shaped with a flat

floor which leaves an opening at either end. The cases of the higher forms (the so-called case-bearers) are to be derived from such structures as the pupal cases of the Hydropsychidae in which the primitive cocoon, such as appears among the Rhyacophilidae, has been dispensed with.

The very numerous variations in the structure of the larval cases have often been described and figured (Klapálek 1888, 1893; Struck 1899; 1900; Siltala 1904*b*; Rudow 1897). Siltala has given a full account of the cases during different larval stages. Ulmer's table of types of cases, (1903*d*, p. 27), modified from that of Struck, is here added. It does not include the cases of the Rhyacophilidae and Hydropsychidae (s.l.) which have just been mentioned.

## TABLE OF CASE TYPES

<i>A</i> Cases made of silk only	
1 Tube-shaped .....	Type 8
2 Of flatter form.....	Type 10
<i>B</i> Cases of mineral matter or shells	
1 Straight or curved, cylindrical or conical, often depressed tubes of sand grains or small stones.....	Type 1
2 Similar tubes but with stones at the sides.....	Type 1a
3 Similar tubes with the lateral and anterior margins broadened by the addition of sand grains, forming a flat shieldlike structure .....	Type 1b
4 Straight or slightly curved tubes of shells.....	Type 1c
5 Sand tubes closely wound like a snail shell.....	Type 9
<i>C</i> Cases of vegetable matter	
1 Straight or curved tubes with the vegetable matter placed lengthwise	
<i>a</i> Without ballasts at the sides.....	Type 2
<i>b</i> With ballasts at the sides.....	Type 2a
<i>c</i> Similar to ( <i>a</i> ) but with dorsal and ventral parts extended considerably beyond the sides.....	Type 2b
2 Tubes of vegetable matter placed transversely.....	Type 3
3 Tubes of vegetable matter (pieces of leaves) placed at right angles to the long axis of the case.....	Type 4
4 Cases which are square in cross section.....	Type 5
5 Cases which are triangular in cross section.....	Type 6
6 Cases made of pieces of vegetable material of about equal size and shape placed so as to form a spiral.....	Type 7

Cases of most of these various types are shown in plates I-4. In many cases the rear end has a closing membrane after the manner of those commonly found in the pupal cases.

## PUPAE

The pupae of Trichoptera distinctly resemble the adults. The head is broader than long, the antennae and the mouth parts (except the mandibles) are much like those of the adults, the wings are formed, the head, thorax and abdomen are in the same relations as

in the last stage, the legs are free, and the insect is more or less active throughout the whole period.

### Head and appendages

Attention need here be directed only to the antennae and the mouth parts. The former are like those of the adult except of course in chitinization and coloration. They are held backward, often following the wing pads posteriorly and ventrally; in forms with very long antennae the ends may be wrapped around the end of the abdomen and the anal processes. The mouth parts differ from those of the adults chiefly in that the mandibles are strongly developed and that in many cases these and the labrum are directed upward.

The labrum generally has a distinct thickening at the base. Its shape varies greatly; it is generally broader behind than in front but the reverse may also be true. The anterior margin may be produced in the middle (text fig. 43a) or there may be several incisions and convexities (text fig. 43b). The bristles on the labrum are often striking in appearance; their length and arrangement is characteristic in several groups; for their function see page 103.

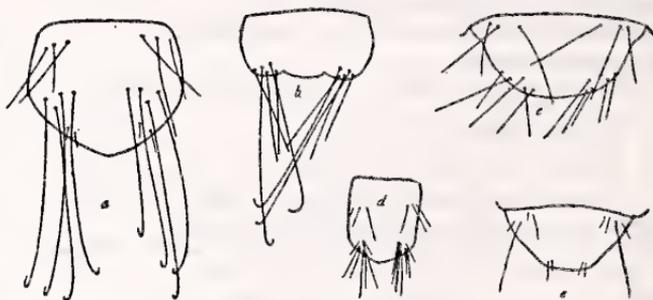


Fig. 43 Pupal labra. *a* *Platycentropus maculipennis* Kol. *b* *Goera* sp. *c* *Rhyacophila fuscula* Walker. *d* *Phryganea sayi* Milne. *e* *Chimarra* sp.

The mandibles<sup>14</sup> of the pupa are highly characteristic in form (text fig. 44) and in function (p. 104). The base is relatively heavy and joins the head by two condyles, one of which is a smooth surface, the other a spherical knob. The distal end of the mandible is a slender blade, the cutting margin being along the median side. The teeth of the blade are generally very fine, sometimes they are larger

<sup>14</sup> F. Müller (1888b, p. 276) describes a species of the Macronematinae in which the mandibles are absent.

and correspondingly fewer in number. The mandibles of *Odonotoceram* and *Tinodes* are described as having the blade much elongated and somewhat bifid (cf. *Psilotreta*, pl. 29, figs. 7, 8). In practically all species there are two bristles on the outer convex side of the base; in *Hydropsyche* and *Macronema* (pl. 18, fig. 6; pl. 22, fig. 6) there is, instead, a bunch of long hairs. In *Chimarrha* I find within the base of the mandible a circular clear area (text fig. 44*b*). In the Phryganeidae the basal bristles stand upon a tubercle which is often of considerable size (text fig. 44*e*).

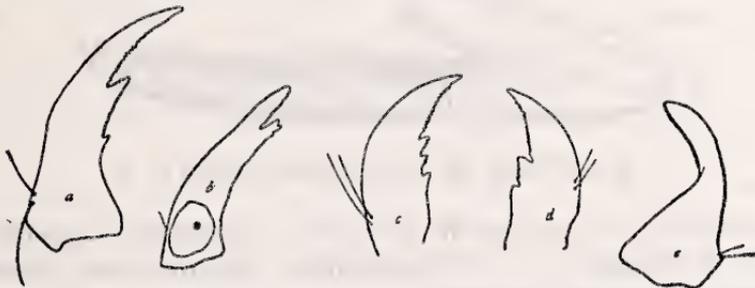


Fig. 44 Pupal mandibles. *a* *Rhyacophila fuscula* Walker. *b* *Chimarrha* sp. *c, d* *Rhyacophila carolina* Banks. *e* *Phryganea sayi* Milne

The maxillae and labium are not fully developed and the parts are difficult to distinguish. The palpi are, however, much as they are in the adults.

#### *Thorax and appendages*

The prothorax, as in the adults, is very narrow; the mesothorax is commonly a little larger than the metathorax. The adult wings are inclosed in very delicate wing sheaths folded backward and downward, covering the sides of the thorax and of the first abdominal segment. The shape of the adult wings is roughly indicated in those of the pupae. Ulmer states that in *Rhyacophila* there is a blunt prolongation which serves as a pocket for a whorl of hairs of the adult wing; I have not been able to find it in American species. The legs of the pupae show many of the characteristics of those of the adults, such as the arrangement and number of the spurs, and the widening of the tarsi and tibiae in certain forms. In certain other respects the legs are modified for the needs of the pupal stage. Thus the middle tibiae and tarsi are in most forms provided with a fringe of hairs along either margin; similar hairs appear in less numbers on the fore and hind tibiae and metatarsi. The absence of such hairs on the legs of certain pupae living in moss on rocks or

between the leaves of Bromelias, suggested to Fritz Müller ('79b) the now familiar problem of the action of natural selection on non-living parts of organisms. Another striking feature is that there is a sixth tarsal segment which incloses the adult claws. This segment may sometimes have two terminal projections into which the tips of the adult claws extend. In some species the pupal skin itself has claws (text fig. 45). The distal ends of the tarsal segments are often rough with chitinous points.



Fig. 45 Pupal leg of *Rhyacophila lobifera* n. sp.

Lübben (1907) reports the presence of prothoracic spiracles in pupae of Philopotamidae, Rhyacophilidae, Hydroptilidae, Polycentropidae and Hydropsychinae.

#### *Abdomen and appendages*

The pupal abdomen is composed of nine segments. The total length of the body is generally somewhat greater than that of the adult because there is as yet no telescoping of the segments. Of

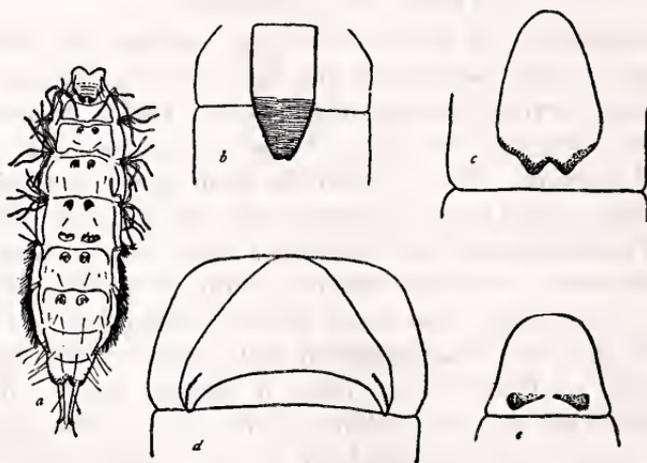


Fig. 46 *a* Dorsal view of pupal abdomen of *Arctoeicia consocia* Walker. *b* First abdominal segment of *Phryganea sayi* Milne. *c* Same of *Anabolia bimaculata* Walker. *d* Same of a Lepidostomatiniid. *e* Same of *Goera* sp.

the appendages some are practically like those of the larva while others have functions peculiar to the pupa.

The first abdominal segment is generally modified dorsally so that it may be held fast to the case and thus give support for the undulating movements of the body. In some species, especially those that lie still within the case (*Rhyacophilidae* etc.), there are no such modifications. In some cases the rear margin of the first segment is chitinized and there is a median process beset with chitinous points; in other cases there are two processes and these may be well toward the lateral margins (text fig. 46). The processes may be constricted toward the base and they may be so long as to overlap the second segment. In the *Leptocerinae* these processes are so varied that they may sometimes serve for specific characterization.

The tracheal gills are as in the larvae, that is, they are well-nigh universally present in the eruciform larvae and either present or absent in the others. It should be noted, however, that in some cases the pupae lack gills when the larvae have them (reported for some European species of *Rhyacophila*) and that conversely some pupae have them when they do not appear in the larvae (*Polycentropidae*). In pupae of *Hydropsyche*, as in the larvae, there is a series of delicate respiratory processes on the sides of some of the abdominal segments.

The lateral line is present in most eruciform and suberuciform larvae and absent in the others. The designation "lateral line" is not so strictly applicable as in the larvae since the fringe curves down beneath the rear segments and forms a loop which is generally interrupted in the middle; the hairs are also longer than in the larvae.

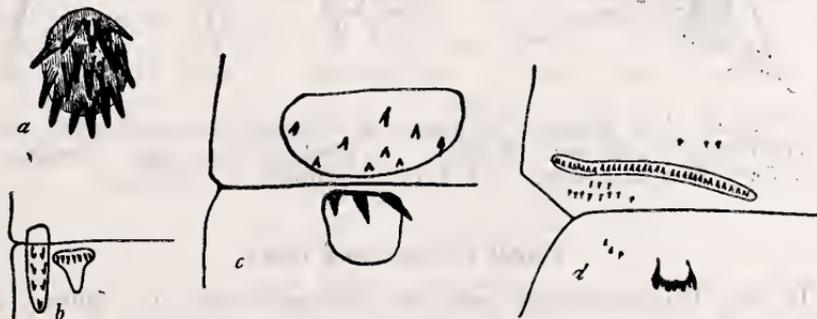


Fig. 47 Dorsal armature of pupae. a Undetermined sp. b 5th and 6th segments of *Phyllocentropus*. c Same of an undetermined sp. d 3d and 4th segments of *Macronema zebratum* Hagen

Extending over a number of the abdominal segments there are two dorsal longitudinal rows of plates bearing small chitinous points or hooks (text fig. 46a). The hooks on the anterior margins of the segments point backward, those on the posterior margin of the fifth segment point forward; the number of hooks is subject to some variation and the shape of the plates is different in different species (text fig. 47). Besides these plates there are chitinous ridges which serve to keep the body wall in shape; these are sometimes conspicuous, more so that in the adults. The plates of hooks may be in connection with these ridges.

The shape of the posterior end of the abdomen is often (in thysanuriform larvae) not much unlike that of the adults, that is, it serves simply as a cover for the adult genitalia. In most forms the body is terminated by blunt processes or by a pair of slender rods, either of these types commonly covered with long and stout bristles, sometimes with smaller hooks (text fig. 48). The function of these will be discussed later.

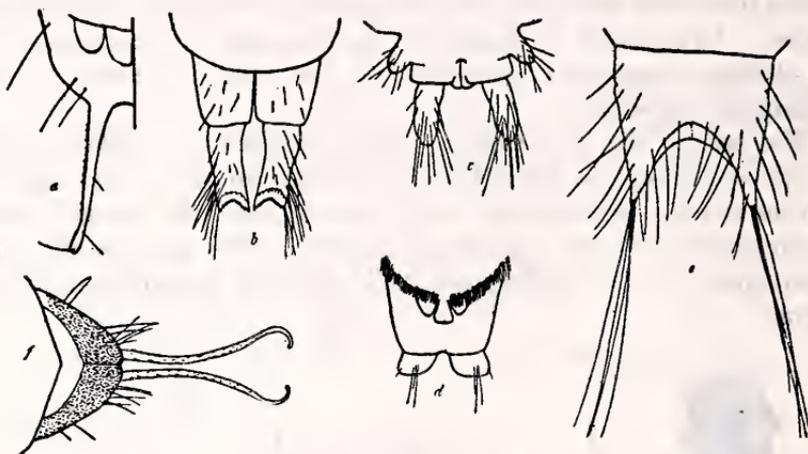


Fig. 48 Anal processes of pupae. *a* *Arctoecia consocia* Walker. *b* *Hydropsyche alternans* Walker. *c* *Phylocentropus* sp. (female). *d* *Phryganea sayi* Milne. *e* A Lepidostomatid. *f* *Goera* sp.

#### *Pupal cocoons and cases*

In the Rhyacophilidae and the Philopotamidae the pupae are inclosed in complete cocoons as well as in cases (pl. I, fig. 1). The Hydropsychidae and Polycentropidae, which may have no cases in

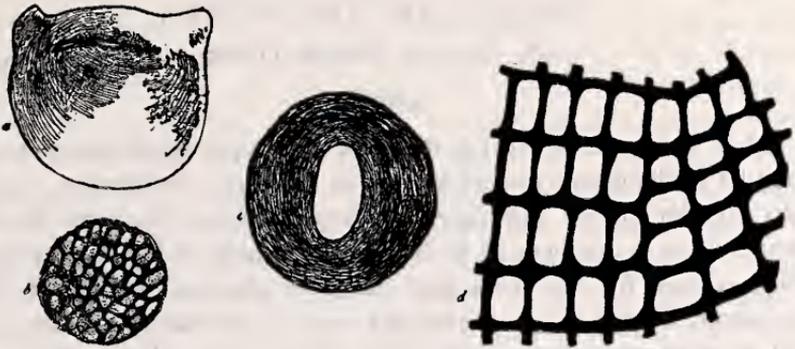


Fig. 49 Case membranes. *a* *Helicopsyche borealis* Hagen (anterior). *b* Same (posterior). *c* *Leptocella albida* Walker (posterior). *d* A *Limnephilid*

the earlier larval periods, build stone pupal cases which are incomplete, that is, they are dome-shaped structures fastened against or between larger stones or other supports (pl. 1, fig. 3). The cases of the pupae of all the other families are much like those of the larvae except that they are somewhat shortened, generally fastened to some support, and the ends are closed in various ways (p. 100).

Vorhies (1909) gives the following description of the type of case found in *Phylocentropus* and some other Polycentropidae:

The larva lives in a non-portable abode. . . . 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 coconut 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 larvae 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.

## HABITS OF THE TRICHOPTERA

BY MARION BRIGGS DAVIS

## ADULTS

Adult Trichoptera are for the most part very unobtrusive insects, so quiet in demeanor and so lacking in striking coloration as to come into popular notice but rarely. Only in some localities do they swarm in such numbers as to become noticeable and even obnoxious. They remain for the most part near the place of emergence from the water, flitting about or running over the herbage near the ponds and streams, more commonly sitting wholly motionless. All species seem to be crepuscular or nocturnal and most easily caught at lights, to which they may be attracted in tremendous numbers. A number of forms are decidedly crepuscular; species of *Mystacides* will very commonly be found swarming over the surface of the water at dusk, while *Oecetis incerta* often appears in even more conspicuous swarms just beneath the spreading limbs of trees. In our latitude the adults of various species may be found from April to October, occurring in greatest numbers in May, June and July; those appearing in late August and early September are perhaps not so numerous in occurrence but are among the larger species. Vorhies (Ent. News, 1913, p. 84) reports taking female specimens of *Platyphylax designatus* at an altitude of about 6000 feet near Salt Lake City during a snow storm on the 30th of November. Some species are known to occur during the greater part of the summer but for most forms the season is largely restricted to a very few weeks, after which stragglers may occur for some time. It is well enough known that some species occur in two broods in southern Europe and this is probably also true of some American species. Thus it has been noticed by Vorhies and by Betten that *Rheophylax submonilifer*, which is in many places by far the most frequent Trichopterous visitor within houses at a long distance from water, becomes common in the spring and again in the fall.

Taking the order as a whole, the power of flight is but little developed. In the case of most species the flight is rather lumbering and awkward. In other forms, such as *Macronema*, *Oecetis* etc., the power of flight is considerable and there is corresponding development in the shape and venation of the wings and in the structures which join the wings in flight (p. 32). Some species, particularly those of the family Hydroptilidae, can run very well considering their size, and in the daytime at least, seem to prefer this method of locomotion.

The period of the adult life has been considered to be very short, lasting from about four to 20 days in specimens that were kept under observation in captivity without special feeding. This is pre-eminently and almost exclusively the period of reproduction. The restriction of the adult stage to the function of reproduction, however, has not gone quite so far in the Trichoptera as in some species of Ephemera. Thus there is evidence that food may be taken by the adults. It has long been noted that some species of Trichoptera fly to bait set out for Lepidoptera, and Lucas (1903) has described the oral apparatus by which liquid and finely divided solid matter might be taken in. Ulmer (1904e) has described striking modifications of the mouthparts of certain exotic forms which undoubtedly point to the fact that these adults take some food. Siltala (1907d, p. 26) reviews these facts and adds that when he gave specimens of *Phryganea striata* and *Limnephilus rhombicus* access to flowers of *Spirea* after they had had only water, they flew to the flowers and sucked eagerly. This author has also seen certain species sipping water and observed that adults of *Cyrrus flavidus* and *Agraylea multipunctata* kept without access to water died after one or two nights. In the alimentary tract of several species he found black, brownish black, and brownish gray structureless lumps, but in one species (*Phryganea striata*) he found green bodies which resembled algal cells.

Döhler (1914) has more recently reviewed this subject and has made some important additions to our knowledge of it. This author shows that the structure of the alimentary tract, as well as that of the mouthparts, is such as to seem fitted for taking fluid food; so far as the latter organs are concerned the contention is greatly strengthened by the description of the mouthparts of a South American species already referred to (p. 22). By the use of litmus Döhler demonstrated that the walls of the midintestine secrete a substance of acid reaction and by the use of stains he showed that absorption takes place chiefly in the same region, though he is aware of the possibility that the penetration of the staining material may not have been a process of true absorption. That sugar solution may serve as food was strikingly shown by keeping two lots of specimens of the same species, one furnished with water only, the other supplied with sugar solution. The average length of life of 23 specimens supplied with water was 29.9 days, of the 19 specimens that had the sugar solution it was 70.6 days, with the added possibility that in the latter case the average was cut down because the specimens were likely to die as a result of getting the mouth

parts stuck together after eating from a too thick sugar solution. The longest lifetime among the specimens furnished with water was 40 days, of the others, 105 days. The feeding was easily accomplished by bringing the insects to a drop of water or of sugar solution on the finger. When given water the insects voluntarily stopped drinking when they had had enough but of the sugar solution they were likely to drink until the alimentary canal burst! Döhler concludes his account by quoting the references of various authors to field observations on the feeding of Trichoptera. Considering the fact that the insects are crepuscular or nocturnal in habit these observations are considerable in amount.

Of the ordinary organs of sense, the eyes and the antennae are well developed, and, as might be expected from what is the case in other insects, the males have these organs somewhat better developed than the females. The larger eyes are found in the males of but few species but the larger antennae are not uncommon. An evidence of fairly good power of vision, although of course other senses may be involved, is the fact that three females left free in a room were able to find a dish of water set upon a table, and deposited their eggs in it.

The antennae are kept porrect whether the insect is at rest or in flight. When the insect is disturbed, they are moved about restlessly and also when the insect is about to fly, they may be seen in trembling motion. The antennae are probably the seat of the sense of smell, at any rate it is clear that some species give off a perceptible odor and, by analogy with other insects, it may be safe to assume that the antennae are the perceiving organs. I have found a pronounced odor in specimens of *Stenophylax*, emitted apparently by a fluid excreted at the anal opening. The scales of various types which are found on the males, particularly of Sericostomatidae, and also the grooves of scales on the wings suggest themselves as scent organs after the manner of the androconia of butterflies. Wilhelm Müller (1887, 1888) was led to this conclusion and he reports finding a male spreading the palpi and unfolding the hairy tips. Upon preventing the refolding, he was able to detect an odor like that of vanilla. He also observed a male place himself before a female and spread the palpi. Attention has also been called by McLachlan and more particularly by Ris (1904a, b) to certain problematical organs in the males of some species of *Oecetis* (see p. 52); while definite proof is lacking, it seems likely that these too are scent organs.

Besides those mentioned there are other organs of uncertain significance occurring solely, or sometimes better developed, in the

males. Such are the teeth and the lobes on the abdomen (text fig. 26), abnormal spurs (text fig. 6), and the numerous spines on the fore legs of certain species (text fig. 6b).

The process of copulation takes place in some species while swarming. Doctor Betten contributes the following observations on species of *Chimarra*. "At about 7 o'clock in the evening of July 30th while walking along the Niagara river some distance above the falls, I observed that there were numerous swarms of *Chimarra* mostly out of reach and extending as high as the tree tops. The pairs came down and settled on vegetation and were apparently not fully copulated while in the air." Renewed copulation has been reported a number of times by Ritesma (1870) for *Enoicyla pusilla*, by Weurlander (given by Siltala, 1906b, p. 62) for *Holocentropus stagnalis* and *Hydropsyche angustipennis*, and by Gedge (Ent. Mon. Mag., 1867, p. 204) for *Chaetopteryx villosa*. In the instances observed by Weurlander, the eggs were laid after the second copulation, not after the first; in the case of *Enoicyla*, egg-laying was not repeated after the first. Cholodkovsky, who has made several contributions to the knowledge of the sex organs of Trichoptera, reports that he has found in *Goera pilosa* and *Molanna angustata* structures which are apparently to be regarded as spermatophores. These were found in the bursa copulatrix, which here serves as a receptaculum seminis.

The time elapsing between copulation and oviposition has rarely been noted. Siltala quotes from Weurlander the record of half an hour in the case of *Holocentropus stagnalis* and adds that captured specimens of *Phryganea striata* and *Silo pallipes* which he himself observed mating in the evening had laid their eggs by 9 o'clock the next morning. Similarly scant are the references to the exact method of extrusion of the eggs. Siltala, whose excellent review of the subject is here followed rather closely, says that those species that do not have egg-masses with a large amount of gelatine, that is, generally speaking, those with thysanuriform larvae, extrude the eggs in a long string. The single interesting exception to this is that of *Rhyacophila nubila* observed by Weurlander. In this case the eggs were laid singly and placed in crevices in submerged wood; this may, however, be an abnormal procedure induced by captivity. In the forms which do have the gelatinous covering around the eggs, it seems to be shown that the manner of extrusion is really the same, that is, the eggs are in a string although the egg-mass that is formed does not commonly show this except in the case of *Triaenodes*. In the Phryganeidae it is quite evident from the ring-form of the egg-

mass (pl. 3, fig. 7) that the eggs are extruded in a thick string with several eggs in a cross section. In species of this family the end of the egg-string is held either above or below the genital opening so that a complete vertical ring is formed. In the Leptoceridae, Limnephilidae, Sericostomatidae, and others which have egg-masses more or less spherical in shape, this mass is formed in the genital pouch by the folding and crumpling of the string. In certain Leptoceridae and Sericostomatidae, particularly in the Brachycentrinae, the females often carry the egg-masses at the end of the abdomen during flight.

The eggs may be dropped free or may be fastened either below the surface of the water, near the water's edge, or at a greater distance. As might be expected, the eggs of the European terrestrial species *Enoicyla pusilla*, are found at the greatest distance from water, placed on damp earth or in moss at the foot of trees. Many forms (Limnephilidae, Sericostomatidae and some tropical Leptoceridae and Hydropsychidae) place their eggs on herbage over the water, or on grass or wood or plant stems near the water's edge. Newly hatched larvae from such masses may be washed into the water by rain or may be reached by a rise in the water level. In many cases the larvae have to travel some distance; I have found the eggs of *Platycentropus maculipennis* on sphagnum moss six inches from water. Siltala (1906b, p. 48) has shown that the early development of some larvae normally takes place before they reach the water, the eggs of *Glyphotaelius punctatolineatus* when placed in water developed slowly, if at all, and many of them died. Wesenberg-Lund comments on the fact that in this species the legs and prolegs of larvae in the first stage are adapted to walking; in the succeeding stages they are not so long and spreading but more fitted for grasping.

In perhaps the majority of forms the female descends beneath the surface for oviposition. Of this there are now many records although but few years ago the occurrence was doubted and even denied. I have observed the process of oviposition in one species. After mating, the female of this species drops into the water, face upward or downward as it may happen, more often downward. Soon after this the eggs gradually appear and at every wriggle of the adult, a little more of the mass emerges. When finally free, this mass is oval in shape and the eggs are packed closely together. In about six hours after it leaves the abdomen, the mass expands in globular form until about 7-9 mm in diameter. The egg-mass remains attached to the body of the female long after it has appeared

and often the insect crawls under sticks or stones with the mass still attached. The insect dies an hour or so after oviposition, either on the surface of the water or on the bed of the stream; in any case she does not leave the water after laying the eggs. The egg-masses are usually found free in the water but sometimes they remain attached until after the death of the insect.

The descent of the female into the water is accomplished in some cases by swimming, in other by crawling down the stems of aquatic plants or other support. There is no particular adaptation for this purpose except that in some genera of several families the middle tibiae are decidedly dilated so as to serve more effectively as oars. Certain species of Leptoceridae and Sericostomatidae drop the eggs into the water and do not descend beneath the surface. This is also the case with *Neophylax concinnus* (see Patten, 1884, p. 1) and in *Beraeodes minuta* (Morton 1890b, p. 235).

The advantages derived from having the eggs covered with a thick coating of gelatine are doubtless numerous; they have been enumerated in some detail by Siltala (1906b, p. 76-92), and are largely the same as those that have been perhaps more fully investigated in the case of the amphibia. The gelatine may guard the eggs from mechanical injury or from the ingress of injurious chemicals or bacteria, its stickiness and possibly its distastefulness may save them from being eaten, it doubtless conserves the heat of the sun's rays, prevents drying and also too rapid changes in temperature. Siltala has shown that some species spend the winter in the egg stage, the larvae being less resistant to cold than are the eggs inclosed in the gelatine mass. Egg-masses of the other type, that is, those not having a thick mass of gelatine which swells up in water, lack most of the advantages just cited; in these masses the chief function of the cementing material is to fasten the eggs to some support.

Viviparity has once been reported for an Indian species—*Notanatolica vivipara* Wood-Mason (Ann. Nat. Hist., (6) 6, p. 139-41). In this instance a specimen which happened to be caught at dinner table lights had partially developed eggs, and another when thrown into spirits gave birth to young larvae, 460 in number.

The occurrence of parthenogenesis is, so far as known, limited to certain species of the genus *Apatania* (Klapálek 1889a, p. 241, 242, Morton 1902a).

There are a few records of the crossing of species of Trichoptera. Meyer (Stett. Ent. Zeit., 1867, p. 153-69) reports the crossing of different species of *Limnephilus*, including *Limnephilus nigriceps*, male with *Anabolia nervosa* female; while the resulting eggs devel-

oped, the young larvae were accidentally destroyed. The pairing of *Chaetopteryx* and *Halesus guttatipennis* is described by Porritt (Ent. Mon. Mag., 33, p. 15).

As already stated, the female dies soon after oviposition. No observations have been made as to whether there is any relation between the time of pairing and the death of the males. Boyd (P. E. Soc., 1874, p. 11) reports finding hundreds of males of *Brachycentrus subnubilus* (Europe) congregated on leaves of *Symphytum officinale* in a moribund condition. Doubtless many caddis flies have their already brief life unnaturally shortened, for they are quite defenseless. Some of them, however, exhibit protective form and coloration to a marked extent. Many species are exceedingly inconspicuous upon leaves or trunks of trees, and the coloration and posture of *Molanna* might well cause it to pass for a snag of wood.

#### LARVAE

##### *Habitat*

The larvae of Trichoptera are found in almost all sorts of aquatic situations. Some forms are found in quiet or slowly flowing water, as are the Phryganeidae, while others are limited to very rapid streams (Rhyacophilidae). One European species, *Enoicyla pusilla*, is known to be terrestrial. Marine species have been reported by Hagen, McLachlan, Hutton and others; Siltala (1906f) has made a study of the Bay of Finland and has shown that not a few species are able to live in salt water, though it should be noted that the proportion of salt present in the gulf is not great. Siltala divided the region studied into three divisions—an eastern, a middle and a western division—with salt contents of .2 per cent or less, .45 per cent to .5 per cent, and .5 per cent to .6 per cent respectively. In a part of the eastern division where the wave action is broken by a peninsula and by presence of islands, 39 species were found; in the other part where the wave action was stronger, there were 26 species. In the middle division there were 24 species, and in the western, 36. The total number of species found was 61. Some of these are to be regarded as typically marine, feeding upon and making their cases of *Fucus* and other marine algae. As Siltala observes, however, "even the larvae of *Agrypnètes crassicornis*, which has been found only on the coast of the Bay of Finland, can very well live in fresh water" (l. c., p. 5).

##### *Larval stages*

The embryological development of Trichoptera has been the subject of several researches, the more important of which are those

of Zaddach (1854), Weissman (1864), Melnikoff (1869), Patten (1884) and Graber (1889a). The length of this period is subject to some variation, being affected somewhat by temperature. Most species hatch in from 10 to 24 days; the longest time reported is the case of *Enoicyla pusilla*, in which it is over a month (Ritsema 1870, p. 119). As before stated, some species spend the winter in the egg stage. After hatching, the larvae remain within the gelatine for from one to four days.

For a knowledge of the postembryological stages we are again indebted to one of the thorough studies of Siltala (1907c). On the basis of successive ecdyses this author distinguishes at least five or six stages aside from the final one and one which may in some cases be passed before the larvae leave the egg-mass. This early ecdysis previous to hatching is reported by von Linden (1892, p. 524). Siltala found two larvae in which the integument was double at the time they were ready to hatch. On the other hand, he was able to find no exuviae in egg-masses which had been left by larvae and which he investigated for this very purpose; moreover, he did observe larvae which still retained the egg-rupturing apparatus after hatching. It thus appears certain that an ecdysis previous to hatching is not very common, but whether or not it occurs, it is best to follow Siltala in designating as the first stage that one which precedes the first molt after hatching.

The duration of the various stages and very possibly their number, are greatly affected by climate and temperature. This is at once apparent when we consider that the same species may have one brood a year in one locality and two in another. In case there are two broods, one of two conditions may obtain. It may be that while there are two periods at which the species is common the second brood is not composed of descendants of the earlier one; such a condition is not far removed from that in which the species is common through several months. Under these circumstances, the winter is passed by the insects in different larval stages. In case one brood is the lineal descendant of the other it is of course only the larvae of the spring adults that live through the winter. Observations on specimens kept in aquaria reveal similar variations since heat hastens and cold retards development, and the nature of the food furnished also has its influence. About all that can therefore be said is that while in summer the duration of the early larval stages is not more than approximately 20 days, in winter it may be several months. During the process of ecdysis the larvae have their cases fastened to some support.

### *Winter condition*

It already has been indicated that caddis flies may spend the winter in the egg or in earlier or later larval stages. Some species winter as pupae (Hudson 1904, p. 85). During the winter period, the larvae may go into a resting condition, retiring under plant débris, or into the mud of the stream or pond, the case being closed as for pupation. Other species are known to be active during the winter and to go through normal development. *Siltala* shows that in some species a rest period is normal and will be entered upon even by specimens that are sheltered in an aquarium (*Siltala* 1907*c*).

The question whether the eggs or the very young larvae may not spend the winter not submerged in water is raised by Doctor Betten, who found the larvae of *Arctoecia consocia* Walker in the very early spring at the head of a small stream which was dry from midsummer on. Careful examination of the stream before and during the period that the larvae appeared seemed to exclude the possibility of migration from the lake into which the stream flowed.

### *Locomotion*

For nearly all the case-bearing Trichoptera the only method of locomotion is that of crawling around on submerged plants or on the bottoms of the ponds or streams which they inhabit. A number of Leptoceridae, particularly species of *Triaenodes* and of *Setodes*, are able to swim well, even vertically, although encumbered with a case. In these forms, the hind legs are modified somewhat for swimming, while, at least in *Triaenodes*, the other pairs serve as rudders, the fore pair extending forward and the middle pair being held nearly at right angles to the body. The forms which do not carry cases are able to swim, and *Siltala* has shown that practically all larvae of either group are able to swim in the earliest larval stages. The Limnephilidae are exceptions to this so far as observed and the Hydroptilidae are more given to swimming in the earlier than in the later stages. The swimming of the larvae is accomplished not only by the movements of the legs but also by powerful undulations of the body. *Siltala* records that he has seen the larvae of Phryganeidae and of Limnephilidae crawling under the surface film even after they had their cases, the abdomen being held at an angle with the surface.

### *Case-building*

The cases are built either from the secretions of the salivary glands or more commonly from a great variety of vegetable and mineral material that is fastened together into a case by means of

the salivary secretions. The types of cases thus formed have been listed on page 75. The larvae of the true case-bearing forms generally leave the gelatine without cases and then at once set about to construct these. They may remain in contact with the gelatine mass and make the cases of the silt which has collected there. In many cases the larvae swim about for a day or two before starting to construct cases. It has been observed (von Linden 1891, Siltala 1907c, p. 339) that many species build the first cases out of the gelatine mass from which they come. Such a case generally serves for but a short time and other materials are added in front and the gelatine either wears off or is bitten off by the larva.

The first cases made, aside from the gelatine case just mentioned, is most often of the general type which is characteristic of the adult larva, though often this type is more or less obscured by deviation in the manner or material of manufacture. In very many forms there is an entire change of architecture during the life of the larva. Siltala has given an account of these changes (1907c, p. 338-55). In the Limnephilidae the rule is that the younger larvae use vegetable material while the later cases are of minerals. I have observed this in a species of *Stenophylax* (?). For their cases these larvae prefer fine pebbles, yet if there is a scarcity of such material they will content themselves with other material which they find in the streams. In the early spring the brooks where these larvae are found begin to fill up with fallen leaves, and when the eggs hatch, the tiny larvae build their cases of these leaves, making their domiciles three-sided, that is, in cross section they are in the form of an equilateral triangle with the sides externally concave. In March, when many of these larvae were again found, the posterior ends of the cases were three-sided and made of leaves, while the new sections added in front were cylindrical in form and made of pebbles; and as soon as the leaf portion dropped the larvae cemented a small stone to the end of the case, entirely closing this opening. At this season of the year the heavy rains and freshets carry away most of the leaves so that both vegetable building material and hiding places are less easily found and the stone cases become a matter of convenience in building, and of advantage for protection, although this may not be an explanation of the change of habit. In the Sericostomatidae the rule is mostly reversed. Thus in several Lepidostomatinae, the larvae have at first slightly curved tubular cases of fine sand and later change to the highly characteristic case which is made of vegetable material and is square in cross section. Doctor Betten writes that *Arctoecia consocia* found by him in a

temporary stream builds cases of pieces of grass stem in the early spring and that later these are changed either to cylindrical tubes made of pebbles, or to cases fashioned from broad pieces of leaves, triangular in cross section; the second type seemed to depend upon the part of the stream in which the older larvae were found and the material there available. The pupal case in this species is of small stones.

It remained for a long time an open question whether the larvae as they grew, gradually enlarged their cases or wholly discarded them for new ones. The latter procedure holds at least in those instances in which the larvae take possession of cases not made by themselves. In most other instances certainly, the larvae gradually enlarge the anterior end of the case. This has been observed many times and, as Siltala remarks, it might also be inferred from the fact that one rarely finds empty cases in an aquarium and also from the reluctance for leaving the cases which the larvae manifest; as is well known most of them will hold with the anal prolegs until torn in two if one tries to pull them forward from the case. Siltala adds the interesting observation that in certain Hydroptilidae in which the anterior and posterior ends of the case differ (*Oxyethira*, *Ithytrichia*) the anterior end is built first and is never enlarged.

Not infrequently caddis fly larvae use cases which they themselves have not made (Siltala 1904*b*). The large well-made cases of the Limnephilidae are sometimes found to contain the cases of pupae of smaller species. Sometimes the larvae are found to have borrowed cases but this is more rare and may be done only in emergency. Among the Phryganeidae the habit of making a case out of the hollow stem of plants is not uncommon. I have seen specimens of *Neuronia semifasciata* crawl into hollow stems which they cut off and then added to as became necessary. Siltala (l. c., p. 147) says that the cases thus made are often too long or otherwise unfit. Thus he found a case of *Agrypnia pagetana*, a species which commonly makes cases of *Phragmites*, *Carex* or *Equisetum*, measuring 88 mm in length and 6.5 mm in diameter. This pupal case had the closing membrane 36 mm from the end.

Among the most interesting cases are those which are made by boring into twigs. Lloyd has described a species of *Ganonema* which has this habit; his notes are as follows:

The twigs used as cases vary greatly in length and diameter, apparently being selected at random from the litter on the bottom of the forest stream. Sometimes pieces of heavy bark or fragments of broken

wood are used. A cylindrical hole always penetrates the wood from end to end. In some twigs the chamber forks near the anterior end, one outlet curving downward and opening to the exterior at one side, while the other perforates the end of the stick. The side outlet, when present, forms the anterior entrance to the case, the other in the end being plugged with silt or with small pebbles. Sometimes the chamber curves downward without forking. The chamber is always lined with silk. Although there is considerable variation in the size of the twigs used, their average size increases with the growth of the larvae. To ascertain how the change in cases is made several experiments were made with captive larvae. Some were removed from their cases and put in cages with twigs of appropriate size. These larvae did not attempt to use the wood for making new cases, but merely spun silken tubes to which particles of silt adhered; others, which had one side removed from their cases, repaired the damage with silk and silt. One larva repaired the damaged side with silt and fragments of bark and then proceeded to cut away the two ends of its case. It worked from the damaged side of the case, cutting narrow incisions across the twig until the opposite side was reached. The operation of cutting the two incisions across the twig 10 mm in diameter consumed about 24 hours. Two specimens, which were retained in aquaria in the laboratory, attached the anterior ends of their cases squarely, by means of silk, to the ends of solid twigs, and then drilled into the wood, emitting, during the task, an abundance of very finely powdered wood. One of these new dwellings proved too long for its occupant. It was accordingly girdled with a circular incision which was deepened until one end of the twig was completely cut away. Several twigs similarly ringed were found in the creek where the larvae occur. No doubt this is the usual method of changing cases, as larval growth proceeds.

Lloyd mentions the fact that *Triplectides obsoleta* (a New Zealand Leptocerid) also has been described as a woodborer by Hudson (1904).

Many experiments have been made testing the ability of the larvae to repair their cases. The results obtained by Marshall and Vorhies (1905) working with *Platyphylax designatus* may here be summarized. When the cases were cut through longitudinally along the dorsal, ventral or lateral lines, the cut was repaired at least at the anterior end. Notches cut in the anterior end of the case were repaired but holes made farther back were neglected. If the cases were cut in two across the middle, the posterior half was always discarded and additions made in front; in but one instance were the halves reunited. Removal of the posterior end of a case or injury in that region showed that the larvae were reluctant to work at that end of the case and that the cases were lengthened anteriorly to

make up for loss behind. That in this species the repair of the posterior end involves some danger the following quotation will show:

As the cases are normally turned in at the posterior end most injuries to this end will result in the larvae ultimately reversing themselves in the case to re-turn the margin. We watched the larvae turn from a reverse to a normal position, the whole process occupying about four minutes. At first the posterior end of the body is protruded from the anterior opening; the head is then bent forward and soon appears at the opening. Next, by a seemingly very strenuous effort, the body is withdrawn into the case and the larva assumes its normal position. During the process the second pair of legs are thrown up into a position dorsal to the thorax and pointing backward. The larva takes a short rest during the reversing process. That the effort is an extremely hard one is evidenced by the fact that we have, during our experiments, found larvae that have been "stuck" in turning and died without being able to completely turn.

It should be noted however that larvae of some other species seem to have no difficulty in reversing their position in the case.

I have observed the building of the net of the larvae of *Hydropsyche alternans*. These nets are funnel-shaped and placed at an angle of about 45 degrees with the stones upon which they are fastened. The nets generally open up stream so as to catch food washed down and often they are woven so closely together that nearly all the water is filtered through them. None of the larvae that I watched would make perfect nets in captivity; but by placing them in shallow aquariums and watching them with a hand lens, I was able to see the formation of an imperfect net. The larva began by exuding some of the salivary secretion on a small pebble, holding its mouth on the surface for a second or two. This made a starting place for the web. Then as the larva crawled along among the pebbles, looking for a new surface for attachment, the thread was constantly lengthened and was held in position by the three pairs of legs. Sometimes the larva went back and forth between two pebbles until several threads were visible. In places where the web would receive considerable strain, the larva took several threads into its mouth, and worked back and forth over them until they appeared as one thick thread. In their native haunts these larvae will rebuild their nets perfectly. When the nets of four different larvae were cut off, in three days two of the larvae had rebuilt their nets making them of the same size as before. Many larvae build nets from both ends of their cases.

The cases of caddis flies are doubtless of great importance in shielding their inhabitants from enemies. Larger fish may swallow case and all, but to many a hungry mouth a case must prove an

effective obstacle. Possibly quite as important is the fact that the case is in most species admirably adapted for making the insect inconspicuous; since it is made from the very materials of its background it can not fail to be so.

The question of the utility of certain details of architecture in caddis fly cases is sure to arise because of the striking nature of some of these structures. Thus not a few species have appendages extending beyond the end of the case, or at the side, and the function of these structures has been variously interpreted. They were formerly regarded as of value in reducing the specific gravity of the case, but Struck (1900, p. 91, 101) has shown that they are heavier than water and might, therefore, better serve as ballast; others think their chief value is in adding to the security of the inmates of the cases. Siltala concluded that, for young larvae at least, they are of importance in making it more difficult to discover, capture, and swallow them, and in saving the insects from being carried away by water currents. Buchner (1905, 1906) indicates that the cases are generally highly protective in being inconspicuous, and he also shows that in some cases (*Goera*) the ballast is placed so that the resistance to the current is decreased. This author suggests that the spiral case of the Phryganeidae and of *Triaenodes* has an advantage in swimming. He says that the larva of *Triaenodes* can swim vertically, that it turns on its own axis and that the head end of the case is inclined outward from the axis of the spiral curve through which the insect moves.

Wesenberg-Lund has carefully studied the building of the spiral case of the Phryganeidae and has written an interesting account of it. He shows that the case is conical while the larva is young and growing, and straight when the larva is full grown. The young larva, therefore, makes a spiral which fits a cone while the older one makes a cylinder. Among other interesting details this author indicates that the even length of the pieces of plant material used in the cases is due to the fact that the angle through which the head can be bent is the measure used, and this angle is definitely limited because the head as it bends down comes against the prosternal horn. The procedure is for the larva to hold a bit of the *Chara* stem, or whatever it may be using, so that the end is at the tip of the extended head, then while the legs are held still the head is bent until in contact with the prosternal horn and an incision is made. Wesenberg-Lund further comments on the fact that larvae of *Triaenodes* and of the Phryganeidae are the only ones living in cases, that can really swim, and that therefore we find spiral cases in those

larvae for whom light and strong cases are most indispensable. He does not agree with Buchner's description of the spiral turning of *Triaenodes*. Betten writes that on this question his observations agree with those of Wesenberg-Lund.

A thorough experimental study of case-building habits has been made by Gorter (1929).

### Food

It was formerly believed that the food of Trichopterous larvae was exclusively or predominantly vegetable material. This opinion was based on few observations and the later studies have shown that the carnivorous habit is quite as common as the other. Siltala (1907*d*) has brought together the literature on the subject and has added much as a result of his own study. He calls attention to the fact that larvae kept in aquaria are likely to be more or less omnivorous and for this reason his own observations were made on the contents of the alimentary tracts of specimens from natural conditions; even with these he reminds us that results are likely to be somewhat misleading because some kinds of food are more easily recognized than others. In this paper Siltala discusses the food of the various forms so far as this is known and he summarizes as follows: The Rhyacophilinae and Polycentropidae are in general carnivorous, the Hydropsychidae, Phryganeidae, Molannidae, and Odontoceridae use both vegetable and animal material, and concerning the Glossosomatinae too little is known to generalize; the others are vegetable feeders with some exceptions. The Hydroptilidae feed largely on algae, while the Limnephilidae restrict themselves largely to phanero-gams. It has sometimes been said that the forms that live in rapid water are largely carnivorous and those in standing water phytophagous, but Siltala concludes that in general the feeding habits follow the distinctions in natural relationship more than those of habitat.

Roques (1912) has carried on some experiments indicating the effects of different kinds of foods. He took three lots of specimens of an omnivorous species (*Limnephilus flavus*) feeding one lot with meat, another with leaves, and a third with green aquatic plants. He found that the carnivorous diet resulted in cases better built, in more silk apparently being produced, in less mortality in all stages, and in increased size. It appeared also that in those fed on meat the development of the larva was hastened, the pupal period being brought forward but also increased in length. There was some tendency toward greater pigmentation in the larvae fed on meat, extending also to the wing markings of the adults.

Several authors have indicated the fact that there is some relation between the type of the mouthparts of the larvae and the food normally taken. Ulmer long ago suggested (1902*b*, p. 50) that in general one might regard the larvae whose mandibles have blunt teeth, as phytophagous, and those whose mandibles have sharp teeth, as carnivorous. Siltala regards the presence or absence of the median bristles of the mandibles as indicative of feeding habits. He shows that all forms that have the median bristles on both mandibles are, so far as known, phytophagous, that those which lack these bristles are carnivorous, either exclusively or as much so as herbivorous. Those which have bristles on the left and not on the right mandible vary, some being carnivorous, some phytophagous and some omnivorous. Of especial interest in this connection are those forms which differ in these respects from their nearest allies. To cite the cases of European species given by Siltala, *Hydropsyche lepida* has an accessory row of hairs on the proximal tooth of the right mandible, not present in other species of *Hydropsyche*, and in contrast to the latter this species is phytophagous. *Ptilocolopus*, the only Hydroptilid which has median bristles on both mandibles, eats moss instead of algae. *Phryganea minor*, which has bristles on both mandibles, lacking in other species of this family, is largely phytophagous. Among the Leptocerinae, the genus *Oecetis* is abnormal in its mandibles and in being carnivorous; and *Leptocerus senilis*, which lives in spongilla, has lost the inner bristles of the left mandible. The case of *Oecetis* is paralleled by an American species, as Betten found a specimen of this genus (*O. resurgens*) whose alimentary canal was distended with two large midge larvae and the mandibles of this species (pl. 35, fig. 6) correspond to those of the European species.

Larvae of a species of *Hydropsyche* found at Cold Spring Harbor, Long Island, New York, were seen eating the larvae of Ephemera, of *Simulium* and of *Chironomus*. If none of these were available, the *Hydropsyche* larvae attacked and devoured those of their own kind. In a small aquarium in which there were but five *Hydropsyche* larvae, 20 small larvae of *Neuronia semifasciata* were placed and in a day nearly every one had been eaten. Sometimes the *Neuronia* larvae crawled into the entrance of a *Hydropsyche* case, whereupon the owner would dart forth, snapping at them in such a ferocious manner that the intruders quickly retreated within their own cases where they remained motionless for some time. While they thus kept quiet, *Hydropsyche* quickly wove the unfortunate *Neuronia* into the walls of his own home near the entrance. When the young

larvae at last attempted to move and found themselves bound fast, they fruitlessly attempted to disengage their cases, finally lost hold of them and were compelled to crawl about unprotected. Again, *Hydropsyche* often played "possum" in order to secure his food. A young *Neuronia* would by chance approach the rear entrance to the lodging of *Hydropsyche*, coming in contact with the posterior end of the abdomen of the inhabitant whose undulations were drawing the larvae along with the water current. Feeling the touch of an intruder, *Hydropsyche* would quickly reverse himself and then lie motionless while *Neuronia* crawled near, often over his head. Then suddenly he would dart at the intruder and quickly devour him. Sometimes the young larvae would escape through the rear openings of their own cases. Apparently the larvae of *Hydropsyche* can not see well as they never seemed conscious of their booty until they felt the contact with some part of the body. They were never seen attempting to capture larvae unless these were very near or touched them. In feeding, *Hydropsyche* used the claws of his fore legs to hold the food near his mouth. Often he tore a piece of a larva and ate that while he held the rest between the forelegs. A *Chironomus* larva offered to *Hydropsyche* was seized by the back of the head and then bitten all the way back to the posterior end. After this was done *Hydropsyche* ate the larva, beginning with the posterior end and cramming the morsel into his mouth with his fore feet. Sometimes *Hydropsyche* had too large a mouthful, whereupon he pulled out considerable of the material and afterward again ate it. When all but the head had been eaten *Hydropsyche's* hunger seemed satisfied, and at this time he attached the remainder of his captives to the roof of his case. The entire process took about 15 minutes.

### *Respiration*

The larval organs of respiration are largely the tracheal gills and the blood gills (p. 70). The blood gills are relatively uncommon; they occur, however, more often in the thysanuriform larvae than in the higher forms. Lübben (1907) is inclined to think that they are organs of double function—excretory when retracted, respiratory when extruded. Wesenberg-Lund regards them as probably respiratory in both positions and adds that the caudal part of the alimentary canal may be a respiratory region, a probability suggested to him by retractile movement of the anal region apparently producing a slight current. The possibility of this type of rectal respiration has also been suggested by Lübben, who says that if his supposition of a double function is not acceptable and if we conclude that the gills are respiratory when withdrawn into the rectum, then

we must also probably regard the cells of glandular appearance found in that region in forms having no blood gills, as likewise respiratory.

Experimental results obtained by Morgan and O'Neil (1931) show that the oxygen intake is mainly through the body wall, that the tracheal gills are only accessory organs, and that the rectal blood gills have no significant part in respiration.

Tracheal gills are not found in most thysanuriform larvae and they are also uniformly absent in the first larval stages of all species. In such cases respiration is doubtless carried on directly through the body wall in contact with which there are bunches of fine tracheal branches. In Polycentropidae, Philopotamidae and Psychomyidae, the respiratory function of the skin is somewhat localized in the region of the hind legs where there are subcoxal sacs. In newly hatched larvae the lateral margins of the abdominal segments are especially thin and folded so as to better serve the respiratory function. Besides the gills, there are larger processes upon the abdomen of certain forms (*Ithytrichia*, *Hydropsyche*) which are probably also to be regarded as organs of respiration.

For most species well-aerated water is a necessity and many are restricted to torrential streams. To provide for a constant water current through the cases the body is kept swaying with an undulating motion and in one case there is reported a separate movement of the tracheal gills (Fritz Müller, 1888*b*, p. 275). In the terrestrial species, *Enoicyla pusilla*, there are open spiracles.

#### *Enemies*

While the larvae are well protected in their cases, it must not be supposed that they are wholly free from attack. Of commensalism I find but one record, that of Scherren (Nature 56, p. 224), who records finding the rotifer *Callidina parasitica* on the larva of *Phryganea grandis*. I find no data relative to the mortality of the larvae but the number of these devoured by fish must under some conditions be very considerable (p. 6). Various Diptera, Hymenoptera and Gregarines are mentioned as larval parasites in the following papers: Ritsema (1870), Weyenbergh (1881), Struck (1900; p. 101), Ulmer (1902*e*, p. 491), Siltala (1905*a*, p. 16). The subject of parasites among Trichoptera is treated by Siltala and Nielson (1906).

#### *Pupation*<sup>15</sup>

It already has been noted that certain groups of Trichopterous larvae do not have cases until the later stages of larval life. All of

<sup>15</sup> In this section and in the later account of the pupa I follow closely the excellent account of the pupal period given by Thienemann (1905*b*).

them have cases at the time of pupation and the case-building habit among Trichoptera may have arisen with this critical period of the life history. These forms which have not carried larval cases start building just before pupation and the case made is not a complete tube but consists of a flat roof or a dome fastened to a stone or other support; within these cases the larvae of some families (Rhyacophilidae, Philopotamidae) inclose themselves in complete cocoons which may be shorter than the larvae themselves and which hence necessitates flexure of the head and prolegs during the process of pupation. The case-bearing forms fasten their cases to some support either lengthwise, obliquely, or almost perpendicularly, and then close both ends with stones, silk or other material and with some membranes which allow the passage of water; the exact order of these events is subject to variation. If the larval case is longer than is necessary, it may be cut off before being closed, or the closing membranes may be placed some distance within the case. If the larval case had a sieve-membrane at the posterior end this may be first removed and a new one made.

The closing membranes are either simple extensions of the case-wall with perforations, or are formed wholly of the salivary secretions. Thienemann distinguishes these structures as membranes when the area of the silk is greater than that of the perforations; in the reverse case he designates them as sieves, or nets. Sometimes most of the opening is closed by a stone or by a number of small stones; in such cases the perforations of the slit may be located along the margin of the case. In text figure 49 are shown various types of these closing membranes; the anterior and posterior membranes are generally not alike.

Fritz Müller (1880, p. 55-56) presents an interesting computation of the area of the openings in the closing membranes of the genus *Grumicha*. In the species studied, the anterior opening is a narrow slit while the rear one is circular. In 34 specimens the average area of the anterior slit was .085 sq. mm and that of the posterior orifice, .087 sq. mm. Müller's later comments (Fritz Müller 1879, p. 393) are as follows (freely translated):

This again, like the comb-building of the bee, gives opportunity to marvel at the unconscious accuracy of instinct or the mathematical genius of the little builder which enables it to build both openings of the same size in spite of their different shapes. Fundamentally the matter may, however, be rather simple; we need only grant that the larva can distinguish when it is bathed by a uniform stream of water. If one of the openings is smaller than the other, the water

passes through it more rapidly and the current is accelerated toward it or retarded away from it according as it is the opening of entrance or of exit for the water.

After the case is closed the larva remains quiet for about two days before the larval skin is cast, and if during this period the case is removed from its support, the process will generally be postponed for some days (see Siltala 1906*d*, p. 89, 90). The larval skin is shed as one piece and is carried to the rear of the case; the softer parts will break up, but the hard parts remain and often serve for the identification of immature pupae. In some forms (Leptoceridae etc.) the larval exuviae are carried out of the case by the water currents.

There may be an inactive prepupal period of some duration. Lloyd (1921) says of *Neophylax concinnus* that during this period, "lasting several months, from the late spring until the latter part of August, the larvae remain quiet with their heads folded between their legs. During this period they are incapable of taking any food, and dissection shows the alimentary canal entirely void of material of any kind."

#### PUPAE<sup>16</sup>

The pupal period lasts about two weeks, depending, of course, to some extent on the temperature; mention has already been made of the fact that the winter is passed in this stage by certain species. It has been found also that the removal of the pupal case from its support is likely to disturb the insect sufficiently to cause a considerable increase in the length of the pupal period.

As Thienemann (1905*b*, p. 14) has suggested, the pupal period is here called a resting period with even more inappropriateness than in the case of some other insects, for while in the latter there may be an outward appearance of inactivity, even this is not so in the Trichoptera. Throughout the entire life of most of the pupae the body is in undulating motion and frequently the mandibles also move freely.

#### Position

Most pupae lie in the case in the same position as was maintained by the larvae. Exceptions to this are known; sometimes the dorso-ventral relations are reversed, and sometimes the reversal is in the other plane; the latter reversal seems to be the rule in the Hydropilidae and it occurs occasionally in other families.

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<sup>16</sup>The account of the pupal stage here given is based almost wholly upon the excellent one given by Thienemann (1905*b*).

*Respiration*

The respiratory function is carried on as in the larvae but there are special adaptations which deserve mention here. The pupae which are inclosed within a complete cocoon lie quiet (see p. 110); in other forms there is an almost constant oscillation of the abdomen in the dorso-ventral plane. The rate of this motion probably varies with the need of oxygen and with the condition of the water in respect to freedom from dirt and silt. The pivot from which these motions take place is formed by the tubercle of the first abdominal segment. That this is the function of the dorsal tubercle finds interesting confirmation in Thienemann's observations on *Enoicyla pusilla*: this terrestrial species is the only Limnephilid that does not go through respiratory movements, it is also the only one which lacks the dorsal tubercle of the first abdominal segment. The dorsal hooks (text fig. 46a) also play a part in these movements. By means of the hooks which project forward (those on the rear of the fifth segment) the pupa can push itself backward, and vice versa. Either set of hooks can be thrown out of action since they stand on the margins of the segments and these latter can be telescopically withdrawn into each other for a sufficient distance to cover the plates of hooks (Struck 1903, p. 11, 12). The effectiveness of the stroke of the abdomen is doubtless also greatly increased by the presence of the lateral fringe. The direction of the water current is in most cases from the anterior end backward. In this connection Vorhies' observations on *Neuronia postica* are of interest.

The beds of the Wingra streams are composed of lumps of peaty material worn into fantastic shapes by the flowing water. These lumps are honeycombed with larger or smaller openings, formed in at least some cases, by decaying roots. The larvae, as the time for pupation draws near, in May, draw their cases tightly into these holes, where they can be found only 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 through the case.

It would be profitable to investigate what the course of the water is in these cases; the same problem arises with those species that burrow into twigs (p. 92).

In connection with the respiratory process there is an interesting problem which has been fully dealt with by Thiennemann in whose words it may well be stated.

The openings in the closing membranes may not exceed a certain size lest all sorts of predaceous aquatic animals, as for example, Chironomid larvae, might gain entrance and injure the delicate parts

of the pupa. The holes are therefore placed rather close together. This, however, involves a disadvantage. The cases are most easily fastened at the bottom of ponds and streams; the respiratory movements might therefore easily fill the holes of the membranes with dirt carried along with the water. But inspection of the membranes always shows that they are clean. How is this possible? (Thienemann 1905*b*, p. 26. Translated.)

The organs which are of importance in this relation have been well enough known but it has remained for Thienemann to point out the manner of their action. He finds that the anterior membranes are cleaned by the slightly hooked bristles of the labrum (text fig. 43*a*), by the mandibles which are likewise somewhat hooked, or by both the labrum and the mandibles. The holes of the rear membranes are cleaned by the bristles which are found on the lobes which terminate the body in some forms or by the rodlike anal processes found in others (text fig. 48). In the latter case the anal processes may themselves pierce and clean the openings or this may be done by bristles upon these processes; the motion is of course the result of the undulating movements of the body and may be a simple back and forth movement, or, in case the opening is a longitudinal slit, it may be more or less pendulous. The pupal case is but little longer than the pupa, so that the membranes are easily reached; such forward or backward movement as there must be is made possible by the action of the dorsal plates of hooks. There are other features that aid in keeping the membranes clean. As has been noted above, the membranes are not always placed at the very ends of the case; in such instances the projecting part of the case doubtless serves to keep some slit from the membranes. The same result is furthered by the presence of the stones or the plant material which is often affixed so as to form a coarse outer grating. The membranes themselves are not infrequently convex outward so that the egress of silt is easier than its ingress.

In this matter, as in the question of the function of the dorsal hooks, Thienemann finds that *Enoicyla* is the exception that proves the rule. In this terrestrial form, in contrast to all other Limnephilidae, there are no holes in the closing membranes, no rodlike anal processes, and no curved bristles on the labrum. It may be noticed that Lucas (1893, p. 25) and Ulmer (1903*d*, p. 22) adduce evidence to show that the bristles of the labrum may have secretory functions also.

#### *Enemies and defenses*

The enemies and defenses of the pupa are much the same as in the case of the larvae. It may be noted also that the cases are not

an absolute protection against the attack of even the smaller aquatic forms, for cases are sometimes found with holes torn in the sides, and caddis fly larvae will occasionally attack each other in this way. In Europe there has long been known an interesting case of parasitism on *Goera*, *Silo*, and sometimes on *Odontocerum*. The parasite in this case is a hymenopterous insect, *Agriotypus armatus*. This insect lives upon its larval host and itself goes through its metamorphoses within the case. Walker (Ent. Mon. Mag. 1836, p. 412) observed *Agriotypus* going beneath the water and remaining for some ten minutes but he did not fully understand the process, though he surmises that the insect must be engaged in laying its eggs on some neuropterous larva. Von Siebold (1858, 1861) reared the parasite and observed that the cases of the parasitized larvae had each a long bandlike process on the head end. He concluded that the parasitized larvae were stimulated to excessive secretion of silk which was deposited in the form of a band. Klapálek (1889*b*) gives evidence to show that the parasite allows the host to go through its natural processes to the time of pupation, that is, the caddis fly larva closes its case with the usual membranes and fastens it down, but the band is spun by the parasite. G. W. Müller presents facts to the same effect. This author (1889, 1891) cut off bands from a number of cases when they were 5 mm long; the bands were replaced and when the cases were opened the parasites were found. In November Müller collected 91 specimens that were parasitized and cut off the appendages from 44; in cases with appendages 62 per cent of the parasites emerged and 38 per cent died, while in those without appendages 9 per cent emerged and 91 per cent died. The next season he removed the appendages earlier in the season (August and September); this time 52 per cent of those in cases with appendages survived, and the others died. Müller therefore concludes that the appendage is formed by the parasite and that it serves some function; on the question of the nature of this function he finds no evidence but he surmises that it has some connection with respiration. It is highly desirable that observations be made on the method of the production of the band as well as on its possible function. The parasites have been reported from Scotland, France, Sweden, Bavaria, Syria and Bohemia.

#### *Emergence*

The first step toward the emergence of the adult must be the opening of the case, or of the cocoon and the case. It has long been surmised that the very highly developed mandibles of the pupae must

be used for this purpose but the manner of the operation is still in doubt. The pupal integument is at this time loose from the adult body to a large extent and yet a part of this dead envelop must somehow perform an operation absolutely essential in the life of every individual. Thienemann (1905*b*, p. 61) is inclined to think that this can not be accomplished through blood pressure within the reduced imaginal mandibles, and the presence of musculature in these degenerate organs has not been demonstrated. Thienemann calls attention to two chitinous strands attached to the base of the pupal mandible as already described by Lucas (1893, p. 26). Of these strands the one attached to the median angle of the mandible is much stouter than the other, as might be expected if these strands are the attachments for muscles controlling the mandibles. If the explanation thus suggested is correct the mandibles must remain attached longer than the rest of the pupal integument, and the detachment of these muscles must occur in the interval between the opening of the case and the emergence of the adult. The quite similar problem of emergence in the Micropterygidae has been worked out by Busck and Böving (Proc. Ent. Soc. Wash. 16, p. 151).

Since the cases are ordinarily fastened to their support at the anterior end, the removal of the anterior membrane at the time of emergence leaves the case fast as before. Fritz Müller (1879*a*, p. 407, 1879*c*, p. 136) describes an interesting exception to this in the genus *Grumichella* (Brazil). In this genus the closing membrane and not the margin of the case is fastened to stones. The cases are generally placed on vertical rocks over which a thin sheet of water is falling, the head of the pupa being uppermost. It would be quite impossible for the pupa to emerge safely against the current but the manner in which the case is fastened obviates the difficulty. When the closing membrane is removed it remains on the rock while the case is carried to quieter waters where emergence from it is a less hazardous process.

The pupa leaves the case by means of the strong undulatory movements of the body, the dorsal hooks catching in the wall of the case with each successive wave; the hooks pointing forward on the rear margin of the fifth segment are thrown out of action by being retracted telescopically within the next segment.

The interval between leaving the case and shedding the pupal skin is generally not long; it is very likely often prolonged by the failure of the mandibular muscles to separate promptly. At any rate pupae

which ultimately fail to transform are sometimes seen to live for some time either in or out of water. I observed a specimen of *Stenophylax* which came out of its case one morning at about 7 o'clock; it emerged rapidly, swam to the surface of the water, and climbed upon a stick, where it remained motionless for about 20 minutes, after which it began oscillatory movements of the body. After a while it went back into the water, swimming on its back, turning somersaults, and performing various other movements. After this had continued for a long time, with short intervals of rest, the adult emerged in the middle of the night.

The pupae are surprisingly active after they leave the cases and can swim or crawl rapidly. The swimming is accomplished by means of the legs, which are equipped with two ranks of hairs. Thienemann finds a correlation between the presence of these hairs and the habit of the insects, the few species that lack these hairs being either terrestrial (*Enoicyla*) or inhabitants of shallow water. Müller (Trans. Ent. Soc. Lon., 1879, p. 132) called attention to the same fact by noting the absence of these hairs in four species of three different families. The pupal claws present in some species are an adaptation for crawling out of the water on plants or stones.

The process of emergence may take place in the daytime but a considerable number of observations indicate that in the majority of cases it takes place during the night. It may occur while the insect is either wholly out of the water or at the water's surface. The former method is the only one adopted by the Limnephilidae, and it is common also among the Phryganeidae and some Rhyacophilidae. When this method is employed the process may take several minutes. The pupal integument bursts over the thorax and the parts of the adult are pulled out—first the head, then the fore and middle legs, the antennae, the wings and hind legs, and finally the abdomen. Not infrequently some part of the pupal integument fails to be released and thus the death of the insect may result. As forms that shed the pupal skins at the surface of the water, Siltala (1906*d*, p. 96) lists certain Sericostomatidae, Molannidae, Leptoceridae, Hydropsychidae, Philopotamidae, Polycentropidae and Hydroptilidae. Several species are known to hold their wings in a vertical position for a little time after emergence, probably for drying, or, as McLachlan has suggested, for the purpose of allowing the tracheae of the wings to become filled with air. This has been reported for several European species; Betten has observed it in *Neureclipsis crepuscularis*.

## RELATIONSHIPS OF THE TRICHOPTERA

The Trichoptera are now universally recognized as a separate order, McLachlan's work in extending and organizing the knowledge of the group having doubtless served to hasten the breaking up of the old Neuropteroid complex. The natural affinity of the Trichoptera with certain of the Neuropteroids on the one hand, and with the Lepidoptera on the other, has been constantly recognized and the relative closeness of the relationships of these groups has been the subject of some controversy.

Packard (1871) in defending the view that the relationship to the Panorpidae is the closer, calls particular attention to the similarity in the structure of the sclerites of the head and thorax, and says (p. 710) that to the Panorpidae "the Phryganidae (Trichoptera) are more nearly related than to any other group of insects, whether we take into consideration the structure of the adults, or the form of the larva and pupa, and their metamorphoses." Klapálek finds that the genitalia also suggest this relationship. Kellogg (1895c) has shown that the wings of the two groups present homologies particularly in the presence of a fibula and also of a rudimentary frenulum.

The similarities of structure and habit between the Trichoptera and the Lepidoptera have been rather fully detailed in the literature. In 1870 Speyer gave an enumeration of a very great number of correspondences and called attention to the fact that he had, as early as 1839 (in Oken's *Isis*), pointed out this relationship and had indicated the Micropterygidae as transition forms. It will scarcely be necessary to call attention here to all these points of resemblance. It is of course obvious that the Lepidoptera are as a whole more specialized than the Panorpidae, the Trichoptera, or the Sialidae but it seems equally clear that the points of origin of all of these groups are not far apart. All authors contributing to the subject have indicated the generalized Jugatae as the Lepidoptera that are nearest to the Trichoptera. The presence of both hairs and scales on the wings, the free limbs of the pupae, and the structure of the mouth parts and the thorax of the adults, are the most striking characters in which Trichoptera and the Jugatae are generalized in comparison with the Frenatae. Some of the lower Frenatae show interesting correspondences in the habit of case-building; Struck (1896) thinks it probable that every type of Trichopterous case may also be found among the Lepidoptera. For further details on the subject of the relationships of the two orders, reference may be made to the con-

tributions of McLachlan (1871, also Proc. Ent. Soc. Lon., 1878, p. 55, 56), Packard (1871, 1895), E. Müller (1871), Chapman (1896), Tutt (1896), Hofman (1892), Struck (1896), Kellogg (1895*a,b,c*), Spuler (1892), Sharp (1896), Acloque (1899), Simroth (1912), Meyrick (1895, 1912), Comstock (1918), Tillyard (1918), Braun (1919) and Riel (1925). A most interesting account of the pupal habits of *Mnemonic auricyana* Walsingham by Busck and Böving (Proc. Ent. Soc. Wash., 16, p. 151-60) is well worth reading in this connection. Comstock (1918) follows Sharp's suggestion by including the Micropterygidae as terrestrial Trichoptera, but the considerations put forward by Tillyard (1918) and by Braun (1919) are sufficient to preclude holding to this arrangement.

#### PHYLOGENY OF THE FAMILIES

In 1848 Kolenati first divided the Trichoptera into two great groups on the basis of the number of the palpal segments; those which had the same number of segments in the male and the female palpi, he designated the Isopalpoidea, the others as Heteropalpoidea. For these names he substituted Aequipalpia and Inaequipalpia in 1859. As the Trichoptera have since come to be regarded as an order, these names are more recently corrected by Ulmer into Aequipalpia and Inaequipalpia. Possibly Martynov's groups, Annulipalpia and Integripalpia are similarly delimited, but his work (1924*c*, p. 19) is not available here.<sup>17</sup> This same primary division is used by McLachlan, who transferred the Hydroptilidae to the Aequipalpia, thus correcting an error which has curiously persisted in some more recent American keys to the families. McLachlan arranged the species treated by him in his great work, in seven families; several of these he subdivided into sections with a fine appreciation of the indications of natural affinity. The order in which these families were placed has been followed in all but the most recent works on the order although it very obviously places the more specialized forms first. These families were named in order: Phryganeidae, Limnephilidae, Sericostomatidae, Leptoceridae, Hydropsychidae, Rhyacophilidae, and Hydroptilidae. In 1891 Wallengren named certain new families but his lines of subdivision did not wholly approve themselves and the family names proposed have since been utilized only in part. Most of the sections of

<sup>17</sup> An English diagnosis has more recently appeared (Martynov 1930*a*, p. 5, 83). The Annulipalpia include the Rhyacophilidae, Hydroptilidae, Philopotamidae, Stenopsychidae, Polycentropidae, Psychomyidae, Arctopsychidae and Hydropsychidae.

McLachlan were given family names by Ulmer (1903-6). Klapálek in his work on the genitalia (1902*b*, 1903*d*) increased the number of families by adding the Molannidae (McLachlan's sections of *Molanna* and *Beraea*) and the Philopotamidae (McLachlan's sections of *Tinodes* and of *Philopotamus*). Ulmer subsequently raised to family rank the Calamoceratidae (1906*b*), the Polycentropidae (1906*b*), the Odontoceridae (1907*c*), and the Psychomyidae (1907*c*). The record of these changes will be found in the bibliography given for each of the families. The total number of families has thus risen to 13; of these 13, one, the Sericostomatidae, is conspicuously heterogeneous. This has been universally recognized but the erection of new families has wisely been postponed until further facts give better basis for judgment in the matter. The families Stenopsychidae and Arctopsychidae, derived from the Philopotamidae and the Hydropsychidae respectively, should be recognized.

The relationships of the families among themselves are here, as in many other orders, not indicated with great clearness. There is, however, no doubt as to which are to be regarded as in general the more primitive forms, and the characters of greatest significance in this respect may be briefly indicated. Siltala's searching investigations on the ontogenetic side have corroborated the general conclusion before attained.

### *Eggs*

The primitive type of egg-mass is undoubtedly that in which the eggs are laid individually against a substratum with little gelatinous attachment; the specialized type is that in which there is abundance of gelatine and the mass has distinctive shape.

### *Larval structure*

The thysanuriform larvae are to be regarded as representing the more primitive type. In these, as before stated, the head is in line with the body, the latter is generally somewhat flattened, the segments of the abdomen are well indicated, and the prolegs are long. The contrasted characters of the eruciform larvae are, I think, mostly correlated with the case-bearing habit; for example, the long prolegs of the thysanuriform type are of great service in helping the caseless larvae to maintain their footing in their nets or on stones in swift currents, in the eruciform larvae the only function of these organs is to catch into the sides of the case to prevent accidental or forcible eviction.

*Cuticular appendages*

The cuticular appendages have been investigated thoroughly by Siltala, who finds that the primitive arrangement of these appendages is practically alike in all larvae of the first stages. The first set of cuticular appendages is later replaced by a secondary armature, the nature and extent of which is used by Siltala as a criterion of relationships (1907c, p. 591-611).

*Case-bearing*

Opinions on the origin of case-bearing will likely not be unanimous but the indications seem to me to be that the habit arose in connection with the pupal stage, since what, on other points, are doubtless to be regarded as the lower forms do not have the cases until near the time of pupation. I am not aware that there is any conclusive evidence showing whether the inner cocoon or the outer case, as they appear in the Rhyacophilidae is to be regarded as the more primitive but I incline to the former opinion. The silken case of the Hydroptilidae (pl. 1, fig. 4) may be regarded as the derivative of the pupal cocoon, coming a little earlier into use. In the Rhyacophilidae (pl. 1, fig. 1) and Philopotamidae there is an outer case around the cocoon; in the former family there is practically no connection between cocoon and case and in the latter a considerable part of the cocoon is fastened. In the true case-bearers the outer case becomes a free tube instead of being a dome-shaped structure fastened to some surface, and the cocoon becomes wholly united to the outer case and disappears as an independent structure. *Mystrophora* shows a transition stage with respect to the outer case. The pupal case is like that of *Rhyacophila* but the larva makes the case earlier in life, the case is movable, and is provided with a floor. It needs but a change in shape and a shifting of the openings from the bottom to the ends to transform this structure (pl. 1, fig. 2) into the free tubular case of the higher forms.

*Pupal respiration*

Fritz Müller (1879a, p. 406) was the first to suggest that the Trichoptera may be divided into two groups on the basis of the pupal respiration. In the first group the pupa is inclosed in a complete cocoon and is not active; in the second group the case has openings at the ends and undulatory movements of the body keep a stream of water passing through. Thienemann has added to this that those which have a case closed with membranes also have the structures for cleaning the latter. He also suggests that the

Polycentropidae should be regarded as an intermediate group since, while they have respiratory movements and the apparatus for cleaning the case membranes, they do not possess the peculiar anal processes of the Hydropsychidae and of the true case-bearers. Further, Lübben (1907) has shown that they are unlike the latter group in having pupal spiracles. The relationships of the families, suggested by these authors, on the basis of the pupal respiration may be indicated by the following table from Lübben (l. c., p. 90). Thienemann would hold that branch 2 of the table is nearer to branch 1 than to branch 3.

Main Group I (Müller). No respiratory movements. No apparatus for cleaning case-membranes.	} Branch 1 (Thienemann)	} Rhyacophilidae Philopotamidae Hydroptilidae	} Pupal spiracles present. No anal processes.
} Branch 3 (Thienemann)	} Hydropsychidae Case-bearers		

#### *Adult mouthparts*

The presence of rudimentary mandibles is of course a relatively generalized condition in this order, and the formation of an haustellum is a specialization. Genthe (1897) notes that arrangement according to these characters agrees in general with that given above. The generalized type of maxillary palpus is that which is 5-segmented and it is found in all the females and in all the males except those of the Phryganeidae, the Limnephilidae and the Sericostomatidae. Only in certain Psychomyidae are the palpi 6-segmented.

#### *Venation*

It has already been indicated that, while the venation of the Trichoptera is of very great importance in differentiating the sub-families and the genera, it does not give clear indications of the relationships of the families. Specialization is mainly in the way of reduction through fusion and in the establishment of a definite "cord" or "line of anastomosis" in the fore wing. There is but one venational character that I have noticed that indicates the general distinction between the lower and the higher families and this like all other venational characters in this group is not without a few exceptions. The character referred to is the presence or absence of the intercubital crossvein (*c. v.* in text fig. 14*b*) in the fore wings near the margin (the relations of this vein are more fully discussed

on page 43). This crossvein is absent in the Rhyacophilidae, Hydroptilidae, Philopotamidae, Polycentropidae, Hydropsychidae and Psychomyidae, some of the Macronematinae being practically the only exceptions; it is present, also with but few exceptions, in the remaining families. In the Calamoceratidae and the Odontoceridae the posterior part of the fore wing is modified so that the identification of this vein is often uncertain.

### Summary

The earlier students of the Trichoptera seem upon the whole to be inclined to regard the Inequipalpia as the primitive families of the order. The contrary opinion was first expressed by Hagen (1852) and by Brauer (1886) on the ground of paleontological evidence, Hagen placing the Hydropsychidae as the most primitive forms followed by the Rhyacophilidae. Müller (1879a) selects the same families because of the caseless larvae, the condition of the male palpi, and the venation. Spuler (1892b, p. 607) also calls attention to the generalized condition of the venation in *Philopotamus* and *Rhyacophila*. Klapálek (1902b) in his study of the genitalia begins with the Rhyacophilidae, while Thienemann (1905b) seems to put the Philopotamidae at the base of the series.

From the study of the venation I would have no choice as between *Rhyacophila* and *Philopotamus* in deciding upon the most primitive Trichoptera, since they are practically alike in this respect and there can be no doubt from any point of view that these two genera are very closely allied. I place *Rhyacophila* lower in the series because *Philopotamus* shows the beginnings of certain specializations in the direction of the Hydropsychidae, that is, the palpi of the adults have the terminal segments multiarticulate, the pupal cocoon is not wholly free from the outer stone case, and the larvae live in covered passageways or elaborate nets.

The Hydroptilidae are undoubtedly to be derived from the Glossosomatinae (Rhyacophilidae) as has been indicated by Eaton (1873), Müller (1879a), Lauterborn (1904), and especially by Thienemann (1904c). The last named author has successfully advanced evidence to show that the European genus *Ptilocolepus* is in many respects a transition form between the two families although of course it exhibits specializations of its own. The figure of the venation here given (pl. 10, fig. 6), differing slightly from those heretofore published, shows the resemblance to such forms as *Synagapetus* especially in respect to the specialized nature of *Sc* and  $R_1$  of the hind wing (see the discussion of these veins on page 50).

The Hydroptilidae are all, it is true, case-bearers, but *Siltala* has shown that the cases are not made until late in the life history (fourth larval stage) and it seems to me justifiable to regard the Hydroptilid cases as derived from the primitive pupal cocoon of the Rhyacophilidae rather than from the outer case to which the houses of the higher forms are doubtless related.

Concerning the relationships of the families derived from McLachlan's old family Hydropsychidae, I have little to suggest. *Siltala* regards the Psychomyidae as the most primitive, followed by the Polycentropidae and the Hydropsychidae (*sensu str.*), basing his opinion on the nature of the cuticular appendages of the larvae. I should rather agree with Ulmer in placing the Psychomyidae higher, the shape of the wings and the venation indicating a high degree of specialization. I should regard the Polycentropidae as more specialized than the Hydropsychidae, in spite of the indications to the contrary shown in the table on page 111. In adult Polycentropidae this specialization is seen particularly in the reduced condition of  $R_1$  of the hind wing. While the genus *Hydropsyche* is specialized, some of the lower genera of Hydropsychidae such as *Arctopsyche* and *Parapsyche* are without doubt more primitive than any Polycentropid, Psychomyid or Calamoceratid. In fact, *Arctopsyche* might without violence be transferred to the Philopotamidae although in the characters most used by systematists (absence of ocelli and the long articulate segment of the palpi) it certainly is related to the Hydropsychidae. The Macronematinae are the most highly specialized of the Hydropsychidae and they form a very homogenous group. In length of antennae, length of the terminal segment of the palpus and in the structure of radius of the hind wing they are approached by the genus *Potamyia*. In the shape of the wings and in the venation they are also closely approached by *Stenopsyche*—an Indian genus now placed in the Philopotamidae.<sup>18</sup> The small subfamily Ecnominae, until recently placed with Polycentropidae, has been removed to the Psychomyidae by Ulmer (1912e).

Of the families formerly constituting the Leptoceridae, the Calamoceratidae are the most primitive. The venation has general resemblance to the primitive type; it is specialized mainly in two respects—the veins of the posterior part of the fore wing are more or less reduced, and there is a tendency for  $R_1$  to turn toward  $R_2$  near the wing margin.

<sup>18</sup> The families Arctopsychidae and Stenopsychidae have been erected since this section was written.

The Odontoceridae share the two general features just noted in the Calamoceratidae but they are evidently more specialized and in general form a less homogeneous group.

The Molannidae are to be regarded as a widely divergent offshoot from the primitive Leptocerid stem. This relationship is emphasized by the structure of radius and media to which particular attention has already been called (p. 47). I would be inclined on the basis of similar indications to place *Helicopsyche* in a like relationship to the Leptoceridae although the maxillary palpi are but 3-segmented. Ulmer has recently suggested that the Beraeinae should be separated from the Molanninae. He is of the opinion that they may be more nearly related to the Sericostomatidae, basing the opinion on the very striking resemblances of the Beraeinae to the fossil genus *Pseudoberaeodes* Ulmer in which the maxillary palpi are 3-segmented. Until there is more evidence I prefer to hold Ulmer's new fossil genus in somewhat the same view as *Helicopsyche*, that is, I should regard it as an offshoot from the Beraeinae which has specialized in the reduction of the maxillary palpi to three segments. *Helicopsyche* is of course different in that it gives no indication of relationship to any particular group of the primitive Leptocerid stock.

Of the Inaequipalpia the Phryganeidae are the most generalized. Siltala is quite insistent that the relationship between the Phryganeidae and the Limnephilidae has been much overestimated and he places the Leptoceridae between the two in the linear arrangement of his text, calling attention to the marked similarity of the larvae of the Phryganeidae with the Molannidae in particular. Aside from the facts given by Siltala regarding the larvae (depressed body and head, distribution of bristles on labrum, lack of median bristles on mandibles, deep constrictions between segments, number of hooks on the claws of the prolegs, etc.) I see no evidence indicating a close relationship between the Phryganeidae and the Leptoceridae.

The Limnephilidae constitute a homogenous family which, in the structure of the palpi, in venation, in the manner of oviposition, in fact in practically all characters, shows an advance in specialization over the Phryganeidae.

With regard to the Sericostomatidae, the opinion now seems unanimous that the four subfamilies are not monophyletic and advancing knowledge of the life histories of these forms will doubtless soon justify the erection of new families. Of the four subfamilies I would select the Brachycentrinae as the most primitive,

the venation of *Brachycentrus* (females especially) being almost as generalized as that of *Rhyacophila*. Stiltala regards the Lepidostomatinae as lower in the scale. Ulmer thinks the Brachycentrinae might be placed near the Phryganeidae. The relationships of the other three subfamilies seems not at all evident. Ulmer thinks the Goerinae may well join the Apataniinae (Limnephilidae). This opinion receives very strong corroboration from the study of the larval characters of the American genus *Neophylax* (page 372).

Krafka has recently (1923) presented conclusions regarding the relationship of the families quite at variance with those indicated above, and based on characters in the structure of the larval head. While regretting to take issue with my former associate, it seems to me that the evidence given in the paper referred to indicates rather clearly that the shape of the sclerites of the larval head varies greatly in closely related forms. For example, it is shown that within the Hydropsychidae, almost within the genus *Hydropsyche*, as great a range of ventral fusion of the epicrania may be found as in the whole order. These differences seem to promise to be of service in separating species and genera but family distinctions are not always clearly shown. I can not accept the view that the Leptoceridae are a primitive family, nor do I find anything to corroborate certain other relationships suggested. As has been stated above, the relationship of the families is none too clear in the Trichoptera, but, if it is clear anywhere, it is in the derivation of the Hydroptilidae from the Glossosomatinae (Rhyacophilidae). It would take extraordinarily good evidence to show that "the Hydroptilidae are . . . not directly related to the campodeiform type with which they are ordinarily associated." It may be surmised that a study of correlation between larval structure and habit would here prove useful and the same comment may be made on the argument of Krafka's later paper (1924). It is quite possible to regard the anal prolegs of the Leptoceridae as of a more primitive type than those of the campodeiform larvae, and still to maintain that, upon the whole, the latter are the more primitive forms of the order. It is reasonable to expect relatively little differentiation of the prolegs in the larvae of widely divergent adult forms when these larvae share the uniform environment afforded by their tubular cases within which the prolegs have a definite function. The prolegs of the campodeiform, caseless larvae, on the contrary, are developed in relation to a vastly more varied environment.

The entire subject of the relationships of the families of Trichoptera is readily seen to be one on which the accumulation of

evidence is still far from complete and one on which no one at present has fully formed opinions. Reference should be made to the excellent statements of the known evidence set forth by Thienemann (1905*b*, p. 53-55), Siltala (1906*b*, p. 101-13, 1907*c*, p. 591-611), and Ulmer (1912*e*, p. 369-77).

So far as the genera are concerned, they are arranged in the text so far as possible according to their natural grouping where this seems apparent, but when so many genera are inadequately known this process can not be carried very far. Within the genera the species are arranged alphabetically.

## KEY TO THE FAMILIES OF CADDIS FLIES<sup>19</sup>

### ADULTS

- 1*a* Small, often minute insects, the fore wings with semierect club-shaped hairs, the fringes of the wings very long, those of the hind wings longer than the breadth of the wings. Wings long and narrow, generally sharply pointed. Antennae short and stout, generally much shorter than the fore wings. Maxillary palpi 5-segmented in both sexes, the terminal segment not flexible and not multiarticulate. p. 143.  
.....HYDROPTILIDAE
- 1*b* Only rarely very small insects. Wing fringes not longer than the breadth of the wings. Antennae but little if any shorter than the wings.....2
- 2*a* Maxillary palpi 5-segmented (includes all females and some males)....3
- 2*b* Maxillary palpi less than 5-segmented, sometimes very abnormal in shape (only males).....15
- 3*a* Terminal segment of the maxillary palpi multiarticulate (sometimes rather indistinctly so), flexible, and generally much longer than any of the others (text fig. 3*a*).....4
- 3*b* Terminal segment of the maxillary palpi not multiarticulate (although sometimes flexible) .....7
- 4*a* Ocelli present. The articulation of the terminal segments of the palpi rather indistinct. p. 164.....PHILOPOTAMIDAE
- 4*b* Ocelli absent. Articulations in the palpi distinct.....5
- 5*a* Spurs 3-4-4. p. 207.....POLYCENTROPIDAE
- 5*b* Spurs 2-4-4, rarely 0-4-4.....6
- 6*a* Cell  $R_2$  present in the fore wing and almost always in the hind wing (text fig. 12*b*). Hind wings not sharply pointed, at least as broad as the fore wings. Males without preanal appendages; females without ovipositors. p. 176.....HYDROPSYCHIDAE
- 6*b* Cell  $R_2$  absent in both wings (pl. 25, fig. 10). Hind wings pointed, narrower than the fore wings. Males with rodlike preanal appendages; females with ovipositors. p. 227.....PSYCHOMYIDAE<sup>20</sup>
- 7*a* Ocelli present .....8

<sup>19</sup> In the construction of the keys, especially those to the families, I have used as a basis those of other authors, particularly those of Ulmer.

Two families, beyond those included in this key, should be recognized. While the descriptions of these (Martynov, 1924*c*) have not been available, a knowledge of some of the genera involved indicates the wisdom of making these divisions. The key will carry the Stenopsychidae (confined to Asia, Australia, and Chili) to the Philopotamidae. The Arctopsychidae (p. 177, 180) are here included in the Hydropsychidae.

<sup>20</sup> The key takes no account of the subfamily Ecnominae (transferred to the Psychomyidae by Ulmer) since it is not represented in America (see p. 208).

- 7b Ocelli absent ..... 10
- 8a Anterior tibiae (except in one European genus) with two or three spurs; middle tibiae with four spurs..... 9
- 8b Anterior tibiae with one spur or none; middle tibiae with two or three spurs. p. 306..... LIMNEPHILIDAE
- 9a The first two segments of the maxillary palpus short and thick, the second rounded, the terminal segment acute at apex. Almost never a crossvein between  $Cu_{1a}$  and  $Cu_2$  near the margin (text fig. 14a). p. 124..... RHYACOPHILIDAE
- 9b Second segment of the maxillary palpus much longer than the first, the terminal segment not acute at apex. A crossvein between  $Cu_{1a}$  and  $Cu_2$  near the margin (text fig. 14b). p. 287..... PHRYGANEIDAE
- 10a Median cell (1st  $M_2$ ) present in the fore wing. p. 230..... CALAMOCERATIDAE
- 10b Median cell not present..... 11
- 11a Discoidal cell (1st  $R_3$ ) not present. p. 242..... MOLANNIDAE
- 11b Discoidal cell present..... 12
- 12a Antennae slender, about twice as long as the fore wings..... 13
- 12b Antennae stouter, but little if any longer than the fore wings..... 14
- 13a Cell  $R_4$  of the fore wing apparently absent.<sup>21</sup> Fore wings narrow. p. 251..... LEPTOCERIDAE
- 13b Cell  $R_4$  of the fore wing clearly present. Fore wings generally broad. Antennae often appearing dentate internally. p. 237..... ODONTOCERIDAE
- 14a  $R_5$  of the fore wing sharply angled so as to appear to arise from  $M_{1+2}$  by way of the crossvein  $r-m$  (text fig. 19b, pl. 66, fig. 1). Anterior margin of the hind wings with costal hooks. Basal segment of the maxillary palpus longer than any of the others. p. 415..... Genus *Helicopsyche*
- 14b  $R_5$  not appearing to arise from  $M_{1+2}$ . Anterior margin of the hind wings without costal hooks. Basal segment of the maxillary palpus not longer than the others. p. 381..... SERICOSTOMATIDAE<sup>22</sup>
- 15a Maxillary palpi with four segments. Ocelli present. p. 287..... Male PHRYGANEIDAE
- 15b Maxillary palpi with three segments or less..... 16
- 16a Ocelli present. Maxillary palpi filiform, the segments cylindrical, not held up before the face. Anterior tibiae with one spur. p. 306..... Male LIMNEPHILIDAE
- 16b Ocelli absent. Maxillary palpi often abnormally thickened, very hairy, often covered with scales, and held so as to mask the face..... 17
- 17a Anterior tibiae with one spur. Second and third segments of the maxillary palpi long but not covered with scales nor thickened. Hind wings with a row of costal hooks. p. 415..... Genus *Helicopsyche*
- 17b Anterior tibiae with two spurs. Second and third segments of the maxillary palpi often thickened and covered with scales. No costal hooks on the hind wings. p. 381..... Male SERICOSTOMATIDAE

LARVAE<sup>23</sup>

- 1a Larvae thysanuriform (text fig. 51a). Abdomen of nine segments; prolegs not fused in median line to form an apparent tenth segment<sup>24</sup> (text fig. 51a and c). No tubercles on first abdominal segment. No prosternal horn. No lateral line. Tracheal gills generally absent; rectal gills generally present, but not always everted..... 2

<sup>21</sup> In *Trianaodes* (pl. 39, fig. 7) one might perhaps be misled into thinking that this cell is present but that genus can easily be recognized by the absence of the main stem of media in the fore wing.

<sup>22</sup> All female *Sericostomatidae* (except *Helicopsyche*) are included here.

<sup>23</sup> This key to the families of trichopteran larvae (from *Can. Ent.*, 47, p. 217) was prepared for this report by Dr Joseph Krafka jr. It is based upon the key given by Ulmer in his work on the *Trichoptera* of Germany but there is considerable revision and addition resulting from an independent study of North American material.

<sup>24</sup> In the *Hydroptilidae* there is an indefinite suture crossing the ninth segment dorsally, giving somewhat the appearance of a tenth, but this family can easily be set off by the general shape of the body (see 2a).

- 1b Larvae eruciform or suberuciform (text fig. 51b). Basal segments of prolegs fused in median line to form an apparent tenth abdominal segment (text fig. 51b and d). Tubercles present on first abdominal segment. Prosternal horn present (text fig. 52q). Lateral line present, but sometimes very light. No rectal gills; tracheal gills generally present .....10
- 2a Abdomen very much wider than the thorax (text fig. 50). Small larvae with portable cases of silk. p. 143.....HYDROPTILIDAE

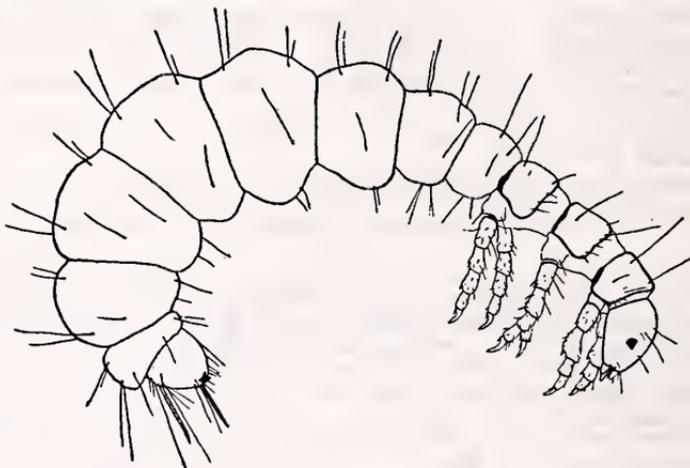


Fig. 50 Larva of *Hydroptila* sp.

- 2b Abdomen not very much wider than thorax. Cases when present not of silk only .....3
- 3a Chitinous shield present on the dorsal surface of the ninth abdominal segment (text fig. 51d, g and h).....4
- 3b No chitinous shield on the dorsal surface of the ninth abdominal segment .....5
- 4a Prolegs well developed, free; claws of the prolegs long and slender, without teeth on convex surface. Sometimes accessory claws present at side of main ones (text fig. 51g). Maxillary lobe long and slender (text fig. 51e). p. 125.....*Rhyacophilinae* (Family RHYACOPHILIDAE)
- 4b Prolegs short; basal segments wholly chitinized and fused to the ninth abdominal segment in a nearly vertical position. Claw very long with small teeth on convex side. Maxillary lobes short, broad, with many sense rods (text fig. 51f). p. 124.....*Glossosomatinae* (Family RHYACOPHILIDAE)
- 5a Branched tracheal gills present (text fig. 51a). All three thoracic segments chitinized dorsally. Numerous bristles on convex side of mandibles (text fig. 51m).....6
- 5b No tracheal gills. Only prothorax chitinized dorsally (except in *Econominae*, where all three segments are chitinized). Only two bristles on convex side of mandibles.....7
- 6a Dorsal surface of head flattened, forming a broad disk, inclosed by a heavy horseshoe-shaped ridge or carina, making a false frons. This carina crosses the true frons near its apex, setting off a small triangle (text fig. 51j). Mandibles toothed on whole inner margin; teeth broad and blunt; interspaces broad and deep (text fig. 51m). p. 200  
.....*Macronematinae* (Family HYDROPSYCHIDAE)
- 6b Dorsal surface of the head flattened, but disk not so sharply defined and practically limited to the true frons (text fig. 51k). No carina. Mandibles with sharp teeth at apical end. p. 177  
.....*Hydropsychinae* (Family HYDROPSYCHIDAE)

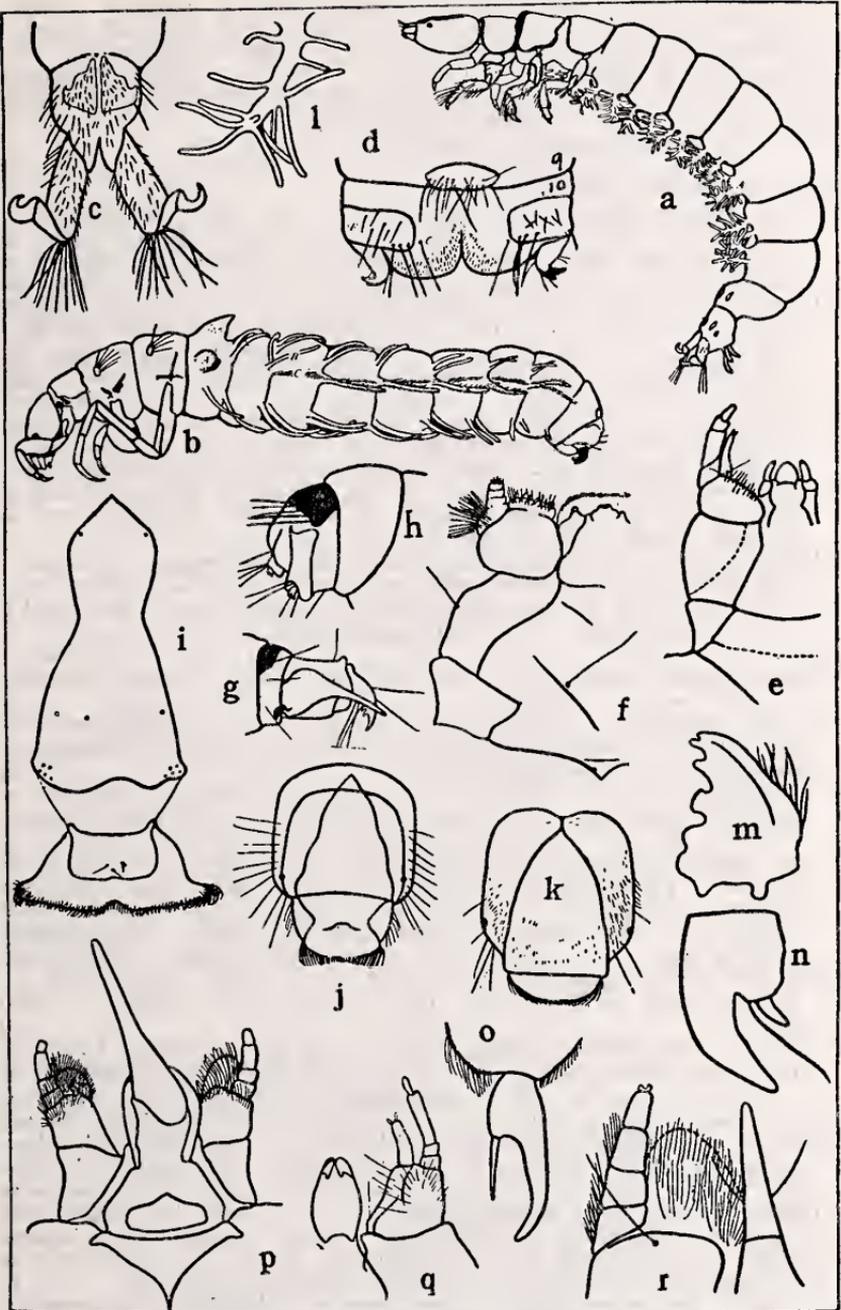


Fig. 51 (After Krafka). Illustrating larval characters used in the table

- 7a Labrum not wholly chitinized; its anterior angles and membrane connecting it to the frons, forming a flexible lip, bearing numerous bristles. Usually the anterior margin of the frons is asymmetrically curved (text fig. 51i). p. 164.....PHILOPOTAMIDAE
- 7b Labrum wholly chitinized; its anterior angles rounded. Anterior margin of the frons never asymmetrically curved.....8
- 8a All three thoracic segments chitinized dorsally. p. 208.  
.....*Ecnominae* (Family POLYCENTROPIDAE)
- 8b Only prothorax chitinized dorsally.....9
- 9a Claws of legs long, slender, with but one basal spur (text fig. 51o). Labial lobes short, not so long as the maxillary palpus except in *Phylocentropus* and probably *Acrocentropus*. Penultimate segment of maxillary palpus very long (text fig. 51q). p. 207.....POLYCENTROPIDAE
- 9b Claws of legs short; claw on first leg bears a basal spur and a bristle beside it (text fig. 51n). Two basal spurs on claws of second and third legs. Labial lobe long, slender, pointed, generally longer than the maxillary palpus. Maxillary palpus short; segments of equal length (text fig. 51r). p. 227.....PSYCHOMYIDAE
- 10a Labrum with a very distinct row of 20 or more heavy bristles traversing its dorsal surface at about one-third the distance from its front margin (text fig. 52a). p. 230. Genus *Ganonema* (Family CALAMOCERATIDAE)
- 10b Labrum without armature as above in 10a. Generally only three pairs of black bristles on its dorsal surfaces and three pairs of yellow spines on its front margin (text fig. 52b).....11
- 11a Labrum much longer than broad (text fig. 52c). Pronotum and mesonotum chitinized. Metanotum with four plates; two broad median ones, lying one behind the other (the posterior one being hard to distinguish), and two lateral ones, small and triangular (text fig. 52d). p. 237.  
.....ODONTOCERIDAE
- 11b Labrum much broader than long (text fig. 52b). Thoracic armature various, but not as above.....12
- 12a <sup>25</sup> Gula subquadrate, widely separating the halves of the epicranium (text fig. 52e, f). Prothorax and mesothorax chitinized dorsally. Metathorax membranous. No prosternal horn.....13
- 12b <sup>25</sup> Gula triangular, or elongated halves of the epicranium contiguous or nearly so at the apex of the gula (text fig. 52g, h). Thoracic armature not as in 12a. Prosternal horn generally present (text fig. 52q).....15
- 13a Long spur-bearing processes on distal ends of first and second tibiae (text fig. 52i). Hind tibiae divided (text fig. 52j). Hind claw either long and bristlelike or very short and bearing many bristles (text fig. 52k). Labial lobe with numerous bristles near the middle of the ventral side. p. 243.....*Molanninae* (Family MOLANNIDAE)
- 13b No spur-bearing processes on first and second tibiae. Hind tibiae not divided except in *Mystacides*. Claws normal. Few bristles on labial lobe.....14
- 14a Femora not divided into a short apical and a long distal piece. Mandibles with inner bristles, and a clump of accessory bristles near distal end of convex side (text fig. 52l). Chitin points over lateral line on abdominal segments 3 to 8. p. 249.....*Beraeinae* (Family MOLANNIDAE)
- 14b Femora of middle and hind legs divided into a small basal and a long apical piece (text fig. 52m). Right mandible without inner bristles. No accessory bristles on back of mandibles. p. 251.....LEPTOCERIDAE
- 15a Postsegmental gills on lateral line always covered with black hairs (text fig. 52o). Prothorax only chitinized. One pair of small bristle-bearing plates on mesothorax and on metathorax. p. 287.....PHRYGANEIDAE
- 15b Gills never with black hairs. Thoracic armature not as in 15a.....16
- 16a Prothorax and mesothorax chitinized dorsally. Metathorax membranous, bearing three pairs of small shields; median anterior pair very small; second pair small, slightly laterad and caudad of first; third pair largest, generally crescent-shaped, lying laterad of second; all well supplied with bristles (text fig. 52p). p. 306.....LIMNAPHILIDAE

<sup>25</sup> In two subfamilies the characters will not agree with all those listed in either 12a or 12b. Forms agreeing with 12b in all except the form and position of the gula (Brachycentrinae) or in all except thoracic armature (Sericostomatinae) should remain in 12b.

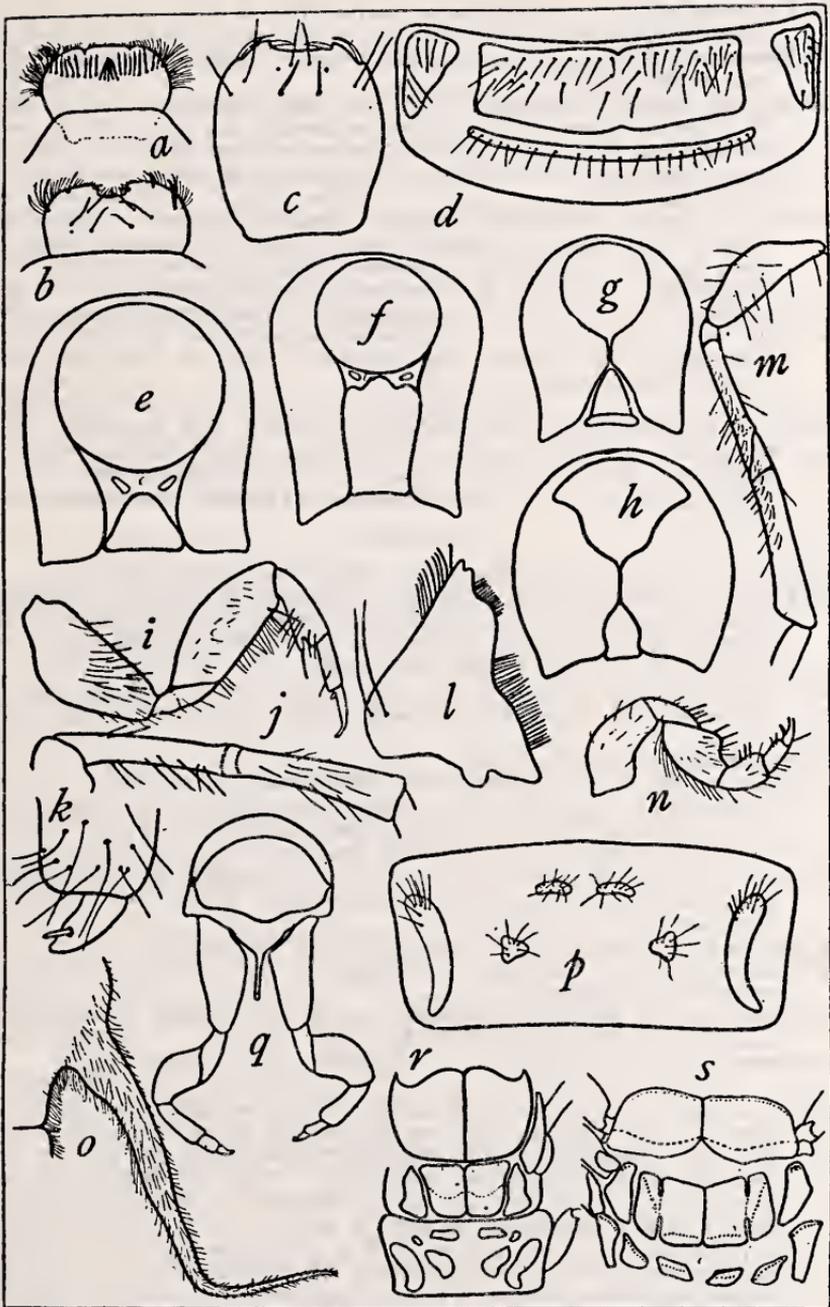


Fig. 52 (After Kraška). Illustrating larval characters used in the table

- 16b Thoracic armature not as in 16a.....17  
 17a Pronotum chitinized. Mesothorax bearing two or three pairs of heavily chitinized plates, metathorax with two or four pairs of smaller plates..18  
 17b Pronotum chitinized. Mesonotum and metanotum membranous, or at most only weakly chitinized.....19  
 18a Anterior angles of pronotum produced into pointed processes. Head retractile. Two or three pairs of plates on mesothorax; four pairs on metathorax (text fig. 52r). Tubercles present on first abdominal segment. Gula triangular; halves of the epicranium nearly contiguous behind its apex (text fig. 52g). p. 395....*Goerinae* (Family SERICOSTOMATIDAE)  
 18b Anterior angles of pronotum rounded. Head not retractile. Four broad plates on mesothorax, but only two pairs of smaller ones on metathorax (text fig. 52s). No lateral tubercles on first abdominal segment. Gula subquadrate; halves of the epicranium separated widely by the gula. p. 382.....*Brachycentrinae* (Family SERICOSTOMATIDAE)  
 19a Only lateral tubercles on first abdominal segment well developed. Gills threadlike, single. Middle and hind tibiae with one distal spur each. Prosternal horn present. p. 396.....*Lepidostomatinae* (Family SERICOSTOMATIDAE)  
 19b All three tubercles on first abdominal segment well developed. Gills threadlike, clustered; only on the anterior margins of the segments. Middle and hind tibiae without distal spur. No prosternal horn. p. 389. ....*Sericostomatinae* (Family SERICOSTOMATIDAE)

PUPAE<sup>26</sup>

- 1a Pupae in complete cases, these latter without inner silken cocoons.....2  
 1b Pupae in incomplete cases; that is, the margins of the case are fastened to some support, the side toward the support being covered with silk only, the latter being a continuation of the silk lining of the case; sometimes there is an inner nearly free cocoon.....15  
 2a Pupae with cases formed of branching tubes made of sand, not movable but submerged in sand bottoms with merely a turret projecting. p. 208. ....*Polycentropinae*  
 2b Pupae with cases not as in 2a.....3  
 3a Cases mostly flat or thickest in the middle, made of silk only or of silk covered with very fine sand. Antennae very short. The pupae themselves very small (not more than 5 mm, generally but 3 mm). Maxillary palpi 5-segmented in male and female. p. 143.....HYDROPTILIDAE  
 3b Cases forming true tubes. The antennae not extraordinarily short, at least nearly as long as the body. Maxillary palpi of the males 3-, 4- or 5-segmented.....4  
 4a Antennae very long, wound around the end of the abdomen.....5  
 4b Antennae at most but little longer than the body, the ends not wound around the abdomen.....6  
 5a Spurs 2-4-4. Mandibles produced into a long slender process whose curved point is divided (pl. 29, fig. 7, 8). p. 237.....ODONTOCERIDAE  
 5b Spurs 2-2-2, or 1-2-2, or 0-2-2. Mandibles not produced. p. 251. ....LEPTOCERIDAE  
 6a In the middle of the posterior margin of the first abdominal segment a broad process which extends over the base of the second segment (text fig. 46b). Mandible with a prominence from which the bristles arise (text fig. 44e), or mandibles rudimentary. Maxillary palpi of the male 4-segmented. Spurs 2-4-4. Anal processes flat, somewhat rhombic, with four long bristles at the end. p. 287.....PHRYGANEIDAE  
 6b First abdominal segment without such a process as described; generally the hind margin is somewhat raised in the middle or there is a saddle-shaped prominence beset with spines; often there are two lateral tubercles (text fig. 46c). Mandibles without the prominence. Maxillary palpi of the males 5- or 3- or indistinctly 2-segmented. Anal processes generally rodlike. Spurs various.....7

<sup>26</sup> This key is, with some changes and additions, a translation of that given by Ulmer. It will doubtless need a great deal of revision for the inclusion of American and other extra-European forms as these become known.

- 7a Cases of sand or of very small pebbles and coiled like a snail shell. p. 415.....Genus *Helicopsyche*
- 7b Cases not so.....8
- 8a Cases made of twigs hollowed out. p. 233.....Genus *Ganonema*
- 8b Cases not so.....9
- 9a Fore tibiae with one spur or with none; middle tibiae never with more than three spurs. The posterior margin of the first abdominal segment has a saddle-shaped prominence the sides of which are beset with short spines. Anal processes rodlike. Male maxillary palpi 3-segmented. p. 306.....LIMNEPHILIDAE
- 9b Anterior tibiae with two spurs. The posterior margin of the first abdominal segment without the saddle-shaped prominence.....10
- 10a Hind tibiae with four spurs.....11
- 10b Hind tibiae with two or three spurs. Maxillary palpi of the male evidently 3-segmented. Anal processes rodlike. p. 382....*Brachycentrinae*
- 11a Spurs 2-4-4.....12
- 11b Spurs 2-2-4.....14
- 12a Anal processes rodlike.....13
- 12b Anal processes short and flat, the last segment merely produced into two triangular lobes. Hind margin of the first abdominal segment with a long or short process on either side, this process beset with small chitinous points. Maxillary palpi of the male thick, masklike. Cases neither flat, shield-shaped, nor with stones along the sides. p. 396.....*Lepidostomatinae*
- 13a First abdominal segment with two lateral tubercles. Anal processes very long and slender. Maxillary palpi of the male indistinctly 3-segmented. Cases with stones along the sides. p. 395.....*Goerinae*
- 13b First abdominal segment without lateral tubercles, the hind margin with a transverse prominence. Anal processes shorter. Maxillary palpi of the male 5-segmented. Cases flat, shield-shaped, made of sand. p. 242.....MOLANNIDAE
- 14a Lateral line lacking. Pupae not more than 6 mm in length. Maxillary palpi of the male 5-segmented. p. 249.....*Beraeinae*
- 14b Lateral line present. Pupae at least 9 mm in length. Maxillary palpi of the male indistinctly segmented, generally broad. p. 389.....*Sericostomatinae*
- 15a Pupal cases made wholly of silk, the floor not closely woven. p. 153.....Genus *Polytrichia* (Family HYDROPTILIDAE)
- 15b Pupal cases not as in 15a.....16
- 16a Spurs 3-4-4. Anal processes not long.....17
- 16b Spurs 2-4-4.....19
- 17a Tracheal gills present, filamentous. Mandibles slender, clear, without teeth, curved like a saber. p. 208.....*Polycentropinae*
- 17b Gills lacking. Mandibles stout, not curved like a saber, dark.....18
- 18a Mandibles suddenly narrowing from a broad base, the blade without teeth. Inner wall of the case lined with a dull-colored cocoon. p. 208.....*Ecnominae*<sup>27</sup>
- 18b Mandibles not suddenly narrowed, with large teeth. Cocoon reddish brown, fastened to the case only at the posterior end. p. 125.....*Rhyacophilinae*
- 19a Tracheal gills present, branched. Mandibles with large teeth. Anal processes long, heavily chitinized, beset with many bristles. Pupal cocoon lines the entire inner wall of the case. p. 176.....HYDROPSYCHIDAE
- 19b Gills absent. Anal processes not long or rodlike, not strongly chitinized..20
- 20a Mandibles with large stout teeth.....21
- 20b Mandibles without teeth, produced into a very slender process. p. 227.....PSYCHOMYIDAE
- 21a Pupal cocoon lining one-half or more of the case. p. 164.....PHILOPOTAMIDAE
- 21b Pupal cocoon of a reddish brown color, affixed to the case only at the posterior end. p. 136.....*Glossosomatinae*

<sup>27</sup> No species so far reported from America.

## RHYACOPHILIDAE

Stephens, 1836, p. 154; McLachlan, 1879*c*, p. 429; Klapálek, 1904*a*, p. 9; Ulmer, 1907*c*, p. 202; Ulmer, 1909*a*, p. 11  
 Immature stages. Klapálek, 1893, p. 126; Ulmer, 1903*d*, p. 123; Siltala, 1905*b*, p. 141; Siltala, 1906*b*, p. 15; Ulmer, 1906*d*, p. 293; Siltala, 1907*c*, p. 375; Ulmer, 1909*a*, p. 204, 217, 288; Lestage, 1921*a*, p. 410; Lloyd, 1921, p. 110

Antennae not longer than the wings, ordinarily slender and with a short basal segment. Ocelli present. Maxillary palpi with five segments and similar in the sexes, the basal two segments short, the others long, the last segment not multiarticulate, often somewhat pointed, ending in a large sense hair (text fig. 3*c-e*). Legs slender, the middle tibiae dilated in the females of some of the genera. Spurs 3-4-4, 2-4-4, or 0-4-4, rather long, the inner and outer ones of about the same length. Wings moderately long, varying in the amount of pubescence. The venation for the most part regular, except in the subfamily Hydrobiosinae. In the fore wing  $Sc_2$  frequently present but may appear as a branch of  $R_1$  as discussed in detail on page 40. A discal cell (cell 1st  $R_3$ ) generally present except in *Rhyacophila*; median cell (cell 1st  $M_2$ ) almost never present (exceptions among the Hydrobiosinae).  $Cu_1$  and  $Cu_2$  not connected distally by a crossvein (except in Hydrobiosinae). In the hind wing the modifications concern chiefly the radius as discussed above (p. 50). Fibula of the fore wing well developed and anal lobe present in the hind wing. The abdomen often with ventral teeth in both sexes; in the female the posterior segments in the form of a retractile ovipositor.

Larvae thysanuriform, widest near the middle, the constrictions between the segments very deep. Antennae rudimentary; on a pale prominence behind the mandible two blunt sense rods and one or two pale bristles. Mouthparts prominent. The pronotum alone chitinized; very rarely a pair of small chitinous plates on meso- and metanotum. Legs about equally developed, increasing but slightly in length from the first. No tubercles on the first abdominal segment and no lateral fringe present. Tracheal gills present or absent. The anal prolegs generally small, but very well developed in *Rhyacophila*, always 2-segmented and with large claws. Larvae with or without cases.

Pupae spindle-shaped. Labrum rounded, approaching a semi-circle. Mandibles stout, sickle-shaped, with some large teeth on the cutting edge, and with numerous small teeth. The dorsal plates of hooks on the abdomen small, appearing in American forms here described on the anterior margins of segments 3 or 4 to 7 and on the posterior margins of segments 3 to 5; the number reported for European species somewhat less. No lateral fringe or tracheal gills.

The larvae of but one of the subfamilies are known to have cases but the pupae of all are of course inclosed; these have an inner silken cocoon and an outer stone case (pl. I, fig. 1). The outer cases are made of rather coarse pebbles and are commonly fastened to

larger stones; the inner cocoon is transparent brown and without openings so that the old larval skin is retained. The cocoon is fastened to the case at one end. The larvae and pupae are found only in swift water.

Very little is known regarding the eggs of Rhyacophilidae; the few recorded observations relate to species of *Rhyacophila* (p. 85).

## KEY TO THE SUBFAMILIES OF RHYACOPHILIDAE

### ADULTS

- 1a Spurs 3-4-4.  $Sc_1$  of the fore wing with an accessory anterior branch. No closed discal cell in either wing (pl. 5, fig. 4).  
.....RHYACOPHILINAE
- 1b Spurs 2-4-4. No accessory on  $Sc_1$ ; a discal cell often present in one or both wings (pl. 8, figs. 4, 5).  
.....2
- 2a Fore wings long and narrow (pl. 8, figs. 1-3), generally with erect thickened hairs on some parts of the wing veins, often with accessory crossveins, and generally with a number of hyaline spots. p. 135.  
.....HYDROBIOSINAE
- 2b Fore wings broader and shorter (pl. 8, fig. 4), without erect thickened hairs on the veins and without hyaline spots and accessory crossveins. p. 136.  
.....GLOSSOSOMATINAE

### LARVAE

- 1a Anal prolegs well developed; the claws long and slender, without hooks on the convex side (pl. 6, fig. 13). No portable case.  
.....RHYACOPHILINAE
- 1b Prolegs short, the claws with small hooks on the convex side (pl. 9, fig. 11). A portable case of elliptical form. p. 136.  
.....GLOSSOSOMATINAE

### PUPAE

- 1a Spurs 3-4-4 .....RHYACOPHILINAE
- 1b Spurs 2-4-4. p. 136. ....GLOSSOSOMATINAE

### RHYACOPHILINAE Ulmer

McLachlan, 1879c, p. 432 (Rhyacophilidae, Section 2); Ulmer, 1907c, p. 206; Ulmer, 1909a, p. 12  
Immature stages. Ulmer, 1903d, p. 124; Ulmer, 1909a, p. 217, 289; Lestage, 1921a, p. 412

This subfamily comprises the single genus *Rhyacophila*.

### *Rhyacophila* Pictet<sup>27a</sup>

Pictet, 1834, p. 181; McLachlan, 1879c, p. 434; Ulmer, 1907c, p. 206; Ulmer, 1909a, p. 12; Banks, 1911b, p. 354  
Immature stages. See Rhyacophilidae above.

Antennae shorter than the wings, slender, with very short basal segments, the next succeeding segments also broader than long, those toward the tip longer than broad. Head small, transverse, with a prominence between the antennae, posteriorly two large, oblique, elongate, oval warts each with a small rounded wart before it. Ocelli large and distinct. Maxillary palpi with two short, hairy, basal segments, the next ones more slender and much longer, the

<sup>27a</sup> See Addendum, p. 473.

fourth segment shorter than the third or the fifth, the latter somewhat curved and ending in a point (pl. 6, fig. 8). Legs long and slender, intermediate tibiae and tarsi of the females not dilated. Spurs 3-4-4, the inner but little longer than the outer. Wings moderately pubescent, elongate, the apex subangulate, or more rarely somewhat rounded. Hind wings shorter, of much the same shape as the fore wings. In the fore wings cells,  $R_2$ ,  $R_4$ ,  $M_1$ ,  $M_3$ , and  $Cu_1$  present, discal and median cells absent;  $Sc_2$  generally present but may not be well developed (p. 40); a strong accessory vein always present in the costal area (pl. 5, fig. 4). The fibula is well developed. In the hind wing cells  $R_2$ ,  $R_4$ ,  $M_1$  and  $Cu_1$  present, discal and median cells absent,  $Sc_2$  generally present but no accessory vein in the costal area. A large anal lobe present. Abdomen slender, not very hairy; the false sutures very evident on some of the segments; often a small tooth on the false suture of the seventh ventral segment, sometimes on the sixth also, and in one species at least small lobes on the sides of the fifth segment like those described by McLachlan in the males of *Glossosoma*. In the males the ninth dorsal segment ordinarily narrowed laterally and ventrally, the dorsal part sometimes prolonged into a long median process; this process not much developed in described North American forms. Claspers large, broad, 2-segmented, the second segment of various shapes. In some species a sheath extends from beneath the ventral division of the penis (pl. 5, fig. 7); this sheath may be divided into two large flaps (pl. 7, figs. 4, 5). Appendages of the penis sometimes in the form of bunches of stiff hairs on the stem; in some species such a brush of hairs on a stalk on either side of the penis, and in still others, large retractile appendages. In the females the eighth segment of the abdomen more or less emarginate dorsally and ventrally; ninth and tenth segments forming an ovipositor which may be telescoped within the body; the tenth segment with cerci.

Larvae broadest at about the second segment. Head of long oval shape, comparatively small, somewhat depressed. Eyes far forward, immediately behind the bases of the mandibles. Antennae rudimentary, standing between the eyes and the mandibles. Frons (fig. 33a) rather broad with a deep lateral indentation. Labrum broadly elliptical, joined to the frons by a long connecting membrane, anterior margin ordinarily not notched, usually six bristles on each side and one on the median line; in some published figures five lateral bristles and no median one. Mandibles short, bladelike, with one strong tooth which may be divided into three smaller points; no internal bunch of bristles. Maxillae and labium slender, the parts distinct. Maxillary palp curved, the labial lobes small. Pronotum alone chitinized, rectangular, commonly of a yellow color with a black margin. Legs stout, with few bristles; claws short and blunt, each with a very short spur at base. Most European species with tracheal gills on the abdomen and on meso- and metathorax; in the North American larvae now described no tracheal gills. Prolegs (text fig. 42a, b) stout, 2-segmented, with large stout claws

each armed with three blunt spurs. Sometimes long slender claws arising alongside of the prolegs.

Pupae inclosed in cocoons (pl. 1, fig. 1) in one end of which the larval skin may be seen. Body broad spindle-shaped. Labrum rounded in front, almost semicircular, with long bristles. Mandibles (text fig. 44a) large, with sharp apices and with numerous fine teeth; right mandibles usually with three, and the left with two, large teeth; two basal bristles. Pupal legs with claws, middle tibiae heavily fringed with swimming hairs. Plates with hooks on the anterior margins of segments 3 or 4-7 and on posterior margins of 3-5.

According to the observations of Kolenati (1851, p. 13) and of Siltala (1906b, p. 16), the eggs of certain species of *Rhyacophila* are laid in masses containing a large number. Weurlander's observations on *R. nubila*, given by Siltala (1906b, p. 17), are to the effect that they are laid singly and irregularly, the female descending below the water for oviposition.

The larvae are found in rapid streams. They build cases only at the approach of the pupation period; as larvae they are predatory and they keep their footing by the use of silken threads spun on the stones.

In the eastern species studied, the venation shows but little variation, less striking perhaps than the differences in the shape of the wings.

### *Rhyacophila andrea* n. sp.

(Pl. 5, figs. 1-3)

Length to tip of wings 8 mm. Wings brown with darker veins, and with yellow spots distributed rather uniformly; three golden flecks larger and brighter than in *carolina*. A black stripe (an area lacking the golden pubescence) extending obliquely from the apex of cell  $M_2$  to the posterior margin. Stigma prominent in the denuded wing. The seventh ventral segment has a very prominent tooth (pl. 5, fig. 2). The genitalia are very characteristic. As in one of the other species, the penis with a large retractile appendage, the latter in this case paired, the two parts being separate back to the point of juncture with the penis. Each of these appendages branched at the end and covered with a brush of very heavy hairs. The second segment of the claspers concave internally and heavily armed with short heavy bristles. In the fore wing  $Sc_{1a}$  definitely basad of the level of crossvein *m-cu*, the pedicel of cell  $M_1$  divided by the crossvein *r-m* so that its basal part is plainly less than half as long as the other.

The few specimens of this species taken were found on shrubbery near the water's edge in the gorge of Fall creek, Ithaca, N. Y., August 7th-28th.

**Rhyacophila atrata** Banks

Banks, 1911*b*, p. 351

"Belongs to section in which fork 2 extends farther basally than fork 1. Deep black, head and thorax rather shining, abdomen dull black; ocellar warts fully two diameters apart; legs yellowish, tarsi darker, spurs black, preapical one of the front tibiae but little longer than the width of the joint. Wings black, stigma very dark, a snow-white spot over veinlet connecting the medius and cubitus, no other pale spots; fore wings quite short and broad, outer margin rounded, fork 3 fully as long as the pedicel beyond the cross-vein, fork 4 wide at tip, fork 5 with parallel sides for most of the distance; hind wings black, but not so intense as the front pair.

"Expanse 12 mm.

"From Black Mountain, north fork of the Swannanoa River, North Carolina, May. The smallest species so far described from the United States." Banks *l. c.*

**Rhyacophila carolina** Banks

(Text figs. 29*a, b*; 37*f*; 44*c, d*; pl. 5, figs. 4-7)

Banks, 1911*b*, p. 353, pl. 13, fig. 31; Sibley, 1926*a*, p. 79 (*gordoni*); 1926*b*, p. 102, pl. 8, fig. 35 (*gordoni*); Carpenter, 1933, p. 41.

"Belongs to section in which the fork 2 extends farther basally than fork 1. Palpi brown; antennae pale on basal half and annulate with brown, dark or nearly black on apical half, basal joint pale; head dark, mostly golden, but some black hair, ocellar warts nearly twice their diameter apart; thorax brown, black on the sides above the wings, with some golden hair; abdomen brown; legs pale, in male the basal part of the tibia and basal joint of tarsus is dark above, the apical part of tibia very pale, in female legs are all pale yellow, spurs brown, preapical spur on front tibiae nearly twice as long as width of joint. Wings rather short, broad in middle, outer margin rounded; dark brown to nearly black, much spotted with white on apical part, with larger spots along outer and apical margin between veins, and a large spot before middle of wing on the hind margin, a black band across apical cells, black around stigma, and a few other black patches. Fork 3 about as long or longer than the pedicel beyond crossvein, fork 4 wide at tip.

"Expanse 20 mm.

"From Black Mountain, north fork of Swannanoa river, North Carolina, May." Banks, *l. c.*

Of this species I reared male and female from pupae found in Beaver Meadow brook, Old Forge, N. Y., July 2d-29th. Sibley (*l. c.*) reports it from McLean, N. Y., September 5th-23d. I add the following notes.

The pubescence of the fore wing in unrubbed specimens is to a considerable extent golden. In denuded specimens the stigma of

the fore wing is well marked. In the male there is a tooth on the seventh ventral segment and one also on the sixth ventral segment of the female. The penis has a large enveloping sheath as shown in the figures; its appendages are rods ending in knobs covered with hair (pl. 5, fig. 7). In the fore wing  $Sc_{1a}$  is at the level of the apex of cell  $R_3$ . Length to wing tips 10 mm.

### *Rhyacophila fairchildi* Banks

Banks, 1930a, p. 130, figs. 4, 7

Head brown, with yellow and black hair; antennae mostly pale on basal part, beyond dark; palpi dark on apical part; lateral ocelli only about three diameters from the eyes; thorax with mostly yellow hair; legs pale, darker on front tibiae and tarsi, spurs dark; abdomen dark above, pale beneath, on upper sides with rather short, erect, pale hairs. Wings fuscous, stigma darker, clothed with short black hair, and many patches of golden hair, two large spots on anal margin; in apical half of wing the golden occupies most of the space; veins with long, erect black hair, some here and there golden. In forewings fork 2 is a little before fork 1, fork 3 scarcely as far basad as fork 1, crossvein to radius close to fork 1; a rounded hyaline spot over forking of median vein. Expanse 14 mm.

"From Baddeck, Cape Breton, Nova Scotia, 4 Sept." Banks, *l.c.*

### *Rhyacophila formosa* Banks

Banks, 1911b, p. 353

"Belongs to section in which the fork 2 extends farther basally than fork 1. Palpi black, antennae with black basal joint, beyond pale, broadly annulate with deep black; head black, with black and some white hair, ocellar warts small, about twice their diameter apart; thorax black, with two faint white submedian streaks; abdomen black above, paler beneath; legs pale, front and mid-tibiae with black spot before the preapical spur, and also at tip, the tarsi marked with dark, a narrow pale ring at the preapical spur, latter in the front tibia but little longer than width of the joint. Wings deep black, with innumerable small patches of yellow hair, many large white spots, one in base of fork 2, several along the apical and outer margin between veins, but two spaces at tip, and one near anal angle unspotted, numerous small spots near anal angle and in the stigmal region; fore wings long and narrow, outer margin nearly straight, slightly incurved at fork 4, fork 3 longer than pedicel, beyond cross vein, fork 4 scarcely as long as fork 3, fork 5 with parallel sides.

"Expanse 22 mm.

"From Delaware Water Gap, N. J. (Slosson)." Banks, *l. c.*

**Rhyacophila fuscula** Walker

(Text figs. 3c-c; 9c; 26a, b; 34a; 37l; 38a; 42a, b; 43c; 44a; pl. 6, figs. 1-5.) Walker, 1852, p. 10 (*Neuronia*); Hagen, 1861c, p. 295; Ulmer, 1907c, p. 210, pl. 41, fig. 4; Carpenter, 1933, p. 40, fig. 5  
Immature stages. Lloyd, 1921, p. 112-14, figs. 184-89

"Ferruginous, partly with black hair, beneath testaceous; thorax each side with a subfuscous spot; feet testaceous, apex of the anterior tibiae fuscous; wings cinereous, the anterior ones irrorated with whitish and with many marginal guttae. (From the description of Walker.)

"Length to tip of wings 13 mm. Alar expanse 25 mm.

"Hab. St Martin's Falls, Albany River, Hudson's Bay (Barnston)." Hagen, *l.c.*

The following notes may be added:

Ground color of the wings brown with some light dots, veins darker. Pubescence black, golden, and white, the pattern varying considerably, the white spots mostly in the apical half of the wing, the largest patch of white in the middle of the hind margin. Hind wings dark brown with some white spots along the margin. Antennae shorter than the wings; the basal parts of the segments dark, the apical parts lighter. Hind legs pale; in the other pairs the femora pale, the tibiae and the tarsal segments dark with lighter proximal areas; in addition, on these legs, a pale band at the level of the subapical spurs. A green color like that of the larvae often apparent in the legs, palpi, antennae, ocelli, and in the radius of the hind wings. In the male, blunt teeth on the false sutures on the ventral side of segments 6 and 7; in the female, a tooth on the sixth segment only. Length (male) 12-13 mm, (female) 16-17 mm.

This species is common at Ithaca, N. Y., during July and August. The larvae are to be found in Fall creek, more plentifully in Cascadilla creek and Coy glen. The pupal cases are attached along little ledges of the limestone over which the water flows rapidly.

**Rhyacophila glaberrima** Ulmer

Ulmer, 1907b, p. 85, figs. 131, 132; Sibley, 1926b, p. 102; Carpenter, 1933, p. 41

Ulmer's description is as follows (translated):

"Head and thorax dark brown; abdomen blackish brown above, yellowish brown beneath. Warts of the head and prothorax yellowish brown with pubescence of the same color; antennae dark yellow, for some distance from the fifth segment on, ringed with dark brown. Palpi dark brown; legs dark yellow, the coxae brown. Membrane of the fore wing shining brown, transparent, with a few golden yellow spots in the first apical cell ( $R_2$ ) and near the costa (probably rubbed); venation somewhat darker brown; hind wings clearer than the fore wings, iridescent, with brown hairs; veins as in the fore wings; fringes in both wings brown; on the costal

margin of the fore wing at base a row of branched hairs as in *Rhyacophila tristis*, etc., the shape of the wings and the venation as in that species; but fork 3 of the hind wing considerably shorter than its pedicel. Male genitalia (*l.c.*, figs. 131, 132) yellowish brown; the ninth segment dorsally produced into a bandlike process, whose sides are turned down near the base, the other half flat; the distal portion dark; beneath lies the excavated tenth segment, with lateral margins (with the exception of the narrow distal part) folded dorsally; the second segment of the clasper with a very short dorsal and a long ventral side; the distal margin somewhat concave and the ventral angle curved toward the median plane; the penis not visible in the specimen.

"Length of body 5 mm; expanse 14 mm.

"One male specimen, Georgia, Morris.

"This species, because of its small size and its color, resembles dark specimens of *Dolophilus* and *Chimarra*."

Doctor Ulmer informs me that the citation of Massachusetts as a locality in which the species occurs (*Genera Insectorum*, Fasc. 60) is an error. Sibley (*l.c.*) reports the species doubtfully from McLean, N. Y., July 28th.

### *Rhyacophila invaria* Walker

Walker, 1852, p. 101 (*Polycentropus*); Hagen, 1861c, p. 292 (*Polycentropus*); Banks, 1930a, p. 130

"Fulvous, with golden hair; vertex and disk of the thorax black; antennae black, the base fulvous; feet testaceous; anterior wings subfuscous, with ferruginous veins; posterior wings cinereous. (From the description of Walker).

"Length to tip of wings 9 millim. Alar expanse 16 millim.

"Hab. Nova Scotia (Redman)." Hagen, *l. c.*

Banks regards his *luctuosa* (see *torva*) as possibly a synonym.

### *Rhyacophila lobifera* n. sp.

(Text figs. 26f; 36a; 37n; 45; pl. 6, figs. 6-14)

Length to tip of wings 12 mm. Head with some golden hair. Wings dark, spotted with lighter pubescence in the distal half and on the anterior margin. Legs yellow, sometimes marked with green, spurs dark. On the fifth abdominal segment a rounded lateral expansion in both male and female. At the posterior margin of the seventh segment of the female on each side a short blunt rod (pl. 6, fig. 10). The male genitalia (pl. 6, figs. 7, 9) quite unlike those of the eastern species. Like *R. carolina* in having  $Sc_{1a}$  of the fore wing at the level of the apex of cell  $R_3$ .

This species was reared from larvae and pupae found in the south branch of Pettibone's creek near Lake Bluff, Ill. Adults appear during the last of May and the early part of June.

**Rhyacophila mainensis** Banks

Banks, 1911b, p. 354

"Belongs to section in which the fork 1 extends as far or farther basally than fork 2. Palpi pale; antennae pale, basal joint pale; head dark, with yellowish hair; ocellar warts very small, fully twice their diameter apart; thorax black, abdomen brown; legs pale, tarsi darker, spurs brown, preapical one of front tibiae fully twice the width of joint. Wings long and slender, outer margin straight; uniform pale brownish, the stigma hardly darker, no prominent spots, and but little hair, fork 3 a little longer than the pedicel beyond the cross vein, fork 4 long and narrow, fork 5 with subparallel sides, also long, fork 1 reaching a little farther basally than fork 2.

"Expanse 20 mm.

"From Moosehead, Maine, 18 July (Johnson)." Banks, *l.c.*

The type is a female, the wings almost nude, perhaps rubbed.

**Rhyacophila minora** Banks

Banks, 1924, p. 444, pl. 3, fig. 37

"Head and thorax brown, with some yellowish hair; palpi and antennae brown; abdomen dark brown; appendages yellowish brown; legs yellowish. Wings brown, unmarked, except stigma very dark, and a pale spot at thyridium; fork 1 not quite as far back as fork 2, its pedicel twice the width of a cell, fork 3 nearly as long as fork 4, the latter about equal to its pedicel, first anal cell twice as long as the second. Male genitalia are very short; above are two approximate plates, hollowed and sculptured above, the lower appendages have the second joint narrowed from base to tip.

"Expanse 15 mm." Banks, *l.c.*

Described from the White Mountains, New Hampshire.

**Rhyacophila nigrita** Banks

(Pl. 7, figs. 1-5)

Banks, 1907a, p. 132, pl. 9, fig. 16 (*torva* Banks, not Hagen): Banks, 1907a, p. 132

Expanse 17 mm. Head, thorax, and antennae dark brown to black, the basal segment of the antennae somewhat lighter; palpi a little paler. Legs yellow. Wings uniform brown, very sparsely covered with black hair. Stigma of both wings rather darker than the rest of the wing membrane. Abdomen with a small tooth on the seventh ventral segment. Genitalia of the same general type as those of some of the preceding species but the shape of the claspers and of the appendages of the penis far different, as the figures show.

The venation differs from that of most other species in that the accessory branch of *Sc* is relatively far toward the base of the wing.

One male specimen from Colden, N. Y., collected by E. P. Van Duzee, June 7th. It agrees with Banks' *nigrita* from North Carolina. I think it the same as what Mr Banks regards as *torva* Hagen but I do not agree with his determination of the latter.

### *Rhyacophila soror* Provancher

Provancher, 1878*a*, p. 135; Provancher, 1878*b*, p. 142<sup>3</sup>

"Long. .42 pce. Brune, couverte en partie de poils jaune-doré. Tête et thorax brun-foncé; la face jaunâtre. Antennes grêles, longues, brunes. Abdomen jaunâtre. Ailes hyallines-brunes, avec les nervures brunes, les antérieures maculées de points jaune-pâle. Pattes jaune-pâle, leurs épines de la même couleur." Provancher, *l.c.*, p. 142.<sup>3</sup>

This species is attributed to Hagen by Provancher but no reference is given to any earlier description.

### *Rhyacophila torva* Hagen

(Pl. 7, figs. 6-9)

Hagen, 1861*c*, p. 296; Banks, 1907*a*, p. 132, pl. 8, fig. 7 (*terminata*); Banks, 1911*b*, p. 351, pl. 13, fig. 24 (*luctuosa*); Carpenter, 1933, p. 40, fig. 7  
Immature stages. Vorhies, 1909, p. 713; Lloyd, 1921, p. 114-16, figs. 190-92

"Rufo-fuscous; antennae and palpi rufo-fuscous; head and thorax brownish black; feet testaceous; abdomen luteous; wings fuscohyaline, with fuscous veins; anterior ones with dense luteous guttae. Male.

"Length to tip of wings 10 millim. Alar expanse 19 millim.

"Hab. Washington; Trenton Falls (Osten Sacken)." Hagen, *l.c.*

"Belongs to section in which fork 2 extends farther basally than fork 1. Head, palpi and antennae deep black, head with much golden hair, ocellar warts more than two diameters apart; thorax black, with golden hair in front; abdomen dull black, paler beneath, and genitalia pale; legs pale on femora, dark on tibiae and tarsi, spurs dark, the preapical one on first tibia nearly twice as long as the width of the joint. Wings blackish, veins black, stigma also black, heavily spotted with yellow in the cells, a larger spot on the stigma, no large spot on the anal margin; wings long but with outer margin rounded, fork 3 shorter than the pedicel beyond the cross vein, fork 5 with nearly parallel sides; hind wings dusky, black near tips.

"Expanse 20 mm.

"From Woodworth Lake, Fulton County, New York, 23 June (Alexander), and one (not fully colored) from Dane county, Wisconsin (Vorhies)." Banks, 1911.

Banks' description of *terminata* is based on material from Delaware Water Gap, N. J., and from Ithaca, N. Y.

The following may be added from my own notes on specimens taken in Coy's glen, Ithaca, N. Y., June 1st-21st:

There is a ventral tooth on the seventh ventral of the male abdomen. The male genitalia are very different from those of the other species here figured; the ninth segment is as broad ventrally as dorsally, the tenth segment is very long; the basal segment of the clasper is roughly quadrate, the second segment longer, with the dorsal margin curved. The penis is deeply cleft as seen from the side and bears on each side a long slender rod.

Length to tip of wings, male 8 mm, female 10 mm.

Vorhies describes larva and pupa and Lloyd the larva, but the reference to this species is uncertain.

Banks (1930a, p. 130) states that probably his *luctuosa*, which I include here, is the same as Walker's *invaria* (p. 131).

Notes and figures are added of two species of *Rhyacophila* of which I have only fragmentary material.

### *Rhyacophila* sp. 1

(Pl. 7, figs. 10, 11)

Length to the tip of the wings 8 mm. Wings uniform dark brown, veins darker; pubescence not heavy. The pterostigma somewhat darker than the rest of the wing. Cells  $R_2$  and  $R_3$  of the fore wing equal in length. The claspers blunt and heavy, the division into segments not clearly indicated. The penis is small, with a long, pointed, chitinized rod beneath; in addition a very large retractile appendage which ends in a broad scoop, a structure doubtless corresponding to that figured for the European *R. stigmatica* by McLachlan (Rev. and Syn., pl. 48) and by Klapálek (1903e, pl. 1, fig. 12).

One male specimen from Beaver Meadow brook, Old Forge, N. Y., July 4th.

### *Rhyacophila* sp. 2

(Pl. 7, figs. 12, 13)

Length to tip of wings (male) 10 mm. Wing membrane dark brown covered with black, white, and golden hair. The black and the golden hair about equally distributed, the white spots more localized along the margins, with a particularly large patch on the middle of the inner margin of the fore wing. The costal area brown with a series of pale spots widely spaced. Antennal segments dark at base, lighter at their distal ends. Palpi brown, covered with black hair. Anterior and middle legs covered with black hair, with pale bands at the joints, a pale band also on the tibiae two-thirds the way from the proximal end; femora and tibiae of the hind legs pale with no lighter bands on the tibiae. Teeth present on the sixth and seventh ventral segments.

One male specimen taken at the outlet of the sixth lake of the Fulton Chain, August 8th.

## WESTERN AND SOUTHERN SPECIES OF RHYACOPHILA

*Rhyacophila acropedes* Banks

Banks, 1914*b*, p. 201, pl. 10, fig. 39. Utah.

*Rhyacophila alberta* Banks

Banks, 1918, p. 21, pl. 1, fig. 10; Banks, 1919, p. 3, Ketchikan, Alaska, Banff, Alberta.

*Rhyacophila angelita* Banks

Banks, 1911*b*, p. 352, pl. 13, fig. 29. California.

*Rhyacophila anomala* Banks

Banks, 1924, p. 444, pl. 4, fig. 49. Colorado.

*Rhyacophila basalis* Banks

Banks, 1911*b*, p. 352, pl. 13, fig. 26. California.

*Rhyacophila bifila* Banks

Banks, 1914*b*, p. 201, pl. 15, figs. 53, 56. British Columbia.

*Rhyacophila bipartita* Banks

Banks, 1914*b*, p. 201, pl. 15, figs. 43, 54. Banff, Canada.

*Rhyacophila brunnea* Banks

Banks, 1911*b*, p. 352. New Mexico.

*Rhyacophila coloradensis* Banks

Banks, 1904*a*, p. 108, pl. 1, fig. 7 (*stigmatica*, but corrected to *coloradensis* in plate reference); Banks, 1905*c*, p. 10. New Mexico, Colorado.

*Rhyacophila grandis* Banks

Banks, 1911*b*, p. 350, pl. 13, fig. 27. British Columbia.

*Rhyacophila hyalinata* Banks

Banks, 1905*c*, p. 10. Colorado.

*Rhyacophila mexicana* Banks

Banks, 1900*a*, p. 259. Mexico.

*Rhyacophila nevadensis* Banks

Banks, 1924, p. 443, pl. 4, fig. 53. Nevada.

*Rhyacophila pacifica* Banks

Banks, 1895, p. 316. Washington.

*Rhyacophila rotunda* Banks

Banks, 1924, p. 443, pl. 3, fig. 33. Nevada.

## HYDROBIOSINAE Ulmer

Ulmer, 1905*a*, p. 72; Ulmer, 1907*c*, p. 203

Antennae slender, about as long as the wings, the basal segment thick, shorter than the head. Ocelli present. Maxillary palpi with the basal two segments short, the others long, the terminal one not pointed, generally flexible. Middle legs of the females not dilated.

Spurs 2-4-4. Wings very long and generally very narrow, the fore wings (except in one genus) with hyaline spots like those of the common Philopotamid genus *Chimarra*, on the veins erect thickened hairs. The venation irregular, often with accessory crossveins (pl. 8, fig. 2). Ventral abdominal segments generally with long, rarely short, spinelike projections. Male genitalia with greatly developed claspers.

Figures of *Psilochorema*, and *Apsilochorema* (India) are added to illustrate the venation of the subfamily (pl. 8, figs. 1-3).

The following genus was described as being nearly related to *Philopotamus* but was removed to this family by Ulmer who places it near *Psilochorema* (New Zealand, Chile).

### Atopsyche Banks

Banks, 1905c, p. 17; Ulmer, 1907c, p. 205

Ocelli present. Maxillary palpi with the basal two segments short, the others longer and nearly equal. Spurs 2-4-4 (male and female), inner apical longer than the outer. Middle legs of the female not dilated. Fore wing long and narrow, broadened toward the apex. Discal cell present, placed at about the middle of the wing length, apical cells very long; cells  $R_2$ ,  $R_4$ ,  $M_1$ ,  $M_3$ , and  $Cu_1$  present, of which only  $R_4$  is nonpedicellate; crossvein *m-cu* oblique. Hind wings about as broad as the fore wings. Cells  $R_2$ ,  $M_2$ , and  $Cu_1$  present, no discal or median cell. Venation alike in the sexes. Male genitalia with large 2-segmented claspers. Sixth and seventh ventral segments (male and female) with a long, somewhat curved, tooth.

One western and one central American species. The figure of the venation (pl. 8, fig. 1) is from a specimen kindly given to me by Mr Banks.

#### *Atopsyche longipennis* Ulmer

Ulmer, 1905d, p. 110, pl. 4, figs. 144-46; Ulmer, 1907c, pl. 27, fig. 248b; Ulmer, 1913d, p. 404. Brazil, Panama.

#### *Atopsyche tripunctata* Banks (pl. 8, fig. 1)

Banks, 1905c, p. 17; Ulmer, 1907c, pl. 27, fig. 248a. Arizona.

### GLOSSOSOMATINAE Ulmer

McLachlan, 1879c, p. 467 (Rhyacophilidae, Section 3); Ulmer 1903d, p. 128; Silfvenius, 1905b, p. 148; Ulmer, 1907c, p. 210; Ulmer, 1909a, p. 21. Immature stages. Ulmer, 1909a, p. 221, 289; Lestage, 1921a, p. 419; Lloyd, 1921, p. 116

See also the bibliography to the family.

Antennae hairy, widely separated at base, generally shorter than the wings, the basal segment thicker than the others but shorter than

the head. Ocelli present. Maxillary palpi generally hairy, the first two segments very short, the fourth commonly shorter than the third, also shorter than the fifth. Labial palpi very small. Fore wings long, rounded or elliptical at the apex, rarely with the apex somewhat produced, fibula small. Wings with close-lying pubescence but without erect thickened hairs; fringes long. Hind wings narrower than the fore wings, often very narrow, generally with a somewhat blunt apex. Venation of the fore wing much like that of *Rhyacophila*, but no anterior accessory branch on *Sc*; *Sc*<sub>1</sub> and *Sc*<sub>2</sub> separate only in *Glossosoma* and *Mystrophora*; the discal cell always present, often large; apical cells mostly long and narrow, cells *R*<sub>2</sub>, *R*<sub>4</sub>, *M*<sub>1</sub>, *M*<sub>3</sub>, and *Cu*<sub>1</sub> being present in both sexes. In the hind wing the discal cell present or absent. Venation of the hind wing modified mainly in the reduction of the anterior veins as discussed above (p. 50). The genitalia of the male often very complicated. The sixth and seventh segments of the male, more rarely of the female also, with toothlike or platelike projections. The abdomen of the female posteriorly modified as an ovipositor.

Larvae nearly uniformly broad, at least from the second to the fifth abdominal segment. Head bent down somewhat, approaching the eruciform type more than does *Rhyacophila*, but the abdominal constrictions deep. Antennae rudimentary but more developed than in the Rhyacophilinae, consisting of two adjacent rods, each of two segments. Mouthparts prominent. Labrum joined to the frons by a long membrane; the anterior margin notched in most species; from four to six bristles toward each side; the margin of the sclerite distinctly thinner than the middle. Labium and maxillae broader than long and with numerous hairs. Maxillary palpi short. Pronotum alone chitinized. Legs stout, the second and third pairs successively somewhat longer; claws short, stout, with a basal spur. No tracheal gills and no lateral fringe. Claws of the prolegs with hooks on their convex sides.

Pupae cylindrical in shape. Labrum semicircular to transversely elliptical, somewhat widened at the base; three pairs of bristles on the front margin. Mandibles symmetrical, finely toothed, with several large teeth and with two small basal bristles. Tibiae and tarsi of the middle legs broad and with long fringes, other legs naked. Chitin plates present at least on the posterior margin of the fourth segment. No lateral fringe or respiratory filaments.

The larvae, except perhaps in their younger stages, construct dome-shaped cases of small stones (pl. 1, fig. 2), closed beneath except at either end. At the time of pupation the floor of the case is removed and the dome is fastened to a larger stone. The pupae lie in cocoons, red or brown in color, fastened to the case at one end.

The larvae and pupae are oftenest found in small streams. Concerning the eggs and the egg-laying habits in this subfamily nothing appears to be known.

## KEY TO THE GENERA OF ADULT GLOSSOSOMATINAE

- 1a Radial crossvein ( $r$ ) of the fore wing very oblique,  $R_{2+3}$  rather sharply bent at this point, discal cell broad, cell  $M_1$  and generally  $M_3$ , extending toward the base of the wing beyond the level of the crossvein of the sector, radius of the hind wing with five branches running free to the wing margin (pl. 8, figs. 4, 5).....2
- 1b Radial crossvein of the fore wing not very oblique,  $R_{2+3}$  not sharply bent, neither cell  $M_1$  nor cell  $M_3$  reaching the level of the crossvein of the sector, radius of the hind wing with less than five branches running free to the hind margin (pl. 10, figs. 1, 2), p. 141.....*Agapetus*
- 2a The inner apical spur of the hind leg of the male normal.....*Glossosoma*
- 2b The inner apical spur of the hind leg of the male highly modified (text fig. 6e), p. 140.....*Mystrophora*

**Glossosoma Curtis**

Curtis, 1834, p. 216; McLachlan, 1879c, p. 468; Ulmer, 1907c, p. 211; Ulmer, 1909a, p. 22

Immature stages. Ulmer, 1903d, p. 129; Silfvenius, 1905b, p. 151; Ulmer, 1909a, p. 221, 290; Lestage, 1921a, p. 423

Head with two elongate warts posteriorly, and with two small ones between the lateral ocelli. Antennae shorter than the wings, formed as in *Rhyacophila*, but the third segment longer. Maxillary palpi similar to those of *Rhyacophila*, but the last segments thinner; the fifth segment terminated by a sense hair. Legs slender, slightly pubescent. Spurs 2-4-4, those of the anterior legs short, those on the other tibiae long and slender, the inner slightly longer than the outer. In the female the middle tibiae and the basal segments of the tarsi greatly dilated. Fore wings with short, not dense, pubescence, fringes rather long, fibula present. In the males of most European species and in some North American forms a large callosity in the anal area of the fore wing (text fig. 7a). Venation like that of *Mystrophora* (pl. 8, figs. 4, 5). In the fore wing  $R_{2+3}$ , forming most of the anterior boundary of the discal cell, arched toward  $R_1$  to which it is joined by a crossvein. Discal cell present in both pairs of wings. In most other respects the venation like that of *Rhyacophila*. Anal lobe present in the hind wing. Abdomen slender, slightly hairy. In the male on the sixth segment a large spoon-shaped plate, on the seventh segment a median tooth, and at the base of the sides of the fifth segment sometimes an obtusely triangular plate. In the female a sharp triangular tooth on the sixth ventral segment. Claspers of the male finger-shaped and composed of a single segment, the ninth sternite running out into a long unpaired process placed asymmetrically and sometimes having an asymmetrical tooth at its apex.

Of the eastern species I have seen only females. The males of *alascense*, *penitum*, and *ventrale* (western) have the callosity on the fore wing. The type of *parvulum* is a female and not well preserved.

**Glossosoma lividum Hagen**

Hagen, 1861c, p. 295 (*Timodes*)

"Luteous with gray hair; antennae luteous; palpi luteo-fuscous, feet pale, the anterior ones luteous; head and thorax luteo-fuscous,

with luteous hair; anterior wings gray, with gray hair and an anal luteous spot; posterior wings grayish hyaline. Female.

"Length to tip of wings 8 millim. Alar expanse 15 millim.

"Hab. St Lawrence River, Canada (Osten Sacken).

"Does it belong to this genus (*Tinodes*)?" Hagen, *l.c.*, p. 295.

The type is a female and undoubtedly belongs either to *Glossosoma* or *Mystrophora*. Hagen had evidently noted this and had placed it with *Glossosoma* in his collection, although the correction has not been published. In the absence of a male specimen it is at present impossible to decide between the two genera indicated. The type of this species differs from *Mystrophora americana* in having crossvein *r-m* of the fore wing oblique and in line with the base of the free part of  $R_5$ ; in the hind wing cell  $R_3$  is pedicellate, that is,  $R_3$  and  $R_4$  have fused at the place where the crossvein closing the discal cell ordinarily stands. Not enough material of *Mystrophora* is at hand to give basis for judging whether these variations may not occur in that genus.

### *Glossosoma nigrior* Banks

Banks, 1911b, p. 355, pl. 13, fig. 23; Carpenter, 1933, p. 42

"Black; antennae pale, darker at tip; palpi black; head and thorax with black and white hair, ocellar warts transverse, about one and one-half diameters apart; abdomen black; legs pale yellowish, spurs brown. Wings blackish, fringe black, stigma dark. Venter of the male with two spines near tip; metatarsi of middle legs of female broad and flattened. Wings moderately long, fork of median vein as far back as the fork of radial sector, fork 4 wide at tip, much shorter than 3 or 5.

"Expanse 18 mm.

"From Black Mountain, North Carolina, north fork of the Swannanoa River, May." Banks, *l.c.*

I have not seen the male of this species.

#### WESTERN SPECIES OF GLOSSOSOMA

*Glossosoma alascense* Banks

Banks, 1900b, p. 472, pl. 28, figs. 17, 18. Alaska.

*Glossosoma parvulum* Banks

Banks, 1904a, p. 108, pl. 1, fig. 13. New Mexico.

*Glossosoma penitum* Banks

Banks, 1914b, p. 202, pl. 9, figs. 16, 19. British Columbia.

*Glossosoma ventrale* Banks

Banks, 1904a, p. 109, pl. 1, fig. 14. New Mexico.

### Mystrophora Klapálek

Klapálek, 1892, p. 19, fig. 8; McLachlan, 1903, p. 31, fig. 1; Ulmer, 1907c, p. 212; Ulmer, 1909a, p. 23

Closely related to *Glossosoma*; like that genus in respect to antennae, palpi, ocelli, spur formula, and venation. Crossvein of the sector of the hind wing short and sometimes (at least in one species) veins  $R_3$  and  $R_4$  fused at this point making cell  $2d R_3$  (the second apical) pedicellate. Inner spur of the hind leg of the male broader than the outer one, ending in a sharp, twisted hook (text fig. 6e). Abdomen of the male with ventral plate on segment 6 as in *Glossosoma*, a tooth on 7 and another on 8. In contrast to those of *Glossosoma*, the genitalia not asymmetrical.

### Mystrophora americana Banks

(Text figs. 6e, 26e; 34b; 37i; 38c; pl. 8, figs. 4-6, pl. 9, figs. 1-14)

Banks, 1897, p. 31 (*Glossosoma*); Sibley, 1926b, p. 102, 204  
Immature stages. Lloyd, 1921, p. 116-18, figs. 193-97 (*Glossosoma*); Sibley, 1926b, p. 102, 204, pl. 8, figs. 32-34

"Length 9 mm; alar expanse 16 mm. Pale, head yellowish, darker above, with luteous hair; antennae yellow, apical half fuscous; palpi pale brownish; thorax pale, with luteous hair; legs pale yellowish, spurs blackish, coxae fuscous. Abdomen light brown. Wings hyaline, sparsely clothed with luteous and gray hair, some near tips of fore wings and the fringe darker gray, veins luteous, a white mark at end of thyridial area, a spot on forking of cubitus, and another at arculus; antennae shorter than the body, slender; basal joint a little enlarged; third and fifth joints of palpi subequal, fourth a trifle shorter. Legs moderate, hind tibiae quite slender and curved, tibiae and first tarsal joint enlarged in the second legs of female; spurs 2-4-4, the upper pair on hind legs about their length before the apical pair, above them are three small yellow spines; wings moderately broad, rounded at tip, discal cell in both pairs closed, radius above the middle of discal cell in fore wings suddenly, but slightly bent, an oblique crossvein connecting the cell and radius, fifth apical cell almost reaching the anastomosis; near the tip of the antepenultimate ventral segment of the female is a distinct conical tooth.

"One female, Franconia, New Hampshire (Mrs A. T. Slosson)." Banks, *l.c.*

A male specimen of what is probably this species was given me by Dr A. D. Macgillivray. I have more recently bred the species at Ithaca, N. Y., and I have examined some specimens in the collection of Dr J. T. Lloyd. In these specimens the short pubescence of the fore wing is black and there is a luteous spot in the anal area. The tooth on the abdomen of the female is on segment 6, those of the male on segments 6 and 7. Figures of the venation, the genitalia, and of the spurs of the hind leg are added.

The species was collected at Newfield and in Coy glen near Ithaca, N. Y. The larvae were found in a little roadside rill running parallel to the glen and others picked up in the Niagara gorge

perhaps belong to the same species. The materials described and figured by Lloyd (*l.c.*) and by Sibley (*l.c.*) were from McLean, N. Y.

With regard to the adults it should be said that in some the wings seem narrower than in others and that possibly two species are here included but I have found no differences in the genitalia.

### *Mystrophora* sp.

(Pl. 9, figs. 15-17)

In addition to the preceding a single specimen taken at Ogdensburg, N. Y., may possibly be recognized from the figures of the genitalia. The penis and the encircling structures (not shown in the figures) are much like those of the preceding species; the tenth segment is far different and the upper large branch of the claspers is again divided.

### *Agapetus* Curtis

Curtis, 1834, p. 217; McLachlan, 1879*c*, p. 475; Ulmer, 1907*c*, p. 213; Ulmer, 1909*a*, p. 23  
Immature stages. Ulmer, 1903*d*, p. 130; Lestage, 1921*a*, p. 426

Head with warts like those of *Glossosoma* but with an extra pair placed further forward; these elongate, slightly curving and converging anteriorly. Ocelli small. Antennae stout, pubescent, the segments longer than broad, basal segment stouter than the others, but only one-fourth the length of the head. Maxillary palpi pubescent, basal two segments very short, third the longest, the fifth not terminated by a sense hair. Legs long, middle tibiae and tarsi strongly dilated in the female. Spurs 2-4-4, those of the middle and hind legs somewhat unequal; middle tibiae of the female with long stiff hairs along the side. Fore wings very hairy, with dense fringes. *Sc* short, turning into the costal margin rather abruptly at about the end of the discal cell; the upper margin of the latter cell usually somewhat concave. Venation of the hind wing as described on p. 50. Abdomen very short, in the male the fifth ventral segment either side with a very large, somewhat rounded, and slightly elevated hairy plate; on the sixth ventral segment a corneous process, often very long, dilated at base; in the female often a tooth or a slight tuft of hairs on the seventh ventral segment and sometimes a similar tooth on the sixth segment.

The two Canadian species described by Walker will probably always remain doubtful.

### *Agapetus minutus* Sibley

(Pl. 10, figs. 2-5)

Sibley, 1926*a*, p. 79; 1926*b*, p. 102  
Immature stages. Sibley, 1926*b*, p. 203, pl. 8, figs. 23-31

"Length of body—3.8 mm.

"Length to tip of wings—4.3 mm.

"Head fuscous; vertex with two pairs of yellowish warts. Antennae with first two segments yellowish brown; remaining segments brown, lighter toward tip. Palpi brown, all segments short; segments of labial palpi of about equal length.

"Thorax reddish brown. Legs brownish yellow. Fore wings dark brown, shining; a narrow white spot on media where it forks; tip of *Sc* and crossvein *r-m* white. Hind wings smoky.

"Abdomen reddish brown; a stout short backward projecting spine in center of seventh abdominal sternite." Sibley, *l.c.*, p. 79.

The species is described from McLean, N. Y., September 13th-23d. I have a single specimen taken at Ithaca, N. Y., June 19th. It has a rather long tooth on the sixth ventral segment. There is a chitinous point on the side of the tenth segment as shown in the figure (pl. 10, fig. 5).

Possibly the species should be referred to *Pseudagapetus* McL. since *Sc* of the hind wing is nearly confluent with the margin and then distinctly recedes from it but this is true also of *Agapetus* to an extent not shown in published figures.

#### *Agapetus obscurus* Walker

Walker, 1852, p. 121 (*Beraca*); Hagen, 1861c, p. 297 (*Chimarrha*); McLachlan, 1863c, p. 163 (*Chimarrha*)

"Blackish, with fuscous hair; thorax and abdomen ferruginous; feet testaceous; antennae black; wings brownish black, ciliated. (From the description of Walker.)

"Length to tip of wings  $4\frac{1}{4}$  millim. Alar expanse 8 millim.

"Hab. St Martin's Falls, Albany River, Hudson's Bay (Barnston).

"Does it belong to this genus?" Hagen, *l.c.*

"Perhaps an *Agapetus*." McLachlan, *l.c.*

#### *Agapetus tenebrosus* Walker

Walker, 1852, p. 134 (*Hydroptila*); Hagen, 1861c, p. 274 (*Hydroptila*); McLachlan, 1863c, p. 158 (*Hydroptila*)

"Blackish; antennae fuscous, the basal article larger, ovate; feet testaceous; wings blackish gray, ciliated, with black veins. (From the description of Walker.)

"Length to tip of wings 4 millim. Alar expanse 6 millim.

"Hab. St Martin's Falls, Albany River, Hudson's Bay (Barnston). Hagen, *l.c.*

"Some of the types of this species (*H. tenebrosa*) belong to the genus *Agapetus*." McLachlan, *l.c.*

#### WESTERN SPECIES OF AGAPETUS

##### *Agapetus celatus* McLachlan

McLachlan, 1871, p. 139, pl. IV, fig. 23. California.

##### *Agapetus malleatus* Banks

Banks, 1914b, p. 202, fig. 57. California.

## HYDROPTILIDAE

Stephens, 1836, p. 151; Eaton, 1873, p. 125-49; McLachlan, 1880a, p. 501; Klapálek, 1904a, p. 13; Thienemann, 1904c, p. 437; Ulmer, 1907c, p. 216; Ulmer, 1909a, p. 25  
Immature stages. Klapálek, 1893, p. 135; Ulmer, 1903d, p. 131; Silfvenius, 1904a, p. 1-38; Ulmer, 1906d, p. 294; Silfvenius, 1906b, p. 18; Siltala, 1907c, p. 383; Ulmer, 1909a, p. 204, 222, 291; Lestage, 1921a, p. 432

Head with warts which may be prominent and sometimes elevated into lobes, clothed with dense tufts of hair. Antennae (see *Orthotrichia pictipes*, Banks, p. 152) generally stout, shorter than the wings; the basal segment shorter than the head but generally decidedly larger and more rounded than the other segments; the second segment often shorter than any of the others. Ocelli present or absent, present in most genera. Maxillary palpi 5-segmented in both sexes, the first two segments short, third and fourth about equal, fifth somewhat longer, sometimes considerably longer. Labial palpi 3-segmented, the first and the second segments about equal, the third generally larger. Legs moderately long, rather hairy; in most of the genera the middle femora equal in length to the tibiae or slightly less, in *Protoptila* slightly longer than the tibiae; hind femora from one-half to five-sevenths the length of the tibiae. Tibial spurs varying in number according to the genus but the number alike for the sexes; inner spurs always longer than the outer; on the middle legs the larger subapical spur shorter than the larger apical spur; in the hind legs this condition reversed. Wings generally long and narrow, often with acute apex; fringes very long, especially on the hind wings where they may be several times as long as the wing is wide. The fibula of the fore wing present in some genera as a narrow fingerlike lobe; in other genera much reduced or absent. Fore wings with numerous erect thickened hairs. Venation varying from the generalized to a highly specialized type, the specialization almost wholly by reduction. Abdomen hairy, somewhat longer in the female than in the male; the sixth or seventh ventral segment of the male with a process which may be long enough to reach to the end of the body. Genitalia various; the penis often with a chitinous rod wound around its base and extending out to about its own length. Abdomen of the females like that of the Rhyacophilidae, the last two segments being retractile. The tenth segment with cerci.

Larvae thysanuriform, the head long, oval in shape, the abdomen somewhat compressed, widest from the fourth to the sixth segment, much wider there than elsewhere or than the head and thorax. Antennae fairly large, about as large as the mandibles; with but a single segment and this tipped by at least one bristle. Mouthparts not prominent. Labrum much broader than long, the anterior portion not strongly chitinized, anterior margin notched and with a bunch of bristles on either side; on the dorsal surface three lateral bristles, one on either side posteriorly and one also on each side anteriorly. Mandibles short, conical, and asymmetrical, the left often longer than the right and often having a bunch of bristles not

found on the right. Maxillae and labium broad but the lobe and the palp of the maxilla long and slender.

All the segments of the thorax chitinized, the sclerite of the pronotum extending over the sides of that segment. Legs equal in length or the hind legs longer than the others. No tubercles, no lateral fringes, and no tracheal gills on the abdomen; in *Ithytrichia* large lateral out-pouchings which probably function in respiration (text fig. 41e). Anal prolegs short, 2-segmented, with strong claws, the chitinous support at the base of each with three posterior bristles and a lateral one.

Pupae spindle-shaped. Antennae much shorter than the body. Labrum with few hairs or with none. Mandibles stout, with broad base and slender blade, with two basal bristles. Chitinous plates with hooks on the anterior margins of segments 3-7, and on the posterior margins of segments 3-5. No lateral fringe or tracheal gills. Pupal claws not much chitinized. Tibiae of the middle legs generally with swimming hairs.

Larval cases portable, considerably larger than the body, made of silk and often covered with very fine sand grains. Pupal cases similar but the ends closed, fastened to stones or to vegetation, sometimes with conspicuous holdfasts.

Siltala's observations leave no doubt that the females of this family lay their eggs beneath the water, though the tibiae and tarsi are not dilated as is commonly the case when this habit is established. The eggs have scarcely any gelatinous covering and sometimes are laid so close together as to press each other into hexagonal shape.

In this family the venation is obscured by the pubescence which must be carefully removed if one is to trace the veins; also, there are present some confusing furrows which rather closely simulate the appearance of veins, sometimes following the course of the latter and sometimes running between them. The fore wing appears to bend transversely at about its middle and consequently there is ordinarily a well-marked transverse furrow which obliterates some of the regular crossveins. In some of the published figures the furrow is represented as a line of crossveins from the radius to the posterior margin of the wing. It is probable that the part running from  $Cu_2$  to the margin represents a furrow only, the other parts may or may not have obliterated crossveins. Thus in *Allotruchia* (pl. 11, fig. 6) the crossvein  $r-m$  is not obliterated by the furrow but is found some distance beyond it. The details of the venation are mentioned in the generic descriptions that follow; some general facts regarding it may here be noted. There is a general tendency toward reduction correlated with the narrowing of the wings. In the fore wings  $R_1$  tends to fuse with  $Sc$  at tip but the base of its free part remains in all the genera as apparently an oblique crossvein from

Sc to the radial sector;  $R_3$  tends to migrate upon  $R_4$  and then all the branches of the sector tend to fuse from the base outward; media and radius are usually separate, but in one genus, *Polytrichia*, branches of media have migrated upon radius;  $Cu_{1a}$  is always lacking unless, as seems likely, it is represented by the apparent crossvein from  $Cu_1$  to  $Cu_2$  in *Orthotrichia* (pl. 12, fig. 6). If this vein is present in the other genera it must coincide with the transverse furrow of the wing.  $R_2$  and  $R_3$  of the hind wings are always fused. In figures of *Agraylea* heretofore published these veins are represented as separate and this is made a distinguishing character between *Agraylea* and *Allotrichia*. In all the specimens of *Agraylea* that I have examined the veins are fused but there is a furrow in front of  $R_{2+3}$  which might readily be mistaken for  $R_3$ .

The species of this family are all minute, the adults averaging less than 6 mm in length. They swarm at lights and are extremely rapid runners considering their size. Most of my material is alcoholic, so that little is here given regarding the pubescence or the color. It seems probable that the color of the antennae, which is often not uniform, may serve as a means for the easy identification of the species of a given locality. With the material in hand it is impossible to determine the females specifically.

Of the 15 genera of Hydroptilidae at present described, ten are found in North America. These ten may be separated by the following key, exception being made of *Orthotrichia pallida* Banks, *Orthotrichia pictipes* Banks, and *Oxyethira dorsalis* Banks, which are described as having a spur formula of 1-3-4, not characteristic of their respective genera, or indeed of any genera of the family. *Orthotrichia pictipes* at least is representative of a new genus not here described (see under the genus, p. 152).

The species described by Morton were mostly obtained from a miscellaneous undated lot collected at Ithaca, N. Y., in the summer of 1901.

## KEY TO THE GENERA OF HYDROPTILIDAE

- 1a Radial sector of the fore wing with four branches and cell  $R_2$  pedicellate, that is,  $R_3$  joins  $R_2$  instead of having migrated upon  $R_{4+5}$ ; venation of the fore wing fairly complete (pl. 11, fig. 4).....2
- 1b Radial sector of the fore wing with less than four branches or if all are present, cell  $R_2$  not pedicellate owing to the migration of  $R_3$  upon  $R_{4+5}$  (pl. 13, fig. 7); venation much reduced in some of the genera.....5
- 2a Ocelli present. Cell  $R_4$  of the fore wing reaching at least to the middle of cell  $R_2$ ; the first division of the radial sector of the hind wing near the middle of the wing.....3
- 2b Ocelli absent. Cell  $R_4$  does not reach to the middle of cell  $R_2$ ; the first branching of the radial sector of the hind wing at about two-thirds the length of the wing (pl. 12, fig. 6). p. 150.....*Orthotrichia*

- 3a Spurs 0-3-4. First branching of the radial sector of the fore wing near the middle of the wing; no discal cell present;  $Cu_1$  runs free to the wing margin; media of the hind wing three-branched (pl. 11, fig. 4).....4
- 3b Spurs 0-4-4. First branching of the radial sector of the fore wing far toward the base of the wing; discal cell present;  $Cu_1$  runs only to the transverse furrow of the wing; media of the hind wing two-branched (pl. 12, fig. 1). p. 149.....*Protoptila*
- 4a Apex of the fore wings subobtuse. Cell  $R_2$  of the fore wing more than twice as long as the free part of  $R_{2+3}$  (the pedicel of the cell);  $R_1$  appearing separate from  $Sc$ ; cell  $M_1$  of the hind wing not reaching as far toward the base of the wing as cell  $R_4$  (pl. 11, fig. 4). ....*Agraylea*
- 4b Apex of the fore wings more acute. Cell  $R_2$  of the fore wing less than twice as long as its pedicel;  $R_1$  fused with  $Sc$ ; cell  $M_1$  of the hind wing reaching as far back as cell  $R_4$  (pl. 11, fig. 6). p. 148.....*Allotrichia*
- 5a Radial sector of the fore wing with four branches.....6
- 5b Radial sector of the fore wing with less than four branches, venation much reduced and often very obscure.....8
- 6a Spurs 0-3-4. Ocelli present. Media of the hind wing arched forward into the radial sector (pl. 12, fig. 11).....7
- 6b Spurs 0-2-4. Ocelli absent. Media of the hind wing not arched into the radial sector (pl. 13, fig. 7). p. 157.....*Hydroptila*
- 7a Media of the fore wing arched into the radial sector; media of the hind wing three-branched (pl. 12, fig. 11). p. 153.....*Polytrichia*
- 7b Media of the fore wing not arched into the radial sector; media of the hind wing two-branched (pl. 13, fig. 3). p. 155.....*Ithytrichia*
- 8a Four spurs on the hind tibiae.....9
- 8b Spurs 0-2-3. p. 163.....*Neotrichia*
- 9a Spurs 0-3-4. Terminal segment of the maxillary palpi less than twice as long as the fourth. Terminal segment of the antennae not suddenly narrowed to a point (pl. 14, fig. 8). p. 161.....*Oxyethira*
- 9b Spurs 0-2-4. Terminal segment of the maxillary palpi twice as long as the fourth. Terminal segment of the antennae suddenly narrowed to a point (pl. 14, fig. 13). p. 164.....Undescribed genus

### Agraylea Curtis

Curtis, 1834, p. 217; Kolenati, 1848b, p. 103 (*Hydrorchestria*); Hagen, 1865b, p. 219 (*Hydrorchestria*); McLachlan, 1880a, p. 505; Ulmer, 1907c, p. 221; Ulmer, 1909a, p. 27

Immature stages. Lestage, 1921a, p. 441

Antennae with about 27 segments, the basal segment short and wider than the others, the second shorter than those succeeding. Ocelli present. Maxillary palpi with the first and second segments short, the others subequal, the fifth longest. Spurs 0-3-4. Femora and tibiae of the middle legs about equal, femora of the hind legs about four-sevenths of the length of the tibiae. Fore wings (pl. 11, fig. 4) rather broad, the apex rounded; hind wings narrower, the costal margin not excised. Fibula present in the fore wing. Venation nearly typical; in American specimens of *A. multipunctata*  $R_2$  and  $R_3$  of the hind wing not separate as in figures heretofore published.

Of this genus one species is reported from the Eastern States: it is identical with the European species.

*Agraylea multipunctata* Curtis

(Text figs. 5c, 9b, 36h, pl. 10, figs. 7-12, pl. 11, figs. 1-5)

Curtis, 1834, p. 217; Kolenati, 1848b, p. 103 (*Hydrorchestria*); McLachlan, 1880a, p. 506, pl. 58, figs. 1, 2; Morton, 1905, p. 74, fig. 15; Ulmer, 1907c, pl. 27, fig. 258b, pl. 28, fig. 264, pl. 41, fig. 7; Banks, 1907b, p. 164 (*fraterna*); Ulmer, 1909a, p. 28, fig. 37; Sibley, 1926b, p. 102, 204

Immature stages. Morton 1886a, p. 269; Silfvenius, 1904a, p. 6, pl. 1, figs. 1a-e; Siltala, 1907c, p. 386; Ulmer, 1909a, p. 204, 225, 293; Sibley, 1926b, pl. 10, fig. 64

"Antennae blackish fuscous. Body blackish fuscous, abdomen greenish in life; blackish in dry examples, with pale lateral lines; the ventral surface clothed with silky yellowish hairs. Head and pronotum clothed with greyish yellow hairs. Legs subtestaceous, with fuscous femora; clothed with pale hairs. Anterior-wings ordinarily blackish, with numerous distinct golden-yellow markings, mostly forming spots, but usually there is also a long and broad space near the apex of the costal margin, about two elongate spaces on the inner margin, and two or three apical spots extending into the fringes, which are otherwise dark (but these markings are very variable; individuals occur in which they are entirely absent, the wings then being wholly blackish, or in which they invade the whole wing, obliterating the dark ground, and causing the insect to appear pale cinereous). Posterior wings unicolorous gray, with concolorous, slightly iridescent, fringes.

"In the male there appears to be a bilobed shining yellowish plate under the margin of the last dorsal segment. Superior (intermediate?) appendages in the form of two contiguous yellowish bands, very strongly curved downward; from between them escapes the penis, which is dark, straight, updirected, its apex dilated and truncate. Inferior appendages, viewed ventrally, very distant, up-curved, yellowish, subcylindrical, but they are apparently connected with two up-curved contiguous median processes, seen from the middle of the ventral margin, more slender than the appendages and blackish at the tips; internally, on either side of these, is a triangular piece. Lobe of the antepenultimate ventral segment long, flattened and adpressed, dilated gradually to the apex, which is shallowly excised and narrowly blackish; the color otherwise testaceous; at the base of this lobe is a subtriangular blunt tooth.

"In the female the abdomen ends in a stout up-curved ovipositor, and there is the usual small sharp tooth on the ante-penultimate ventral segment.

"Expanse, 7½-9 mm." McLachlan, *l.c.*

"The superior (intermediate?) appendages of McLachlan, described by him as in the form of two contiguous yellowish bands very strongly curved downward, appear to be separate at the base only, the downward tip being rounded. . . . The construction of the so-called triangular pieces is very peculiar and their appearance depends much on the degree to which they are exerted.

"The North American insect is practically identical with the European; the only difference appears to be in the upcurved contiguous median processes which are probably rather shorter and stouter in the American form. The latter was bred by Needham at Lake Forest in June, and he sent the same species from Chicopee, Mass. (23 April 1903). It will probably prove to be common in the Northern States." Morton *l.c.*, p. 75.

I have taken this species at various points in New York State; it was abundant at Ogdensburg. The dates of my captures range from July 19th to September 6th, those of Sibley, June 28th to September 21st. I found the pupae and adults common also at Waubesa lake, Wis., about July 1st and have added figures from specimens there taken. I have collected cases of this species at Diamond lake, Ill. These are much larger than those described above and perhaps another species is to be found here.

Among the specimens which I took in Wisconsin the females seem on the average darker than the males. The males measure 4 mm to the tip of the wings and the females 5 mm.

I have examined the type of *fraterna* with great care and am certain that it is not different.

#### *Allotrichia* McLachlan

McLachlan, 1880a, p. 508; Ulmer, 1907c, p. 221

Antennae as in *Agraylea* but more pubescent. Ocelli present. Maxillary palpi with third segment short and thick, the fourth and fifth slender and subequal. Spurs 0-3-4. Wings (pl. II, fig. 6) more acute than in *Agraylea* and nearly as wide. Venation much as in *Agraylea* but cell  $R_2$  of the fore wing is much shorter, as is cell  $R_3$  of the hind wing; crossvein  $r-m$  of the fore wing placed beyond the transverse furrow of the wing; fibula present.

Of this genus no species is reported from New York State. There is one western species and the following two occur in eastern states.

#### *Allotrichia maculata* Banks

Banks, 1904b, p. 116, 3 figs.

"Head with tufts of white hair over bases of antennae and on the vertex; also on the lateral lobes of the thorax. Ocelli present. Antennae pale on the basal half, then wide black band, then a narrow white band, then a broad black one, with a narrow white tip. Legs pale, anterior tibiae and tarsi marked with brown on the outer side; hind tibiae with long white fringe behind; spurs 0-3-4. Wings dark brown, a white spot on costal third, one at pterostigma, a smaller one near the tip, three on posterior margin, one near middle, and one on apical fourth; there are black spots adjoining most of the

white ones; and two other black patches, one at tip, and one on posterior margin near tip. Hind wings with gray fringe, black around the tip. Expanse 5 mm.

"Specimens from Falls Church, Va., in August and September." Banks *l. c.*

#### *Allotrichia signata* Banks

Banks, 1904*d*, p. 215

"Antennae yellowish; head and thorax with yellowish hairs, ocelli present; fore wings black, with yellow spots as follows: a large oblong one at pterostigma, four rather large ones at subequal distances apart on the hind margin, and several small dots near the apex; fringe black, except at the pale spots where it is of the same color; hind wings gray, with gray fringe, except the apical part of the costal which is black; on the hind margin the fringe is but little longer than width of wing; legs yellow, spurs 0-3-4, hind and middle tibiae fringed, but the fringe not very long. The fore wings have a moderately sharp tip; the hind wings are long and narrow, with an elongate concavity along costal margin beyond middle of the wing. Length 4 mm.

"One specimen from Falls Church, Va., 29th June." Banks, *l. c.*

One western species.

#### *Allotrichia flavida* Banks

Banks, 1907*b*, p. 164. Colorado.

#### *Protoptila* Banks

Hagen, 1861*c*, p. 296 (*Beraea?*); Banks, 1904*d*, p. 215; Ulmer, 1906*b*, p. 99; Ulmer, 1907*c*, p. 220

"Spurs 0-4-4. Last joint of the maxillary palpus simple. Fore wings rather slender and nearly acute at tip, without erect hair, except a few on base, fringe moderately long; hind wing slender, costal margin before middle strongly excised, fringe very broad behind. Ocelli distinct; antennae moderately long, not very heavy; middle and hind tibiae heavily fringed behind.

"Type: *Beraea? maculata* Hagen.

"I place this genus in the Hydroptilidae although there are few erect hairs and there are four spurs on middle tibiae; yet the structure of the hind wing and the palpi place it there without doubt." Banks, *l. c.*

The following may be added: first segment of the antennae stout, the next succeeding vary somewhat in different specimens. The figure (text fig: 5*b*) shows the ordinary type, but the second segment is sometimes longer; sometimes the third and fourth segments are not separated but together form one long segment; the number of the segments is about twenty-five. The maxillary palpus has a short second segment, which is broad as seen from the side (pl. 12,

fig. 2); the fifth segment is longest. The wings are broad as in the two preceding genera. The venation (pl. 12, fig. 1) is nearly typical also; it differs from that of *Agraylea* and *Allotrichia* in having the radial sector separating into  $R_{2+3}$  and  $R_{4+5}$  far back and in having a closed discal cell in the fore wing; media of the hind wing has but two branches; the anterior part of the wing is obscure but  $Sc$  and  $R_1$  do not seem to fuse; in this *Protoptila* is like *Agraylea*.

### *Protoptila maculata* Hagen

(Text fig. 5b, pl. 12, figs. 1-5)

Hagen, 1861c, p. 296 (*Beraca?*); Banks, 1904d, p. 215, pl. 2, figs. 1, 13 16; Ulmer, 1906b, p. 99, fig. 108; Ulmer, 1907c, p. 220, pl. 28, fig. 262, pl. 41, fig. 9

"Black, with black hair; antennae yellow, the base, middle and apex blackish-fuscous; palpi fuscous; feet whitish, annulated with black; abdomen pale beneath; anterior wings black, with black hair and cilia, with two white, transverse apical lines, and the apex pointed with white; posterior wings black, the anterior at the apex emarginated.

"Length to tip of wings 4 millim. Alar expanse  $7\frac{1}{2}$  millim.

"Hab. St Lawrence River, Canada (Osten Sacken).

"Does it belong to this genus [*Beraca*]?" Hagen, *l. c.*, p. 296.

Banks (*l. c.*, p. 215) says that this species is not uncommon along the Potomac in late summer.

The figure of the venation (pl. 12, fig. 1) is practically like that of Ulmer (*l. c.*, fig. 108); those of the genitalia differ somewhat from that given by Banks (*l. c.*, pl. 2, fig. 16). My specimens seem to exceed the type in size, the fore wing alone measuring 4 mm. The number of antennal segments is twenty-five. There is a ventral tooth on segment 6 in male and female.

The species was taken at Buffalo, Ithaca, and Ogdensburg, N. Y. July 9th to August 23d.

### *Orthotrichia* Eaton

McLachlan, 1865b, p. 95 (*Hydroptila*); Eaton, 1873, p. 141; McLachlan, 1880a, p. 518; Ulmer, 1907c, p. 225; Ulmer, 1909a, p. 34  
Immature stages. Klapálek, 1897a, p. 1-16; Struck, 1900, p. 29, 30; Silfvenius, 1904a, p. 23; Lestage, 1921a, p. 455

Antennae thick, the basal segment not much larger than the others (see *O. pictipes*). Ocelli absent. Maxillary palpi slender, the fifth segment largest. Spurs 0-3-4. Wings more acute than in the preceding genera. Venation (pl. 12, fig. 6) fairly complete but not easily distinguishable; ultimate branches of the radial sector in the fore wing separating rather near the margin, particularly so in the case of  $R_4$  and  $R_5$ , the apex of cell  $R_4$  coming about opposite the

point where  $R_3$  reaches the wing margin;  $Cu_1$  and  $Cu_{1a}$  fused at tip forming with  $Cu_2$  a closed triangle.

Case of the one European species known, fastened to erect sub-merged stems, not sharply compressed, the upper surface with deep longitudinal grooves; anterior end of the pupal case blunt and with two flaps between which a ventral slit; posterior end more acute, also with two flaps and a ventral slit; narrow ventral side of the case fastened by a disk at either end.

The appearance of a triangle in the venation, mentioned above as characteristic of the genus, occurs also in at least one species of *Ithytrichia* (pl. 13, fig. 3) and in one of *Hydroptila* (pl. 13, fig. 7), but in these the basal side of the triangle is part of the transverse furrow and is straight while in *Orthotrichia* that side of the triangle is formed by a distinct vein ( $Cu_{1a}$ ?) which is oblique and curved; other characters used in the key will readily avoid confusion with these genera.

### *Orthotrichia americana* Banks

(Pl. 12, figs. 6-10)

Banks, 1904b, p. 116, 1 fig.; Morton, 1905, p. 73, fig. 15 (*cristata*)

"Head with a dense tuft of snow-white hair between eyes, a broad white median stripe on the thorax, and the anal region of fore wings gray-white; so that when the wings are closed there is a median white dorsal stripe the entire length. Antennae wholly pale whitish; legs pale, unmarked, spurs 0-3-4; hind tibiae with long white fringe behind. Wings acute, anterior pair brown, with some white hairs, mostly forming several white spots near costal margin toward tip. Hind wings narrow, with long pale-gray fringe; hair of abdomen long and appressed. The male shows the long, two-jointed penis, as in the common European species, and a black ventral plate, hid in dense hair. Expanse 4.8 mm.

"Many specimens from Washington, D. C., in July and August." Banks, *l. c.*

Morton adds the following:

"The dorsal plate in the male is almost entire in its outer edge; from the one side, on the upper surface, arises a short hook, while on the other side, nearer the middle, arises a long, slender, much-curved process bent strongly inwards under the plate itself. The last ventral segment terminates in two separate blackish plates which are broadest where they approach each other, narrowing outwards, their apices bearing a spine; between these plates is a black appendage which seen from the side is hook-shaped and bears two spines. The seventh ventral segment with a process covered with strong thick blunt hairs; the sixth segment with a small tooth.

"Lake Forest, Ill. (Needham).

"The process on the seventh ventral segment is very similar to that found in the European *O. tetensii*." Morton, *l. c.*, p. 75.

I include figures of the venation and of the genitalia; these from a specimen sent by Mr Morton. The species occurs also in Ithaca, N. Y.

### **Orthotrichia brachiata** Morton

Morton, 1905, p. 70, pl. 14, figs. 18, 19

"Although but one poor specimen existed in the collection, I have no hesitation in referring this to the genus *Orthotrichia* on its general characters. As a species it is critically near *O. angustella* and the two are almost certainly representative of each other on the two continents. In *O. brachiata* the side pieces appear to be asymmetrical, but the specimen is somewhat damaged in this respect. The penis is typical of the genus and is notched at the apex. Alongside of it is a very strong acute sheath and under it a cover with rounded apex. The inferior appendages are very strongly divergent, aristate. Above these (according to what is found in *O. angustella*) there should be two spiniform processes slightly divergent and terminating in a hair, but in the specimen before me these can not be made out satisfactorily. The margin of the last ventral segment has a small chitinized median plate broader anteriorly and with excised fore and hind margins, the posterior projections each bearing a short bristle. The dorsal plate is as usual unequal on its two sides, but I can see no trace of teeth although portions of the margins are more or less strongly chitinized.

"It is to be regretted that the material is so unsatisfactory, but the figures should serve for identification." Morton, *l. c.*, p. 70. Collected at Ithaca, N. Y.

### **Orthotrichia pallida** Banks

Banks, 1904*d*, p. 215, pl. 2, figs. 2, 7

"Antennae white, in the male rather long and heavy; head white above; thorax with white hair; fore wings with pale yellowish hair, the posterior fringe white, the anterior fringe whitish, except a black patch at pterostigmatic region; slightly beyond middle of wing, at equal distances from each margin, is a black spot, and another, less distinct, on posterior margin, basad of this one; hind wings pale, nearly hyaline, fringes nearly white. Legs yellowish, spurs 1-3-4; hind tibiae with long white fringe. Fore wings slender, acuminate at tip, which is upturned; hind wings angulate near base on costal margin, thence rapidly tapering to slender tip. Length 3 mm.

"From Potomac river near the Long Bridge, 25th August." Banks, *l. c.* p. 215.

### **Orthotrichia pictipes** Banks

(Text fig. 5*u*)

Banks, 1911*b*, p. 359

"Face densely black haired; basal third of antennae heavy, densely jet black haired, beyond brown, each joint annulate with pale on base; antennae not half as long as wings; palpi pale yellowish; vertex

with grayish white hair; thorax mostly with gray hair, a black tuft each side at anterior base of mesothorax; femora of legs rather pale, tibiae darker, mid and hind pairs distinctly fringed behind toward tip; spurs [see below] 0-3-4 mostly white, but black on extreme base; tarsi pale, very distinctly marked with brown on basal part of each joint above; abdomen dark. Wings slender acute; deep black, in some lights rather tawny near middle, with three white spots near middle in a transverse row, nearly forming a line across wing, a white dot at base of stigma, three smaller beyond; and three on the posterior apical border, the fringe beyond the white stigmal dot is very long, dense, and black, a tuft of white fringe at extreme tip of wing; the posterior fringe jet black, and about as long as the width of the wing; hind wings uniform blackish, with a long, deep black fringe; the front margin of hind wing is straight to the middle and then only barely excavate or rather incurved at the tip.

"Expanse 7 mill.

"From Johnstown, N. Y., 25 June, Hales creek (Alexander coll.) and Poquonock, Conn., 22 May (Walden coll.).

"On account of the short and basally thickened antennae it may form a new genus." Banks, *l. c.*

Mr Banks gave me a male specimen of this species and the study of this certainly confirms his impression that this should form the type of a new genus. The spurs seem to me to be clearly 1-3-4. The head of the male has very large dorsal lobes. The venation also is peculiar.

One species west of the Mississippi described.

### *Orthotrichia nigratta* Banks

Banks, 1907*b*, p. 163, figs. 1-3. Texas.

### *Polytrichia* Sibley

Sibley, 1926*b*, p. 102

Antennae slender, the basal segment large, the remaining segments cylindrical, the middle ones widest, decreasing in width markedly to the tip; number of segments about 30. Ocelli present. Posterior warts of the head large but not elevated as lobes as in *Hydroptila*. Maxillary palpi hairy, first and second segments short, third and fourth equal, fifth somewhat longer. Spurs 0-3-4. Legs and spurs very hairy, middle femora but little shorter than the tibiae, hind femora half the length of the tibiae. Wings hairy, shaped like those of *Ithytrichia*; fibula present. Hind wings excised beyond the middle. Venation (pl. 12, fig. 11) as complete as in the preceding genera but highly modified in having media of both wings arched into the radial sector and fused with it for a considerable distance. A tooth on the seventh ventral segment of the male and a blunter one on the eighth ventral segment of the female.

*Ithytrichia* is similar in having media of the hind wing arched into the radial sector (pl. 13, fig. 3) but in that genus the fusion has not taken place in the fore wing, and in the hind wing  $M_1$  and  $M_2$  are fused.

The larva (discovered and described by Lloyd) also differs decidedly from those of the genus to which the single species was provisionally referred. The fifth and sixth abdominal segments are several (4-6) times as wide as those preceding and the case (at least of the older larvae) is immovable and incomplete, that is, the margins are fastened to the support and there is no floor.

The name of this genus, used in this manuscript for many years, was validated by Sibley (*l. c.*).

### *Polytrichia confusa* Morton

(Pl. 12, figs. 11-14)

Morton, 1905, p. 69, pl. 14, figs. 16, 17 (*Ithytrichia*); Sibley, 1926, p. 102  
Immature stages. Lloyd, 1915c, p. 117-21, pl. 3, figs. 1-7 (*Ithytrichia*)

"Antennae about 28-jointed in the male, long and slender, none of the joints really submoniliform, entirely fuscous, save a few basal joints, which are pale yellow.

"The last segment is open dorsally and within it lies a complicated organ represented in figure 16 [Morton's figure]. The appendages are closely approximated ventrally; in the side aspect they consist of a broad basal part, from the upper portion of which springs a long bladelike process, with rounded outer margin, beset within with numerous spines or spinous hairs. The outer margin of the basal part is beset with strong incurved teeth.

"This species, which is very easy of identification is referred provisionally to *Ithytrichia*, but the form of the appendages and the long slender antennae isolate it from the typical species of *Ithytrichia*. It is almost certain to be ultimately regarded as the type of a new genus." Morton, *l. c.* p. 69.

This is a very hairy, dark colored insect. Length of the fore wing a little over 3 mm. The antennae are dark brown in alcoholic specimens, about thirty segments. Venation as figured (pl. 12, fig. 11), the veins rather strong. Spurs very hairy, subapical on the middle legs placed at two-thirds the length of the tibiae, subapical on the hind legs at five-eighths the length of the tibiae. The species should be easily recognized by the genitalia. The claspers are exceedingly large and prominent; the other appendages are very complicated and the figures of them (pl. 12, figs. 12-14) are not satisfactory although they should be sufficient for easy identification.

Specimens were taken at Ithaca on August 15; Sibley reports the species from McLean, N. Y., July 6th, 7th.

*Ithytrichia* Eaton

Eaton, 1873, p. 139; McLachlan, 1880a, p. 514; Ulmer, 1907c, p. 224; Ulmer, 1909a, p. 32

Immature stages. Morton, 1888a, p. 171, 173; Ulmer, 1902a, p. 364, pl. 2, figs. 16-18; Needham, 1902, p. 375-78; Lauterborn and Rimsky-Korsakow, 1903, p. 281-83; Silfvenius, 1904a, p. 20; Lestage, 1921a, p. 450

Antennae stout, the segments hardly longer than wide. Head hairy, the posterior warts large but not raised into lobes. Ocelli present. Maxillary palpi slender, the fifth segment longest. The venation differing from that of the preceding genera in having  $R_3$  of the fore wing migrated upon  $R_{4+5}$  so that cell  $R_2$  is not pedicellate (pl. 13, fig. 3). In the American species  $Cu_1$  and  $Cu_{1a}$  of the fore wings fused at tip and  $M_{1+2}$  of the hind wing migrated upon the radial sector; neither of these characters shown in the figures of the European species. At least in the male there is a long tooth on the antepenultimate ventral segment.

The peculiar structure of the larva and that of the case were first described by Morton, as follows:

"The cases are made of the usual transparent material. Those of the larva have the outline oval, with a deep incision at the mouth end; towards the other end the sides come close together, the vent being in the form of a slit. The appearance of the nymph case is different, and it might well be held to belong to another species. But a close examination reveals the original case; the mouth end (or what was formerly that) has been supplied with an elongate stopper, and the other end has been slightly produced by the addition of more material. The cases are fixed to the stems etc. of water plants, and, as has already been hinted, the head of the nymph is turned toward the broader end.

"In form the larva departs largely from the Hydroptilid type, and instead of being obese, it is rather slender, and so transparent that it is a splendid object for microscopical examination, the organs of the alimentary and other systems being clearly visible. The head is elongate, with eyes placed at about the middle of its length; it becomes narrower towards the mouth; behind the eyes it contracts a little, then the sides are almost parallel; antennae long, at least two-jointed, the second joint one-third the length of the first; a few long hairs scattered over the head (mouth parts I can not separate). Thorax with three segments chitinous above, covered sparsely with long hairs; posterior legs rather long.

"Abdomen with four of the segments (I think 3d to 6th) produced into large protuberances; to these are attached by short pedicels the foliaceous branchial tracheae. These protuberances are the most opaque parts of the body, apparently on account of the collection therein of the bulk of the 'fat globules.' In the following segments the form of the branchial tracheae is different; they are triangular processes arising directly from the segment without constriction. At first I considered the position of these organs lateral, but after taking

the larva out of the case, I am now almost sure it is dorso-ventral." Morton, *l. c.*, p. 171.

### *Ithytrichia clavata* Morton

(Pl. 13, figs. 1-3)

Morton, 1905, p. 67, pl. 14, figs. 14, 15, pl. 15, fig. 35

"In the male the antennae are about 24-jointed. The appendages may be described as follows: There appears to be a transparent dorsal plate with outer margin nearly semicircular in outline, but the plate is very difficult to separate from the other parts. There are very large side pieces of subtriangular form in the lateral aspect, blade-like if viewed from above, the apex down-turned and out-turned rather acute and blackened at the extreme tip. What may be termed the inferior appendages are not distinctly separated from the side pieces, and consist of a ventral plate apparently deeply slit; seen from the side the separate divisions of the plate appear as a long appendage slightly upturned and blackened at the point. The penis is club-shaped at the apex in one aspect; in another it is slightly excised at the apical margin and the club is hollow with a slender rodlike process lying within it. The penis seems to be formed of two joints, the apical probably capable of being partly retracted within the other; the latter joint is broad at the proximal part, but becomes constricted before the apex; a spiral sheath arises from about the middle of the organ. Beneath the penis is a transparent process out of which proceed two or more spines, and on either side of this central process are sometimes visible two minor ones.

"There is some uncertainty about the form of the dorsal plate, but the true form of this will be readily ascertained from preparations made from fresh or dried specimens. Equally there is uncertainty about the cleavage of the ventral plate. These transparent membranous plates seem to suffer in form from immersion in alcohol.

"A species closely allied to *I. lamellaris* of Europe, of whose appendages no adequate figures have so far been published. In *I. lamellaris* in the part corresponding to that which is called above 'inferior appendages' there is, I believe, no slit, although a long narrow part where the membrane is thinner sometimes gives an illusory idea of a slit. In *lamellaris* the dorsal plate is produced in the center with a blunt slightly rounded lobe, while the process underneath the penis is about equal in breadth to the above-mentioned lobe, and instead of being simple as in *clavata* it is subdivided by an excision." Morton, *l. c.* p. 67.

One specimen of this species of which the venation is given in plate 13, fig. 3, was collected at Ithaca, N. Y. Length of the fore wing 3.6 mm.

**Hydroptila Dalman**

Dalman, 1819, p. 125; Eaton, 1873, p. 132 (*Phrixocoma*); McLachlan, 1880a, p. 510; Ulmer, 1907c, p. 222; Ulmer, 1909a, p. 29  
 Immature stages. Ulmer, 1903d, p. 135; Silfvenius, 1904a, p. 12-20; Lestage, 1921a, p. 445

Antennae thick, the segments short, the terminal one pointed at its distal end. Ocelli absent. The posterior warts of the head produced into large lobes. Maxillary palpi long and slender; in the labial palpi the third segment as long as the other two. Fore wings lanceolate, subacute, extremely pubescent; fibula present. Wings and venation (pl. 13, fig. 7) like *Ithytrichia* so far as the fore wing is concerned; in hind wing media not arching into the radial sector.

Larvae widest at about the fifth abdominal segment. Labrum with anterior margin slightly emarginate. Mandibles stout, the right one bladelike with blunt teeth, the other chisellike. Fore tibiae broad. The cases kidney-shaped, covered with fine sand.

**Hydroptila albicornis Hagen**

(Pl. 14, figs. 1-3)

Hagen, 1861c, p. 275; Provancher, 1877, p. 269; Provancher, 1878b, p. 144; Banks, 1907b, p. 163 (*transversa*); Sibley, 1926b, p. 102 (listed)

"Gray; antennae stout, snow-white, with the middle and apex fuscous; palpi whitish; head with snow-white hair, the vertex with fuscous hair; thorax fuscous; feet whitish, the posterior ones ciliated with white; anterior wings grayish-fuscous, ciliated with gray, the margin and disk pointed with snow-white, posterior wings gray, clothed and ciliated with gray hair. Female.

"Length to tip of wings  $3\frac{1}{2}$  mm. Alar expanse 6 mm.

"Hab. St Lawrence River, Canada (Osten Sacken)." Hagen, *l. c.*

"Head with gray hair on face, black between antennae, and white on vertex, antennae yellowish white, with a dusky band near middle, and the tip broadly dark; white hair on thorax, with some brown at base of wings; abdomen mostly clothed with white hair; legs pale yellowish, with yellowish hair, tibia and part of tarsus one darker, other tarsi also darker, and a long gray fringe from hind tibiae of male. Wings mostly black haired, not densely so; a very narrow, and not always distinctly complete transverse white line across wing near middle, beyond is one pale spot in middle, one on costa, and one near tip, the extreme tip jet black; fringe dark gray to blackish, whitish at two spots on front margin, and two spots behind; hind wings pale, with gray tip, and a gray fringe, extremely long behind. Expanse 5.5 to 5.8 mm.

"Several from Washington, D. C., September, at light." Banks, *l. c.*, p. 163.

This species was taken at Ithaca and at Old Forge about the middle of August. Sibley reports it from McLean, June 20th to September 14th. The length of the fore wing is  $2\frac{1}{2}$  mm (male).

The genitalia are figured on plate 14, figures 1, 2. The claspers are united along the middle and are strongly recurved. Of the antennae the basal half is pale, next follow about three dark segments, then the remainder is half light and the distal half dark.

### **Hydroptila consimilis** Morton

(Pl. 13, figs. 4-8)

Morton, 1905, p. 65, pl. 13, figs. 1-4, pl. 15, fig. 36; Sibley, 1926*b*, p. 102

"The male appendages as far as they can be described from the available specimens, are as follows: A large dorsal plate, convex above, notched on its outer margin, and the angles of the plate seen from above appear to be acutely produced, viewed from the side they are seen to be rounded. Side pieces of the last segment produced into somewhat curved subacute processes. Inferior appendages nearly parallel, blades slightly outturned at the tip which is pointed and blackened; the inner margin is oblique near the apex; a small wart on the inner margin before the apex; the outer or upper margin bears a row of short spinous hairs. The penis considerably below the apex has a strong curved acute process. Ventral lamina short.

"This species, as has been indicated, is close to *H. sparsa*, but differs from that species in minor details, and particularly on the process on the penis, this process in *H. sparsa* being smaller and nearer the tip of the organ.

"Ithaca, N. Y., and Belfrage, Texas." Morton, *l. c.*, p. 65.

I have found but a few specimens of this species at Ithaca, August 11th to 15th. The number of antennal segments is 33 (male), the third the shortest. Length of the fore wing a little over 3 mm.

Sibley's dates for specimens from McLean, N. Y., are July 6th to September 13th.

### **Hydroptila delineata** Morton

(Pl. 13, fig. 9)

Morton, 1905, p. 66, pl. 13, figs. 5-7

Immature stages. Sibley, 1926*b*, p. 103, 205, pl. 9, figs. 38-42

"This species has the lobes on the head enormously developed. The antennae are about 31-jointed in the male.

"The last dorsal segment appears to be deeply excised, the excision being followed by a large semitransparent plate difficult to separate from the basal portion of the appendages, but apparently having a small submarginal projection on either side of a larger median one, but the outline of the plate is rather uncertain. The inferior appendages are nearly parallel, the apex outturned and upturned; the apical portion seen from the side has the lower angle somewhat produced while the upper part of the apex forms a kind of a knob which in some positions shows a slight angle on its anterior side. Arising from the upper side of these appendages is a long spirally curved

acute process which winds itself round the under side of the apical lobe. On the outer (or lower) edge of the appendages, near their middle, is a slightly raised part bearing two or three spinous hairs. Ventral lamina short.

"This species can be determined without difficulty from the ventral aspect of the appendages. It has no very near known ally." Morton, *l. c.*, p. 66.

I have two dry specimens of this insect taken at Ithaca on July 22d. Sibley reports it from McLean, August 7th to September 12th. The erect black hairs seem to be localized largely on the basal third of the wing and along the anterior margin; the rest of the wing is dark brown with a broken line of white across the middle of the wing and a white spot along the anterior margin toward the apex. Legs yellow with considerable black hair. Length of fore wing  $2\frac{1}{2}$  mm.

### *Hydroptila hamata* Morton

(Text figs. 26c, h)

Morton, 1905, p. 67, pl. 13, figs. 11-13; Sibley, 1926b, p. 102

"The dorsal plate is small, broadest in the middle, apex excised. Beneath it there is a small, rounded penis-cover. The appendages are narrow, finger-shaped, aristate and widely divergent. Two strong hooks visible at the posterior margin of the last ventral plate or segment. The penis is very slender, curved at the apex and accompanied by a slender sheath of equal length. Ventral lamina very long; in lateral outline somewhat club-shaped, but the lower margins oblique and minutely serrate.

"This species is certainly near to the European *femoralis*, but it differs especially in the form of the dorsal plate which in *femoralis* is not notched and is boat-shaped in outline." Morton, *l. c.*, p. 67.

I have specimens of this species taken at Ithaca, June 22d to August 1st. The antennae are heavy, yellow at base, somewhat darker at tip, 29-jointed in the male. Head with white hair; in front of and alongside of the posterior lobes there is shorter dense black hair. Wings hairy, with a white transverse line in the middle and with white spots on the margin toward the apex, and a few less distinct ones at the apex. Legs yellowish with considerable dark hair. The claspers are, I think, united along the middle line and the appearance varies tremendously according to the degree of exertion, thus my figure (text fig. 26c) differs from that of Morton (*l. c.*, fig. 11). The ventral lamina also differs in appearance. The margins of the end are sometimes spread apart (text fig. 26c). Length of the fore wing 3 mm. On the fifth ventral segment of the male there is a small, aristate tubercle on either side (text fig. 26h).

**Hydroptila perdita** Morton

Morton, 1905, p. 67, pl. 15, figs. 31-34

"Antennae about 31-jointed in the male. The dorsal plate is large, rounded posteriorly, gradually becoming wider, the margins slightly retracted at the base, a small hollow looking patch near the apex. The inferior appendages subparallel blades, twisted outwards at the apex, which is obscurely bifid; scattered spinous hairs, particularly on external (superior) margin. Penis broad toward the base; in the exerted part tapering to a point, below which is a very strong curved acute process standing out strongly from the stem. Ventral lamina small." Morton *l. c.*, p. 67.

Collected at Ithaca, N. Y.

**Hydroptila spatulata** Morton

(Pl. 13, figs. 10, 11)

Morton, 1905, p. 66, pl. 13, figs. 8-10

"The dorsal plate in the male narrower than in *consimilis*, deeply notched in the posterior margin. Inferior appendages approximated at the base, slightly curved outwards and downwards, superior edge with a few spines; apex apparently scabrous. Side pieces of the last segment produced into rather long subacute processes. The penis, usually much exerted, with a flattened rounded apex, immediately below which is a small acute process placed at right angles. Ventral lamina very long and slender, slightly swollen at the apex when viewed from the side, the outer margin obliquely truncate, blackish and roughened. No very near ally known to me." Morton, *l. c.*, p. 66.

Collected at Ithaca, N. Y.

**Hydroptila tarsalis** Hagen

Hagen, 1861c, p. 275; Eaton, 1873, p. 148

"Gray; antennae somewhat robust, rather long, fuscous, with gray hair; palpi black, the apex snow-white; head black, the vertex white; thorax fuscous; feet whitish, anterior tibiae, spurs, and tarsi fuscous, the latter annulated with white; posterior feet with gray cilia; anterior wings fuscous, the anterior margin black, ciliated with gray, and pointed with snow-white; posterior wings with gray hairs and cilia. Male.

"Length to tip of wings 3 millim. Alar expanse  $5\frac{1}{2}$  millim.

"Hab. St Lawrence River, Canada (Osten Sacken).

"Is this the other sex of the preceding species? [*albicornis*]" Hagen, *l. c.*, p. 275.

**Hydroptila waubesiana** n. sp.

(Pl. 13, fig. 12)

Head with black and faintly yellowish hairs in front, with only the latter above. Antennae white in the basal half; in the distal

half four bands alternately black and white, of about equal length, the white tip shorter than the other bands. Legs pale yellow. Fore wings with mostly black hair; a sparse distribution of light golden hair, forming also a few marginal flecks. The male genitalia obscured by the heavy hairs fringing the rear body segments. Four stout processes near together in the median line, the tips of the lower ones appearing, unless closely studied, as appendages of the upper; between these four appendages the penis, which is a straight rod without appendages.

Length to tip of wings 3-3½ mm.

This species is common at Waubesa lake, Wisconsin, during July.

### *Oxyethira* Eaton

Eaton, 1873, p. 143; McLachlan, 1880a, p. 520; Ulmer, 1907c, p. 226; Ulmer, 1909a, p. 36  
Immature stages. Morton, 1887a, p. 201-3; Silfvenius, 1904a, p. 24; Siltala, 1907c, p. 388; Lestage, 1921a, p. 458

Antennae stout, segments slightly longer than broad, basal segment much longer than those succeeding. Ocelli present. Maxillary palpi slender, the last three segments successively longer. Spurs 0-3-4. Fore wings very narrow, acute, and, at least in dry specimens, with tips upcurved; wings very pubescent. Venation much reduced (pl. 14, fig. 4).

The larval case somewhat flask-shaped, the anterior end broad with an almost straight margin, the posterior end much narrower; pupal case fastened with long strands of silk leading to four disks.

### *Oxyethira coercens* Morton

(Pl. 14, figs. 9, 10)

Morton, 1905, p. 70, pl. 14, figs. 20-22

"Antennae in the male about 31-jointed.

"The last segment dorsally is semicircularly excised when viewed from above; seen from the side the edges are strongly toothed. The ventral plate, if viewed from side, is in the form of a strong claw with serrate margin; from beneath, its margin is excised rather deeply, and each of the side lobes has about three teeth. On either side the apex of a blackish rod is usually visible. The penis has the apex much dilated and armed with two or three teeth.

"This species, which belongs to the same group as the European *O. frici* Klap., should be very easily recognized from the ventral plate." Morton, *l. c.*, p. 70.

Collected at Ithaca, N. Y.

### *Oxyethira dorsalis* Banks

Banks, 1904d, p. 216, pl. 2, fig. 5

"When at rest it is blackish, with a median dorsal white stripe formed by the white hairs of head, middle of thorax, the basal part of hind margin of the fore wings, and the white fringe of hind

margin. The antennae are white, with a few dark spots before tip, the vertex with two rosettes of white hair; the thorax has white hair on the middle, dark on the sides; the fore wings are clothed with dark brown hair, with the apex and the basal part of radius jet black; before the middle there is a white spot on each margin, sometimes apparently connected, beyond these is a white patch in the middle of wing, and farther out are two white patches on each margin, the last just before the black upturned tip. The fringe of the fore wing is rather long on the costal margin, and before tip it is much longer than the width of the wing at that point; the fringe of hind margin is much longer, especially toward tip. The hind wings are gray, with darker veins, and dark costal fringe, the gray hind fringe more than three times as long as width of wing. The fore wings are very slender, the costal margin before the tip is slightly concave, the tip almost sharp; the hind wings are very slender, acuminate, the costal margin near base swollen. Legs yellowish; spurs 1-3-4; hind tibiae with long fringe, the hind spurs also very long. Length 3 mm.

"Many specimens from Washington, D. C., Falls Church, Va., and Plummers Island, Md.; June to September.

"This species is separated from *Orthotrichia americana*, which it superficially resembles, by the fact that the costal fringe of fore wings near tip is longer than the width of the wings at that place, while in the latter species the fringe is barely longer than elsewhere along the costal margin." Banks, *l. c.*, p. 216.

### *Oxyethira dualis* Morton

Morton, 1905, p. 71, pl. 15, figs. 37-39

Immature stages. Sibley, 1926b, p. 103, 206, pl. 9, figs. 43, 44

"In this species the appendages are very simple; seen from above the penultimate segment is deeply excised; from the same point of view is visible a quadrate penis cover, the posterior margin of which has two slight excisions. From beneath is seen the simple ventral plate, almost straight in its posterior outline, the hind angles slightly oblique; the plate is rather broader at its base and on each lateral margin is a faint angle. The apex of the penis has an elongate swollen part, probably exaggerated in figs. 37 and 38 [of Morton], through the presence of some extraneous matter; after preparation this part had the appearance of having two slightly chitinized straight rods and a sickle-shaped one.

"1 male Las Vegas, New Mexico. (Cockerell)" Morton, *l. c.*

Sibley reports the species from McLean, N. Y., August 20th to September 9th, and describes the larva, pupa and case.

### *Oxyethira grisea* n. sp.

(Pl. 14, figs. 4-8)

This species seems to be sufficiently distinguished from all the others by the genitalia (pl. 14, figs. 5-7). The two specimens in the collection are somewhat rubbed but the wings appear to have a

covering of gray and yellow hairs. The antennae are yellow and consist of 27 segments. Maxillary palpi slender, first two segments short; third, fourth, and fifth almost equal; of the labial palpi the first and second segments are equal, the third slightly longer. Sub-apical spurs on the hind legs very little beyond the middle of the tibiae, but half the length of the larger apical spur. Length of fore wing a little less than 3 mm.

Old Forge, N. Y., July 19th to August 6th, Ithaca, N. Y., August 11th.

### *Oxyethira viminalis* Morton

Morton, 1905, p. 71, pl. 14, fig. 23

"The margin of the last dorsal segment is slightly and simply excised. Beneath, the margins of the segment recede and form a deep excision. The ventral plate has the margin nearly straight, and above it are two blackish appendages—no doubt the homologues of the hooks which lie above the ventral plate in several European forms. The penis is large, and with its sheaths forms a very complicated structure; the apex, however, is simple. The only other appendages visible are a pair of lateral rods.

"Described with great hesitation from a single male from Ithaca, but afterwards fully verified from further material from Professor Needham (Lake Forest, 15 Oct. 1902)." Morton, *l. c.*

### *Neotrichia* Morton

Morton, 1905, p. 72; Ulmer, 1907c, p. 227

"Spurs 0-2-3. Ocelli present. Head posteriorly with two large pyriform warts; disc elevated with a median longitudinal line. Antennae with 18-19 joints (probably in both sexes), joints shorter and more submoniliform in the female; rather stout, basal joint moderately long and slightly curved, second joint somewhat shorter, the four following subequal and cylindrical, the remainder submoniliform. (Palpi uncertain from the material in hand.) Legs long and slender. Neuration apparently simpler than in any of the other known genera." Morton, *l. c.*

To this may be added that the maxillary palpi have the first two segments short, the third and fourth equal, the fifth a little longer. The venation (pl. 15, fig. 1) in my specimens is rather more complete than that given by Morton and by Ulmer. The inner apical spur of the middle and hind legs and the subapical spur of the hind legs are very long.

### *Neotrichia collata* Morton

(Pl. 15, figs. 1, 2)

Morton, 1905, p. 72, pl. 14, figs. 24-28, pl. 15, figs. 29-30; Ulmer, 1907c, pl. 28, fig. 272

"In the male the apex of the abdomen may be described as follows: Above there is a semitransparent transverse plate, at either

side of which are two rather longer thin processes which seem to be slightly outturned at the apex. There are also semitransparent side pieces rather slender and slightly curved. The inferior appendages consist of two parallel contiguous processes which at the apex on their inner edges are obliquely truncate and bear one or two teeth. The penis in its apical portions consists of two closely lying parts of nearly equal length, slightly hooked at the tips." Morton, *l. c.*

I took this species at Ithaca and at Old Forge, N. Y., July 20th to August 11th.

In addition to the forms described above there is a species which undoubtedly represents a new genus but the material at hand is too fragmentary for adequate description. The collections are from Old Forge and Ithaca, N. Y., undated. The following notes are included for whatever they may be worth:

Antennae stout, basal segment longest, second globular, smaller than those succeeding; number of segments about 18 (male), the terminal one pointed (pl. 14, fig. 13). Ocelli present. Maxillary palpi with first two segments short. Spurs 0-2-4, the longer sub-apical spur of the hind leg one and one-half times as long as the longer apical spur of the same leg. Wings hairy, venation (pl. 14, fig. 12) very obscure even when the wing is denuded. Abdomen very hairy, a tooth on the sixth ventral segment (male). Penis slender and apparently without a chitinous rod alongside of it.

The venation indicates close affinity to *Oxyethira* from which, however, it may be separated by the points enumerated in the table (p. 146).

### PHILOPOTAMIDAE

McLachlan, 1878*b*, p. 373. (Hydropsychidae, Section 4). Wallengren, 1891, p. 143; Klapálek, 1904*a*, p. 16; Ulmer, 1907*c*, p. 195; Ulmer, 1909*a*, p. 37. Immature stages. Ulmer, 1903*d*, p. 116; Silfvenius, 1903*b*, p. 3 (Hydropsychidae-Philopotamus Group); Silfvenius, 1905*b*, p. 118; Ulmer, 1909*a*, p. 205, 226, 293; Lestage, 1921*a*, p. 464

Antennae stout (more slender in *Chimarra*), the segments short, the basal ones not much thicker than the others. Ocelli present though sometimes not easily seen because of the pubescence. Palpi with the terminal segment flexible, approaching the multiarticulate condition of the palpi of related families, and sometimes ending in a conical tip almost as in the Rhyacophilidae. Of the maxillary palpi the fourth segment shorter than the third. Venation for the most part generalized. In the fore wing an accessory from *Sc* to the wing margin; anal veins reaching the posterior margin at about the middle of the wing; cell *Cu*<sub>1</sub> back to the same level; the discal and median cells always present. In the hind wing the discal cell present but no median cell. The claspers of the male well developed;

in some of the European genera the second segment divided but not so in the North American forms here included. Abdomen of the female often prolonged into an ovipositor.

Larvae very slender, somewhat depressed. Antennae represented by two sense rods and three bristles (Silfvenius). Eyes far forward, frons generally asymmetrical. The labrum fragile, retractile, not heavily chitinized, much wider in front than behind; the anterior corners produced into lobes margined with bristles (text fig. 36*d*). Mandibles (text fig. 37*b, c*) curved and asymmetrical, with no median bunch of bristles. Maxillae long and slender, the lobe conical. Labium long, obtuse, reaching as far forward as the maxillary palpi. Of the thorax only the first segment chitinized. Legs about equally long, anterior coxae sometimes with a stout spine. No lateral fringe or tracheal gills on the abdomen. Four anal blood gills. Prolegs stout, their claws stout and without dorsal hooks.

Pupa has head relatively small, almost globular. Labrum semi-circular. Mandibles stout and long. Middle legs with fringes. Claws large. Tibiae and tarsi of the females dilated. No lateral fringe or tracheal gills present. First abdominal segment not heavily chitinized. Cases of small stones, with inner cocoon.

The larvae and pupae are found in rapid streams, the larvae in silken nets.

Martynov (1924*c*, vol. 5; 1926*a*) has created the family Stenopsychidae for the genera *Stenopsyche* McL., *Stenopsychodes* Ulmer, and *Pseudostenopsyche* Döhler, from Asia, Australia, and Chili, respectively. It is the only one of the families not represented in North America.

#### KEY TO THE GENERA OF PHILOPOTAMIDAE

- 1*a* Spurs 2-4-4. Anal veins of the hind wing (pl. 15, fig. 13) not fused so as to form a closed cell. Cell  $M_1$  of the hind wing not less in length than its pedicel ..... 2
- 1*b* Spurs 1-4-4. Anal veins of the hind wing (pl. 16, fig. 6) fused so as to form a closed cell. Cell  $M_1$  of the hind wing variable in size but not equaling its pedicel in length. p. 171..... *Chimarra*
- 2*a* Discal cell of the fore wing longer than the median cell; no discal cell in the hind wing. p. 171..... *Ventrarma*
- 2*b* Discal cell of the fore wing shorter than the median cell; discal cell present in the hind wing..... 3
- 3*a* Media of the fore wing four-branched..... 4
- 3*b* Media of the fore wing three-branched. p. 170..... *Wormaldia*
- 4*a* Cell  $R_2$  present in the hind wings..... 5
- 4*b* Cell  $R_2$  not present in the hind wings. p. 170..... *Dolophitiella*
- 5*a* Cell  $R_2$  of the hind wing not sessile; cell  $Cu_1$  of the hind wing not reaching as far toward the base of the wing as cell  $M_2$  (pl. 15, fig. 3). No long ventral processes on the abdomen of the male; the abdomen of the female not formed as an ovipositor (p. 166)..... *Philopotamus*
- 5*b* Cell  $R_2$  of the hind wing sessile; cell  $Cu_1$  of the hind wing reaching as far back as cell  $M_2$  (pl. 15, fig. 13). The abdomen of the male sometimes with processes on some of the ventral segments; abdomen of the female formed as an ovipositor. p. 168..... *Dotophilus*

### Philopotamus Leach

Leach, 1815, p. 136; McLachlan, 1878*b*, p. 379; Ulmer, 1907*c*, p. 196; Ulmer, 1909*a*, p. 39

Immature stages. Silfvenius, 1906*b*, p. 26; Siltala, 1907*c*, p. 398; Thienemann, 1908*b*, p. 378, 380; Wesenberg-Lund, 1911*b*; Lestage, 1921*a*, p. 473

Antennae stout, the segments short. Ocelli present. Head very hairy, with a wart between the antennae, a pair of small triangular warts farther back and another long oblique pair posteriorly, the latter oval with median ends acute. Maxillary palpi with the first and sometimes the second segment small, the third larger than the first and second together, the fifth at least equal to the second or to the third and fourth together. Labial palpi with the first and second segments about equal, the third longer. Palpi terminated by sense hairs as in *Rhyacophila*. Shape of the wings and the venation (pl. 15, fig. 3) much as in *Rhyacophila*. Length of the apical cells somewhat variable. Most of the North American species apparently different from the European in having  $R_2$  and  $R_3$  of the fore wing fused far out towards the margin so that cell  $R_2$  is small. Spurs 2-4-4, the subapicals of the middle legs a little before the middle of the tibiae, those of the hind legs at about five-eighths the length of the tibiae; femora of the middle legs equal to the tibiae in length, those of the hind legs one-half as long as the tibiae. A small tooth on the seventh and another on the eighth ventral segment of both male and female. The claspers of the male large, two-segmented; the second segment divided into two branches in the European forms, not so in the known North American species.

The eggs, described for some European species (Siltala, *l.c.*, p. 26), with sufficient quantity of gelatinous covering to prevent their being in contact.

### Philopotamus americanus Banks

(Pl. 15, figs. 3-6)

Banks, 1895, p. 316; Banks, 1914*b*, pl. 10, fig. 38

"Length 9-10 mm. Black, some tawny hairs on head and some on second joint of palpus, also a few on thorax. Antennae wholly black, about as long as the wings; three distinct ocelli; tips of the coxae pale; hind legs mostly testaceous, hind tibiae slightly curved and almost twice as long as the femur; spurs 2-4-4. Wings black, more or less thickly spotted with golden, generally following the veins; and four small white spots as follows: a larger basally furcate one before the middle of the wing on the origin of the divisialis, a transverse one at arculus, one at end of thyridial cell, and the fourth at end of thyridial area; but three distinct transverse veinlets in fore wing, one between branches of radial sector, another between radius and upper branch of radial sector, the third in the anal region; upper branch of radial sector forks a little before tip, lower branch forks near base.

"Many specimens from a stream near Sea Cliff, N. Y., in December, March and April." Banks, *l.c.*

A single specimen of this species was received from C. P. Alexander at Gloversville, N. Y., dated March 28th, and another was taken at Ithaca. Drawings of the venation, palpi and the genitalia are added. It is noted that in cleared specimens there is a dark median longitudinal line on abdominal segments 2 and 3 ventrally.

### *Philopotamus distinctus* Walker

(Pl. 15, figs. 7-12)

Walker, 1852, p. 104; Hagen, 1861*c*, p. 291; Ulmer, 1906*b*, p. 88, fig. 90; Banks, 1914*b*, pl. 10, fig. 30; Sibley, 1926*b*, p. 103

"Black, with black and yellow hair; antennae much longer than the body; palpi and feet testaceous; anterior wings brownish gray, closely guttated with yellow. (From the description of Walker).

"Length to tip of wings 6 millim. Alar expanse 11 mm.

"Hab. Trenton Falls, New York (Doubleday)." Hagen, *l.c.*

Ulmer has examined the type, which is now unfortunately without abdomen. The following may be added from his additional description: Antennae blackish brown, the basal third ringed with clear brownish; as long as the fore wings. Palpi brown with the last two segments darker. Legs with blackish brown coxae; the femora, tibiae and tarsi of the fore legs dark brown; the femora and tibiae of the hind legs yellowish brown, the tarsi blackish brown. Membrane of the fore wings clear gray, with dark brown hair and dotted with yellow. Hind wings clear gray, with scattered brown pubescence; fringes of both wings dark brown.

Ulmer further calls attention to the long pedicel of cell  $R_2$  in both wings, a feature also found in *P. americanus*.

Two males of this species were taken at West Falls, N. Y., on July 15th, and one in Coy's glen, Ithaca. I found also several wings on a stone slightly projecting out of the water. These wings are all somewhat larger and may belong to females of this species. The venation is practically like that of *P. americanus* and like that figured from the type by Ulmer (*l.c.*, fig. 90). I have collected the larvæ at Coy's glen, Ithaca, N. Y. They are practically like those of *Chimarrha* which are found in the same situation but this species does not have a spur on the anterior coxa (pl. 15, fig. 11) and the frons (pl. 15, fig. 12) is not very asymmetrical.

Hagen's adult specimens seem to have been collected by Doubleday; they are possibly the ones on which Doubleday made the interesting observations quoted on p. 28. This seemed to me very likely because of my discovery of the detached wings referred to above and I think it may now be regarded as certain since Mr

Banks showed me apterous female specimens of the species collected in the vicinity of Washington, D. C.

Sibley's dates for the adults in McLean, N. Y., run from June 30th to September 15th.

#### OTHER NORTH AMERICAN SPECIES OF PHILOPOTAMUS

##### *Philopotamus aequalis* Banks

Banks, 1924, p. 450. Colorado.

##### *Philopotamus barrettae* Banks

Banks, 1900a, p. 259. Mexico.

##### *Philopotamus bicolor* Banks

Banks, 1901b, p. 370. Mexico.

##### *Philopotamus mexicanus* Banks

Banks, 1901b, p. 370. Mexico.

#### Dolophilus McLachlan

McLachlan, 1868b, p. 301; McLachlan, 1878b, p. 387; Ulmer, 1907c, p. 197; Ulmer, 1909a, p. 40, 41; Banks, 1914b, p. 202 (*Paragapetus*).

Antennae moderately stout, not longer than the wings. Maxillary palpi with the third segment as long as the first and second together and twice as long as the fourth; the fifth somewhat longer than the third. Fore wings with elliptical apex, hairy. The venation (pl. 15, fig. 13) much as in *Philopotamus* but cell  $R_2$  sessile in both pairs of wings. Cell  $R_2$  very narrow, cell  $Cu_1$  very large. Median cell narrower and longer than the discal cell. Crossvein *m-cu* very far back so that cell *2d M* is unusually small. In the hind wings cells  $R_4$  sessile, cell  $Cu_1$  long pedicellate; cell  $R_2$  short pedicellate in the European and sessile in the North American forms. In the males the claspers 2-segmented, the last segment not branched, its tip bearing stout black spines internally; in the female an ovipositor present.

The species described differ in some important points mentioned in the descriptions. *D. major* is probably more like the European species than like *D. abbreviatus* or *D. moestus*.

##### *Dolophilus brevatus* Banks

(Pl. 15, figs. 13, 14, pl. 16, figs. 1-5)

Banks, 1914b, p. 254, pl. 20, fig. 61

"Face dark; antennae brown, annulate with yellowish; palpi brown; gray hair between antennae, and on vertex and thorax, a tuft of black hair near each eye; abdomen brownish; legs yellowish, brownish on tarsi; hind tibiae with much long pale hair. Wings dark, densely irrorate with golden, a large golden spot before and one beyond stigma, costal area interrupted once with golden; the golden on wing is so dense a reticulation that the dark appears to be broken into many little rectangles; hind wings gray, blackish at tip.

Fork 1 reaches to discal cell in both wings; in fore wings forks 3 and 4 subequal, in hind wings fork 3 is much longer than pedicel; the third joint of maxillary palpi much longer than fourth; in female there is a long yellowish ovipositor.

"Expanse 12 mm.

"Coy. Glen, Ithaca, N. Y. July, Black Mt. north fork Swannanoa River, N. Car., May." Banks, *l.c.*

This species is represented by a few specimens from Old Forge, and Buffalo, N. Y., July. The abdomen of the male has a flat and rather broad piece projecting from the posterior margin of the seventh ventral segment, another of the same nature reaching equally far back from the eighth segment, and a smaller sharp tooth on the ninth segment. In the hind wings the anal veins are peculiar in that but two of these veins are apparent at the margin, the posterior two probably having fused; or possibly this area has gone farther than *Chimarraha* (pl. 16, fig. 6) in the fusion of  $2d A$  and  $3d A$ . In contrast with the next species, cell  $M_2$  of the hind wing does not reach as far basad as cell  $Cu_1$ .

#### *Dolophilus major* Banks

Banks, 1914b, p. 254, pl. 20, fig. 66

"Black, with black and golden-yellow hair; golden hair on front of vertex and base of thorax; palpi brown, antennae dark, annulate with black, coxa and femora rather dark, rest of legs paler; abdomen black; wings black; fore wing beautifully spotted with golden hair, spots rather small, and mostly subequal in size and situate in the cells, each apical cell with four to ten of them, all over wings; hind wings blackish. Wings long, fork 1 reaches to the discal cell, fork 2 is its width on discal cell, fork 4 a little before fork 3, both long, discal cell nearly three times as long as broad; hind wings with forks 1 and 2 very narrow, as long as in the fore wing.

"Expanse 22 mm.

"From Black Mt., north fork of the Swannanoa River, N. Car., May. I have no female, and its large size seems out of place in this genus, but the genitalia and long fork 1 will not fit in *Philopotamus*." Banks, *l.c.*

This differs from the preceding species in having a ventral tooth instead of a long process on the male ventral segments, the anal veins are normal, and the apex of cell  $M_2$  of the hind wing is a little further basad than the apex of cell  $Cu_1$ .

#### *Dolophilus moestus* Banks

Banks, 1914b, p. 202, pl. 9, figs. 18, 20, 23 (*Paragapetus*); Carpenter, 1933a, p. 42 (*Paragapetus*)

"Palpi black; antennae dark, annulated pale, head brown, white hair on the anterior part of vertex, brown hair on warts; abdomen

dull black, genitalia yellowish, legs yellowish, tips of tibiae darker above and tarsi also darker. Wings black, with some scattered yellow hair, the principal marks being three costal spots of yellow, and three on hind margin, one at arculus, one beyond, and one before it; in disc various faint markings, transverse; anastomosis hyaline white, hyaline forked, mark on fork of median vein; hind wings gray, with gray fringe.

"Expanse 8 mm.

"From Black Mt., north fork Swannanoa River, N. Car., May." Banks, *l.c.*

The anal veins of the hind wing are like those of *D. breviatus*.

### Dolophiliella Banks

Banks, 1930b, p. 230

"Closely related to *Dolophilus*, having ocelli, palpi, vertex, spur formula, hairy hind tibia, and general shape of male appendages as in that genus. The venation is the same, except that fork 1 is lacking in both front and hind wings. In 1909 Ulmer described a new genus, *Dolophiloides*, for a form from Central Asia in which fork 1 was absent from the hind wings. This species has gone a step further in dropping that fork in the fore wings. It might be better to consider both this and *Dolophiloides* as subgenera of *Dolophilus*." Banks, *l.c.*

One western species is reported.

#### *Dolophiliella gabriella* Banks

Banks, 1930b, p. 230, fig. 14. California.

### Wormaldia McLachlan

McLachlan, 1865b, p. 140; McLachlan, 1876a, p. 389; Ulmer, 1907c, p. 198; Ulmer, 1909a, p. 41

Immature stages. Morton, 1887b, p. 115; Silfvenius, 1903b, p. 6; Silfvenius, 1905b, p. 120

Antennae moderately stout. Ocelli present. Maxillary palpi with two short, stout, and equal basal segments; third long and slender, fourth about half the length of the third, fifth slightly longer than the third. Legs rather long and slender; the four hinder tibiae hairy. Spurs 2-4-4. The middle tibiae and tarsi not dilated. Fore wings elongate, elliptical at the apex, densely clothed with unicolorous pubescence.  $M_3$  and  $M_4$  fused so that there is no cell  $M_3$ .

There are two species described from Nicaragua and from Costa Rica, and probably *Chimarrha braconoides* Walker, St Domingo, should be placed here.

#### *Wormaldia albata* Navás

Navás, 1924b, p. 75. Costa Rica.

#### *Wormaldia banksi* Ulmer

Banks, 1905c, p. 18 (*mediana*); Ulmer, 1907c, p. 198 (new name given); Ulmer, 1913d, p. 405. Nicaragua, Costa Rica.

**Ventrarma Navás**

Navás, 1924*b*, p. 76.

Described as similar to *Wormaldia*. The eighth and ninth segments each bear a long spine in male and female. The author's figure of the venation does not suggest close affinity to *Wormaldia* or other genera of this family. The absence of the discal cell and of cell  $R_4$  of the hind wing is sufficient to distinguish the genus, if it belongs in this family.

Two Costa Rican species.

*Ventrarma callosa* Navás

Navás, l.c., p. 78, fig. 15. Costa Rica.

*Ventrarma implexa* Navás

Navás, l.c., p. 77, fig. 14. Costa Rica.

**Chimarrha Leach**

Leach, 1815, p. 136; McLachlan, 1879*c*, p. 431; Ulmer, 1907*c*, p. 199; Ulmer, 1909*a*, p. 43. Immature stages. Fritz Müller, 1887*a*, p. 225, 226; Fritz Müller, 1887*b*, p. 289, 290, 1 fig.; Morton, 1888*d*, p. 269; Thienemann, 1905*b*, p. 50; Noyes, 1914*a*, p. 259.

Antennae shorter than the head, the basal segment largest but not longer than the head; inserted somewhat far apart. Ocelli present, prominent. Maxillary palpi stout, the first, fourth, second, third, and fifth segments successively longer, the second with stout bristles at its distal end. Legs of moderate length, the middle pair slightly dilated in the female. Spur formula, concerning which there has been some doubt, normally 1-4-4, the spurs somewhat unequal.<sup>28</sup> Wings covered with short pubescence, with generally a nude spot just behind the radial sector at its first branching. In the fore wing  $Sc$  with an accessory to the wing margin,  $Sc_2$  present and fused with  $R_1$  at the tip; the base of the sector arched forward somewhat at the nude spot; a discal cell present; media 3-branched; the medial cross-vein present and placed far back so that a small median cell is formed.  $Cu_1$  fused with media for a considerable distance so that cell  $M$  is unusually small in this genus. In the hind wing a discal cell present; media 3-branched; the course of the anals peculiar and this alone would serve to identify the genus (pl. 16, fig. 6). The ninth ventral segment of the male with a process which varies in shape in the species. In the female on the seventh ventral segment a narrow longitudinal slit, at the posterior end of which is a small tooth; the eighth segment with two small chitinous plates on the

<sup>28</sup> In his generic synopses Ulmer describes the outer claw of the fore leg of the male as distinctly larger than the inner and shows it thus in a figure. Examination of three North American species fails to reveal this condition though the claws of the fore leg are several times as large as the others.

posterior margin and two smaller ones at the sides; the ninth segment weakly chitinized, emarginate below; the tenth segment with cerci. Male genitalia hard to make out clearly; besides the heavy claspers a small side piece shown in the figures; this piece apparently prolonged into a large flap, not shown in the figures, covering the penis laterally; in addition a dorsal appendage covering the penis above and one or two pairs of stout chitinous rods alongside.

Larval labrum much widened (text fig. 36*d*), its anterior margin with rather long bristles, back of which a row of very small teeth and still farther back another row of longer bristles. Mandibles (text fig. 37*b, c*) asymmetrical and the frons (text fig. 33*g*) very decidedly so. The fore leg with a stout spine on the coxa and a long bristle arising near the point of this spine. No lateral fringe and no tracheal gills present. Four anal blood gills. Anal prolegs long and stout.

Pupal labrum (text fig. 43*e*) with a number of long bristles but no heavy bunches of them as in those forms that have a grating at the end of the case. Mandibles (text fig. 44*b*) of peculiar shape; at the base of each a clear circle with a smaller dot within. No tracheal gills and no lateral fringes. Dorsal plates with hooks on the anterior margins of segments 2-7 and on the posterior margin of segment 5. These plates small and with few teeth on them. The first abdominal segment not strongly chitinized. Pupal legs provided with claws. Swimming hairs present on the middle legs.

The larvae live in swift water associated with *Hydropsyche*. There is no larval case but the insects spin nets. These have recently been described by Miss Noyes (*l. c.*). "The nets of *Chimarra* are long, narrow pockets built entirely of a very fine mesh of delicate silken threads. The average size of the net of the growing larva is about 25 mm long and 3 mm wide. The nets are rarely found singly, but generally placed five or six in a row. There is a large opening at the end facing the current, and a tiny opening at the hinder end just large enough for the larva to step through and make its escape when alarmed. The nets are fastened at the entrance by their entire lower edge, the rest of the sac floating freely, and kept distended by the current. They are found fastened to the underside of stones or to their upper surface when they are covered by other stones. I have also exposed them on the upper surface of the shelving rocks by pushing aside the covering mats of *Cladophora*. The separate threads of the net are only clearly seen with the highest power of the microscope when it is seen that the units of the mesh are rectangular in shape, one dimension being about eight times the other. The double nature of the silken threads is not recognizable, as is that of the *Hydropsyche*'s when examined with a microscope."

The pupa lies in a case of stones. There is an inner cocoon as in the Rhyacophilidae, and it is fastened to the case at either end, more securely at the anterior end. Its material is not so strong and rigid as that of *Rhyacophila* and it is not so nearly free from the case.

There has been some question regarding the systematic position of this genus. It was for a long time placed among the Rhyacophilidae, where it is still retained by Banks in his latest catalog (1907c). McLachlan (Rev. and Syn., p. 431) called attention to the fact that the genus had certain characters in common with the Hydropsychidae and left the conclusion to be decided by the discovery of the immature stages. The larva and pupa of a South American species were studied by Fritz Müller who removed the genus to the Hydropsychidae (s.l.) because he found the pupa going through respiratory movements and because he found no pupal cocoon. He comments on the resemblance to *Wormaldia* in respect to adult venation.

There can no longer be much question as to the relationships of this genus; the structure of the adult (particularly the venation), and the highly characteristic form of the larval labrum being in themselves sufficient evidence that the genus belongs to the Philopotamidae. Thienemann (*l.c.*) has more recently questioned the retention of *Chimarra* in the Philopotamidae (where it has been placed by Morton) on the ground of Müller's statement regarding the respiratory movements of the pupa. He says that if the movements occur the pupa will doubtless be found to have the gratings at the ends of the case, and bristles for cleaning the gratings will be found on the head and on the posterior end of the body. The bristles are certainly not present in *Chimarra*, but it is not necessary to assume that Müller's observations are mistaken. I have seen similar movements in *Rhyacophila* though they may in this case have been preparatory to emergence from the cocoon. So far as the presence of a cocoon is concerned, my observations are certainly at variance with those of Müller, who states that there is no cocoon but a ventral wall as in *Hydropsyche*. I have been unable to satisfy myself from a study of the few pupae now at hand that the cocoon is anteriorly complete; it seems at any rate to be attached to the case so that it can not be removed whole. The rear end at least can be so removed and then remains as a closed sac in which the larval hard parts are retained; in the species examined it is not simply a ventral wall as stated by Müller.

There are three North American species of this genus. They may be separated by the shape of the ventral lamina and of the

claspers of the male. The differences in size and in venation, while considerable, are too variable to admit of use in this connection. The females I can not separate satisfactorily except that those of *C. socia* are recognizable by the color of the legs.

Some of the West Indian species, such as *C. pulchra* Hagen and other undescribed species in the Hagen collection, are very strikingly colored.

### **Chimarraha aterrima** Hagen

(Text figs. 33*g*, 36*d*, 37*b*, *c*, 38*f*, 43*e*, 44*b*; pl. 16, figs. 6-9)

Hagen, 1861*c*, p. 297; Provancher, 1877, p. 268; Provancher, 1878*b*, p. 145;

Ulmer, 1907*b*, p. 82, fig. 128; Ulmer, 1907*c*, pl. 26, fig. 243

Immature stages. Noyes, 1914*a*, p. 259, pl. 38, fig. 1; Sibley, 1926*b*, p. 103, 207, pl. 10, fig. 65

"Deep black, with black hair; body, antennae, palpi and feet black, the front with hardly hoary hair; anterior wings with black hair. Male and female.

"Length to tip of wings 6-8 millim. Alar expanse 11-15 millim.

"Hab. Pennsylvania; Washington; Dalton, Georgia; St Lawrence River, Canada (Osten Sacken)." Hagen, *l.c.*

Ulmer adds the following notes on a female type in the Selys collection: The entire body black; the abdominal segments in the middle part dark brown; head (with the exception of the whitish gray haired vertex), pronotum, and anterior part of the mesonotum with black hair. Antennae black; palpi blackish brown; legs dark brown with close-lying, clear hairs. Wings with uniformly dark brown pubescence, shining, iridescent. Second apical cell of the fore wing with a short pedicel; radial sector sharply curved, the nude spot evident. Length of the body about 4 mm.

The following is added regarding the male genitalia. The ventral lamina comparatively short, triangular (pl. 16, fig. 8) forming a blunt tooth not extending beyond its own segment. The claspers short and stout not prolonged upward as in the other two species. In the female the next to the last segment with a very inconspicuous tooth or median ridge.

Sibley describes a decidedly gray color phase for this species and states that many intermediates between it and the typical form are found.

This appears to be the most common of the three species known to me. I have specimens from New York State, from Delaware, from Winona, Ind.; Dr J. Chester Bradley has given me specimens from Waycross, Ga., and Dr M. D. Leonard, one from Micanopy, Fla. My New York specimens are dated July and August;

those from Georgia, May 8th. Specimens from Oklahoma are dated July 10th.

In Hagen's collection the first specimen is the species here described and figured. Among those placed as *aterrima*, however, there are several of the similar species next described.

### *Chimarrha lucia* n. sp.

(Pl. 16, figs. 10-12)

Head, antennae and abdomen black, palpi dark brown. Wings dark brown with darker hair. Legs dark brown, coxae and femora darker, legs covered with yellow hair, spurs not conspicuously darker than the legs. The claspers very stout, curving upward and inward; the penis dark brown and more prominent than in the other species, its downward curved tip often protruding beyond the margin of the claspers. The ventral lamina long and slender extending much beyond the end of its segment.

This species was collected at several places in New York State, dated June 1st to August 1st. I have also a few conspicuously larger specimens collected by J. H. Lovell at Waldoboro, Me., May 29th to June 5th. The New York specimens average 6 mm for the males and those from Maine 8 mm for the males and 9 mm for the females. This species is more rare than the others in New York.

The third specimen under *aterrima* in Hagen's collection is of this species.

### *Chimarrha socia* Hagen

(Pl. 16, fig. 13)

Hagen, 1861c, p. 297; Banks, 1911b, p. 358, pl. 13, fig. 34 (*Wormaldia plutonis*); Banks, 1911b, p. 358 (*Wormaldia femoralis*); Döhler, 1915, p. 397, figs. 1-3

"Blackish-fuscous, with fuscous hair; antennae blackish-fuscous; palpi and feet luteous; head and thorax blackish-fuscous, with luteous hair, anterior wings blackish-fuscous, with fuscous hair, and black cilia; posterior wings blackish-hyaline.

"Length to tip of wings 6 millim. Alar expanse 11 millim.

"Hab. Washington (Osten Sacken)." Hagen, *l.c.*

Palpi darker at the tips than at the base. Tarsi sometimes dark. Tibial spurs conspicuously darker than the legs. Claspers like those of *C. lucia*, but noticeably narrowed in the middle. The ventral lamina much shorter and thicker than in that species.

I have taken this species at Ithaca, Niagara Falls and Lancaster, N. Y. Doctor Felt has sent me specimens from Cornwall, Canada. The dates run from July 19th to August 9th. Dr J. C. Bradley sent me specimens collected June 7th, Spring creek, Decatur Co., Ga.

Dr J. G. Needham collected it at Dead lake, Wewahitchka, Fla., on April 8th. Mr Banks' specimens are from New York and New Jersey.

#### OTHER AMERICAN SPECIES OF CHIMARRHA

There are one Mexican and several West Indian species; of these latter, *C. braconoides*, Walker ought probably, according to data given by Ulmer, to be listed in *Wormaldia*.

#### *Chimarrha albomaculata* Kolbe

Kolbe, 1888d, p. 175; Banks, 1913b, pl. 23, fig. 12 (*Curgia*). Porto Rico.

#### *Chimarrha angustipennis* Banks

Banks, 1903a, p. 242. Arizona.

#### *Chimarrha argentella* Ulmer

Ulmer, 1906b, p. 92, fig. 98-100. Jamaica.

#### *Chimarrha braconoides* Walker

Walker, 1860, p. 179 (*Curgia*); Hagen, 1864b, p. 810 (*Curgia*); McLachlan, 1866b, p. 277; McLachlan, 1879c, p. 431; Kolbe, 1884, p. 167 (*Curgia*); Ulmer, 1906b, p. 94, fig. 101 (Indicates that the species should probably be in *Wormaldia*). St Domingo.

#### *Chimarrha fraterna* Banks

Banks, 1924, p. 449. Cuba.

#### *Chimarrha mexicana* Ulmer

Ulmer, 1905d, p. 89, figs. 58-60 (*Wormaldia*); Ulmer, 1907c, p. 200. Mexico.

#### *Chimarrha moesta* Banks

Banks, 1924, p. 449. Cuba.

#### *Chimarrha picea* Navás

Navás, 1924b, p. 79, fig. 16. Costa Rica.

#### *Chimarrha pulchra* Hagen

Hagen, 1861c, p. 298; Kolbe, 1888d, 167; Ulmer, 1909f, p. 127, fig. 3. Cuba.

#### *Chimarrha texana* Banks

Banks, 1920a, p. 360, San Antonio, Texas.

### HYDROPSYCHIDAE

Curtis, 1835, p. 601; McLachlan, 1878b, p. 350, 353, 355, 373; Klapálek, 1904a, p. 18; Ulmer, 1906b, p. 107, 108; Ulmer, 1907c, p. 153; Banks, 1914b, p. 204 (Key to tribes of Hydropsychidae, *sensu lato*)

Antennae (except in *Arctopsyche* and *Parapsyche*) slender, about as long as the wings or much longer. Palpi with the terminal segment multiarticulate, the basal segment very short, the second rather long, the next two of about equal length and shorter than the second. No ocelli. Middle legs of the female often dilated. Spurs various, but the fore tibiae never with subapical spurs. Venation varying in the genera. Claspers 2-segmented. Female abdomen not modified into an ovipositor.

The eggs in practically all cases laid beneath the surface of the water, being fastened to the upper or lower surfaces of submerged stones or plants, laid flat in irregular rows with very little gelatinous material. The number of eggs in a mass ordinarily not large but it may run to 800.

Larvae thysanuriform with not very deep constrictions between the abdominal segments. Antennae short. Mouth parts generally not very prominent. Labrum transversely elliptical with numerous short bristles dorsally and a thick bunch of lateral bristles. Mandibles stout, asymmetrical, the left one with an inner bunch of bristles; on the convex side near the base numerous bristles instead of the usual two. Legs short and stout, of about equal length; the anterior pair particularly stout and provided with heavy brushes. No lateral fringe and no tubercles present. Tracheal gills on the ventral side, much branched; also soft conical processes on segments 3-7 with doubtless a respiratory function. Blood gills present at the anal end. The anal prolegs long and armed with heavy claws; at the ends a bunch of long bristles. The larvae found in swift water.

Pupae stout, spindle-shaped. Labrum with many long bristles. Mandibles long, the base broad, the right blade with three, the left with four teeth, many bristles on the outer side at base. The arrangement of the dorsal hooks unusual in that there are posterior plates on segments 3 and 4; the anterior plates of these segments very broad. No lateral fringe. Gills as in the larvae. Anal prolegs stout, narrower in the middle than at the bases or at the concave ends.

The two subfamilies are rather far divergent, with the genera *Smicridea*, *Rhyacophylax*, and *Potamyia* probably nearest to the point of division.

While the description of the family Arctopsychidae (Martynov, 1924c) has not been available, it is altogether probable that of North American genera, *Arctopsyche* and *Parapsyche* are included.

#### KEY TO THE SUBFAMILIES OF HYDROPSYCHIDAE

1a Antennae not much, if any, longer than the wings (except in *Potamyia*). A discal cell present in the fore and in the hind wings; cell *R* of the hind wings not conspicuously large;  $Cu_{1a}$  and  $Cu_2$  of the fore wing almost never joined by a crossvein. Palpi always present.

1b Antennae much longer than the wings. A closed discal cell not always present in the hind wing; cell *R* of the hind wing often conspicuously large (pl. 21, fig. 13);  $Cu_{1a}$  and  $Cu_2$  of the fore wing either fused at tip or joined by a crossvein. Palpi sometimes wanting. p. 200

#### MACRONEMATINAE

#### HYDROPSYCHINAE Ulmer

McLachlan, 1878b, p. 355 (Hydropsychidae, Section 3); Klapálek, 1904a, p. 18 (Hydropsychidae); Ulmer, 1907c, p. 167; Ulmer, 1909a, p. 60; Banks, 1914b, p. 204 (*Hydropsychini*)  
Immature stages. Ulmer, 1903d, p. 112; Ulmer, 1909a, p. 205, 233, 299.

Antennae slender, generally somewhat longer than the wings, those of the female commonly a little shorter than those of the male;

first segment short, thicker than the others. Maxillary palpi with very short basal segment, the second comparatively long, the next two about equally long, the fifth as long as the others taken together. Labial palpi with a short basal segment, the third long. The terminal segment of both pairs multiarticulate. Venation very regular, the differences between the genera for the most part slight and presenting no obscure homologies. Claspers 2-segmented, the second segment much shorter than the first (see *Parapsyche*, p. 181); the penis strongly chitinized, often with retractile appendages tipped with spines. The abdomen of the females not in the form of an ovipositor. In some genera on the median line at the fourth or the fifth abdominal segment a long slender appendage, longer in the male than in the female (text fig. 26*d*).

Larvae with the head rather small, flattened in front. Mouthparts not prominent. Frons broad, but little incised laterally (text fig. 33*f*). Mandibles stout, asymmetrical, basal bristles scattered and more than two in number. The thoracic segments covered with chitin plates which are of about equal size. Legs short, stout, of about equal length. The abdomen covered with small black hairs. No lateral fringe present but on segments 3-7 conical appendages (text fig. 41*c*). The tracheal gills branched and found ventrally on the meso- and metathorax as well as on the abdomen. Three, four, or five anal blood gills. Anal prolegs long, 2-segmented (text fig. 42*d*).

Pupal labrum with many bristles. Mandibles (pl. 18, figs. 6, 7) long, the left with four and the right with three teeth. Chitinous plates with hooks on the anterior margins of segments 2 or 3-8, and on the posterior margins of segments 3 and 4, the number of the plates not absolutely constant. Tracheal gills as in the larvae but beginning with the second segment. No lateral fringe but lateral appendages as in the larvae. The anal appendages stout, heavily chitinized processes (text fig. 48*b*).

The larvae and pupae occur in rapid streams. The thick integument of the larva, the chitinization of the thorax, the stout legs and prolegs are all evident adaptations for this habitat.

#### KEY TO THE GENERA OF HYDROPSYCHINAE<sup>29</sup>

- 1*a* Fore wings lacking cells  $M_1$  and  $Cu_1$ . Hind wings without discal and without apical cells. Spurs (male) 2-4-3. Mexican species. p. 179  
 ..... *Xiphocentron*
- 1*b* Fore wings with cells  $M_1$  and  $Cu_1$  present. Hind wings with discal and apical cells. Spurs not 2-4-3. .... 2
- 2*a* Anterior margin of the fore wing rather strongly convex;  $Sc$  of the fore wing with an accessory to the costal margin (pl. 17, fig. 1) ..... 3
- 2*b* Anterior margin of the fore wing nearly straight for about two-thirds of its length. No accessory branch to costa except sometimes in *Dipletrona* ..... 4

<sup>29</sup> The key needs modification because of the discovery (to be credited to H. H. Ross) that females of *Potamyia* are like *Hydropsyche* as to antennae and the presence of cell  $R_3$ , and like *Hydropsychodes* in the position of the crossvein referred to.

- 3a Last segment of the maxillary palpus not longer than the first four taken together. Tibiae of the female dilated. p. 180.....*Arctopsyche*
- 3b Last segment of the maxillary palpus longer than the other four taken together. Tibiae of the female not dilated. p. 181.....*Parapsyche*
- 4a  $Sc$  and  $R_1$  of the hind wing strongly arched toward  $R_s$  near the margin (pl. 17, fig. 6). The abdomen with slender lateral filaments at the fourth segment. Antennae rather stout. p. 182.....*Diplectrona*
- 4b  $Sc$  and  $R_1$  of the hind wing not strongly arched toward  $R_s$  near the margin. Lateral filaments on the abdomen present in but two genera. Antennae slender. . . . .5
- 5a Discal cell of the fore wing of normal size, its area at least not less than that of cell  $R_2$ ; cell  $R_4$  extending some distance upon the discal cell (pl. 18, fig. 1).....6
- 5b Discal cell of the fore wing small, its area less than that of cell  $R_2$ ; cell  $R_4$  pedicellate, the pedicel being as long as that of cell  $R_2$ ; cell  $M_2$  not reaching back farther than the crossvein.....8
- 6a Antennae but little, if any, longer than the fore wings. Spurs 2-4-4.....7
- 6b Antennae at least one and one-half times as long as the wings. Spurs 0-4-4. p. 197.....*Potamyia*
- 7a Cell  $R_2$  of the hind wing present; the transverse vein between  $Cu_1$  and  $Cu_2$  of the fore wing at or about the level of the apex of the median cell (pl. 18, fig. 1). p. 183.....*Hydropsyche*
- 7b Cell  $R_2$  of the hind wing not present; the transverse vein between  $Cu_1$  and  $Cu_2$  at or beyond the apex of the median cell (pl. 20, fig. 9). p. 194  
*Hydropsychodes*
- 8a Hind wings with a discal cell, radial sector normal. Area between the anal veins and the posterior margins of the fore wing very broad (pl. 21, fig. 4). p. 198.....*Smicridea*
- 8b Hind wings without a discal cell; the radial sector arises from the much thickened base of  $M$  and  $Cu$ . Area between the anal veins and the posterior margin of the fore wing not very broad (pl. 21, fig. 7). p. 199  
.....*Rhyacophylax*

### Xiphocentron Brauer

Brauer, 1870, p. 66; Brauer, 1871, p. 103, pl. 2; Ulmer, 1907c, p. 176

Spurs, male, 2-4-3; the inner spur longer than the outer; the apical spur of the hind leg apparently composed of two spurs fused, forming a long sword-shaped structure reaching over two-thirds of the first tarsal segment and having at its tip a small point. Legs rather long and stout. Antennae rather stout, the distal third more slender; antennae shorter than the wings. Maxillary palpi with short basal segment, the next three longer, the fifth as long as the others together. Labial palpi more slender, the first segment short, the second twice as long, the third flexible. Wings narrow, the fore wing with elliptical apex, and with silky pubescence. Discal cell closed, apical cells  $R_2$ ,  $R_4$  and  $M_3$  present, the first and last with long pedicels. Hind wings narrow, sharply pointed, with long fringes.  $Sc$  and  $R_1$  fused,  $Cu_1$  the only apical cell present.

One Mexican species.

### *Xiphocentron bilimeki* Brauer

Brauer, 1870, p. 66; Brauer, 1871, p. 104, pl. 2; Ulmer, 1907c, pl. 23, figs. 217a, 217b

**Arctopsyche McLachlan**

McLachlan, 1868*b*, p. 300; McLachlan, 1878*b*, p. 377; Ulmer, 1907*c*, p. 177

Antennae thick, the segments short, each segment a little dilated internally at its distal end; antennae of the female more slender. Ocelli absent. Maxillary palpi 5-segmented, the basal segment very short, the second somewhat longer, the third almost twice as long as the second, the fourth equal to the third, the fifth shorter than the first four. Spurs 2-4-4. Venation as in the next genus (pl. 17, figs. 1, 2). Genitalia complicated, the claspers 2-segmented, short and broad.

The specimens I have seen of one of the western species have  $Sc$  and  $R_1$  fused at tip in both fore and hind wings.

It is with much hesitancy that I leave this and the next genus in this family. The relationship to the Philopotamidae, previously noted by others, is very marked.<sup>30</sup>

**Arctopsyche irrorata Banks**

Banks, 1905*a*, p. 217; Banks, 1905*c*, p. 15, pl. 2, fig. 26

"Head dull dark brown, with some yellowish hair; palpi yellowish; antennae clear yellowish, basal joint brown; thorax and abdomen brown, pleura yellowish; legs pale yellowish, the tibiae and tarsi very pale. Wings brown, densely irrorate with yellow, mostly in the form of rounded spots, about a dozen of these along the costal region, the brown sometimes forming bands; hindwings gray. Forewings rather long, the radial sector connected to radius beyond the discal cell, fork 1 with a pedicel one-half its length, forks 4 and 5 of about equal length. Expanse 32 mm

"One specimen from Black Mt., North Carolina, June (Beutenmuller)." Banks, *l. c.*

There are three other North American species described.

McLachlan (*l. c.* page 379) quotes from Hagen (*in litt.*) a few notes on a Coloradan species and (in footnote) speaks of a female specimen he himself had seen from that state. Perhaps these notes may refer to one of the following:

***Arctopsyche grandis* Banks**

Banks, 1900*a*, p. 258 (*Hydropsyche*); Ulmer, 1907*c*, p. 178. Colorado

***Arctopsyche ladogensis* Kolenati**

Kolenati, 1859*b*, p. 201, pl. 1, fig. 4 (*Aphelocheira*); McLachlan, 1868*b*, p. 301, pl. 14, fig. 1; McLachlan, 1872*e*, p. 68; McLachlan, 1878*b*, p. 378, pl. 40. Slave Lake, also from Siberia.

***Arctopsyche phryganoides* Banks**

Banks, 1918, p. 21. Banff, Alberta

<sup>30</sup> Since this was written Martynov (1924*c*) has erected a family Arctopsychidae.

**Parapsyche** n. g.

Antennae (pl. 16, fig. 18) stout, shorter than the wings. Ocelli absent. Maxillary palpi (pl. 16, fig. 16) 5-segmented, the last segment multiarticulate, the first two segments very small, the third more than two times as long as the first or the second, the fourth shorter than the third, the fifth longer than the other four. Labial palpi (pl. 16, fig. 16) much smaller, second segment longer than the first, the third about equal to the other two. Femora of the first legs a little longer than the tibiae; in the other legs, tibiae and femora about equal. Spurs 2-4-4. Subapical spurs of the middle legs at about middle of the tibiae, those of the hind legs about one-third the way from the proximal end. Middle tibiae of the female not dilated. The venation (pl. 17, figs. 1, 2) generalized; in the fore wing apex of cell  $Cu_1$  at about the middle of the wing, anals reaching the wing margin at about the same level. In the hind wing (as also in *Arctopsyche*) a crossvein between the radial sector and media at base. As in the preceding genus, the genitalia complicated, the claspers broad, very unlike those of the other Hydropsychinae.

**Parapsyche apicalis** Banks

(Pl. 16, figs. 14-18, pl. 17, figs. 1, 2)

Banks, 1908c, p. 266 (*Arctopsyche*); Sibley, 1926b, p. 104 (*Arctopsyche*)

"Similar to *A.* [*Arctopsyche*] *ladogensis*; wings pale, veins fuscous and more or less margined with fuscous, mostly in spots, and at apex of the veins are other spots, sometimes more or less connected, and two spots on costa near the stigma. Body black, head and thorax clothed with mostly greyish white hair, some yellow hair on prothorax, and black on the warts; legs pale yellowish, tips of hind tibiae faintly blackish; antennae heavy, yellowish, faintly marked with brown. The first pair of spurs on the middle tibiae are at about the middle of the length. Discal cell of forewings much longer than in the other species, nearly twice as long as in *A. ladogensis*. Expanse 19-24 mm.

"Franconia, New Hampshire (Mrs A. T. Slosson); Fourth Lake, Fulton Chain, Adirondack Mountains, New York, June 12th (Dickerson).

"Much smaller than the other species (referring to *Arctopsyche*), and also differs from *A. grandis* in lacking the many pale spots on the wings." Banks, *l. c.*

The following may be added from my own notes:

Antennae with a broad band of brown hair on each segment; cleared specimens showing a narrow brown band in the chitin of the basal segments. Wings very hairy, the membrane dark brown irrorated with lighter dots; pubescence of the wings dark brown, closely irrorated with golden yellow. Genitalia not prominent in dried specimens; claspers large, the ventral side with a fingerlike

branch internally, the penis with two spinous processes bent sharply downward.

Length to tip of wings, male 10 mm. female 12 mm.

This is a very pretty and rather a robust insect. I have several specimens taken at Old Forge, N. Y., July 11th-28th. Lloyd and Sibley have collected the species at McLean, N. Y., June.

### Diplectrona Westwood

Westwood, 1840, p. 49; McLachlan, 1878*b*, p. 375; Ulmer, 1907*c*, p. 176; Ulmer, 1909*a*, p. 68

Immature stages. The immature stages of the European species *Diplectrona felix* are described by Morton, Ent. Mon. Mag., 1893*b*, p. 84-86

Head with large and prominent posterior warts. Antennae somewhat slender, not longer than the fore wings, the segments elongate, sometimes wide in the middle, each with a false suture in the middle, sometimes a short spine or tooth at the false suture. Maxillary palpi with a short basal segment, the second, third and fourth long and nearly equal, the fifth scarcely as long as the others taken together. Spurs 2-4-4. Intermediate legs not dilated in the female. At the posterior margin of the fourth abdominal segment a slender curved filament, extending nearly to the apex of the abdomen, more evident in the male. Fore wings short and mostly broad. Discal cell closed in both wings; an accessory branch from *Sc* to the costal margin generally present though faint. Hind wings at least as wide as the fore wings. Genitalia of the male similar to those of *Hydropsyche*.

### Diplectrona modesta Banks

(Text fig. 5*f*, pl. 17, figs. 3-7)

Banks, 1908*c*, p. 266, pl. 19, fig. 13; Banks, 1911*b*, p. 359, pl. 13, fig. 33. Sibley, 1926*b*, p. 104.

"Black; with golden hair on head and thorax, especially on the warts, between the antennae and at bases of the wings, rest of thorax and abdomen brownish; legs pale yellowish, the femora rather darker; wings brown, venation brown, surface with very short golden hairs. Maxillary palpi very long; antennae with each joint prominent below; spurs 2-4-4, those on front pair very short, and the first pair on middle tibiae are at about the middle of length. On the side of abdomen, between the fourth and fifth segment arises a very slender, stiff filament, which in the male reaches nearly to the tip of the body. Wings moderately long; venation similar to that of *D. felix*, but the discal cell is much longer, and in the hind wings fork 1 is extremely short. Expanse, male, 17 mm; female, 19 mm.

"Riverside, Massachusetts, June (C. W. Johnson)." Banks, *l. c.*, p. 266.

I have but a single incomplete specimen given me by Dr A. D. MacGillivray, collected by him at Newfield, N. Y., June 17th. This

differs from the European species on which the genus is erected in not having a costal branch on *Sc*, in having the third segment of the maxillary palpi somewhat longer than the second or the fourth, and the fifth segment somewhat longer than the others taken together. Sibley reports the species from McLean, N. Y., June 22d–July 1st.

Alice A. Noyes of Cornell University has bred the species and the drawing of the male genitalia is from her material and has been compared with the type specimen. Miss Noyes kindly gave me permission to list from her material the main larval characters distinguishing the genus from *Hydropsyche*. The frons (pl. 17, fig. 7) is strongly indented along the sides and its anterior margin is not scalloped, the sternite of the prothorax (pl. 17, fig. 5) is much longer in proportion to its width, there is a large tooth and not a Y-shaped piece on the supporting plate of the first leg, and the tracheal gills are not found on the seventh segment. Of these characters the last mentioned is also noted by Morton in his description of *D. felix* Mc L. of Europe.

The other species described are western or southern.

#### *Diplectrona californica* Banks

Banks, 1914b, p. 253, pl. 20, fig. 63. California

#### *Diplectrona nigripennis* Banks

Banks, 1911b, p. 358, pl. 13, upper part of fig. 33. California

#### *Diplectrona unicolor* Banks

Banks, 1901b, p. 370, pl. 12, figs. 11, 12. Mexico

### Hydropsyche Pictet

Pictet, 1834, p. 199; McLachlan, 1878b, p. 355; Ulmer, 1907c, p. 169; Ulmer, 1909a, p. 61

Immature stages. Ulmer, 1903d, p. 114; Silfvenius, 1905b, p. 91; Thienemann, 1905b, p. 50; Silfvenius, 1906b, p. 25; Silfvenius, 1907c, p. 413; Ulmer, 1909a, p. 235, 300, 301; Wesenberg-Lund, 1911b, p. 23; Ulmer, 1913f, p. 96; Lestage, 1921a, p. 535

Antennae slender, somewhat longer than the wings, shorter in the female than in the male; the basal segment thick, the others long. Generally a black line around the antennae as a spiral (p. 25), appearing in denuded antennae as a dark line in the chitin, more or less completely encircling each of about the first dozen segments beginning with the third, the heavy hair along this line often giving the antennae a slightly serrate appearance. Maxillary palpi with a short basal segment, the second longer than the third or the fourth which are about equal; the fifth segment multiarticulate and about as long as the others taken together. Labial palpi (pl. 18, fig. 8) with terminal segment multiarticulate and as long as the other two together. Spurs 2–4–4, middle tibiae and tarsi of the female

dilated. The outer claws of the male covered with a brush of black hair. Venation (pl. 18, fig. 1) generalized. In the fore wing a closed discal cell and a median cell. The fibula narrow and not set off from the wing. On the fused anal veins a set of strong blunt bristles (text fig. 11*b*). In the hind wing  $Sc$  and  $R_1$  usually fused at tip, but separate in a few species. Discal cell almost invariably present and in most species the median cell also present; the radial sector somewhat angled at its base and joined to media by a cross-vein (pl. 18, fig. 1), this not shown in figures of the European species. Anal lobe of the hind wing broadly joined to the wing and containing a curved vein. A dark fleck in cell  $R_2$  of the fore wing seems almost a constant characteristic of the genus. The claspers of the male 2-segmented; the penis generally with retractile appendages, the end of the organ itself usually extrusible (text fig. 28*a, b*). A large membranous sheet between the tenth segment and the penis.

Eggs laid beneath the water as might be inferred from the dilated intermediate tibiae and tarsi of the females, with very little gelatinous material and laid so close together that they touch along the lateral margins.

Larval head narrower than the prothorax, its dorsal surface with many short bristles. Antennae represented by two rods and two bristles. Labrum about twice as wide as long; its corners rounded so that it forms almost a semicircle; no median anterior notch; one large bristle on each side and many other small bristles; anteriorly a bunch of small hairs on the lateral margin. Mandibles strong, asymmetrical; the edge bladeliike, sometimes approaching the chisel-type. Maxillae slender with numerous hairs and bristles; the lobe very close to the palp, almost united with it; cardo of the labium of peculiar and characteristic shape (text fig. 38*g*). Shield of the prothorax covering the sides of that segment, that of the mesonotum likewise in part, that of the metanotum very little. Prothoracic shield the only one that has a median suture. A prosternum present, consisting of a large transverse piece followed by two smaller ones. Branched tracheal gills on the ventral surface of the meso- and meta-thorax and on the first abdominal segments. Laterally on segments 3-7 conical protuberances which serve as gills; one of these on each side of the third segment, one or two on the seventh and three on segments 4-6. On the ventral side of segment 8 two triangular chitinous shields, and on segment 9 two larger ones. The latter segment sometimes with small plates dorsally and laterally. Legs short and stout. Prolegs long, the basal segment with a large bunch of bristles. Four anal blood gills.

The pupa with long mandibles (pl. 18, figs. 6, 7), the right with less teeth than the left. Tibiae and tarsi dilated in the female; the middle legs provided with long fringes for swimming. The dorsal plates of hooks in the normal arrangement except that there are plates on the posterior margins of segments 3-4. The gills and lateral protuberances as in the larva, except gills not present on the thorax or on the first abdominal segment. The stout anal appendages concave internally (text fig. 48*b*).

The larvae are found in rapid streams. They lie in loosely built retreats made of silk and vegetable materials; in front of this a net is extended (p. 94). The pupal case (pl. 1, fig. 3) is formed of sand or stones, the latter often rather large. The lower side of the case is formed of silk only and this is fastened to a stone. The pupal cases were formerly supposed to be wholly closed but Thienemann 1905*b*, p. 51) has shown that the cocoon has perforated membranes at the ends and he indicates that this is as might have been expected from the development of the apparatus for keeping the openings free from dirt.

The larvae and pupae of the genus are not easy to distinguish. The color pattern of the larvae is subject to some variation.

This is one of the largest and most cosmopolitan genera of Trichoptera, noteworthy for the number of its individuals as well as for the number of the species (p. 9). It is a matter of gratification that most of the species can now be recognized with some certainty. Walker's three species remain uncertain and even of these one (*alternans*) has its identity fairly well established. The shape of the clasper is distinctive of some of the species (text fig. 53).

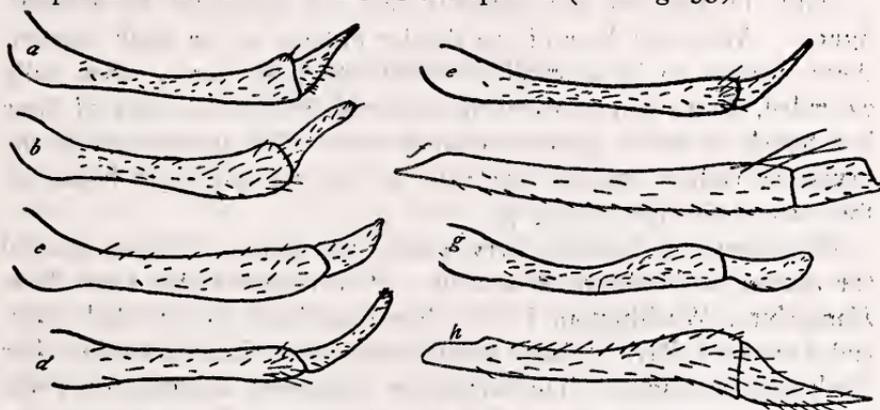


Fig. 53 Claspers of species of *Hydropsyche*. *a alternans* Walker and *codona* n. sp. *b chlorotica* Hagen. *c scalaris* Hagen. *d incommoda* Hagen. *e phalerata* Hagen. *f venularis* Banks. *g* sp. 1. *h* sp. 2

### *Hydropsyche alternans* Walker

(Text figs. 5*g*, 33*f*, 34*c*, 36*b*, 37*d*, *e*, 38*g*, 48*b*, 53*a*; pl. 18, figs. 1-7)

Walker, 1852, p. 104 (*Philopotamus*); Walker, 1852, p. 104 (*Philopotamus indecisus*); Hagen, 1861*c*, p. 287 (*morosa*); Hagen, 1861*c*, p. 288 (*alternans*); Hagen, 1861*c*, p. 288 (*indecisus*); McLachlan, 1863*c*, p. 159 (*indecisus* reduced to synonymy); Hagen, 1864*b*, p. 821; Banks, 1905*c*, p. 14, pl. 1, figs. 4, 7 (*slossonae*); Banks, 1908*b*, p. 65 (*slossonae*, listed from New Hampshire); Vorhies, 1909, p. 707, pl. 60, figs. 7-10; Sibley, 1926*b*, p. 104; Carpenter 1933*a*, p. 43, fig. 1

Immature stages. Vorhies, 1909, p. 709, pl. 53, fig. 7, pl. 60, figs. 11-19

Vorhies has given very good descriptions and figures of all the stages of this species; part of his description of the adult is here copied.

"Length of body, 6-7 mm. Expanse, male, 18 mm; female 20-22 mm. Antennae 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 the 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 pair of large 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 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." Vorhies, *l. c.*

Some features of the genitalia are not indicated in Vorhies' figures. Above the base of the slender process of the tenth segment there appears to be a small chitinous spot; the penis, when fully extended, shows an undivided tip with stiff bristles and back of these is a bunch of half a dozen similar bristles. The appendages of the penis are rather long and the spur at the end has sharp hooks on the convex side (pl. 16, fig. 5).

This species is doubtless very widely distributed. Vorhies studied the species at Madison, Wisconsin. It is reported also from New Hampshire, Washington, D. C., Newfoundland, North Red river, and Hudson's Bay. I have taken adults at various places in New York and in Illinois. The larvae are sometimes common on rocks and piers along the shore of Lake Michigan. Sibley reports the adults from McLean, N. Y., July 7th–September 12th.

Hagen's type of *morosa* is certainly the species here described. I could not see the points on the tenth segment and the penis was not extruded but in other respects the correspondence is complete. Banks' *slossonae* also I regard as the same.

### **Hydropsyche chlorotica** Hagen

(Text figs. 28a, b, 53b, pl. 18, figs. 8, 9)

Hagen, 1861c, p. 290; Ulmer, 1907b, p. 64, figs. 93–95

"Pale ochreous, with ochreous hair; antennae ochreous at base, annulated with fuscous, the apex fuscous; palpi fuscous; feet luteous; head and thorax luteo-fuscous, with luteous hair; abdomen luteous; anterior wings ochreous, the anal angle and apical margin ciliated with fuscous; posterior wings cinereous. Male and female.

"Length to tip of wings 10-12 millim. Alar expanse 19-23 millim. "Hab. St Lawrence River, Canada; Chicago; Trenton Falls (Osten Sacken); N. Red River (Kennicott)." Hagen, *l. c.*

Ulmer has redescribed the type in the Selys collection, and has figured the genitalia. In my specimens I do not find the antennae colored as there indicated (basal segments clear yellow with broad, dark brown bands, middle segments uniform dark brown, distal segments clearer); they agree rather with the original description. The penis has one pair of extrusible appendages tipped with chitinous spurs; the latter are not very large and are covered with small spines.

This is the species that occurs in such enormous numbers in the vicinity of Buffalo, N. Y. (p. 7). I did not find the larvae but observed the pupae transforming on the surface of the water alongside of the government breakwater. The species was commonest during June. I took great numbers of them *in copulo* and find great differences of color between the individuals mating.

#### *Hydropsyche codona* n. sp.

(Text fig. 53a, pl. 18, figs. 10-12)

Similar to *H. chlorotica* in size and color. Wings and legs pale yellow, paler than in most specimens of *chlorotica*; sometimes the wings covered with faint irrorations and almost always a dark spot on the margin at the tip of  $R_2$  of the fore wing. The male genitalia with some resemblance to those of *H. chlorotica* and *H. alternans*, clearly distinguished from these in that when fully extended the tip of the penis deeply divided (pl. 18, fig. 10) and the claw of the membranous appendage very long and slender. The margin of the tenth segment dentate (pl. 18, fig. 11); the terminal processes of the segment bent downward more than in either of the other species mentioned.

The species was rather common at Ogdensburg, N. Y., during my stay there in August.

#### *Hydropsyche depravata* Hagen

Hagen, 1861c, p. 290

"Blackish-fuscous; antennae blackish-fuscous, the base annulated with luteous, palpi blackish-fuscous; head, thorax, and abdomen fuscous; feet brownish-luteous; anterior wings blackish-fuscous, obsoletely irrorated with luteous; posterior wings blackish-grey. Female.

"Length to tip of wings 12 millim. Alar expanse 23 millim.

"Hab. Dalton, Georgia (Osten Sacken).

"One specimen only, which is not fully unfolded." Hagen, *l. c.*, p. 290.

It is probable that this species can never be surely recognized. The specimen was freshly emerged when killed, the wings still longitudinally folded as in the pupal skin.

### *Hydropsyche incommoda* Hagen

(Text fig. 53*d*, pl. 19, figs. 1-5)

Hagen, 1861*c*, p. 290

"Luteous, with luteous hair; antennae, palpi and feet luteous; head and thorax luteous, with luteous hair; anterior wings luteous, with luteous veins, and obsoletely irrorated with brownish-gray, especially at the pterostigma; posterior wings luteous; posterior tibiae ciliated. Male.

"Length to tip of the wings 10 millim. Alar expanse 10 millim.

"Hab. Georgia (collection of Hagen)." Hagen, *l. c.*

My own notes are as follows:

Head and thorax dark brown with black and white hair. Antennae dark brown, the basal segments lighter; the line on them very oblique, not quite so distinct as in *scalaris*. Palpi dark brown. Legs dark brown, the coxae lighter. Fore wings with membrane dark brown, the veins black; numerous flecks of white hair all over the wing and some in the apical fringe.

The species has some resemblance to *scalaris* with which it may sometimes have been confused. The differences in the genitalia are striking, as the figures show. In *scalaris* the second segment of the clasper is moderately long and the penis is rounded at the end; in this species the distal segment of the clasper is very long and slender and the penis truncate as seen from the side or from above. There is also a very decided difference in the curvature of the stem of the penis; in *incommoda* this is sharply bent upon itself at base.

This species appears to be common. I have taken it in several places in New York State and at Lake Forest, Ill. The dates range from May 13th to September 6th. The pupal cases (Old Forge, N. Y.) were found concealed in the moss covering the stones in a small brook.

### *Hydropsyche maculicornis* Walker

Walker, 1852, p. 113; Hagen, 1861*c*, p. 289

"Blackish, hairy; antennae testaceous, annulated with fuscous; palpi pale; pectus ferruginous; feet testaceous; anterior wings fusco-cinereous, with obsolete irrorations; posterior wings cinereous. (From the description of Walker).

"Length to tip of wings 8 millim. Alar expanse 15 millim.

"Hab. St Martin's Falls, Albany River, Hudson's Bay (Barnston)." Hagen, *l. c.*, p. 289.

*Hydropsyche phalerata* Hagen

(Text fig. 53e, pl. 19, figs. 6, 7)

Hagen, 1861c, p. 287; Provancher, 1877, p. 267; Provancher, 1878b, p. 142; Banks, 1894, p. 180; Betten, 1901, p. 566, pl. 15, figs. 1-4, 17; Ulmer, 1907b, p. 66, figs. 98-100 (note text below); Sibley, 1926b, p. 104

"Fuscous, with luteous hair; antennae fuscous, annulated with luteous; palpi and feet luteous; head and thorax fuscous, with luteous hair; anterior wings fuscous, guttated with luteous, with larger spots at the base, pterostigma and anal angle; veins fuscous; posterior wings blackish-gray. Male and female.

"A variety has the anterior less spotted, the female obscurer.

"Length to tip of wings 7-10 millim. Alar expanse 13-19 millim.

"Hab. St Lawrence River, Canada; Washington (Osten Sacken); Pennsylvania (Zimmerman)." Hagen, *l. c.*, p. 287.

Ulmer (*l. c.*) has examined two female types in the Selys collection. He reports that these types are in poor condition and adds figures and descriptions from a specimen sent him by Banks. I am inclined to think that this latter specimen probably belonged not to *phalerata* but to another which is listed below as *Hydropsyche* sp. 3.

In Hagen's collection the specimens immediately following the species label of *phalerata* are females. There are many specimens and farther from the label are males—not all of the same species. There is therefore no way of determining *phalerata* except from the female specimens; and these resemble most closely a species of which I have a few examples from Saranac Inn and Ithaca, N. Y., dated May 22d to August 18th. This species is much like *alternans* Walker, scarcely to be distinguished by coloration, a little less in size, the males measuring 9 or 10 mm to the wing tips. The males are easily recognized by the genital appendages when these are extended (pl. 19, fig. 7). Each of the appendages of the penis is tipped with a number of small chitinous points, and in addition has a stout chitinous spur at the side.

Sibley lists the species from McLean, N. Y., June to September 12th, and Banks records it from Washington, D. C.

*Hydropsyche reciproca* Walker

Walker, 1852, p. 104 (*Philopotamus*); Walker, 1852, p. 112 (*dubia*); Hagen, 1861c, p. 288; Hagen, 1861c, p. 288 (*dubia*); McLachlan, 1863c, p. 160

"Blackish, antennae and feet testaceous; palpi ferruginous, with the base black; anterior wings subfuscous, closely irrorated with yellow; posterior wings pale fuscous. (From the description of Walker).

"Length to tip of wings 14 millim. Alar expanse 27 millim.

"Hab. North America?"

"It is very much like *H. indecisa*." (Hagen, *l. c.*, p. 288, *H. reciproca*.)

"Black, beneath testaceous; antennae pale testaceous, annulated with fuscous, the apex fuscous; palpi ferruginous; feet testaceous; anterior wings subfuscous, obsoletely irrorated; posterior wings subcinereous. (From the description of Walker.)

"Length to tip of wings 11 millim. Alar expanse 23 millim.

"Hab. North America?" (Hagen, *l. c.*, p. 288, *H. dubia*.)

### ***Hydropsyche recurvata* Banks**

(Pl. 19, fig. 15)

Banks, 1914*b*, p. 253, fig. 73 (*slossonae* var. *recurvata*); Sibley, 1926*b*, p. 104

"Very similar to *slossonae* [*alternans*] in appearance and structure, the genitalia of male on same plan, the penis having practically the same structure, but the superior plate has only very short processes, instead of the long ones of true *slossonae*.

"From Go Home Bay, Georgian Bay, Ontario (Walker)." Banks, *l. c.*

I have a specimen in poor condition, also from Ontario, dated June 13th. Besides the shape of the tenth segment, it will be noted from the figure (pl. 19, fig. 15) that the distal segment of the clasper is different from that of *alternans*. Sibley lists the species from McLean, N. Y., June 9th–August 21st.

### ***Hydropsyche scalaris* Hagen**

(Text fig. 53*c*, pl. 19, figs. 8–12)

Hagen, 1861*c*, p. 286; Banks, 1894, p. 180 (listed from Kansas); Banks, 1904*a*, p. 109 (listed from New Mexico); Banks, 1905*c*, p. 14, pl. 1, figs. 6, 10, 12 (*hageni*); Banks, 1905*c*, pl. 1, figs. 11, 13; Ulmer, 1907*b*, p. 65, figs. 96, 97

"Black-gray, with white hair; antennae luteous, the base obliquely striated with black, the first article with snow-white hair; head grayish-fuscous, with snow-white hair; thorax grayish-fuscous, with a broad, medial stripe of white hair; eyes of the male larger, approximated; palpi luteo-fuscous; abdomen fuscous; feet pale luteous; anterior wings blackish-gray, densely flecked with white; veins black; posterior wings cinereous, luteous at base. Male and female.

"Length to tip of wings 13 millim. Alar expanse 25 millim.

"Hab. St Lawrence River, Canada (Osten Sacken); Washington." Hagen, *l. c.*

Ulmer (*l. c.*) gives figures of the genitalia of the type in the Selys collection and adds that the color of the type does not now agree with the description.

The wings of this species are covered with yellowish brown hairs; the flecks of white hair are particularly plain toward the apex; the

apical fringes are alternately brownish and white; a blackish brown spot at the end of cell  $R_2$ .

I have taken this species at various places in New York between July 19th and September 18th. Doctor Needham has given me a few specimens from Piasa Bluffs, Ill., and Dr J. C. Bradley, others from Bainbridge, Fla., July 16th. Banks reports it from Washington, D. C. The species may easily be confused with *H. incommoda* but can be readily separated by the genitalia.

A study of the genitalia of Banks' type of *hageni* shows that the species are identical. Banks says, "Readily separated from *H. scalaris* by the large eyes of the male," but the eyes are equally large in Hagen's type of *scalaris* and the original description refers to their size.

### **Hydropsyche venularis** Banks

(Text fig. 53f, pl. 19, figs. 13-14)

Banks, 1914b, p. 252, pl. 20, fig. 62

"Black; head and thorax with whitish hair; palpi very dark; antennae yellow, annulate with brown; legs pale yellow. Wings pale, the cubitus heavily bordered with dark brown or black, anal also bordered, a large, elongate streak near stigma, sometimes broken by pale spots, a black spot at end of first apical vein, apical part of wing often infusate, elsewhere dark spots, often along veins, and some patches of gray hair, all marks tend to be longitudinal; hind wings gray, tip darker. Eyes of male large, approximate. Venation as in *H. scalaris*. Male superior plate with minute emargination, the second part of lower appendage very short and broad, with bifid tip.

"Expanse 22 mm.

"From Washington, D. C.; Great Falls, Virginia; Dane County, Wisconsin; St Louis, Missouri, June to September. I had thought that this might be *H. reciproca* (*indecisa*) but that species is near *H. scalaris*." Banks, *l. c.*

My notes on this species do not differ greatly from the description above. The pale appearance of the wings of the type is due to rubbing, the pubescence being heavier in my specimen.

Length to tip of wings 11 mm. Antennae dark brown with narrow rings a little paler. Head with mostly gray hair, a tuft of black hair above each eye. Mesothorax black with a median stripe of gray hair. Wings very dark brown with numerous spots of white hair; these spots rather evenly distributed, a few along the posterior margin somewhat larger than the others, just before the apex an area free from them, and on the apical margin a distinct one in each apical cell. The veins somewhat darker brown than the rest of the wing. Legs and palpi brown. The genitalia (pl. 19, figs. 13, 14) highly charac-

teristic, the tenth segment bordered with a row of stout hairs, on its upper surface on each side a strong spur; viewed from above the segment deeply cleft. The penis heavy and without appendages.

A single specimen taken at Old Forge, N. Y., July 4th.

This species has genitalia somewhat resembling those of *H. scalaris* but the claspers are different and the spur on the tenth segment is highly distinctive.

The following three are doubtless distinct enough species but my material is not such as warrants assigning names.

### **Hydropsyche sp. 1**

(Text fig. 53g, pl. 20, figs. 1, 2)

Of this species I have one specimen taken at Niagara Falls, N. Y., August 9th and another from Ithaca. These are of almost uniform brown color. The penis is armed with two pairs of appendages. In the case of the lower appendage there are two or more small points at the tip, on the upper one there is a single very stout one (pl. 20, figs. 1, 2).

### **Hydropsyche sp. 2**

(Text fig. 53h, pl. 20, fig. 3)

This is a rather robust species, the male measuring fully 11 mm to the tip of the wings. I have a single specimen from near Ithaca, N. Y., taken June 17th. The antennae are somewhat pale, the palpi very dark. The first pair of legs and the femora of the second are lighter than the third pair. The wings are dark brown with black and silvery white pubescence, the latter in dots a few of which are conspicuous along the margin. The anterior margin near the apex is very narrowly bordered with yellowish. The tip of the penis is undivided and is covered with heavy spines, another bunch of spines is at each side near the tip, the extrusible appendages of the penis have the terminal spur shorter than in *H. codana* n. sp., shorter even than in *H. alternans*; it is not covered with spines. The terminal process of the tenth segment (pl. 20, fig. 3) is rather broad and of characteristic shape.

### **Hydropsyche sp. 3**

(Pl. 20, figs. 4, 5)

This is the species referred to under the description of *H. phalerata*. Ulmer (Cat. Coll. Selys, Fasc. 6, p. 66, figs. 98-100) examined two female types of *phalerata* in the Selys collection which he says are in bad condition and he adds a description and figures from

a specimen sent him by Mr Banks and determined as the same. I doubt that this specimen was really *phalerata*. The description (quoted below) and the figures seem to me to apply better to a species of which I have an alcoholic specimen collected in Georgia by Dr J. C. Bradley, than to *phalerata* as I determined that species in comparison with Hagen's types. The species which Banks and Ulmer take to be *phalerata* has a general resemblance to *scalaris* Hagen, but the figures of the genitalia will separate them. Not having more than one alcoholic specimen I prefer to leave the species unnamed.

"Antennae alternately brown and yellow, with the usual oblique black line. Palpi yellow to yellowish-brown. Hind wings of these specimens not (as Hagen says) blackish-gray, but almost colorless, faintly clear gray, iridescent, with brownish to yellowish pubescence. Median cell of the hind wing closed. Genitalia brown; the tenth segment rather long in dorsal view, rooflike, divided into two flaps at the end, these flaps bent sharply upward and appearing to be pointed when viewed at right angles to the body axis, but being in reality truncate at the ends. Between these and the sharply angled tergite of the ninth segment a deep depression. The penis ends as in *H. pellucidula* Curtis and has neither teeth nor tubercles. Claspers of the usual appearance.

"Length of body 5 mm. Expanse 17 mm." Ulmer, *l. c.* (*phalerata*).

WESTERN AND SOUTHERN SPECIES OF HYDROPSYCHE

*Hydropsyche auricular* Ulmer

Ulmer, 1905*b*, p. 33, fig. 21. Mexico.

*Hydropsyche bifida* Banks

Banks, 1905*c*, p. 15, pl. 1, fig. 14. Colorado.

*Hydropsyche californica* Banks

Banks, 1898, p. 217. California.

*Hydropsyche cockerelli* Banks

Banks, 1905*c*, p. 14. New Mexico, Colorado.

*Hydropsyche confusa* Walker

Walker, 1852, p. 103 (*Philopotamus*); Hagen, 1861*c*, p. 291 (*Philopotamus*); McLachlan, 1863*c*, p. 160. Slave and Mackenzie rivers, Canada.

*Hydropsyche marqueti* Navás

Navás, 1907*a*, p. 398, fig. 2. Montana.

*Hydropsyche mexicana* Banks

Banks, 1901*b*, p. 369, pl. 12, figs. 1, 2. Mexico.

*Hydropsyche novamexicana* Banks

Banks, 1904*a*, p. 110, pl. 1, fig. 12. New Mexico.

*Hydropsyche occidentalis* Banks

Banks, 1900a, p. 258. Washington.

*Hydropsyche oslari* Banks

Banks, 1905c, p. 13, pl. 1, fig. 2. Colorado.

*Hydropsyche partita* Banks

Banks, 1914b, p. 252, pl. 20, figs. 58, 59. Utah, California, New Mexico.

**Hydropsychodes** Ulmer

Ulmer, 1905b, p. 34; Ulmer, 1905f, p. 99; Ulmer, 1907c, p. 174

This genus has been set off from *Hydropsyche* on the following characters:  $R_2$  and  $R_3$  of the hind wing are fused (pl. 20, fig. 9), the median crossvein of the hind wing is often lacking, the claws of the male are normal, and in one species, *H. kraepelini* Ulmer (Java), the spur formula of the male is 0-4-4.

From acquaintance with the American species the following may be added: The wings are like those of *Hydropsyche* in shape and in having the row of stiff bristles on the fused anal veins of the fore wing.  $R_2$  of the hind wing may be present in part or weakly developed. The venation (pl. 20, fig. 9) differs slightly in other respects than those mentioned. The crossvein  $Cu_1-Cu_2$  (really part of  $Cu_1$ ) is at or beyond the apex of the median cell in the fore wing. In this latter respect *Hydropsychodes* differs from all species of *Hydropsyche* known to me. The dorsal portion of the tenth segment is more or less divided posteriorly, and anterior to this division there is a large spinous wart.

The larvae are like those of *Hydropsyche* and are found in similar situations; in the only larva so far described the frons is concave anteriorly. Miss Noyes informed me that she finds that in this genus the metathorax has ventrally a tuft of gills toward each side and one in the median line while in *Hydropsyche* there are two pairs of tufts. In *Hydropsychodes* the gill on the side of the seventh abdominal segment is sometimes absent.

**Hydropsychodes analis** Banks

(Text figs. 40h, 54b, pl. 20, figs. 8-13)

Banks, 1903b, p. 243 (*Hydropsyche*) Banks, 1907a, p. 130; Banks, 1908c, p. 265, pl. 19, fig. 12 (*Hydropsyche pettiti*). Sibley, 1926b, p. 104

"Head black, with sparse black hair. Antennae brown, annulate with pale; thorax black, with some black and yellowish hair; legs pale yellowish, a dark mark on tips of tibiae, and the tarsi dark; abdomen brown. Wings a uniform brown, except a triangular white mark at end of anal vein, surface very sparsely clothed with short

golden hairs, hind wings not so dark as fore pair; venation brown. Anterior wings rather narrow, hind pair with a rather long fringe on posterior margin. Length of wings 7-8 mm.

"Several specimens from Ithaca, N. Y., May till July; and Riverton, N. J., July 16th. Easily known from our other species by the uniform brown wings, except the anal white mark." Banks, *l. c.*, p. 243.

I have what I take to be this species, and add the following points to the description.

Palpi dark brown. Abdomen a brilliant green in fresh specimens. The color of the wings varying; the most common pattern for the most part brown with a patch of yellow at the tip of the anal veins, forming a median light patch when the wings are at rest; commonly light spots also in the apical cells; not infrequently light patches on the anterior margin from the middle of the wing outwards; more rarely a light patch transversely across the entire wing, in the most extreme variation, in a specimen taken at Buffalo, the wings uniformly light yellow. In most specimens a large dark patch in the middle of the hind wing extending from the posterior margin to the apex of cell  $Cu_{1a}$ . The tenth segment of the male clearly divided posteriorly; the second joint of the clasper acute at tip (text fig. 54*b*). Length from 7 to 10 mm.

The species is widely distributed. I have specimens from various places in New York, from Watertown, Mass., Porter, Ind., and Lake Forest, Ill., May 28th-September. Dr M. L. Leonard has given me specimens from Gainesville, Fla., dated July 10th and Dr R. D. Bird sent me some from Oklahoma. I regard Banks' *pettiti* from Michigan as the same. The species was common at Old Forge, N. Y. Many of the larvae were carried into the fish hatchery through the intake pipes and were a source of trouble in the hatching troughs where they used fish eggs in lieu of other materials for case building.

### *Hydropsychodes minuscula* Banks

Banks, 1907*a*, p. 130, pl. 8, fig. 5

"Dull black, head and thorax clothed with yellowish gray hair, almost golden on vertex, with some black hair each side; antennae pale,

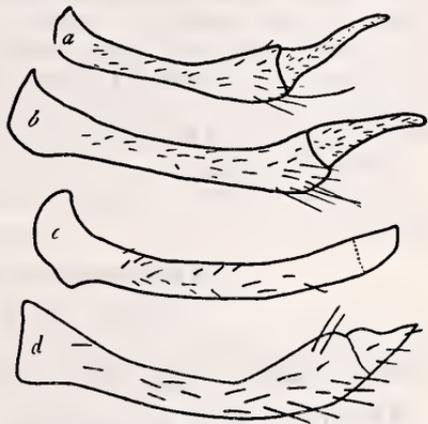


Fig. 54 Claspers of species of *Hydropsychodes*. *a speciosa* Banks. *b analis* Banks. *c sordida* Hagen. *d* Same as *c* from above

annulate with dark; abdomen blackish above, yellowish below; legs yellowish, with yellow spurs, some longer black hair on hind tibiae. Wings clothed with black and yellowish hair, giving them a uniform grayish or brownish appearance, devoid of markings, except sometimes a little more heavily marked with black on the middle of the hind margin, and sometimes a faint yellowish mark near outer anal angle; fringe blackish, or broken with yellow near outer anal angle; hind wings gray, with gray fringe. Eyes of male widely separated; antennae rather heavy; fore wings broadly rounded at tips, fork 1 reaching more than one-half way to discal cell; in hind wings fork one is absent, and the tip is slightly upturned.

"Length 6 mm.

"Several specimens from Plummers Island, Maryland, in August."  
Banks, *l. c.*

### *Hydropsychodes sordida* Hagen

(Text figs. 54c, d, pl. 20, figs. 6, 7)

Hagen, 1860c, p. 285 (*Hydropsyche*); Hagen, 1861c, p. 290 (*Hydropsyche*);  
Ulmer, 1907b, p. 69, figs. 108, 109; Sibley, 1926b, p. 104

The following is a translation of most of Ulmer's redescription of the type in the Selys collection.

"Head and thorax blackish brown, with yellow hair to the anterior part of the mesonotum, over the eyes a bunch of brown hair, dark brown beneath; abdomen blackish, more grayish black beneath. Antennae (broken) dark brown, but, at least at base with clearer rings (indistinct), not dentate. Palpi brown, legs yellowish brown, femora brown; pubescence yellow, longer on the hind tibiae. According to Hagen the fore wings blackish-fuscous, with fuscous hair; those of the type lighter. Fore wings brown with dark brown, dense, somewhat shining pubescence; hind wings gray to grayish brown with scattered brown hair, somewhat shining and iridescent. In the hind wing the first apical cell and the median cell absent.

"The ninth segment dorsally produced into a triangle overlying the tenth segment which is very large. The dorsal surface of the latter keeled, its side sharply turned downwards, the middle part of the posterior margin somewhat produced and terminated by small hooks directed dorsally; beneath it a slender chitinous rod; penis with an enlarged rounded end, slightly excavated; claspers with proportionately broad end segment [text fig. 54c and d].

"Length of body 6 mm; expanse about 16 mm."

Hagen's specimens were from the St Lawrence river and from Washington; I found this species at Ogdensburg, N. Y., July 10th-August 14th. Sibley reports it from McLean, N. Y. It occurs also in Oklahoma. My figures differ somewhat from Ulmer's but I think that we are dealing with the same species.

**Hydropsychodes speciosa** Banks

(Text fig. 54a, pl. 20, fig. 14)

Banks, 1904d, p. 214, pl. 2, fig. 6 (*Hydropsyche*); Banks, 1908a, p. 156 (*Hydropsyche*)

"Head brown; antennae pale yellow; thorax almost black; abdomen dark yellow-brown; legs pale yellowish. Wings dark brown, with several large white patches as follows: One at the base not reaching costal margin, a nearly complete oblique band before middle, two triangular spots beyond middle, one in front, the other on hind margin, their apices nearly touching, a spot on costa beyond the pterostigma, and a few small spots along apical margin; hind wings blackish. Length 5 mm.

"Many specimens from Plummer's Island, Maryland, 28th August." Banks, *l. c.*, p. 214.

Listed from North Carolina, Banks, *l. c.*, page 156.

This species is smaller and better marked than the others. It occurs in Hagen's collection under the manuscript name *crucifera* with specimens from Pennsylvania. I have others collected at Ogdensburg and Ithaca, N. Y., dated June 23d–August 9th. These are, I think, the same species although they measure 6–7 mm to the wing tip. The claspers in this species are much like those of *H. analis*, the distal segments being acute and turned inward (text fig. 54a). The tenth segment has on each side two upturned prongs covered with long hairs and a smaller spinous process besides.

## WESTERN SPECIES

*Hydropsychodes gracilis* Banks

Banks, 1899, p. 216 (*Hydropsyche*), Colorado.

**Potamyia** Banks

Hagen, 1861c, p. 285 (*Macronema*); Banks, 1900a, p. 259; Ulmer, 1907c, p. 168

"A Hydropsychid near *Macronema*. No ocelli; spurs 2–4–4; antennae long, basal joint short; maxillary palpi slender, destitute of long hair; wings rather long, with scant pubescence, discal cell closed, longer than in *Macronema*, first and fifth apical cells long pedicellate, third acute at base, no veinlet closing off base of first subapical into a median cell, and the radius does not run into the subcostal vein before tip. Type *P. flava* Hag. (sub *Macronema*)." Banks, *l. c.*, p. 259.

Ulmer places this genus among the Hydropsychinae and gives the following characters, including a new spur formula, for the male. I find the anterior spurs small in the females, absent in the males, though small stumps may be present.

"Spurs (male) 0-4-4; inner spurs longer than the outer, excepting that the inner subapical spur of the hind tibiae is not greater than the outer; subapical spurs of the second pair of legs in the middle of the tibiae; claws of the male normal. Antennae very slender, much longer than the fore wings (at least one and a half times as long); basal segment very thick (as in the *Macronematinae*), shorter than the head; no ocelli; maxillary palpi rather slender; the first segment very short, the second long, the third considerably shorter, the fourth longer than the third, but somewhat shorter and more slender than the second; fifth segment almost as long as the others taken together; fore wings long and narrow, with apical forks 1, 2, 3, 4, and 5 present, of which forks 1, 3 and 5 [cells  $R_2$ ,  $M_2$ ] and  $Cu_1$  have long pedicels; discal and median cells present; hind wings broader and shorter than the fore wings, with a discal but no median cell; forks 1, 2, 3, and 5 present; fork 1 [cell  $R_2$ ] very small; fork 3 [cell  $M_1$ ] long pedicelled. Genitalia as in *Hydropsyche*, Pictet. Female unknown to me.

"N. B. This genus, on account of its long antennae, has a resemblance to the *Macronematinae*; but the venation of the hind wing precludes this possibility. The median cell of the fore wing as that of the hind wing is often not distinctly closed." Ulmer, *l. c.*, p. 168.

I note that this genus resembles *Hydropsyche* and *Hydropsychodes* in having the very stout bristles on the compound anal vein. It is only the male that has the long antennae.

### Potamyia flava Hagen

(Text fig. 5j, pl. 20, fig. 15, pl. 21, figs. 1-3)

Hagen, 1861c, p. 285 (*Macronema flavum*); Hagen, 1864b, p. 845 (*Macronema flavum*); Banks, 1900a, p. 259; Banks, 1905c, p. 15 (*Hydropsyche kansensis*); Ulmer, 1907c, pl. 23, fig. 209

"Yellow, pale; antennae yellow, slightly annulated with fuscous; palpi, head, thorax, feet, and abdomen pale yellow, anterior wings yellow, subnude, a little clothed with golden hair, veins and cilia yellow; posterior wings whitish-yellow, ciliated with pale. Male.

"Length to tip of wings 9 millim. Alar expanse 17 millim.

"Hab. St Louis, Missouri (Osten Sacken)." Hagen, *l. c.*, p. 285.

Several specimens of this species were collected by Doctor Needham at the Piasa Bluffs, Ottawa, Ill., September 18th. Figures of the venation, genitalia, and of the basal segments of the antennae are here added.

### Smicridea McLachlan

McLachlan, 1871, p. 134; Ulmer, 1907c, p. 175

Antennae very slender, slightly serrate beneath, as long as the fore wings, basal segment very short, hardly thicker than the others. No ocelli. Maxillary palpi (pl. 21, fig. 5) with very short basal segment, the second and third longer, the fifth about as long as the first four.

Spurs 1-4-4, the inner spur longer than the outer. Fore wings (pl. 21, figs. 4, 6) rather broad, not much widened toward the apex. The discal cell small, shorter and narrower than the median cell. The transverse vein between  $Cu_1$  and  $Cu_2$  beyond the apex of the discal cell. In the hind wing the discal cell short and narrow. At the base of the sixth abdominal segment a long filamentous appendage (text fig. 26d).

Ulmer says that the median cell is set off in the hind wing but this does not apply to the North American species—at least I do not find it so in *S. divisa* nor is it shown in McLachlan's figures. It should also be noted that in McLachlan's figure of *S. fasciatella* there is a crossvein connecting  $Cu_1$  and  $Cu_2$  near the wing margin; this is very unusual for this subfamily.

Five southern species are reported.

*Smicridea albosignata* Ulmer

Ulmer, 1907a, p. 34, figs. 49-51; Ulmer, 1913d, p. 390. Brazil, Cuba.

*Smicridea bivittata* Hagen

Hagen, 1861c, p. 291 (*Hydropsyche*); Ulmer, 1913d, p. 390. Panama.  
Hagen left a note to the effect that this is the same as *fasciatella*.

*Smicridea comma* Banks

Banks, 1924, p. 451. Cuba.

*Smicridea divisa* Banks, (text fig. 26d, pl. 21, figs. 4-6.)

Banks, 1903a, p. 244, pl. 4, fig. 12 (*Hydropsyche*); Banks, 1904a, p. 109 (*Hydropsyche*); Ulmer, 1907c, p. 175. Arizona, New Mexico.

*Smicridea fasciatella* McLachlan

McLachlan, 1871, p. 136, pl. 4, fig. 19. Texas.

**Rhyacophylax** Fritz Müller

Fritz Müller, 1879c, p. 140, 1880, p. 105; Fritz Müller, 1881, p. 53; Banks, 1903b, p. 243 (*Pellopsyche*); Ulmer, 1905c, p. 105

Allied to *Smicridea*. Spurs, male 1-4-2, female, 1-4-4. (Banks gives 2-4-4 for the American species.) Maxillary palpi with the third segment somewhat longer than the fourth. Antennae not serrate. In the fore wing the discal cell very narrow. In the hind wing the discal and median cells absent; the radial sector apparently removed from  $R_1$  at base, arising from the much-thickened vein formed of the bases of  $M$  and  $Cu$ . The male abdomen on each side of the sixth segment with a threadlike jointed appendage. Male genitalia as in *Smicridea*.

Banks' figure of the fore wing of the species from Colorado is here copied (reversed for easy comparison).

One western and one West Indian species are reported.

*Rhyacophylax signatus* Banks. (Pl. 21, fig. 7.)

Banks, 1903b, p. 243, fig. 2 (*Pellopsyche*); Ulmer, 1907c, p. 176. Colorado.

*Rhyacophylax varius* Banks.

Banks, 1913b, p. 239. Costa Rica.

## MACRONEMATINAE Ulmer

Brauer, 1868a, p. 264 (*Oestropidae*); McLachlan, 1878b, p. 350, 353 (*Hydropsychidae*, Sections 1 and 2); Ulmer, 1905c, p. 38; Ulmer, 1905d, p. 88; Ulmer, 1907c, p. 154; Ulmer, 1908a (Monograph); Banks, 1913a, p. 87 (*Macronematidae*)

Antennae long and slender, often two or more times the length of the wings; longer in the males than in the females. No ocelli. Palpi sometimes wanting. Maxillary palpi, when present, long and thin (pl. 21, fig. 9), the fifth segment about as long as the others taken together. Middle tibiae and tarsi of the female dilated, sometimes very much so (pl. 22, fig. 3). Spur formula according to the genus. Fore wings with slight pubescence or with none. The venation varying in the different genera and sometimes according to the sex. Often several accessory veins from subcosta to the costal margin of the wing (pl. 21, fig. 13); cell  $R_2$  always pedicellate; the median cell probably always present;  $Cu_1$  and  $Cu_2$  either fused at tip or joined by a crossvein. Hind wings (pl. 21, fig. 13) very broad, and armed with hooks along the costal margin (pl. 21, fig. 14). The radial sector unbranched until far toward the wing margin, cell  $R$  therefore very long; no discal cell present. The penis simple with an enlarged apex; covered by the tenth segment which is generally divided dorsally (text fig. 27d, f, pl. 21, fig. 11). The abdomen of the male sometimes with lateral filamentous appendages.

Larva thysanuriform. The head oblique and flat in front, rounded behind. Seen from the side the upper anterior margin of the head a straight line except for an elevation directly above the eye. All the segments of the thorax strongly chitinized dorsally. Legs stout. Tracheal gills, each consisting of a main trunk with numerous branches, on the ventral side of the abdominal segments 1-7 and sometimes at least on the mesothorax and metathorax. These sometimes of the same type as found in *Hydropsyche* (pl. 22, fig. 1), and sometimes (Thienemann, 1905a, p. 289-90) the branches distinctly two ranked. In one species (studied by Fritz Müller) the flow of water in contact with the gills is brought about by movements of the gills themselves instead of by the waving motion of the body. Four rectal blood gills. Anal prolegs 2-segmented, with long hairs; those described by Thienemann exceedingly long. Legs stout, sometimes with various kinds of branched hairs, spurs or other peculiar appendages (Thienemann, 1905a, p. 290-91); claws of some of the legs with more than one basal spur, or at least the spur with two prongs (text fig. 40g).

Pupa with tracheal gills on segments 2-7. Plates of points on the anterior margins of segments 3-8; a long plate of points on the posterior margin of segment 3. Tibiae and tarsi of the females greatly dilated; tarsi furnished with swimming hairs; no chitinous claws present. The entire abdomen covered with rather coarse hair; no lateral fringe present. Two chitinous plates on the ventral side of the last segment. Pupal cases like those of *Hydropsyche*.

The eggs are laid beneath the water as the greatly dilated middle tibiae of the females would lead one to expect. Strangely enough the middle legs of the males of some of the genera are also dilated.

This is a very large and interesting subfamily; its venation particularly seems to offer many problems. The group has been monographed by Ulmer (1908a). The description of the larvae and pupae of two species by Fritz Müller (1880, p. 51, 52, 75; 1888b, p. 275-77) and by Thienemann (1905a, p. 289; 1909b), and the descriptions of four larvae by Ulmer (1912d, p. 119-22), are all that have heretofore been published on the immature stages. The reference by Müller of one of these species to the genus *Macronema* seems open to question particularly because the pupa is described as lacking the usual mouthparts. This is what might be expected in some of the genera but not in *Macronema*. At Buffalo, N. Y., I bred *M. zebratum* (see under the species) and that species certainly does not agree with that described by Thienemann in what would certainly be characters of generic importance; thus I find the usual pupal mouthparts present, the larval gills are branched but each has one main stem; some of the gills may stand in pairs but they are I think separate to the body wall. Unfortunately the nature of the Niagara river at the only point where I discovered the larvae, is such that I could not determine whether nets like those of *Hydropsyche* were made.

Almost all of the genera and species are tropical; no species occur in Europe and not more than four in America, north of Mexico. These latter are of the genus *Macronema*.

#### KEY TO THE GENERA OF MACRONEMATINAE

- 1a Maxillary palpi with second segment large, longer than the third. An accessory costal branch present on *Sc* of the fore wing.  
 .....*Leptonema*  
 1b Maxillary palpi with the third segment longer than the second. Rarely one or more accessory branches on *Sc*.....2  
 2a Distal end of the fore tibia externally produced into a long stout process which overreaches the first tarsal segment. Wings very hairy. p. 203.  
 .....*Centromacronema*  
 2b Distal end of the fore tibia not produced. Wings not very hairy. p. 203.  
 .....*Macronema*

#### *Leptonema* Guerin

Guerin, 1829-38, p. 396; Ulmer, 1907c, p. 162; Ulmer, 1908a, p. 44; Banks, 1913a, p. 88 (key to species); Mosely, 1933e, p. 1-69, figs. 1-200 (monograph) Immature stages. Ulmer, 1909b, p. 308

Antennae about twice as long as the fore wings, the basal segment stout, but half the length of the head; the latter without a median ridge. Maxillary palpi with short basal segment, the second longer than the third, the fifth about as long as the others taken together. Spurs, male and female, 2-4-4, the inner ones longer than the outer.

Middle legs generally not dilated, though the middle tibiae of the female may be somewhat flattened. Legs not hairy. Fore wings broad, with rounded apex, not emarginate at the tip of the anal. Discal cell closed, of the apical cells  $R_2$  is the only one that is pedicellate. Hind wings broader and shorter. Cell  $Cu_1$  very long, reaching about to the crossvein, sometimes, however, the cell lacking. Ordinarily  $Sc$  and  $R_1$  of both pairs of wings fused at tip.

Larva. The thoracic segments all chitinized. Mandibles dorsally with a large number of bristles and on the left mandible a median bunch of bristles, lacking on the right. The labrum similar to that of *Hydropsyche*, bearing stout lateral bristles. The gills each with two main stems on which the small lateral branches are arranged in two rows, found on the meso- and metathorax and on segments 1-7 of the abdomen. Claws of the legs with a single basal spur.

Pupal antennae very long, wound twice around the tip of the abdomen, each anteriorly with many long, stiff, hooked bristles; at the sides about ten moderately long bristles. Mandibles well developed, with a number of basal bristles; the right one with three, the left with four, stout teeth. Tibiae and tarsi of the first and second legs with swimming hairs. Fore wings reaching to the beginning of the fifth segment, the hind wings to the end of the third. Dorsal plates of hooks on the anterior margins of segments 3-8, and on the posterior margin of segment 3. On the sides of segments 3-7 triangular processes similar to those of *Hydropsyche*.

Five Central American species are reported.<sup>30a</sup> Of these Hagen regarded *albovirens* and *pallidum* as the same; at least a specimen in his collection has these two names on the label and "*agraphum*" also, the latter species being Brazilian.

*Leptonema albovirens* Walker

Walker, 1852, p. 76 (*Macronema*); McLachlan, 1866a, p. 263, 264 (*Macronema*); Ulmer, 1905c, p. 56, pl. 2, figs. 48, 49, pl. 3, fig. 102; Banks, 1914a, p. 150. South America, Costa Rica.

*Leptonema crassum* Ulmer

Ulmer, 1905c, p. 58, pl. 2, figs. 52, 53; Ulmer, 1908a, p. 50, figs. 46-48; Banks, 1913a, p. 87. South and Central America.

*Leptonema guatemalum* Banks

Banks, 1913a, p. 89, pl. 4, fig. 9. Guatemala.

*Leptonema insulanum* Banks

Banks, 1924, p. 455. Porto Rico.

*Leptonema pallidum* Guérin

Guérin, 1829-38, p. 396; Walker, 1852, p. 78; McLachlan, 1866a, p. 264; Banks, 1901b, p. 370, pl. 12, fig. 5; Ulmer, 1905c, p. 55, 60, pl. 2, figs. 54, 55 (*Macronema*); Ulmer, 1908a, p. 47, figs. 40, 41; Ulmer, 1913d, p. 394. Mexico, Costa Rica.

<sup>30a</sup> Mosley in his recent monograph of this genus (1933e) gives descriptions and drawings not only of some of the species here listed but also of eight new species (*acutum*, *championi*, *complexum*, *forficulum*, *intermedium*, *plicatum*, *salvini*, and *simulans*) from Central America and the West Indies.

**Centromacronema Ulmer**

Ulmer, 1905*d*, p. 86; Ulmer, 1907*c*, p. 166; Ulmer, 1908*a*, p. 3

Spurs 0-4-4, male and female; inner spurs longer than the outer. Fore tibia produced into a process which overreaches the first tarsal segment. For the rest much like *Macronema* except that the warts of the head are flat, the antennae almost three times the length of the fore wings. The pubescence of the wings often golden, more rarely with striking markings. The discal cell large, *Sc* and *R*<sub>1</sub> not fused at the tip. In the hind wing cell *Cu*<sub>1</sub> very long, reaching to the crossvein. On the ventral surface of the sixth abdominal segment on each side a low, oval appendage.

One species reaches as far north as Mexico, another is described from Panama, and two are recorded from Costa Rica.

***Centromacronema auripenne* Rambur**

Rambur, 1842, p. 507 (*Macronema*); Walker, 1852, p. 76 (*Macronema cuprea*); Kolenati, 1859*b*, p. 240, pl. 2, fig. 23 (*Macrostemum*); Walker, 1861, p. 177 (*Leptocerus abjurans*); Walker, 1861, p. 177 (*Leptocerus quadrifurca*); Hagen, 1861*c*, p. 286 (*Macronema cupreum*); McLachlan, 1866*a*, p. 275 (*Macronema niveistigma*); McLachlan, 1866*a*, p. 275 (*Macronema abjurans*); McLachlan, 1866*a*, p. 275 (*Macronema quadrifurca*); Ulmer, 1905*c*, p. 81, pl. 2, figs. 68-71 (*Macronema*); Ulmer, 1905*c*, p. 83 (*Macronema obscurum*); Ulmer, 1905*d*, p. 88; Ulmer, 1907*b*, p. 62; Ulmer, 1908*a*, p. 112, figs. 113-16; Martynov, 1912*a*, p. 21; Ulmer, 1913*d*, p. 397. Mexico, Guatemala.

***Centromacronema extensum* Banks**

Banks, 1913*b*, p. 238, pl. 25, fig. 31. Panama.

***Centromacronema faciale* Navás**

Navás, 1924*b*, p. 81, fig. 18 (*Leptonema*); Mosely, 1933*e*, p. 65. Costa Rica.

***Centromacronema ferrugineum* Navás**

Navás, 1924*b*, p. 80, fig. 17 (*Leptonema*); Mosely, 1933*e*, p. 65. Costa Rica.

***Macronema* Pictet**

Pictet, 1836, p. 399; McLachlan, 1878*b*, p. 353; Ulmer, 1907*c*, p. 164; Ulmer, 1908*a*, p. 62

Immature stages. Thienemann, 1905*a*, p. 289; Ulmer, 1912*d*, p. 119-21

Antennae longer than the wings, fully twice as long as the wings in the male. Maxillary palpi (pl. 21, fig. 9) with the second segment shorter than the third and about as long as the fourth. Spurs 0-4-4, 1-4-4, or 2-4-4; the inner spurs longer than the outer. The fore wings (pl. 21, fig. 13) rather long, elliptical at apex. Discal cell always present as are all the apical cells, of which only cell *R*<sub>2</sub> has a long pedicel. Hind wing much broader and shorter than the fore wing; *Sc*, *R*<sub>1</sub> and *R*<sub>2</sub> fused at tip. Fore wings either naked or with little pubescence, often with dark markings on a clear background or vice versa.

**Macronema carolina** Banks(Text figs. 27*d*, *f*)

Banks, 1909, p. 342

"Head brown, shining, warts dull black, circular; antennae blackish; palpi yellow; legs yellow, anterior tibiae black towards tip; prothorax yellow, thorax and abdomen black; fore wings dark brown, marked with pale patches having golden hair; a curved oblique mark, near base, an oblique costal mark, two larger costal marks near the pterostigma, both triangular, a half band in middle below the last of these, a larger triangular one on the posterior margin beyond, a broader one before with a basal extension, and a small spot in the otherwise uniformly dark apex of the wing. Hind wing blackish at apex. Male antennae about twice as long as wings. Expanse 23 mm.

"Two specimens from Southern Pines, North Carolina, (Manee)." Banks, *l. c.*

Professor J. G. Needham collected a number of specimens at Dead Lake, Wewahitchka, Fla., on April 5th and A. G. Richards jr has one taken in Clarke county, Georgia, in May.

**Macronema polygrammaticum** McLachlan

McLachlan, 1871, p. 129, pl. 3, fig. 14

"Fuscous. *Head*: occiput with two very large, oval (or somewhat reniform) yellow tubercles on the disk, on each side, and two more elongate ones posteriorly, each of these latter extending below the eye, these tubercles clothed with short yellow hairs; face and palpi yellow, or yellowish ochreous; antennae very long and slender, the basal joint ochreous, somewhat fuscous, the succeeding ten or twelve joints yellow, each with a very narrow fuscous ring at its apex, the rest fuscous gradually shading off from the yellow of the basal joints.

"*Thorax* fuscous, hairless; the metanotum with a depressed space in the middle, which is somewhat yellowish. *Legs* pale yellow, a black dot on each of the trochanters, and the apex of the tibiae, and the apical joint of the tarsi also with a black point; anterior tibiae with two short and subequal apical spurs; intermediate and posterior tibiae each with two pairs of long and unequal yellow spurs. Abdomen ochreous, somewhat fuscous, margin of the terminal joint with a fringe of long yellow hairs; inferior appendices very long and slender, yellow and cylindrical, approximate at the apex, two-jointed, the apical joint curved upwards; penis short, roundly capitate at its apex.

"*Anterior wings* long and narrow, gradually dilated to before the apex, which is subelliptical, nearly nude, and shining, pale straw-yellow, with numerous pale fuscous markings, as follows: rather beyond the middle are two fasciae commencing together on the costa, but then running obliquely into the inner margin in different directions, leaving a broad triangular space between them, in which is a line and one or two points; the apex broadly fuscous, ending in a

narrow transverse curved line of the pale ground-color; the basal portion of the wing before the first fascia is occupied by numerous short transverse streaks and points, and then several similar streaks between the second fascia and the apical portion, pterostigma indicated by a sub-opaque space clothed with short yellow pubescence; veins pale yellow. *Posterior wings* whitish hyaline, the costa abruptly excised before the apex; extreme apex rather broadly margined with pale grey; veins greyish-white, more obscure at the apex; fringe of the anal margin whitish." McLachlan, *l. c.*, p. 130. North America. No special locality indicated.

### *Macronema transversum* Walker

Walker, 1852, p. 114; Hagen, 1861c, p. 289; McLachlan, 1866a, p. 264; Ulmer, 1906b, p. 77, fig. 77

"Testaceous; antennae black, testaceous at base; abdomen black, apices of the segments pale; feet white; wings whitish, the anterior ones on the front margin and at the veins, yellow, with numerous, transverse cinerous spots, part of which are confluent; the apex sub-cinerous, spotted with pale; veins pale yellow. (From the description of Walker.)

"Length to tip of wings 13 millim. Alar expanse 25 millim.

"Hab. Georgia (Abbot)." Hagen, *l. c.*, p. 289.

The following may be added from Ulmer's notes on the single damaged specimen in the British Museum.

"Head and thorax yellowish brown, the warts small and with scarcely any pubescence, the anterior somewhat darker brown; abdomen black, the ends of the segments lighter. Antennae black, yellow brown at base (at least the first three which alone remain on the specimen); palpi dark yellow, delicate, short, of usual structure. Fore legs clear yellow, as also the femora and tibiae of the middle legs; apices of the tibiae of the first pair of legs brownish; spurs 2-4-4, those of the fore legs thin, about equal. Forewings rounded at the apex, hyaline, costal and subcostal areas and their corresponding veins yellow; numerous narrow transverse grayish brown spots; in the apical region these transverse lines are more gray and they run together more, so that few of the hyaline spots remain; in the region of the stigma there is a somewhat darker spot; veins clear yellow. Fringes yellow, hind wing hyaline, colorless; discal cell of the fore wing short, median cell rather broad at base.

"Expanse 25-30 mm.

"One specimen (without antennae, pro- and mesonotum, and forewing) in the British Museum." Ulmer, *l. c.*, p. 77.

### *Macronema zebratum* Hagen

(Text figs. 2b; 3a; 5e; 6a; 11c, d; 33d; 36e; 37a; 38b; 40e, f, g; 47d; pl. 21, figs. 8-15, pl. 22; figs. 1-7)

Hagen, 1861c, p. 285; Provancher, 1877, p. 266; Provancher, 1878b, p. 142; Ulmer, 1907b, p. 59, fig. 88, pl. 3, figs. 14, 15; Ulmer, 1907c, pl. 21, fig. 191a, c, pl. 40, fig. 3

"Brassy-fuscous, spotted with yellow; antennae black, head, thorax, and abdomen brassy-fuscous; palpi yellow; feet yellow, the anterior

tibiae and base of the femora a little infuscated; posterior tibiae with long, yellow spines; anterior wings subnude, yellow, with longitudinal stripes at base, and transverse ones on the disk, fuscous; the apex fuscous, with an orbicular, yellow spot; posterior wings cinereous, the anterior margin and pterostigma yellow." Hagen, *l. c.*, p. 285.

I add the following notes: Antennae of the female about 18 mm long, those of the male about 40 mm; the basal segment large, the second small, the third very long (pl. 21, fig. 10). Head and thorax black, except the pronotum, which is yellowish. Legs and palpi yellow, the palpal segments as figured (pl. 21, fig. 9). Femora and tibiae of the fore legs nearly equal, femora of the middle and hind legs six-fifths and three-sevenths the length of their respective tibiae. Subapical spurs on the middle legs at about four-ninths, those on the hind legs at about two-thirds the length of the tibia. The extent and form of the dark coloring of the wings varying; the ordinary pattern as shown in the figure (pl. 21, fig. 8). The male with a filamentous appendage on each side of the fourth abdominal segment. Length to tip of wings 15 mm.

This species occurs in myriads along the Niagara river during July. On July 19th, while walking along the Erie canal at Buffalo, I observed hundreds of individuals of this species going through peculiar movements whose meaning I failed to learn. The insects flew to the middle of the canal and then rapidly dipped their bodies into the water ten or twenty times at intervals of two or three feet; they then returned to the shore with swift flight and disappearing in the foliage they were exceedingly elusive of capture. The only one caught returning was a spent female. By the time a boat could be secured but few specimens remained at the spot and those caught dipping were all males. It seems therefore that both sexes took part in this performance but no mating seemed to be taking place. While the facts have doubtless no relation, this curious habit at once suggests that other female characteristic found in the males of some of the genera of this subfamily, namely, the dilated middle tibiae and tarsi.

The larvae were found in the Niagara river. The eggs were found attached to stones about a foot under water. This species is probably very widely distributed. It is recorded from the eastern states from Canada to Maryland and Virginia. I have a specimen from Elkhart, Ind., and I observed what looked like the same species as I was crossing the Mississippi river from Quincy, Ill., on September 8, 1905.

There are four southern species:

*Macronema centrale* Navás

Navás 1924b, p. 82, fig. 19. Costa Rica.

*Macronema gundlacki* Banks

Banks 1924, p. 454. Cuba.

*Macronema latum* Navás

Navás 1924b, p. 83, fig. 20. Costa Rica.

*Macronema percitans* Walker

Walker, 1861, p. 177; Ulmer, 1907b, p. 60 (*fulvum*, mentioned as a variety from Panama); Ulmer, 1908a, p. 73, fig. 77; Ulmer, 1913d, p. 395, fig. 14 (description). Panama, Mexico.

## POLYCENTROPIDAE Ulmer

McLachlan, 1878b, p. 373 (Hydropsychidae, sections 4 and 5 in part); Silfvenius, 1903b, p. 10 (Hydropsychidae. Plectrocnemia-Group); Klapálek, 1904a, p. 16 (Philopotamidae, in part); Ulmer, 1906b, p. 83; Ulmer, 1907c, p. 179; Ulmer, 1909a, p. 44; Banks, 1913d, p. 179; Banks, 1914b, p. 204, 205 (*Polycentropini*); Lestage, 1925b, p. 93-120  
 Immature stages. Ulmer, 1903d, p. 117 (Polycentropinae); Thienemann, 1905b, p. 51 (Polycentropinae); Silfvenius, 1905b, p. 121 (Polycentropinae); Silfvenius, 1906b, p. 26 (Polycentropinae); Siltala, 1907c, p. 404 (Polycentropinae); Ulmer, 1909a, p. 205, 227, 295; Lestage, 1921a, p. 476

Antennae stout, not longer than the wings, the basal segment not much thicker than the others. No ocelli. Maxillary palpi 5-segmented, the first two segments short, except in *Ecnomus*<sup>31</sup> (no North American species), where the second is longer; the third segment generally longer than the fourth, about equal in *Acrocentropus*; fifth multiarticulate, not longer than the other four taken together (one exotic genus is an exception). Spurs 3-4-4. Middle tibiae dilated in the females of most of the genera. Fibula present in the fore wing; the lobe of the hind wing broadly joined to the wing. In the fore wing the discal cell and the median cell present with rare exceptions; an accessory branch from *Sc* to the costal margin except in *Neureclipsis* and *Ecnomus*. In many genera (see key to the Polycentropinae) *R*<sub>1</sub> of the hind wing obsolescent and *Sc* strongly developed. The abdomen often with lateral filaments. In certain exotic genera unusual modifications of venation and mouthparts, not detailed here (p. 21).

Eggs laid with considerable gelatine and therefore not contiguous.

Larvae with head rather large and but little narrowed anteriorly or posteriorly. Antennae small, represented by two rods and three bristles. The labrum of broad oval shape; its anterior margin somewhat notched, with a bristle on each side near the notch, from three to six bristles at each side anteriorly and a bunch of hairs on each lateral margin. Mandibles of medium size, with double cutting edges; on the inner face a bunch of bristles. The bases of the maxillae and labium broad and short but the lobes long and slender. The fourth segment of the maxillary palpus longer than the others. The labrum, except in *Phylocentropus*, and probably *Acrocentropus*, not extend-

<sup>31</sup> The Ecnominae have been transferred to the Psychomyidae by Ulmer (1912e, p. 176).

ing beyond the maxillae; the labial palps very small and the lobe very much elongated. The pronotum alone chitinized (*Ecnomus* excepted); its posterior angles produced into long processes which nearly meet beneath. Fore legs much shorter than the others; the middle ones longest. The tibia with two long black distal spines. No lateral fringe and no tracheal gills on the abdomen. The prolegs large, 3-segmented, with long bristles; claws long.

Pupal labrum short, its sides emarginate, the apex rounded; four pairs of long bristles on the anterior margin and three pairs on the posterior margin, besides a few other short ones. The tarsi of the middle legs with hairs for swimming. Tarsal claws present. The first segment of the abdomen not heavily chitinized. No lateral fringe, but tracheal gills present. Dorsal plates with hooks on segments 3-8; on the plate of segment 6 the hooks in a row which is concave posteriorly, on the other segments they are concave anteriorly. The fifth segment with a plate of hooks pointing forward on the rear margin of the segment. Abdomen terminated by large blunt processes (text fig. 48c).

Cases of the pupae made of pieces of leaves or of small grains of sand; as in the *Hydropsychidae*, the ventral side of the case made of silk only. In *Phylocentropus* and *Acrocentropus* the larval case a long branched tube, in *Neureclipsis* a trumpet-shaped net.

I have not included the genus *Dipseudopsis*, as the reference of a single species to North America is a very doubtful one. For the sake of completeness the description of this species is given (p. 226). The genus can easily be recognized by the very peculiar mouthparts (p. 21).

#### KEY TO THE SUBFAMILIES OF POLYCENTROPIDAE

- 1a Second segment of the maxillary palpi at most but little longer than the first. Fore wing ordinarily with an accessory vein from *Sc* to the costal margin (lacking in *Neureclipsis* only). Hind wings generally broader than the fore wings.....POLYCENTROPINAE
- 1b Second segment of the maxillary palpi much longer than the first, about as long as the third. No accessory from *Sc* to the costal margin. Hind wings narrower than the fore wings, particularly at base.ECNOMINAE<sup>32</sup>

#### POLYCENTROPINAE Ulmer

Ulmer, 1907c, p. 179; Ulmer, 1909a, p. 44  
Immature stages. Ulmer, 1903d, p. 117; 1909a, p. 228, 295

The references given above (p. 207) to the family refer almost wholly to this subfamily.

The characters are as indicated for the family. The main distinguishing characters of the *Ecnominae* have been indicated in the key to the subfamilies.

<sup>32</sup> This subfamily has been transferred to the *Psychomyidae* by Ulmer. There are no American species.

KEY TO THE GENERA OF POLYCENTROPINAE<sup>33</sup>

- 1a Media of the hind wing three-branched. Except in *Neureclipsis*, the apex of the discal cell of the fore wing is beyond the apex of the median cell. . . . . 2
- 1b Media of the hind wing two-branched. Apex of the discal cell of the fore wing always before that of the median cell. . . . . 4
- 2a Cell  $R_2$  pedicellate in both wings; no accessory branch from  $Sc$  to the anterior margin of the fore wing; apex of the discal cell about on a level with that of the median cell or a little before it (pl. 22, fig. 9) . . . . . *Neureclipsis*
- 2b Cell  $R_2$  of both wings sessile; an accessory branch from  $Sc$  to costa; apex of the discal cell distinctly beyond that of the median cell. . . . . 3
- 3a Radial sector of the fore wing arched downward near its base so as to fuse with  $M$  (pl. 23, fig. 5) p. 211. . . . . *Phylocentropus*
- 3b Radial sector of the fore wing not fused with  $M$  at base. p. 213 . . . . . *Acrocentropus*
- 4a Cell  $R_2$  present in the hind wing<sup>34</sup>. . . . . 5
- 4b No cell  $R_2$  in the hind wing. . . . . 6
- 5a Discal cell present in the hind wing though the crossvein of the sector is sometimes very faint; no crossvein between  $Cu_2$  and 1st  $A$  near the posterior margin of the hind wing (pl. 24, fig. 1). p. 214. . . *Plectrocnemia*
- 5b No discal cell in the hind wing; a crossvein present between  $Cu_2$  and 1st  $A$  (pl. 24, fig. 10). p. 220. . . . . *Polycentropus*
- 6a Cell  $R_2$  present in the fore wing. p. 222. . . . . *Holocentropus*
- 6b Cell  $R_2$  not present in the fore wing. p. 224. . . . . *Nyctiophylax*

*Neureclipsis* McLachlan

McLachlan, 1864b, p. 30; McLachlan, 1878b, p. 392; Ulmer, 1907c, p. 181; Ulmer, 1909a, p. 45

Immature stages. Silfvenius, 1903b, p. 11; Silfvenius, 1905b, p. 124; Siltala, 1907c, p. 407; Wesenberg-Lund, 1911b, p. 7, pls. 1, 3; Lestage, 1921a, p. 481

Antennae shorter than the fore wings, moderately stout, basal segment longest. No ocelli. Maxillary palpi (pl. 22, fig. 10) with fifth segment not longer than the others taken together, third segment longer than any of the remainder. Spurs 3-4-4. Middle legs of the females dilated (pl. 22, fig. 12). Venation generalized (pl. 22, fig. 9); no accessory branch from  $Sc$  to the costal margin of the fore wing. Fibula of the fore wing present; anal lobe broadly joined to the hind wing. Abdominal filaments on several segments in the female and at least on segment 4 in the male.

The extraordinary nets of species of this genus were first described by Esben-Petersen (1907a) and by Wesenberg-Lund (1911). They are long, trumpet-shaped structures reaching nearly a decimeter in length; they face upstream and are supported by bits of straw or leaves.

<sup>33</sup> A species taken in Illinois runs to *Nyctiophylax* by this key but in the shape and venation of the hind wings shows resemblance to the *Psychomyidae*.

<sup>34</sup> Very rarely this cell is absent in specimens of *Plectrocnemia*. If such specimens are females they may be separated from the genera that fall under 4b by the fact that the middle tibiae are not much dilated.

**Neureclipsis crepuscularis** Walker

(Pl. 22, figs. 9-13)

Walker, 1852, p. 87 (*Brachycentrus*); Walker, 1852, p. 113 (*Hydropsyche dubitans*); Hagen, 1861c, p. 289 (*Hydropsyche dubitans*); Hagen, 1861c, p. 292 (*Polycentropus crepuscularis*); McLachlan, 1878b, p. 393; Banks, 1897, p. 30 (*Polycentropus signatus*); Banks, 1914b, p. 257, pl. 20, fig. 72 (*signatus*)

Antennae yellow, broadly ringed with black hair. Palpi and legs yellow with scant black hair. Head and thorax black, with whitish hair. Wings very dark brown, with short black hair; three spots of golden hair, one at the end of the discal cell, one on the median cell, and one at the tip of the anals; these vary in extent. Venation as figured (pl. 22, fig. 9). The male genitalia large. The tenth segment a long transparent piece reaching beyond the penis; the lower, strongly chitinized half of the tenth segment on each side with a long dark slender rod which arises far back externally on the segment and issues between the ninth and the tenth segments, running close along the penis and sometimes partially enclosed by the tenth segment above; the claspers large, at the base internally a sharp prong which extends obliquely towards the penis. Length, male, 8 mm, female, 12 mm.

Many specimens of this species were captured along the Erie canal at Buffalo, N. Y., as they were transforming at the surface of the water. June 20th-July 11th. Walker's specimens are designated as from St Martin's falls, Albany river, and Hudson bay.

**Neureclipsis parvula** Banks

(Pl. 22, fig. 8; pl. 23, fig. 1)

Banks, 1907b, p. 163, figs. 2, 3

"Head brown in the middle, posterior warts yellow, as also those of prothorax and lateral lobes of mesothorax; all warts bearing dense tufts of long yellow hair; antennae and palpi yellow; abdomen brown, the ventral segments margined with pale; anal appendages yellow; legs clear, pale yellow. Wings yellowish, with yellow hair, venation pale, four whitish hyaline cross-veins; the arculus, one connecting cubitus to median, that between the forks of the median, and one from median to radial sector; hind wings yellowish, dusky toward tip. Expanse 11 mm.

"Several specimens from Washington, D. C., High Island and Plummer's Island, Maryland, June 17 to August 29." Banks, *l. c.*

Several specimens were taken at Ogdensburg, N. Y., August 8th-11th. The crossveins are not whitish in many of these specimens. In the Cornell University collection there are also specimens taken at Ithaca during July. Possibly more than one species may be here included but the only difference observed is a marked one in size.

The genitalia (pl. 22, fig. 8) are not at all like those of the preceding species. The accompanying figure is not satisfactory as to the tenth segment, and the preanal appendage should be shown as larger, of irregular contour, and heavily spined.

One western species is reported.

*Neureclipsis bimaculata* L.

Linné, 1746, p. 224 (*Phryganea*); Fabricius, 1798, p. 201 (*Phryganea figurinensis*); McLachlan, 1878b, p. 392, pl. 42, figs. 1-7; Ulmer, 1907c, pl. 24, fig. 222.

Immature stages. Silfvenius, 1903b, p. 11, figs. 2a-j; Ulmer, 1903d, p. 147; Siltala, 1907c, p. 407; Wesenberg-Lund, 1911b, p. 7, pl. 1, figs. 1-6, pl. 3, fig. 8.

For complete earlier bibliography see McLachlan (*l. c.*).

Distributed over north and central Europe and reported from Great Slave lake, Canada.

**Phylocentropus** Banks<sup>34a</sup>

Clarke, 1891, p. 153 (*Plectrocnemia*); Betten, 1901, p. 565 (*Polycentropus*); Banks, 1907a, p. 130; Ulmer, 1907c, p. 182; Vorhies, 1909, p. 711

Antennae stout, shorter than the wings. Maxillary palpi (pl. 23, fig. 3) with the third segment longer than the first and the second together, fourth shorter than the third, fifth not quite as long as the other four taken together. Middle legs of the female dilated. An accessory branch from *Sc* to the costal margin present in the fore wings; the radial sector and media arched against each other near the base of the wing, or united by a short crossvein; cell  $R_2$  sessile in both wings; media of the hind wing three-branched. The tenth segment of the male viewed from above concave and at the lateral angles several teeth. Differences (possibly specific) in the sharpness of the concavity of this segment.

In the larva no tracheal gills and no lateral fringe; the legs of unusual form (fig. 40n). The pupa with gills on segments 1-4. Middle legs of the pupa furnished with hairs for swimming and in the females the tibiae and tarsi dilated. Plates of hooks on the anterior margins of segments 3-8 and on the posterior margin of segment 5. Mandibles with a very slender blade, and very fine (microscopic) teeth.

The cases are peculiar, consisting of long branching tubes made of fine sand, and being covered, except for a small projecting turret, by the sand of the bottom of the streams which the larvae inhabit. The pupa lies in an enlarged portion of the case within an inner covering of the same nature as the outer. I observed these cases many years ago at Saranac Inn, N. Y., but I did not at that time study their structure with care; I now have none in good condition. Vorhies' description of these cases has been quoted above (p. 81).

The type of the genus is *P. placidus* Banks.

<sup>34a</sup> See Addendum, p. 473

*Phylocentropus maximus* Vorhies

Vorhies, 1909, p. 711, pl. 53, fig. 8, pl. 61, figs. 1-3; Döhler, 1915, p. 403  
Immature stages. Vorhies, 1909, p. 711, pl. 61, figs. 4-13

"Imago. Length of body, male, 7 mm; female, 10 mm. Expanse, male, 21 mm; female, 28 mm. Antennae of males longer than of females. Antennae 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 base of the antennae, 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 coxae browner. Anterior wings with blackish hair guttated with yellow, a larger obsolete spot of yellow above the fifth apical fork; darker spots at the arculus, at the tips of the branches of the fifth fork, at crossvein 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 ninth dorsal segment is represented by a median plate excised in the middle, and bearing upturned hooks at the outer angles. What appear to be superior appendages are leaflike, 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 leaflike 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." Vorhies, *l. c.*, p. 711.

Vorhies describes all stages of this species. His description of the case has already been referred to (p. 81).

*Phylocentropus placidus* Banks

(Text figs. 5i; 370, *♂*; 40n; 48c; pl. 23, figs. 2-8)

Banks, 1905c, p. 15 (*Holocentropus placidus*); Banks, 1907a, p. 131 (*Holocentropus*); Ulmer, 1907c, p. 182, pl. 24, fig. 223; Sibley, 1926b, p. 103  
Immature stages. Betten, 1901, p. 565, pl. 13, figs. 7-11 (*Polycentropus lucidus*)

"Head black, above with white hair; palpi brown; antennae pale yellowish, darker on tips; prothorax with gray hair; mesothorax gray in middle, rest of thorax and abdomen black; legs pale yellowish.

Wings often nearly hyaline, barely marked with brown and yellowish spots in apical and anal regions; when fully marked, densely irrorate with brown and yellowish or whitish; mostly in form of narrow irregular bands, a larger spot at arculus, a distinct one at pterostigma, and several others of large size on costal region, also a dark brown one at middle of cubital vein; hindwings dusky, venation darker. Forewings rather slender, discal cell about one-half the length of its pedicel, fork 1 not pedicellate and broad at base; fork 3 with pedicel scarcely one-third its length; fork 4 sometimes absent, its pedicel about twice its length, the median cell thus extremely long. Expanse 14 mm.

"Many specimens from Washington, D. C., August." Banks, *l. c.*, p. 15.

The larvae reared by me in 1900 doubtless belong here.

This species was found at Saranac Inn, N. Y., July 9th–August 16th. Dr J. G. Needham has collected it at Dead lake, Wewahitchka, Fla., in April. Sibley reports it from McLean, N. Y. I have two specimens, perhaps another species, from Buffalo, N. Y. These are very much paler and larger than the others; the males measure 9 mm. They also show a venational difference in that cell  $M_3$  of the fore wing is very short and therefore pedicellate. No differences in genitalia are apparent.

### Acrocentropus n. g.

Antennae with stout basal segment, the second shorter, the third longer, than those immediately succeeding. Ocelli absent. Maxillary palpi (pl. 23, fig. 14) with first and second segments short, third and fourth longer and equal, the fifth equal to all the others together. Spurs 3–4–4. Wings rather broad; fibula of the fore wing and anal lobe of the hind wing present. Venation (pl. 23, fig. 9) like that of *Neureclipsis* and *Phylocentropus* in having media of the hind wing three-branched and, in the males at least, like *Phylocentropus* in having cell  $R_2$  sessile in both wings; accessory to *Sc* is present;  $M_4$  and  $Cu_1$  of the fore wing rather strongly converging, often more than indicated in pl. 23, fig. 9.

Type: the following species.

### Acrocentropus lucidus Hagen

(Pl. 23, figs. 9–14)

Hagen, 1861c, p. 294; (*Polycentropus*); Banks, 1907a, p. 131 (*Phylocentropus*)  
Immature stages. Sibley, 1926b, p. 103, 208, pl. 10, figs. 56–63 (*Phylocentropus*)

"Luteous, subnude; antennae luteo-fuscous, obsoletely annulated; palpi luteous; head and thorax luteous-fuscous, prothorax yellow; feet luteous; wings fusco-hyaline, with fuscous veins, the anterior ones subnude, in part a little clothed with luteous pile. Male.

"Length to tip of wings 7 millim. Alar expanse 13 millim.

"Hab. Trenton Falls (Osten Sacken); Pennsylvania (Zimmerman)." Hagen, *l. c.*

Antennae yellow, banded with black. Legs in general yellow but with a varying amount of dark coloration. Wings dark brown with golden yellow pubescence, the veins dark and readily seen through the pubescence. The hind wings concave anteriorly, and considerably narrowed toward the base. Venation as figured (pl. 23, fig. 9).  $M_4$  of the fore wing apparently tends toward  $Cu_1$  at tip and in some specimens fused with it. Abdomen dark brown, darkest above, with a lighter lateral line, genitalia yellow. The claspers strongly concaved internally and on the ventral internal margin a brush of short, heavy, black teeth much as in *Phylocentropus*. Length, male, 7-8 mm.

A number of male specimens of this species were taken as they were flying in swampy woods near Old Forge, N. Y., June 30th. Sibley's dates for the adults range from June 10th to August 22d.

Two specimens taken at West Falls, N. Y., July 15th, may belong to a different species although I see no difference in the genitalia. The length to the wing tips is but 5 mm. The anterior margin of the hind wing does not appear to be quite so concave. Cell  $M_2$  of the fore wing has a longer pedicel. In other respects these seem to agree with the others.

### Plectrocnemia Stephens

Stephens, 1836, p. 168; McLachlan, 1878*b*, p. 393; Ulmer, 1907*c*, p. 182; Ulmer, 1909*a*, p. 45

Immature stages. Ulmer, 1903*d*, p. 119; Silfvenius, 1903*c*, p. 12; Ulmer, 1909*a*, p. 205, 230, 296; Wesenberg-Lund, 1911*b*, p. 10; Lestage, 1921*a*, p. 487

Antennae stout, the basal segments short, the first one thick, the second shorter than the others. Head hairy, not broader than long. Maxillary palpi (pl. 24, fig. 7) long, the basal two segments very short and without stout hairs on their ends, the third inserted before the tip of the second, somewhat convex internally, longer than the first two taken together, fourth like the third but shorter, the fifth multiarticulate, about as long as the others combined. Labial palpi with first two segments together shorter than the third. Spurs 3-4-4. Middle legs of the female not greatly dilated. Fore wings hairy, with short fringes. Fibula of the fore wing present; the lobe of the hind wing large and broadly joined to the wing. Venation as in pl. 24, fig. 1; in some specimens  $R_2$  and  $R_3$  of the hind wing fused. Male genitalia complicated; the claspers, in some of the species at least, like those of *Phylocentropus*. The preanal appendages sometimes with a pair of secondary appendages on the inner side (pl. 24, fig. 4). Slender filaments sometimes present, at least on the fourth abdominal segment.

The larvae of *P. conspersa* of Europe are described by Wesenberg-Lund as living on stream bottoms and spinning flat nets measur-

ing a square decimeter and having a hole in the center leading to a tunnel hidden under some stone.

### **Plectrocnemia adironica** Banks

Banks, 1914*b*, p. 256, pl. 20, fig. 60

"Palpi brownish; antennae pale, broadly annulate with brown; vertex with gray hair in middle, black hair on sides; whitish hair on thorax; abdomen black above, yellowish beneath, legs pale yellowish. Wings gray, with blackish marks along costa and cubitus; blackish spots at end of veins, yellowish between them, rest of wing with pale brown areas, mostly with yellowish hair; hind wings pale, darker at tip. In fore wings no fork 1, fork 2 reaches a little way on discal; fork 3 with short pedicel, fork 4 hardly longer, not as far back as fork 2, fork 5 broad near base; in hind wings fork 1 is nearly as long as its pedicel, fork 2 back on cell, fork 5 very broad; the male genitalia have a rather long median ventral plate.

"Expanse 20 mm.

"From Axton, Adirondack Mountains, New York, 12-22 June (MacGillivray). The absence of fork 1 in the fore wings makes its generic position rather doubtful; if the loss is accidental, it is a *Plectrocnemia*." Banks, *l. c.*

### **Plectrocnemia albipuncta** Banks

Banks, 1930*a*, p. 131, figs. 6, 9

"Below antennae mostly black hair, above mostly white, a large patch of black on each side on vertex, thorax with mostly black, but some patches of white hair; antennae brown, annulate with pale; legs pale, outer side of tibiae and mostly beyond dark, spurs dark on outer side, pale beneath; abdomen dark above, paler beneath.

"Fore-wings black, with many white spots, largely grouped, some near base, others tending to form band near middle, others near stigma and below, a few near tip, but marginal fringe black, close to base of wing is some erect, black hair; hind-wings slightly fumose, darker on tips. Fore-wings rather narrow for the genus; fork 1 longer than its pedicel, fork 2 back to the cross-vein, forks 3 and 4 subequal, but not as far basad as fork 2. In hind-wing discal cell faintly closed (except in one specimen), fork 1 three times as long as pedicel, fork 2 scarcely back on cell; male appendages show a large curved plate each side. Expanse 15 mm.

"From Pt. Bevis, 10 August, and Baddeck, 9 August, Cape Breton, Nova Scotia." Banks, *l. c.*

### **Plectrocnemia aureola** Banks

Banks, 1930*a*, p. 130, figs. 2, 3, 5

"Face with dark hair below antennae, above mostly yellowish, but a tuft of black each side near eye; antennae pale, faintly annulate with brown; thorax with mostly yellow hair; abdomen dark above,

pale beneath; legs pale yellowish, front tibiae and tarsi darker on outer side, spurs pale. Fore-wings with mostly golden or yellowish hair, some patches of dark, mostly along the veins and at their ends, larger dark spots near end of anal, and over connection from anal to cubitus.

"Fore-wings fairly broad; fork 1 a little longer than its pedicel, fork 2 a trifle back on discal cell, fork 3 and 4 subequal, not near as far basad as fork 2, fork 5 broad, as wide before middle as at tip. In the hind-wings fork 1 shorter than pedicel, fork 2 back a little on discal cell, fork 5 very broad, broader before middle than at tip. Male appendages show a very broad ventral plate, emarginate in middle. Expanse 16 mm.

"From Baddeck, Cape Breton, Nova Scotia, 20 July, and Hampton, N. H., 1 July (S. A. Shaw)." Banks, *l. c.*

### **Plectrocnemia auriceps** Banks

Banks, 1905a, p. 218; Banks, 1905c, p. 17, pl. 2, fig. 24

"Head with much golden hair; palpi yellowish brown, basal joint of antennae yellowish, beyond dark brown, strongly crenate within; prothorax yellow, with golden hair, and golden tufts on mesothorax in front; thorax and abdomen brown, margins of abdominal segments narrowly yellowish; legs yellow, hind tibiae brown. Wings brown, densely marked with patches of golden hair between the veins, which are brown; a larger spot at the arculus; fringe golden, interrupted with brown at tips of veins; discal cell not one half as long as its pedicel, fork 1 not pedicellate, fork 3 with a pedicel not one-half its length; hind wings blackish. Expanse 27 mm.

"One male from Black Mountain, North Carolina (Beutenmüller), June." Banks, *l. c.*, p. 17.

### **Plectrocnemia australis** Banks

Banks, 1907a, p. 131, pl. 9, fig. 17

"Face below antennae deep black, with black hair; palpi black; head above antennae with much golden hair, but a tuft of long, black hair above each eye; antennae yellow, faintly annulate with pale brown; thorax with a stripe of yellow hairs in the middle, and black hair on each lateral lobe; abdomen brown; legs rather brownish yellow. Wings brown, thickly spotted with yellow, median vein and anal region darker brown than elsewhere, a patch of longer black hair near base of fore wings, and several black marks along the costa. Hind wings grayish hyaline, darker near tips on costal part. Venation like *P. conspersa*, but fork 1 is not nearly as long as its pedicel; fork 5 is wide-spread at base. The legs are long and slender; on middle tibiae the submedian spurs are as far from base as the longer spur of the pair; on hind tibiae the submedian spurs reach scarcely more than one half way to tip; and the apical spurs are hardly one

half the length of the first tarsal joint. The tip of female abdomen ends in a slender upturned ovipositor, widened at tip.

"Expanse, 21 mm.

"From Jacksonville, Florida (Mrs. Slosson)." Banks, *l. c.*

### *Plectrocnemia canadensis* Banks

(Pl. 24, figs. 1-8)

Banks, 1897, p. 31 (*Polycentropus*); Banks, 1907c, p. 48 (*Holocentropus*);  
Banks, 1914b, p. 256, pl. 10, fig. 37; Sibley, 1926b, p. 103

"Length 6 mm; alar expanse 11 mm. Head and thorax with long white hair, patches of black above eyes and just before bases of wings; antennae pale, annulate with brown. Legs yellowish, faintly marked on the tarsi. Wings blackish, thickly spotted with white, rather larger at posterior base and at cubitus; hind wings uniform gray, with a white fringe behind; both branches of the radial sector forked, the upper one much beyond, and the lower one just before the crossvein; both branches of the cubitus forked, the lower nearer the base; spurs 3-4-4.

"Two specimens, Sherbrooke, Canada, July (L'abbé P. A. Begin). Recognized by its small size and mottled wings." Banks, *l. c.*, p. 31.

Antennae with alternate whitish and brown bands. Head with white and black hair. Legs and palpi yellowish brown. Wings dark brown, covered with brown and golden hair; at certain angles of reflection, these spots white. The genitalia (pl. 24, figs. 2-5) somewhat difficult to make out clearly. The claspers inturned above, truncate as seen from the side. The preanal appendages with, internally, two conical processes, shown in pl. 24, fig. 4.

Length to tip of wings, male 6½ mm; female 7/8 mm. Ogdensburg, Ithaca and Old Forge, N. Y., June, July and August; Diamond lake, Ill., May 30th, and Waubesa lake, Wis. Sibley lists it from McLean, N. Y., July and August.

This is a pretty and a very active insect. I found it mostly on tree trunks, where it furnishes a fine example of protective coloration.

I doubt that *flavicornis* is different, and I think both are equivalent to *cinerea* Hagen.

### *Plectrocnemia cinerea* Hagen

Hagen, 1861c, p. 293 (*Polycentropus*); Banks, 1914b, p. 256, pl. 10, figs. 25, 26

"Fuscous, with fuscous and whitish hair; antennae fuscous, annulate with white; palpi luteous, head with white hair, occiput each side with fuscous hair; disk of the thorax with white hair; feet luteofuscous, the femora luteous; abdomen fuscous, beneath pale; anterior wings fuscous, with fuscous veins, and closely guttated with white; posterior wings blackish-grey, ciliated with black. Male and female.

"Length to tip of wings 8-10 millim. Alar expanse 15-19 millim.

"Hab. St Lawrence River, Canada (Osten Sacken)." Hagen, *l. c.*

**Plectrocnemia confusa** Hagen

Hagen, 1861c, p. 293 (*Polycentropus*); Ulmer, 1907c, p. 184, footnote; Banks, 1914b, p. 258, pl. 20 fig. 70 (*Polycentropus*); Sibley, 1926b, p. 103

"Fuscous, with luteous hair; antennae yellow, annulated with fuscous; palpi fuscous, annulated with pale; disk of the head with luteous hair; feet luteo-fuscous; abdomen fuscous; the apex in the female triangular, acute; the anterior wings fuscous, closely guttated with yellow; posterior wings brownish, cinereous. Male and female.

"Length to tip of wings 8-10 millim. Alar expanse 15-19 millim.

"Hab. Trenton Falls (Osten Sacken); Washington (*id.*)"  
Hagen, *l. c.*

Sibley lists the species from McLean, N. Y., August 15th and September 20th.

**Plectrocnemia crassicornis** Walker

Walker, 1852, p. 101 (*Polycentropus*); Hagen, 1861c, p. 292 (*Polycentropus*); McLachlan, 1863c, p. 160 (*Polycentropus*); Ulmer, 1906b, p. 83, fig. 84

Ulmer has redescribed the type in the British Museum as follows (translated):

"The entire body dark reddish brown, yellowish brown beneath; head and anterior part of thorax closely set with clear yellow hairs. Legs and palpi yellowish brown; the first two segments of the maxillary palpi very short, the third somewhat longer than the fourth. Antennae red, obscurely annulated. Forewings with hyaline-gray membrane and reddish brown pubescence; the clear hairs forming many uniformly scattered spots of which some larger ones at the costal and apical margins; fringes dark, but clear yellow where the spots are adjacent. Hind wings hyaline, shining and iridescent, with scattered brownish pubescence; at apex somewhat brownish; fringes dark. In both wings the first apical cell ( $R_2$ ) very small, shorter than its pedicel; in the fore wing the third apical cell ( $M_2$ ) reaching the crossvein of the median cell, therefore not pedicellate; discoidal cell in the fore wing somewhat bent. The abdomen of the female narrowed posteriorly.

"Length of body 8 mm; expanse about 18 mm.

"One female type from Georgia in the British Museum."

Hagen in citing the original description adds that "a variety has the wings immaculate." McLachlan (*l. c.* p. 160) says that the variety is a distinct species.

The venation as figured by Ulmer is practically identical with that of *canadensis* Banks.

**Plectrocnemia flavicornis** Banks

Banks, 1907b, p. 162, fig. 1 (*Holocentropus*)

"Vertex with a large patch of long white hair, and a tuft of dark rich brown hair each side; antennae and palpi pale yellow; thorax white-haired in the middle and a brown stripe each side; abdomen

brown, tips of the segments above, pale; appendages yellowish; legs pale yellow, the hind tibiae with many long hairs, the anterior tarsi somewhat dusky on the outer side. Wings brown, densely mottled with whitish or pale yellowish, the costal area before end of subcosta with three large dark spots, apical fringe alternately brown and pale; venation brown, with four whitish hyaline cross-veins; the arculus, that connecting cubitus to median, that between forks of median, and that from median to radial sector. Hind wings gray, with brown venation, and gray fringe. Expanse 12 mm.

"Several from Washington, D. C., High Island and Plummer's Island, Md.; June 23d to September. Fork 1 is present in the hind wings, as in *Plectrocnemia*; but its small size and general appearance is more like *Holocentropus*." Banks, *l. c.*

I regard this as equivalent to *P. canadensis*.

### *Plectrocnemia lutea* n. sp.

This species is differentiated from *P. canadensis* very largely by color. The wings, legs, antennae and palpi are uniformly golden yellow. Both fore and hind wings are more slender, with a straighter costal margin. The crossvein between  $Sc$  and  $R_1$  (probably in reality a part of  $Sc_2$ ) is present in the fore wing. In some specimens the anal veins of the hind wing do not reach the wing margin. I find no difference in the genitalia of the two species.

A few specimens were taken with trap lantern at Buffalo July 2d; no others were observed at any time.

### *Plectrocnemia pallescens* Banks

Banks, 1930b, p. 231, fig. 3

"Pale yellowish throughout and clothed with pale yellowish hair; hair of fore wings very short, appressed, and almost golden; veins pale, sometimes tips of apical veins darker, with a dark spot on margin, pale dot between each pair, a hyaline white streak on the median vein at fork and on cross-vein just beyond and on the cross-vein from median before the second apical fork; fringe wholly pale. Venation normal, discal cell long, four or five times as long as broad, fork 1 more than one-half its pedicel (male) or one-third of pedicel (female); fork 3 plainly pedicellate, fork 4 before cross-vein; in the hind wings fork 1 is very short, fork 3 present in the female, not in male.

"Expanse 13 to 15 mm.

"From Put-in-Bay, Ohio, August (G. Townsend); also St. Anthony Park, Minn. (Lugger)." Banks, *l. c.*

The following two western species are placed here rather than in *Polycentropus* because, while the crossvein setting off the discal cell

is not present, the crossvein of the anal veins of the hind wing, so characteristic of *Polycentropus*, is also not present:

*Plectrocnemia remota* Banks

Banks, 1911b, p. 359 (*Polycentropus*). British Columbia.

*Plectrocnemia variegata* Banks

Banks, 1900a, p. 259. Washington.

**Polycentropus** Curtis

Curtis, 1835, p. 544; McLachlan, 1864b, p. 25; McLachlan, 1878b, p. 397; Ulmer, 1907c, p. 183; Ulmer, 1909a, p. 47

Immature stages. Ulmer, 1909a, p. 205, 230, 297; Wesenberg-Lund, 1911b, p. 13; Lestage, 1921a, p. 491

Characters in general like those of *Plectrocnemia*. The middle legs of the female, however, distinctly dilated, the third and fourth segments of the maxillary palpi proportionately shorter, in the hind wing no crossvein in the sector, and  $Cu_2$  joined to 1st  $A$  by a crossvein toward the wing margin (pl. 24, fig. 10). The forewings commonly with a pattern of yellow or golden spots on a dark background. The tenth segment of the male produced into two long curved processes (pl. 24, fig. 12).

The species of this genus are particularly in need of further study. I have seen few specimens and can add nothing to the published descriptions, except figures of one species.

The nets of *P. flavomaculatus* of Europe are described by Esben-Petersen (1907b) and by Wesenberg-Lund (*l. c.*, p. 13). They resemble swallows' nests in shape and are found either facing upstream or opening upward. They are reported as occurring in slow water courses, but also on the stony beaches of larger lakes.

**Polycentropus carolinensis** Banks

Banks, 1905a, p. 217; Banks, 1905c, p. 16

"Head densely clothed with yellowish gray hair in front, and blackish behind; palpi pale; antennae yellowish, very strongly crenate within; prothorax with yellowish hair; rest of thorax and the abdomen brown, former with some yellowish hair; legs pale yellowish, tarsi rather darker. Wings uniformly clothed with jet black hair, and with about twenty small snow-white spots, several arranged in an irregular, broken band across wing near middle, two at the pterostigma, one or two at posterior apical angle, one at arculus, and two or three on the apical margin, those in basal part of wing indistinct; a tuft of erect black hair at base of fore wings; posterior wings blackish, with darker venation; discal cell slender, as long as its pedicel; fork 1 not as long as its pedicel, fork 3 longer than its pedicel, fork 4 reaching basad of fork 3, but with a long pedicel;

fork 5 reaching much farther toward base. Expanse 13 mm.

"One specimen from Black Mt., North Carolina (Beutenmüller)." Banks, *l. c.*, p. 16.

### ***Polycentropus maculatus* Banks**

Banks, 1908*b*, p. 65, pl. 2, fig. 6

"Black, head with gray and some yellow hair; antennae yellowish, faintly marked with brown, palpi pale, legs pale yellowish. Wings brown, stigma blackish, a basally forked hyaline mark on thyridium, the outer cross-veins hyaline, a hyaline spot over arculus, two more spots on posterior margin beyond arculus, a rounded spot in middle of the fourth apical cell, and less distinct one in apex of third apical, and in apex of first subapical cell; venation brown; fork four reaching a little before the cross-vein, fork three not reaching to crossvein, fork one not as long as pedicel; discal cell about as long as pedicel; hind wings grayish, fork one distinct.

"Expanse 15 mm.

"One from Grand Lake, Newfoundland." Banks, *l. c.*

In the type the rods (preanal appendages) are very long, reaching to the base of the claspers.

### ***Polycentropus validus* Walker**

Walker, 1852, p. 100; Hagen, 1861*c*, p. 292

"Blackish, with yellow hair, beneath ferruginous; maxillary palpi testaceous, the first article black; antennae stout, fulvous; feet testaceous; wings cinereous, with yellowish pubescence. (From the description of Walker).

"Length to tip of wings 8 millim. Alar expanse 15 millim.

"Hab. United States (Doubleday)." Hagen, *l. c.*

### ***Polycentropus* sp. 1**

(Pl. 24, figs. 10-12)

Figures are included (pl. 22, figs. 10-12) of a species of which I have only fragmentary material from collections at Ogdensburg, N. Y., August 10th. The genitalia resemble those of *P. centralis* but in the latter the upper branch of the clasper is broader than the lower.

Other North American species are:

*Polycentropus arizonensis* Banks

Banks, 1905*c*, p. 16. Arizona.

*Polycentropus centralis* Banks

Banks, 1914*b*, p. 258, pl. 20, fig. 67. Missouri.

*Polycentropus dispar* Banks

Banks, 1905*c*, p. 16, pl. 1, fig. 5. Arizona.

**Holocentropus McLachlan**

McLachlan, 1878*b*, p. 400; Ulmer, 1907*c*, p. 185; Ulmer, 1909*a*, p. 48  
 Immature stages. Ulmer, 1901*a*, p. 200; Ulmer, 1903*d*, p. 120; Silfvenius,  
 1905*b*, p. 125; Ulmer, 1909*a*, p. 205, 230, 296; Wesenberg-Lund, 1911*b*,  
 p. 15; Lestage, 1921*a*, p. 496

Characters in general like those of *Polycentropus* except that in the hind wing there is no cell  $R_2$ , there is no crossvein between  $Cu_2$  and the first anal vein, and there is a crossvein in the sector setting off a discal cell. The terminal segment of the maxillary palpus is shorter than in *Polycentropus*, but little longer than the third segment.

The larvae of the common European species (*H. dubius*) are described by Wesenberg-Lund as living among algae and water plants in quiet water; there is a funnel-shaped net leading to a tube fastened to the plant stems, the whole structure enmeshed with algal threads. The larvae overwinter in the masses of algae covering plants and the pond bottoms.

**Holocentropus flavus Banks**

(Pl. 24, figs. 13-16)

Banks, 1908*b*, p. 66, pl. 2, fig. 3; Sibley, 1926*b*, p. 103

"Body black, head and thorax with short yellow hair; palpi yellowish brown; antennae pale; legs pale yellowish; abdomen yellow brown. Wings yellowish, clothed with fine short yellow hairs; venation yellowish, stigma brown, a whitish hyaline spot on thyridium, one at end of discal area, and one on the arculus; hind wings yellow gray. In fore wings the discal cell fully as long as pedicel; forks three and four reaching a little before the crossvein, fork one not as long as the pedicel; in hind wings fork one is absent.

"Expanse 16 mm.

"One from Grand Lake, Newfoundland." Banks, *l. c.*

I have a single specimen in much damaged condition taken at Long Point, Cayuga lake, N. Y. The preanal appendages are curved, and viewed from the side they have the appearance of being segmented. The upper edge of the heavy clasper is turned inward and on the inner face there is a heavy tooth (pl. 24, fig. 15). Sibley lists the species from McLean, N. Y., June 23d-July 10th.

**Holocentropus interruptus Banks**

Banks, 1914*b*, p. 257, pl. 20, fig. 71

"Brown with white and gray hair; palpi pale yellowish; face with dark brown hair, white hair on vertex and thorax; antennae yellowish, annulate with brown; legs pale yellow. Wings brownish, with many spots and dots of whitish hair, the costal area is interrupted three

times with white, a white mark over stigma, beyond are white spots between ends of veins, larger spots on basal middle region, elsewhere mostly small, but often connected, fringe black at ends of the veins, hyaline marks not noticeable. Fork 1 is shorter than pedicel, sometimes only one-half as long, fork 3 is twice as long as its pedicel. Lower appendage of male is broader at base than *H. flavus*. A slender appendage on each side of body like *Diplectrona*.

"Expanse 17 mm.

"From Hampton, N. H., June (Shaw); Dane Co., Wisc., July (Vorhies); and Squam Lake, N. H., July (Allen)." Banks, *l. c.*

### *Holocentropus longus* Banks

Banks, 1914*b*, p. 258, pl. 20, figs. 65, 68

"Palpi pale, dark on last joint; face dark, with black bristles above; vertex black with white hair; antennae yellowish, annulate with brown; thorax with white hair; legs yellowish; wings brown; irregularly spotted with white, four white marks on costal area before stigma, spots between veins on margin and many elsewhere, often connected; hyaline marks not distinct. The fore wings are longer than usual, fork 5 with sides parallel for most of its length, in type fork 1 is a mere rudiment at margin, but in another specimen (female) it is longer than pedicel, in this female there is a short fork 1 in one hind wing.

"Expanse 20 mm.

"From Framingham, Mass., June (Frost), and Digby, Nova Scotia (Russell), June." Banks, *l. c.*

I should regard the type as the female of *flavus*.

### *Holocentropus robustus* Walker

Walker, 1852, p. 114; (*Hydropsyche*); Hagen, 1861*c*, p. 289 (*Hydropsyche*); Banks, 1904*d*, p. 213 (*Polycentropus*); Banks, 1907*c*, p. 48

"Ferruginous, hairy; antennae, palpi and feet testaceous; thorax bivittated with piceous; wings cinereous, somewhat covered with yellow hair; the anterior wings with pale spots, which are clearer at the margin. (From the description of Walker.)

"Length to tip of wings 8 millim. Alar expanse 17 millim.

"Hab. North America?" Hagen, *l. c.*

### *Holocentropus* sp. 1

(Pl. 25, fig. 1)

Length to tip of wings 8 mm. Antennae, legs and palpi yellow. Wings brownish, the veins more yellow. Fore wings covered with short whitish and yellow hair, the anterior margin and the fringes yellow. Head with white hair and the patagia likewise. Mesothorax brown with a median patch of white hair. Venation differing from that figured (pl. 24, fig. 13) chiefly in that the discal cell is short in both wings, the apex of that cell in the fore wing being at the level

of the lower end of the crossvein *m-cu*. The claspers (pl. 25, fig. 1) of the same general type as those figured for *H. flavus* (pl. 24, fig. 14) but the returned upper part wide as seen from above. The dorsal rods not so long as in that species and crossing each other.

One male specimen taken at Diamond lake, Ill., May 30th.

### **Holocentropus sp. 2**

(Pl. 24, fig. 9)

A single damaged specimen taken at Diamond Lake, Ill., May 30. Possibly this is *interruptus* but the type of the latter seemed to me more like *flavus*.

One Western species is reported.

### *Holocentropus orotus* Banks

Banks, 1914*b*, p. 257, pl. 20, fig. 69. Colorado.

### **Nyctiophylax Brauer**

Brauer, 1865*a*, p. 419; Brauer, 1866, p. 7; Ulmer, 1907*c*, p. 186; Banks, 1907*a*, p. 131

Antennae thick, as long as, or somewhat shorter than the wings. Maxillary palpi with first two segments very short, third about as long as these together, fourth shorter than the third, the fifth not as long as the others taken together. Spurs 3-4-4. Middle legs of the female much dilated. Subapical spurs of the fore legs at about the middle of the tibiae. Fore wings broadly rounded at apex.  $R_2$  and  $R_3$  fused in both wings. In exotic species the crossvein *m* of the fore wing said to be present only in the females and but weakly developed there. In the American species referred to here the crossvein *m* is present in the males also. In at least one American species all anal veins of the fore wing fused back nearly to the same point (pl. 25, fig. 2).

### **Nyctiophylax affinis** Banks

Banks, 1897, p. 30 (*Polycentropus*); Banks, 1907*a*, p. 131

"Length 6 mm; alar expanse 11 mm. Head and thorax with long yellowish hair, fuscous behind the eyes and on sides of thorax; antennae luteous, barely annulate with fuscous; palpi pale; legs luteous, with whitish hair; wings grayish, with scattered yellow hair, a white spot at the forking of the cubitus, with a downward projection, another white spot on the veinlet connecting branches of cubitus and radial sector, upper branch of radial sector not forked.

"Two specimens, one Ontario, Can.; the other Buffalo, N. Y. (E. P. Van Duzee)." Banks, *l. c.*, p. 30.

I regard this as the same as *vestitus*.

### **Nyctiophylax fraternus** Banks

Banks, 1905*c*, p. 17 (*Cyrnus*); Banks, 1907*a*, p. 131

"Head with whitish hair in front, brown from the posterior warts; palpi brown; antennae pale yellowish, narrowly annulate with brown;

thorax and abdomen brown, former with yellowish and gray hair; legs very pale yellowish. Wings uniformly pale brown, clothed with yellowish and black hair; fringe mostly black, especially so at outer apical angle; hind wings dusky, fringe dark. Forewings rather long and narrow; fork 3 has a pedicel nearly as long as self, fork 4 but little longer than 3. Expanse 10 mm.

"Several specimens from Plummer's Island, Md., August.

"Differs from *C. pallidus* in larger size, in longer fork 3, in darker color, and in genital parts." Banks, *l. c.*, p. 17.

Perhaps this is the same as *vestitus*.

### *Nyctiophylax marginalis* Banks

Banks, 1930*b*, p. 231, fig. 15

"Brown, head with pale yellowish hair, palpi brown, antennae pale yellowish, pronotum with pale hair in the middle and brown on the margins, legs very pale, front tibiae on outer side dark. Fore wings brown, clothed with brown and yellowish or golden hair, paler than in *N. vestitus*, around the outer margin are about eight to ten pale spots, between them the margin is darker; sometimes some of the spots are faint; hind wings brownish, with fine yellow hair, the fringe gray. In shape the wings are hardly as broad at stigma as in *N. vestitus*, the venation about the same as in that species.

"Expanse 13 mm.

"From Put-in-Bay, Ohio. (G. Townsend.)" Banks, *l. c.*

### *Nyctiophylax pallidus* Banks

Banks, 1904*d*, p. 214 (*Cyrnus*); Banks, 1907*a*, p. 131

"Pale yellowish throughout; wings sparsely clothed with yellow and gray hair, fringe gray; antennae paler than body, plainly crenate within for entire length; vertex swollen; mesothorax with a central depression containing two approximate tubercles. Wings of usual shape and venation (one specimen lacks a fork to upper branch of thyridium [fork 3]); the forks 3 and 4 are shorter than in *C. flavidus* [Europe], and the wing a little more slender; the membrane shows only one pale spot, that on the fork of thyridium, near middle of wing. Legs slender, spurs 3-4-4. Length 5 mm.

"Specimens from Washington, D. C., and High Island, Md., 17th June; also Plummer's Island, Md., 19th August (Barber)." Banks, *l. c.*, p. 214.

### *Nyctiophylax vestitus* Hagen

(Text fig. 14*a*; pl. 25, figs. 2-9)

Hagen, 1861*c*, p. 293 (*Polycentropus*); Banks, 1907*a*, p. 131; Banks, 1914*b*, p. 256, pl. 10, fig. 35 (*Phylocentropus*); Sibley, 1926*b*, p. 103

"Luteo-fuscous, with fuscous hair; antennae yellow, a little annulated with fuscous; palpi luteous; feet luteo-fuscous, the tarsi obsoletely annulated with yellow; head and thorax with fuscous hair;

the disk with yellow hair; anterior wings fuscous, with fuscous hair; posterior wings black. Male.

"Length to tip of wings 7 millim. Alar expanse 13 millim.

"Hab. Washington (Osten Sacken)." Hagen, *l. c.*

Antennae yellowish with dark rings; in prepared specimens the dark annulations in the chitin narrower and shown for about one-half, or less, of the length of the antennae. Head with brown hair, white on the disc. Legs brownish yellow. Wings brown, the veins darker, the pubescence reddish brown with a sprinkling of white. The genitalia as figured (pl. 25, figs. 3-5, 8, 9. The claspers branched as seen from the side, the upper ends bifid as seen dorsally or from below; the preanal appendages large; on the inner faces stout processes curved downward beneath the penis; the margin of the appendage sometimes notched slightly. Above the penis two long and stout rods (pl. 25, fig. 8).

Length, male 5-6 mm; female, 5-7 mm.

This species was taken at Buffalo, Old Forge and Nassau, N. Y., June 25th-August 11th. Sibley lists it from McLean, N. Y., June 20th-July 29th.

At Ogdensburg, N. Y., a variety was found which ought perhaps to be described as a different species. It differs from the preceding mainly in color. It is decidedly darker brown with no white intermingled so that the distinctions of color in the pubescence of the head and of the antennae are much more marked. The wings seem a trifle more obtusely rounded at apex. While the total length is about the same the body appears more robust. I find no difference, except of size, in the genitalia. July 8th-18th.

There is one western species described.

#### *Nyctiophylax moestus* Banks

Banks, 1911b, p. 359. British Columbia.

#### *Dipseudopsis notata* Fabr.

Fabricius, 1781, p. 390 (*Phryganea*); Fabricius, 1787, p. 246 (*Phryganea*); Fabricius, 1793, p. 78 (*Phryganea*); McLachlan, 1863c, p. 156; McLachlan, 1864a, p. 659; Hagen, 1864b, p. 811; McLachlan, 1875a, p. 20 (indicates that the origin of the type is doubtful)

The occurrence of this species is so doubtful that I have not included the genus in the key nor given a generic synopsis. The peculiar mouthparts (p. 21) alone will suffice to determine the genus. The original description of the species by Fabricius is included for the sake of completeness.

"P. alis anticis cinereo flavescentibus, macula marginali fusca.

"Habitat in America boreali. *Mus. Dom. Banks.*

"Statura et magnitudo praecedentis, at distincta. Corpus fuscum antennis pedibusque testaceis. Alae antice cinereo flavescentes unicolors macula marginali fusca, posticae albae, hyalinae, nitidae."

## PSYCHOMYIDAE

Kolenati, 1859*b*, p. 68; McLachlan, 1878*b*, p. 408 (Hydropsychidae, section 5 in part); Wallengren, 1891, p. 154; Klapálek, 1904*a*, p. 16 (Philopotamidae in part); Ulmer, 1907*c*, p. 191; Ulmer, 1909*a*, p. 53; Ulmer, 1912*e*, p. 176 Immature stages. Siltala, 1903*b*, p. 16 (Hydropsychidae, Tinodes-Group); Silfvenius, 1906*b*, p. 27 (Psychomyiinae); Ulmer, 1909*a*, p. 205, 231, 298; Lestage, 1921*a*, p. 510, 514

Antennae fairly stout, more so than in the Hydropsychidae, less so than in the Polycentropidae, at most not longer than the wings, first segment shorter than the head, but little thicker than the succeeding segments. Maxillary palpi 5-segmented in male and female. The first segment short, the second longer, the fifth flexible, multiarticulate, as long as the third and fourth taken together. First two segments of the labial palpi short, the third longer, multiarticulate. Spurs 2-4-4, those of the fore legs short and equal; the other pairs long and unequal. Middle tibiae of the females often dilated. Wings long, the hind wings more slender than the fore wings; a slender fingerlike fibula present in the fore wing; the hind wing often acute at tip. In the fore wing  $R_2$  and  $R_3$  fused, cell  $R_4$  sessile, the others pedicellate; the discal cell present.

There remains some doubt regarding the veins of the hind wing. The figures of the European species suggest that  $Sc$  has disappeared largely into the costal margin. From my specimens of *Lype* it seems that  $Sc$  and  $R_1$  have fused for the greater part of their length and that there has been no fusion with the costal margin.

Larvae thysanuriform. Labrum chitinized, transversely elliptical, with rounded anterior angles, the anterior margin but slightly convex. Mandibles asymmetrical, the left with two dentate edges with median bristles, the right with but one cutting margin and without median bristles. Maxillary lobe small, the labial lobe produced into a slender process which is longer than the mandible. The pronotum alone chitinized. No prosternal "horn." Legs short and stout, of about equal length, the claws very short and thick. No lateral fringe and no tracheal gills; five anal gills present. Anal prolegs long, claws stout. The larvae free in long curved passageways on stones; no transportable case.

Pupal mouthparts anterior. The labrum short, broader than long, with five straight bristles at each of the anterior angles. Mandibles very long with a broad base and slender tip. The last abdominal segment produced and divided into two lobes.

Ulmer (1912*e*, p. 176) has included the Econominae in this family. The latter subfamily has no described species in North America and I have not adopted this change in this report for the reason that it would involve changes in the keys which I can not make without access to representative materials.

## KEY TO GENERA OF PSYCHOMYIDAE

- 1a Third segment of the maxillary palpi longer than the second. Cell  $M_1$  of the hind wing when present reaching to the crossvein  $r-m$ . Middle legs of the females not dilated.....*Tinodes*
- 1b Third segment of the maxillary palpi not longer than the second. Cell  $M_1$  of the hind wing pedicellate or wanting. Middle legs of the females dilated.....2
- 2a Fore wing with a rounded apex. Radial sector of the hind wing of the male with three free branches. Claspers long. (p. 229).....*Lype*
- 2b Fore wing with apex somewhat pointed. Radial sector of the hind wing of the male with less than three free branches. Claspers small. (p. 229).....*Psychomyia*

**Tinodes Leach**

Leach, 1815, p. 36; McLachlan, 1878b, p. 412; McLachlan, 1880a, p. xxiii; Ulmer, 1907c, p. 192; Ulmer, 1909a, p. 54  
 Immature stages. Morton, 1890a, p. 38; Ulmer, 1903d, p. 122; Thienemann, 1905b, p. 52; Siltala, 1907c, p. 401; Ulmer, 1909a, p. 205, 232, 298; Lestage, 1921a, p. 518

Antennae shorter than the wings, fairly stout. Maxillary palpi long and stout, the third segment longer than the second. Fore wings rounded at the apex, very hairy. At the base of the radial sector a rounded nude spot, not always evident. Discal cell of the fore wing short, its posterior side distinctly angled. Cell  $M_2$  of the hind wings sessile. The claspers of the male broad, 2-segmented.

Larval body uniformly broad, with only the head, prothorax and the last two segments narrower. Head elliptic or broadly oval. Mouth parts moderately prominent. Mandibles stout, blackish brown, with blunt teeth, asymmetrical, the left one with inner bristles. Maxillary lobe small, semicircular, with many short bristles, and with longer ones within and without. Labial lobe a narrow, long, conical process, without palpus. The pronotum along chitinized. The legs short, stout; the anterior pair shorter and much stouter than the others.

The determination of the following species may remain doubtful.

**Tinodes parva Walker**

Walker, 1852, p. 134 (*Hydroptila*); Hagen, 1861c, p. 294 (*Psychomyia*); McLachlan, 1863c, p. 160; Eaton, 1873, p. 129 (*Psychomyia*)

"Testaceous; dorsum of the abdomen piceous; wings whitish. (From the description of Walker.)

"Length to tip of wings 4 millim. Alar expanse 6 millim.

"Hab. St Martin's Falls, Albany River, Hudson's Bay (Barnston).

"The type is much mutilated; it certainly is not an *Hydroptila*. Does it belong to this genus [*Psychomyia*]?" Hagen, l. c.

"The type is almost destroyed. Dr Hagen now thinks it belongs to the genus *Tinodes*." McLachlan, l. c.

There is one other American species.

**Tinodes consueta McLachlan**

McLachlan, 1871, p. 138, pl. 4, fig. 22; Banks, 1905b. California.

**Lype McLachlan**

McLachlan, 1878*b*, p. 422; Ulmer, 1907*c*, p. 193; Ulmer, 1909*a*, p. 59  
Immature stages. Lestage, 1921*a*, p. 524 (? *Lype*)

Characters in general like those of *Tinodes*. The third segment of the maxillary palpi not longer than the second or than the fourth. The middle tibiae and tarsi of the female dilated. Cell  $M_1$  of the hind wing not sessile (pl. 25, fig. 10). The claspers of the male long and narrow. The female with a long slender ovipositor.

The genus has not heretofore been recorded from America.

**Lype griselda n. sp.**

(Pl. 25, figs. 10-13)

Antennae of about 29 segments, dark, covered with dark hair, with narrower rings of yellow. Head and wings also with dark hair. Palpi dark. Legs yellow at base, tibiae and tarsi, and spurs covered with dark brown hair. Venation, male genitalia, and palpi as figured.

A few specimens were taken at Old Forge, N. Y., June 26th-July 8th.

**Psychomyia Latreille**

Latreille, 1829, p. 263; Hagen, 1868*c*, p. 259-66, McLachlan, 1878*b*, p. 425;  
Ulmer, 1907*c*, p. 194; Ulmer, 1909*a*, p. 60  
Immature stages. Ulmer, 1909*a*, p. 299; Lestage, 1921*a*, p. 527

Similar to *Lype*. The maxillary palpi with the second segment longer than the fourth, the third and the fourth about equal. The wings (pl. 25, fig. 14), particularly the posterior pair, narrow and acute. The middle legs of the female dilated. The genitalia quite different from those of *Lype*. In the European species *media* of the hind wing 3-branched; in at least one American species  $M_1$  and  $M_2$  fused.

**Psychomyia diversa Banks**

Banks, 1914*b*, p. 253, pl. 20, fig. 64

"Black; palpi brown; antennae dark, faintly annulate with pale, black hair on face, brown on warts and some yellowish on front of vertex, thorax with black hair; wings black, especially dark along the costa; no marks, some yellowish hair scattered through the black; femora pale yellowish, in the male, tibia and tarsi dark or nearly black, in the female, pale, and in the female the wings are generally less dark than in the male; male genitalia pale, the upper lateral pieces are longer and not as broad as in *P. canadensis*; in fore wings the tip of the discal cell is oblique and the fork 2 reaches one half way back on the cell, fork 3 begins beyond fork 4.

"Expanse 10 mm.

"From Black Mt., North Fork of the Swannanoa River, N. Car., May." Banks, *l. c.*

Unlike the next species, this one has *2d A* normal in the fore wing and *media* in the hind wing is three branched.

*Psychomyia flavida* Hagen

(Pl. 25, figs. 14-16)

Hagen, 1861c, p. 294; Sibley, 1926b, p. 104; Carpenter, 1933, p. 44, fig. 6

"Yellow, with ochreous hair; antennae whitish, with obsolete annulations; palpi and feet whitish; head and thorax luteous; anterior wings yellow, with dense ochreous hair and cilia; posterior wings cinereous, acute, with cinereous hair.

"Length to tip of wings 5 millim. Alar expanse 9 millim.

"Hab. St. Lawrence River, Canada (Osten Sacken); Washington (*id.*)."

This is a very slender insect with wings much longer than the body. The antennae have alternating bands of yellow and brown, the latter less distinct at base. The legs are yellow; the wings brownish. The female genitalia as shown in pl. 25, figs. 15, 16. I have no male specimen. The two specimens I have were taken at Buffalo, N. Y., July 2d, and Niagara Falls, July 30th. The venation (pl. 25, fig. 14) is peculiar in that media of the hind wing is but two-branched. In the fore wing crossvein *m-cu* is faintly shown; it is far back and closes off a very small cell *M* in which the corneous spot is. The second anal vein does not run to the third but joins the first by a crossvein beyond which it has become atrophied.

Sibley reports the species from McLean, N. Y., June 20th to August 21st, in 893 specimens, no males.

Other American species are:

*Psychomyia moesta* Banks

Banks, 1907a, p. 131. Colorado.

*Psychomyia pulchella* Banks

Banks, 1899, p. 217. Colorado.

## CALAMOCERATIDAE

McLachlan, 1877, p. 345 (Leptoceridae, section 4); Ulmer, 1905a, p. 30; Ulmer, 1905e, p. 80 (key to genera); Ulmer, 1906b, p. 106; Ulmer, 1907c, p. 113

Antennae almost always longer than the wings, sometimes three times as long, the basal segment thick, not longer than the head. No ocelli. Palpi stout, hairy, 5-segmented in both male and female, the last segment not multiarticulate. Spurs 2-4-4, rarely 2-4-3, 2-4-2, 2-4-1, or 1-4-2. The spurs of the anterior tibiae small, of the other pairs, the inner much longer than the outer. Fore wings generally broad, greatly widened toward the apex. Venation for the most part not highly modified, alike in the sexes. In the fore wing the discal cell and the median cell always present;  $R_1$  generally fused with  $R_2$  at tip. The hind wing much shorter than the fore wing.  $R_1$  always fused with  $R_2$ ; the discal cell almost never present, the median cell may or may not be.

Our knowledge of the immature stages is limited to Müller's and Thienemann's notes on species of *Phylloicus* (Fritz Müller, 1880 and 1881, Thienemann, 1909a, p. 127), Ulmer's description of the African species referred to *Anisocentropus* (Ulmer, 1909d, p. 359), and Lloyd's recent description of the life history of *Ganonema*. A statement of family characters for the larvae is not yet possible.

This family has most of its representatives in India, China, Japan, and Australia. Five of the seven genera are reported from North America; the present inclusion of *Anisocentropus* is doubtful.

#### KEY TO THE GENERA OF CALAMOCERATIDAE

- 1a Cell  $R_2$  present in the hind wing. No furrow of scale hairs in the wings of the male.....2  
 1b Cell  $R_2$  of the hind wing not present.....4  
 2a  $R_1$  of the fore wings not fused with  $R_2$  at tip.....3  
 2b  $R_1$  of the fore wings fused with  $R_2$  at tip. p. 233.....*Ganonema*  
 3a Spurs 2-4-3 or 1-4-2. Second segment of the maxillary palpus short. .... *Anisocentropus*<sup>34b</sup>  
 3b Spurs 2-4-2 or 2-4-4. Second segment of the maxillary palpus very long. p. 232.....*Heteroplectron*  
 4a A furrow of scale hairs in the fore wing of the male. p. 236....*Notiomyia*  
 4b No furrow of scale hairs in the wings of the male. p. 236.....*Phylloicus*

#### *Anisocentropus* McLachlan

McLachlan, 1863a, p. 492; McLachlan, 1875a, p. 20; Ulmer, 1906b, p. 54; Ulmer, 1907c, p. 118; Ulmer, 1909d, p. 359

Antennae about twice as long as the wings, the basal segment short and very thick; a bunch of hairs between the bases of the antennae and the eyes. Maxillary palpus very long, hairy; first and second segments short, about equal, third segment longer than the first and second together, the fourth half as long as the third, the fifth about as long as the fourth, flexible. Labial palpi short, hairy, the segments of about equal length. Wings hairy. Fore wings short and broad, widened toward the apex. Discal cell present in the fore wings, long. In the hind wings  $R_1$  fused with  $R_2$  at the tip. Spurs 2-4-2, or 2-4-3.

The only larva described is that referred here by Ulmer, the material being from Madagascar. The most striking characters in this species are the acute anterior angles of the pronotum, the extraordinarily developed lateral fringe, the divided hind tibiae, and the flat shield-shaped case consisting of a ventral and a dorsal piece of leaf. In all of these characters and in the shape of the gula the species is wholly different from the larvae of *Ganonema*, the only other of the Calamoceratidae now known; nevertheless Ulmer's reasons for placing the larva in this family seem fairly conclusive. The two

<sup>34b</sup> The species described by Hagen as *Macronema chalybeum* is here listed in this genus (p. 232). The spur formula of the type is 2-4-2 but the second segment of the palpus is short and the third long.

genera seem to agree in the structure of the labrum and of the tubercles of the first abdominal segment.

Ulmer (*l. c.*, p. 54) after removing certain species formerly included wrongly in this genus, remarks upon the fact that there may be doubt as to the occurrence of this genus in America. He found specimens in the Paris Museum corresponding to McLachlan's description of the only remaining American species but these came from Australia. I have included here Hagen's *chalybeus* though its spur formula is 2-4-2.

### *Anisocentropus latifascia* Walker

Walker, 1852, p. 90 (*Notidobia*); Walker, 1852, p. 95 (*Goera elegans*); Hagen, 1861c, p. 279 (*Leptocerus*); McLachlan, 1863c, p. 159 (*Leptocerus elegans* reduced to synonymy); McLachlan, 1863a, p. 495, pl. 19, fig. 5 (figure of venation defective according to author); Ulmer, 1906b, p. 54

"Length of body 3 lin.; of antennae 9 lin.; alar expanse 9 lin.

"Antennae fuscous, annulated with yellow in the basal half; head, palpi and thorax testaceous; abdomen somewhat fuscous; legs testaceous, the posterior tibiae and tarsi darker and clothed with long hairs; anterior wings yellowish-ochreous, with a broad brownish band beyond the middle, only the inner margin of which is well defined; posterior wings brownish-gray.

"Hab. North America.

"In the collection of the Brit. Museum, formerly in that of the Entomological Club.

"There is not the slightest doubt as to the types of Mr Walker's species being identical." McLachlan, *l. c.*

Ulmer (*l. c.*, p. 54) implies that the species was described from Georgia although I can find no habitat reference other than "North America" in the descriptions.

One Cuban species is known. The type of this species has spurs 2-4-2. Of the maxillary palpi the first two segments are short, the third very long, the fourth shorter than the first or second, the fifth nearly as long as the third. Hagen evidently judged it belonged in this group since he has so placed it in his collection.

### *Anisocentropus chalybeus* Hagen

Hagen, 1861c, p. 285 (*Macronema*); Kolbe, 1888d, p. 167 (*Macronema*); Ulmer, 1905d, p. 83, fig. 53 (*Macronema*). Cuba, Mexico.

### Heteroplectron McLachlan

McLachlan, 1871, p. 123; Ulmer, 1907c, p. 119

Antennae stout, longer than the wings; basal segment short, almost globular; from the third on, each segment long and (with the exception of the terminal ones) with one or two short spines or bristles, causing the antennae to appear somewhat serrated. Eyes small.

Maxillary palpi long, stout, hairy; basal segment short, second very long, third slightly shorter than the second, and thinner, fourth and fifth each about one-third shorter than the third. Labial palpi small, basal segment short, second long, the third still longer. Anterior legs short, the others very long. The posterior tibiae of the female fringed externally with very long silky hairs. Spurs 2-4-2 or 2-4-4 in the male, 2-4-4 in the female. Fore wings broad, hairy.  $Sc$  and  $R_1$  parallel to the costa, with a crossvein ( $Sc_2$ ) between them; discal cell long and narrow, the median cell somewhat longer and broader. Hind wings short and broad, the costal margin convex in the middle, concave toward the apex.  $R_1$  and  $Sc$  fused at tip; no discal cell present; cells  $R_2$  and  $R_4$  exceptionally long.

### *Heteroplectron boreale* Provancher

Provancher, 1877, p. 263; Provancher, 1878*b*, p. 139; Ulmer, 1905*a*, p. 30; Banks, 1914*b*, p. 264

"Long. .52 pce., extension des ailes 1.15 pce. D'un brun cendré avec poils jaunâtres sur la tête et le thorax. Antennae à article basilaire fort, conique. Palpes velus, l'article 5 à peu près de même longueur que 4. Pattes avec les jambes et les tarses plus pâles, éperons longs et forts, point d'autres épines aux jambes. Ailes d'un cendré uniforme, les supérieures donnant quelques reflets irisés dans certaines positions et ne portant que 2 nervules transversales; les inférieures fortement obliques à l'extrémité." Provancher, *l. c.*, p. 263. Canada.

As to identity of *Psilotreta frontalis* Banks with this species, see p. 240.

A western and a southern species are reported.

### *Heteroplectron californicum* McLachlan

McLachlan, 1871, p. 125, pl. 3, fig. 10; Ulmer, 1907*c*, pl. 16, fig. 146. California.

### *Heteroplectron maculatum* Banks

Banks, 1901*b*, p. 369. Mexico.

### *Ganonema* McLachlan

McLachlan, 1866*a*, p. 253; Ulmer, 1906*b*, p. 50 (key to species); Ulmer, 1907*c*, p. 115

Antennae a little more than twice the length of the fore wings, often dentate. Maxillary palpi hairy, the first segment short, the second somewhat longer, the third the longest, the fourth the shortest, the fifth about as long as the second. Fore wings broad, widened toward the apex. Hind wings short, broadest at the middle.  $R_1$  of both wings fused with  $R_2$  at the tip. In the fore wing the discal cell closed and the median cell also present. In the hind wing the discal cell either closed or open. Spurs generally 2-4-4 in male and female, more rarely 2-4-3 or 2-4-1.

**Ganonema americanum** Walker

Walker, 1852, p. 85 (*Sericostoma*); Hagen, 1861c, p. 270 (*Sericostoma*); McLachlan, 1876b, p. 225 (removed to Leptoceridae); McLachlan, 1877, p. 345 (placed in Calamoceratidae); Ulmer, 1906b, p. 47, fig. 57

Ulmer has examined the type in the Brit. Mus. (labelled *Asotocerus americanum*) His description (translated) is as follows:

"Head dark brown, the warts but little lighter; pronotum blackish brown, the other two segments and the entire under surface of the thorax dark brown; abdomen blackish brown, the segments laterally (in part) dark brown, the last segment and the appendages brown. Antennae with the basal segment very dark brown, the following ones (to about the eighth) blackish, the others blackish brown; longer than the fore wings, twice as long as the body, slender; palpi brown, with blackish hairs; first segment of the maxillary palpi longer than the fourth, second longer than the first, third the longest, the fourth the shortest, the fifth about as long as the first, more slender. Legs dark brown; spurs 2-4-4; hind legs broken off; wings with dark gray membrane, rather closely set with clinging brown hairs, but the membrane everywhere visible, the veins brown, costal and postcostal space deeper brown; fore wings much longer and broader than the hind wings, not produced at the apex;  $R_1$  of both wings running into  $R_2$ ; in the hind wing apical cells  $R_2$ ,  $R_4$ , and  $Cu_1$  present, apical cell open; in the fore wing cell  $R_2$  not further back on the discal cell than cell  $R_4$ ; the insect similar to some specimens of *Ganonema brunneum* Ulmer (Sumatra); the preanal appendages of the female broad, their common posterior margin forming an emarginate semicircle; these appendages hairy. Male unknown.

"Length of body, 10 mm; expanse, about 28 mm.

"One female, labelled: Georgia."

**Ganonema nigrum** Lloyd

(Pl. 26, figs. 1-14, pl. 27, figs. 1-6)

Lloyd, 1915a, p. 19-20, pl. 2, figs. 1-6; Sibley, 1926b, p. 105 (*americana*)  
Immature stages. Lloyd, 1915a, p. 18-20, pl. 2, figs. 7-20; Lloyd, 1921, p. 87-92, figs. 149-61 (*americanum*).

"Length of body 11 mm; front wing 15 mm; expanse 32 mm. Dominant color of wings and body dull smoky black. Head black or dark brown with jet black hairs. Antennae dark brown with black hairs. Maxillary and labial palpi lighter brown with black hairs. Membranous intersegmental portions light, broken between the head and the prothorax on the venter by a projection of the prothorax and on each side by a similar projection. On each side of the neck there is a white, somewhat oval, prominence which bears long black hairs. The chitinous portions of the prothorax are black or dark brown with several lighter areas which bear tufts of long black hairs. Ventral side of the prothorax mostly white and unchitinized, except for a narrow median strip which projects backward between the coxae of the mesothorax. A narrow chitinous plate projects obliquely upward and forward from each front coxa and

bears a tuft of long black hairs. The meso- and metathorax are black with narrow borders of lighter color along the sutures. The abdomen has three narrow black lateral lines, the middle one narrowest and extending only as far forward as the second segment; above and below these lines the color is dark brown, below them it is lighter. One or two gill-like processes, some of which bear black hairs, project from the sides of each of the first five abdominal sutures. The femur, trochanter, and tarsus of each leg is rather densely clothed with short black hair. Each fore coxa has two parallel rows of black hairs between which the femur fits when the leg is folded. Each of the two succeeding coxae is provided with a single row of long hairs . . . .” Lloyd, 1915a.

Doctor Lloyd kindly gave me some adults of this species and took me to collect some of the interesting larvae. I received some years previously some pupae and a single male adult from Mrs Nelson F. Davis, the material being collected at New Rochelle, N. Y. I can find no differences between the adults from the two localities except in the spurs and a few rather trifling ones in the venation. The adult from New Rochelle has spurs 2-4-1 and the discal cell of the hind wing is open, as shown in my figure (pl. 26, fig. 1). I had determined my material as representing *G. americanum* and am now uncertain whether *nigrum* should be placed as a synonym of that species as is done by Lloyd himself. Perhaps material from Georgia is needed to settle this question. As the chances are that my material is of the same species as Lloyd's, rather than of the Georgia species, if these are distinct, I label all my drawings as of *nigrum*. My figures of the adult are from the New Rochelle specimen; those of the larvae are from Lloyd's material. Sibley reports the species from McLean, N. Y., June 18th to July 4th.

### *Ganonema pyraloides* Walker

Walker, 1852, p. 90 (*Notidobia*); Hagen, 1861c, p. 271 (*Notidobia*); McLachlan, 1863c, p. 158 (*Notidobia*); McLachlan, 1863a, p. 4, 5, pl. 19, fig. 3 (*Anisocentropus*); Ulmer, 1906b, p. 48, figs. 58-60; Ulmer, 1907c, pl. 16, fig. 142a, b; Döhler, 1915, p. 405, figs. 12-14

“Antennae ochreous, annulated with brownish towards the base; head, thorax and abdomen ferruginous; legs ochreous, posterior tibiae and tarsi with a few long hairs; anterior and posterior wings uniformly dark brown.

“Anal appendages. Male: App. sup. long, finger-shaped, with long hairs at the apex; app. inf. long, obtusely pointed, curved upwards; penis thickened at the apex.

“Habitat, Georgia (Mr. Abbott).

“Two specimens in the collection of the British Museum.”  
McLachlan, *l. c.*, p. 4, 5.

The following is abstracted and translated from Ulmer's description of the male in the British Museum.

The entire body clear yellowish brown; head and pronotum with yellowish brown hair. Antennae (according to Hagen) twice the length of the body, with the base fuscous, and the apices of the basal articles testaceous, the remainder dark yellow. Palpi dark yellow, very thickly covered with dark brown hair; ventral surface of the body except the legs dark yellow; the legs with close-lying pubescence, the hind tibiae with longer yellow hairs. Spurs 2-4-3. Wings short and broad, fore wings broader than the hind wings, not very oblique at apex; the wing membrane very thickly covered with brown hair so that the veins show but little; in the hind wings the pubescence less thick and the venation therefore more clear; in both wings  $R_1$  joined to  $R_2$ ; the cell  $R_2$  over-reaching the discal cell considerably. Fringes of both wings dark brown, in certain lights rather grayish black. Male genitalia dark yellow; tergite of the ninth segment but little curved posteriorly; the tenth divided into two somewhat ventrally curving processes, very hairy at the tips; the claspers slender, unbranched, broader at base than at tip, directed dorso-medially, curved, with long bristles along the upper outer margin before the middle. Length of body 8 mm, expanse 23 mm.

### Notiomyia Banks

Banks, 1905c, p. 18; Ulmer, 1907c, p. 120

Antennae almost twice as long as the fore wings. Maxillary palpi with the third segment longest, the fourth shortest, the fifth about equal to the second.  $R_1$  fused with  $R_2$  near the margin in both wings; discal cell closed in the fore wing, of small size. A narrow groove of scale hairs through the fore wing of the male. Spurs 2-4-3 (male).

One western and one southern species are reported.

#### *Notiomyia ornata* Banks

Banks, 1909, p. 342. Texas.

#### *Notiomyia mexicana* Banks (pl. 27; figs. 7, 8).

Banks, 1900a, p. 257 (*Heteroplectron*); Banks, 1901b, p. 369, pl. 12, fig. 4 (*Heteroplectron*); Banks, 1905c, p. 18, pl. 2, fig. 15; Ulmer, 1907c, pl. 16, fig. 148a, b. Arizona, Mexico.

### Phylloicus Fritz Müller

Fritz Müller, 1878, p. 131; Fritz Müller, 1880, p. 81; Ulmer, 1905c, p. 33 (*Homoeoplectron*); Ulmer, 1905d, p. 77-80; Ulmer, 1906b, p. 58 (key to species); Ulmer, 1907c, p. 120

Immature stages. Thienemann, 1909a, p. 127-31

Head above with a gradually sloping longitudinal ridge. Antennae about twice as long as the head, the basal segment thick, shorter than the head. Maxillary palpi with basal segment short, the second long, the third still longer, the fourth short, the fifth as long as the second. Spurs 2-4-2, 2-4-3, 2-4-4, the inner spurs longer than the outer. Fore wings broader than the hind wings, often much wider toward the apex.  $R_1$  of the fore wing fused with  $R_2$  near the tip. The hind wings much shorter than the fore wings.  $R_2$  and  $R_3$  fused, and  $R_1$  also near the wing margin. The fringes on the anal angle of the hind wing sometimes very long and thick.

Four American species are recorded.

*Phylloicus aeneus* Hagen

Hagen, 1861c, p. 285 (*Macronema*); Hagen, 1864b, p. 804 (*Anisocentropus*); Kolbe, 1888d, p. 167 (*Anisocentropus*); Ulmer, 1905d, p. 79, fig. 49 (description). Cuba, Mexico.

*Phylloicus angustior* Ulmer

Ulmer, 1905d, p. 78, figs. 46-48; Ulmer, 1913d, p. 399; Thienemann, 1909a, p. 129, figs. 11-13. Brazil, Panama, Colombia, Argentina.

*Phylloicus cubanus* Banks

Banks, 1924, p. 445. Cuba.

*Phylloicus nigripennis* Banks

Banks, 1900a, p. 256 (*Heteroplectron*); Banks, 1901b, p. 369, pl. 12, fig. 3 (*Heteroplectron*); Ulmer, 1907c, p. 120. Cuba, Mexico.

## SPECIES OF UNCERTAIN POSITION

— *indecisus* Walker

Walker, 1852, p. 95 (*Goera*); Hagen, 1861c, p. 279 (*Leptocerus*); McLachlan, 1863c, p. 159 (genus not indicated); Hagen, 1864b, p. 829 (*Leptocerus*).

"Black, with black hair; feet ferruginous; antennae extremely long; palpi very hairy; wings blackish, the anterior ones with fuscous pubescence. (From the description of Walker.)

"Length to tip of wings 11 millim. Alar expanse 21 millim.

"Hab. St. Martin's Falls, Albany River, Hudson's Bay (Barnston)." Hagen, *l. c.*, p. 279.

McLachlan says of the species: "The type has 2-4-4 spurs. It is of doubtful position." The synonymy is confused by the fact that Hagen (1864b, p. 855) makes this species equivalent to another *indecisus* (Walker's *Philopotamus indecisus*) which he himself had previously removed to *Hydropsyche* and which McLachlan had made a synonym of *alternans* of that genus.

The species is listed here rather than in either *Goera* or *Leptocerus* since, according to Walker, the antennae are more than twice the length of the body and, according to McLachlan, the spurs are 2-4-4.

## ODONTOCERIDAE

McLachlan, 1877, p. 290 (Leptoceridae, section 2); Wallengren, 1891, p. 12;

Ulmer, 1907c, p. 122; Ulmer, 1909a, p. 110

Immature stages. Morton, 1890b, p. 181, figs. 1-11; Ulmer, 1903d, p. 99;

Ulmer, 1909a, p. 251, 311, Lestage, 1921a, p. 592

Antennae various as to length, often dentate. No ocelli. Eyes generally prominent, those of the male sometimes larger than those of the female. Maxillary palpi long and stout, 5-segmented, the last segment not multiarticulate. Spurs generally 2-4-4, more rarely 2-4-2, 2-2-2, 0-2-2, or 0-0-2; spurs generally large, the inner more so than the outer. Wings generally broad and hairy. The venation varying a good deal in the genera and not the same for the sexes.

The discal cell closed in both wings; no median cell;  $R_1$  of both wings fused with  $R_2$  or these veins united by a crossvein. In the Japanese genus *Perisoneura* and in two American genera several accessory branches from  $Sc$  to the costal margin of the fore wing (pl. 27, fig. 9).

The only immature stages heretofore described are those of the European species *Odontocerum albicorne*. The following characters are common to this species and to *Psilotreta frontalis*.

Larvae rather stout, widest at the thorax, the abdomen tapering but slightly. Frons narrow with two lateral concavities, the anterior of which is the less deep. Maxillary lobes (pl. 29, fig. 4) with three median spurs and many bristles. Pronotum and mesonotum chitinized, metathorax partly so. Legs not very unequal in length, beset with many long bristles, these latter mostly on coxae, trochanters, and femora. All of the tibiae with two distal spurs. The first abdominal segment with three blunt tubercles. The constrictions between the segments slight. Lateral fringe well developed. Tracheal gills in bunches which lie close to the body, the filaments of each bunch radiating from a center.

Pupae cylindrical. Antennae long. Labrum broad. Mandibles (pl. 29, figs. 7, 8) broad, triangular, with a sharply toothed blade and a long curved point (the latter generally broken from exuviae). Maxillary palpi very stout, 5-segmented. A presegmental plate with one stout hook on segments 3-7 (3-8 in *Odontocerum*); a post-segmental plate with two stout hooks on segment 5. Tracheal gills as in the larvae. Lateral fringe on segments 6-8. Anal appendages rodlike, curved, without bristles but with small chitinous points. Case conical, curved, not much narrowed posteriorly, made of rather small grains of sand.

#### KEY TO THE GENERA OF ODONTOCERIDAE

- 1a The apex of the fore wing rounded.....2  
 1b Fore wings narrow, the apex very oblique (pl. 29, fig. 14). p. 242  
 .....*Marilia*  
 2a Cell  $R_4$  not pedicellate in both fore and hind wings. Accessory veins present in costal area of fore wings though not easily apparent.....3  
 2b Cell  $R_4$  pedicellate in fore and hind wings. p. 239.....*Psilotreta*  
 3a  $R_1$  not fused with  $R_2$  at tip in fore and hind wings. Cell  $R_4$  of the hind wing not reaching to the discal cell.....*Nerophilus*  
 3b  $R_1$  fused with  $R_2$  at tip in fore and hind wings. Cell  $R_4$  of the hind wing reaching to the discal cell. p. 239.....*Namamyia*

#### Nerophilus Banks

Banks, 1899, p. 211; Ulmer, 1907c, p. 125, pl. 17, figs. 154a, b

"Spurs 2-4-4; maxillary palpi rather long, second and third joints of female very stout, rest shorter and more slender; basal joints of antennae much longer than broad; wings rather broad, hind pair but little shorter, discal cell of fore pair slender, closed, of hind pair shorter, closed, in each of the fore wings the veinlet behind the third apical cell is, for the most part of its middle, divided, forming a slender cell (possibly this is only an aberration)." Banks, l. c.

Ulmer gives a figure of the head and one of the venation and adds the following points to the generic description. The antennae are much shorter than the fore wings, the basal segment longer than the head. The maxillary palpi have a long second segment, this and the third considerably thicker than the fourth and fifth. The fore wings are broad and short, truncate, the hind wings as broad as the fore and but little shorter.

The accessory crossveins which are present in the costal area have escaped observation but are evident enough when the wing is denuded. Media is three branched in the male (pl. 27, fig. 9), four branched in the female.

One American species is reported.

*Nerophilus californicus* Hagen (pl. 27, fig. 9)

Hagen, 1861c, p. 272 (*Silo*); McLachlan, 1877, p. 290 (referred to Odonotocoridae); Banks, 1899, p. 212 (*oregonensis*); Ulmer, 1907c, p. 125, pl. 17, figs. 154a, b. California, Oregon.

### Namamyia Banks

Banks, 1905c, p. 10

Antennae shorter than the wings, basal segment longer than the head. No ocelli. Maxillary palpi with short basal segment, the second and third longest and nearly equal, the fourth and fifth successively shorter. Spurs 2-4-4. Wings broad; the anterior margin of the fore wing convex; that of the hind wing produced at the humeral angle. In the fore wing several accessory veins from *Sc* to the margin, a crossvein also to *R*<sub>1</sub>. *R*<sub>1</sub> fused with *R*<sub>1</sub> in both wings. Discal cell closed in both wings. Media four-branched in female, 3-branched in male. Abdomen of the female toothed on segments 5 and 6; in the male highly developed plates on segments 5, 6, 7 and 8.

One western species is reported.

*Namamyia plutonis* Banks (pl. 28, fig. 1)

Banks, 1905c, p. 10, pl. 2, fig. 19; Ulmer, 1907c, p. 125 (*Nerophilus*). California.

### Psilotreta Banks

Banks, 1899, p. 213; Ulmer, 1907c, p. 126; Banks, 1914b, p. 264 (*Astoplectron*)

Antennae a little longer than the fore wings, the basal segment as long as the head. Maxillary palpi long (pl. 28, figs. 2, 3), those of the female more slender and not so strongly recurved as those of the male, the fifth segment the longest, the third next in order followed by the fourth (not so apparently in the Japanese *P. japonica* Banks, referred to this genus by Ulmer, *l. c.*, page 126). The second, third and fifth segments of the male maxillary palpi very hairy. Of the labial palpi the basal segment small, the other two about equal in length. Spurs 2-4-4. Fore wings long and narrow, at least in the female, the anal angle reduced; hind wings of the male with a

broader and more angulate anal field (pl. 28, figs. 5, 6). Venation different in the sexes and in addition subject to considerable variation. Cell  $R_2$  some distance on the discal cell; cell  $R_4$  pedicellate. A crossvein between  $Sc$  and  $R_1$ , and another between the latter and  $R_2$ ; the tips of  $R_1$  and  $R_2$  tending to approach (fused in one specimen), crossvein  $r-m$  sometimes obliterated by the fusion of  $R_{3+4}$  and  $M_{1+2}$  at that point;  $Cu_2$  fused with 1st  $A$  as far back as the crossvein between the former and  $Cu_{1a}$  (sometimes farther in the male); in the hind wing a crossvein between  $R_1$  and  $R_2$  and another between the latter and  $Sc$ , often very faint. The main differences in the male and female venation as follows: in the fore wing media 3-branched in the female, in the male but one free branch with no indication of the method of fusion; the anal veins more reduced at base in the male than in the female; in the hind wing of the female media 3-branched, in the male the fusions are again uncertain.

Banks has described a genus *Astoptectron* with *borealis* Prov. as type, and with two other species—*connexa* from Virginia, and *dissimile* from New York. The specimens in Banks' collection identified as *borealis*, I regard as equivalent to *Psilotreta frontalis*. If, then, Banks is correct in his surmise as to the identity of *borealis*, the species must be known as *Psilotreta borealis* Prov. Until the identity of *borealis* is more definitely established, I leave that species in *Heteroptectron* (Calamoceratidae) as heretofore. The species *connexa* and *dissimile* I think are likely the same as *frontalis*, the differences in venation indicated for them being partly sexual and partly accounted for by a rather great variability in this respect.

### *Psilotreta connexa* Banks

Banks, 1914b, p. 265, pl. 10, fig. 24, pl. 15, fig. 55 (*Astoptectron*)

"Similar in appearance to *A. boreale* Prov.; body and wings brown, without markings, legs paler; basal joint of antennae dark. Differs from *A. boreale* in that the vein at upper side of fork 1 is angularly bent up toward radius, and connected to radius by a crossvein, this just alike in both fore wings; in three males of *A. boreale* there this vein is straight; besides the proportion of the cells are slightly different. The male appendages are a little shorter than in *A. boreale*.

"Expanse 18 mm.

"From Great Falls, Va., 12 June." Banks, *l. c.*

I regard this a male of *frontalis*.

### *Psilotreta dissimilis* Banks

Banks, 1897, p. 30 (*Heteroptectron* ?); Ulmer, 1905a, p. 30 (*Heteroptectron*)

"Length 10.5 mm; alar expanse 19 mm. Dull black, palpi paler, hairy, last joint slender, rather longer than the next to last; antennae pale, basal joint fuscous, longer than diameter of eye, scarcely annulate beyond, longer than the wings; legs yellowish, spurs 2-4-4;

abdomen black, segments margined with white, especially the last ventral. Wings blackish, sparsely clothed with black and yellow hairs, fringe black; venation much as in *H. borealis*, but the upper fork of the upper branch of radial sector is angulate and connected to radius, beyond the angle it is concave (in *H. borealis* it is straight), this makes the first apical cell wider in the middle; the lower branch of radial sector is forked, but much nearer to tip; at about region of anastomosis the veins are faint, and somewhat coalesce as in *H. borealis*; at this point there is a hyaline spot; behind there are two transverse veinlets as in that species; hind wings rather broad, blackish, with black fringe. Sea Cliff, New York, June and July." Banks, *l. c.*

Probably a male of *frontalis*.

### *Psilotreta frontalis* Banks

(Text figs. 99; 11a; 36i; pl. 27, figs. 10, 11; pl. 28; figs. 2-8; pl. 29; figs. 1-13) Banks, 1899, p. 213

Immature stages. Lloyd, 1921, p. 93-94, figs. 162-65; Sibley, 1926b, p. 105, 209, pl. 10, figs. 66, 67

"Head brown, with black hair; second joint of palpi with long and dense, black and gray hair on upper and inner sides, rest of the palpi less pilose; antennae yellowish; thorax and abdomen brown; legs yellowish; wings gray hyaline, with short gray and yellow hairs, basal joint of antennae about as long as head, with short hair; fore wings long, slender, rounded at tip, discal cell very long, three times as long as its pedicel, scarcely closed, first apical cell extending nearly one-half way upon discal cell, third apical short pedicellate, veinlet at base of subapicals angulate, in hind wings there is a large folded anal region, the hind margin is long fringed, the discal cell is slightly narrowed at tip, but scarcely closed, twice as long as its pedicel, third apical cell short pedicellate. Expanse 23 mm.

"Sea Cliff, New York, June." Banks, *l. c.*

The species is probably widely distributed. My specimens were taken at Old Forge, N. Y., July 5th. Mrs Davis reared the species at New Rochelle as did Doctor Sibley at McLean. Specimens are at hand from Ogdensburg and Nassau, N. Y., and from Chapel Hill, N. C. Sibley's dates are from June 16th to 23d.

I note the following slight differences between the Old Forge specimens and the original description of the adult, copied above. The antennae are dark brown and in cleared specimens there is a clear line on each segment. The legs are brown, with lighter pubescence, the femora darker than the other segments. The fore wings are very dark brown with pubescence of the same color; the Old Forge specimens are slightly lighter. The genitalia (pl. 28, figs. 7, 8) are yellow in color, exceedingly complicated in structure. Length male, 13 mm, female 15 mm.

As indicated above, I regard *connexa* and *dissimile* as synonyms of this species. In addition I regard the specimen determined by Mr

Banks as Provancher's *borealis* (p. 240) as the same. There is therefore the possibility that the species should be called *Psilotreta borealis* Prov. with *connexa*, *dissimile*, and *frontalis* as synonyms; but I have not seen Provancher's type.

### Marilia Fritz Müller

Fritz Müller, 1878, p. 127; Fritz Müller, 1881, p. 76; Ulmer, 1905c, p. 23; Ulmer, 1907a, p. 9; Ulmer, 1907c, p. 127  
Immature stages. Fritz Müller, 1878, p. 127; Fritz Müller, 1881, p. 76; Thienemann, 1905b, p. 45

Antennae slender, more than twice the length of the fore wings, basal segment thick, about as long as the head, second segment very short, ringlike, the remainder long. Eyes of the male large, sometimes even touching each other. Maxillary palpi very hairy, the first segment one-half as long as the second, the third somewhat longer than the second, the fourth as long as the second, the fifth somewhat shorter than the second. Spurs 2-4-2 or 2-4-4 according to the species, inner spur much longer than the outer, subapicals of the middle legs at the end of the first third of the tibia, those of the hind leg about at the middle. Middle legs longer than the hind ones. The wings slender, the hind ones but little broader. The venation different in the sexes.  $R_1$  and  $R_2$  fused at tip in practically all species. In the fore wing media tending to fuse with  $R_5$  and also, farther toward base, with cubitus; this carried farther in the male wings.

The first two species listed below are probably the same. Banks' type agrees with Ulmer's figure of *flexuosa* (copied in pl. 29, fig. 14) except that the base of  $M_{1+2}$  is fused very little with  $R_5$  and in the hind wing the crossvein *m-cu* is somewhat longer than in the figure.

The species are all southern.

#### *Marilia flexuosa* Ulmer

Ulmer, 1905d, p. 70, fig. 32. Texas and Brazil.

#### *Marilia fusca* Banks

Banks, 1905c, p. 19 (*Anisocentropus*) Arizona.

#### *Marilia scudderi* Banks

Banks, 1924, p. 446, pl. 3, fig. 34. Isle of Pines and Cuba.

#### *Marilia wrighti* Banks

Banks, 1924, p. 446, pl. 3, fig. 42. Cuba.

## MOLANNIDAE

Wallengren, 1891, p. 116; Klapálek, 1904a, p. 20; Ulmer, 1907c, p. 148; Ulmer, 1909a, p. 77  
Immature stages. Ulmer, 1909a, p. 206, 240, 303; Lestage, 1921a, p. 656

Antennae as long as or a little longer than the wings. No ocelli. Maxillary palpi 5-segmented, very hairy, the terminal segment not

flexible nor multiarticulate. Wings generally very hairy. The venation very abnormal, generally differing in the sexes. The tip of  $R_5$  appearing to arise from *media* (p. 47). Spurs 2-4-4 or 2-2-4.

Larval antennae large, the basal segment broad, the second more slender and tipped with a fine bristle. Mandibles chisel-shaped. Pro- and mesonotum chitinized. No prosternal "horn." Hind legs very long and slender.

There are two very distinct subfamilies. Ulmer has expressed the opinion that these have no close relationship and that the *Beraeinae* are probably nearer to the *Sericostomatidae* than to the *Molannidae* (p. 114).

## KEY TO THE SUBFAMILIES OF MOLANNIDAE

## ADULTS

- 1a Spurs 2-4-4. Maxillary palpi with the basal two segments very short. ....MOLANNINAE  
 1b Spurs 2-2-4. Maxillary palpi with the basal segment short, the second about equal to the third. p. 249. ....BERAEINAE

## LARVAE

- 1a Distal spurs of the fore and middle tibiae on prominences (text fig. 40, a, b). Claws of the hind legs abnormal (text fig. 40d). Cases of sand, broad shield-shaped, except those of very young larvae which are straight tubes of sand together with bits of mollusk shells. ....MOLANNINAE  
 1b Distal spurs not on prominences. Hind claws of the legs normal. Cases curved tubes, never broad or shield-shaped. p. 249. ....BERAEINAE

## PUPAE

- 1a Spurs 2-4-4. Case shield-shaped. ....MOLANNINAE  
 1b Spurs 2-2-4. Case conical. p. 249. ....BERAEINAE

## MOLANNINAE Ulmer

McLachlan, 1877, p. 283 (*Leptoceridae*, section 1); Wallengren, 1891, p. 116. (*Molannidae*); Klapálek, 1904a, p. 21; Ulmer, 1909a, p. 240; Ulmer, 1912e, p. 250 (*Molannidae*)  
 Immature stages. Ulmer, 1903d, p. 97; Silfvenius, 1905b, p. 34; Ulmer, 1909a, p. 206, 240, 304

Maxillary palpi rather stout and hairy, the basal two segments short, the next three long and about equal. Spurs 2-4-4; those of the anterior tibiae short, the others longer. Fore wings generally long and narrow; the hind wings no wider than the fore wings; fore or hind wings sometimes traversed by furrows filled with scale hairs. Venation different in the sexes in *Molanna*, not so in *Molannodes* (European).

The larvae somewhat depressed, generally widest at the second abdominal segment. The margins of the frons bordered with a black band; in contrast to the *Leptocerinae* (family *Leptoceridae*) no lateral whitish line running to the margin of the frons anteriorly; a curved chitinous ridge near the anterior margin. Gula large. Labrum transversely elliptical, its connecting membrane long; three bristles near the anterior margin, a lateral bristle on each side, sometimes two or three spurs along the anterior margin; sometimes spurs

also on the ventral side. The mandibles short, stout, asymmetrical, with three or four blunt teeth. The maxillae and labium slender, the palpi and the lobes short, the maxillary lobe with numerous hairs on the inner surface. Pronotum chitinized, mesonotum less so; the latter with a median longitudinal suture and also a transverse curved suture; meso- and metanotum each with a small lateral bunch of bristles. Legs of very unequal length, the hind legs one and one-half times as long as the fore legs; hind tibiae divided; on the inner surface of the fore tibiae a row of spines; apical spurs of the middle and fore tibiae on long processes. Hind claws abnormal (text fig. 40*d*). The lateral line runs from the third to the seventh segment, on the eighth represented by a curved line of chitin points. The abdominal segments deeply divided; the tubercles of the first segment large. Tracheal gills in small groups at the anterior margins of the segments, sometimes branched. Cases flat, shield-shaped, made of sand; young larvae with tubes of sand and bits of mollusk shells.

Pupae with the labrum rounded anteriorly or sometimes (at least in European species) produced in the median line and this process covered with chitinous points. Mandibles large. The legs with swimming hairs on the fore and middle tarsi; those on the hind tarsi not heavy. Pupal claws poorly developed or absent. The rear margin of the first abdominal segment somewhat thickened but not produced. The anal processes covered with small teeth and a few bristles. Dorsal plates with hooks on the anterior margins of segments 3-6 and on the posterior margin of segment 5.

Pupal case closed anteriorly by a membrane covered with sand or with one or several stones, leaving a horizontal slit ventrally; the posterior end with a vertical opening.

### Molanna Curtis

Curtis, 1834, p. 214; McLachlan, 1877, p. 283; Ulmer, 1907*c*, p. 149; Ulmer, 1909*a*, p. 78  
 Immature stages. McLachlan, 1877, p. 284; Ulmer, 1903*d*, p. 98; Silfvenius, 1905*b*, p. 34; Silfvenius, 1906*b*, p. 42; Siltala, 1907*c*, p. 455; Ulmer, 1909*a*, p. 206, 242, 304; Lestage, 1921*a*, p. 661

Antennae as long as the fore wings or somewhat longer; basal segment as long as the head or a little shorter. Maxillary palpi stout, hairy, with the basal two segments short, the others longer and about equal. Spurs 2-4-4; the subapical spurs of the middle and hind legs near the apicals. Fore wings long and narrow, with dense pubescence; when at rest the wings more or less wrapped around the abdomen. Furrows of scale hairs sometimes present in the fore or the hind wings. The venation (pl. 29, fig. 15) very highly modified; differing in the sexes in most species and in addition subject to much variation. In the females  $R_{2+3}$  fused to  $R_1$  at tip;  $R_5$  arched toward  $M_{1+2}$  and fused with it for some distance but free at tip;  $M_{3+4}$  similarly fused for some distance with  $Cu_1$ ;  $Cu_2$  not extending to the margin but atrophied at tip, joining  $Cu_1$  through the crossvein. In the fore wings of the males (pl. 30, fig. 11) the same changes but these farther advanced;  $R_5$  fused with  $M_1$ , and  $M_2$  swung over to

$M_3$ . In the hind wing  $R_1$ ,  $R_2$  and  $R_3$  fused at tip as in the fore wing;  $R_5$  arched against  $M_{1+2}$  but free at tip. Genitalia rather prominent with the tenth segment, the preanal appendages, and the claspers all large.

Immature stages as described for the subfamily above.



Fig. 55 Tenth segment of species of *Molanna* in side view. *a* *cinerea* Hagen. *b* *flavicornis* Banks. *c* *tryphena* n. sp. *d* *blenda* n. sp. *e* *musetta* n. sp.

Of the three described American species one is from Georgia and the others from New York, Wisconsin and neighboring territory. I have five species which are not easy to distinguish. The following key will separate them but the characters are not shown well in most dry specimens.

Figure 55 shows the tenth segment of the males known to me as seen from the side.

#### KEY TO SPECIES OF MOLANNA

- 1a No furrow of scale hairs in either wing.....2  
 1b A furrow of scale hairs in one or the other pair of wings.....4  
 2a Pale yellow species.....*flavicornis*  
 2b Dark species .....3  
 3a Tenth segment, viewed laterally, not sharply pointed (text fig. 55a)..*cinerea*  
 3b Tenth segment emarginate, the lower angle acute (text fig. 55c)..*tryphena*  
 4a A furrow prominent in the fore wings.....*blenda*  
 4b A furrow prominent in the hind wings.....*musetta*

#### *Molanna blenda* Sibley

(Text fig. 55d, pl. 30, figs. 14, 15)

Immature stages. Sibley, 1926b, p. 105, 210, pl. 12, figs. 82-92

Antennae dark brown, with short hair of a little lighter color. Head blackish brown with black hair. Palpi dark brown with lighter hair. Legs light brown, the tarsi darker, a double row of black spines on tarsi and a few on tibiae. Fore wings dark brown with black, and with reddish brown hair. A furrow running through the length of the wing, as indicated in plate 30, figure 14, this furrow filled with black scale hairs. Hind wings with relatively few scales. The venation of the fore wings greatly modified by the furrow and that of the posterior part of the hind wing also far from typical even for this genus. The ninth segment of the males produced dorsally. The tenth segment sharply narrowed posteriorly as shown in figure 55d. Length of tip of wings 10 mm (male).

This species was found at Old Forge, N. Y., July 8th-24th. Sibley reports it from McLean, N. Y., August 13th to September 16th.

The species was originally named in this manuscript in honor of Blenda Kjellgren, to whom reference is made on p. 22.

### *Molanna cinerea* Hagen

(Text figs. 20*b*, 37*m*, 38*c*, 40*a-d*, 55*a*, pl. 29, fig. 15, pl. 30, figs. 1-10)

Hagen, 1861*c*, p. 276; McLachlan, 1863*c*, p. 158; Provancher, 1877, p. 265; Provancher, 1878*b*, p. 141; Vorhies, 1909, p. 705, pl. 53, fig. 6, pl. 57, figs. 11, 12 (*uniophila*)

Immature stages. Vorhies, 1909, p. 706, pl. 53, fig. 6, pl. 57, figs. 13-19 (*uniophila*)

"Ferruginous, sparingly clothed with gray hair; antennae stout, ferruginous; palpi ferruginous; anterior feet ferruginous, the four posterior ones gray, the tarsi with black spines; wings narrow, gray, clothed with gray hair, the apex obsoletely marmorated with fuscous; posterior wings gray.

"Length to tip of wings 12 millim. Alar expanse 23 millim.

"Hab. St Lawrence River, Canada (Osten Sacken). Can this be *M. inconspicua*?" Hagen, *l. c.*

The following is most of Vorhies' description of the adult of this species. He describes larva and pupa also.

"Imago. Length of body, 7-8 mm. Expanse, 22-23 mm. Antennae grayish-black. Palpi thickly clothed with gray and black hair. Head black, with a median anterior wart, a small pair above the antennae 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; tibiae 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 ninth 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."

The measurements given by Hagen would apply to the males of my collection but the females measure up to 16 mm.

I have taken this species at Ogdensburg and Old Forge, N. Y., Diamond Lake, Ill., and specimens have been sent me from Walnut

lake, Mich. Vorhies' specimens were collected from the lakes near Madison, Wis., and from a small lake near Minocque, Wis., the adults being common in June and July. Vorhies found some of the larvae at a depth of 10-12 feet; at Diamond Lake I find them also at this depth and not in the shallow water but here the shallow water is mostly over a mud bottom.

On the question of the identity of this species with *inconspicua*, raised by Hagen (see above), McLachlan says, "There are two specimens in the British Museum, answering to the description of this [*cinerea*], which seem distinct from *inconspicua*, being smaller and darker; but I am by no means sure that the fact of their being recent and in good condition may not account for the difference in color."

Hagen's type of the species is without abdomen, the next following specimens from Port Huron are of the species here described and figured, still further on some of *M. musetta* are included:

### **Molanna flavicornis** Banks

(Text fig. 55b)

Banks, 1914b, p. 261, pl. 15, fig. 46

"Body black, including thorax above, head and thorax clothed with whitish gray hair, basal joint of antennae dark, beyond wholly pale yellowish (in both sexes); palpi pale, legs pale yellowish, more or less infuscated on femora. Wings yellowish gray. Venation similar to *M. uniophila*, alike in both sexes, venation pale; in fore wing the cubitus united to the median at a rather obtuse angle, but separates at a very acute angle, as in other species; in the hind wings fork 2 has diverging sides.

"Expanse 27 mm.

"From Husavick, Man., July, and Winnipeg, Man., May, (Wallis)." Banks, *l. c.*

Vorhies has collected the species at Madison, Wis., and I took two specimens at Buffalo and at Ogdensburg, N. Y. Dr C. C. Adams also sent me specimens from Colorado. The venation is as in *cinerea* except that in the hind wing of the female,  $M_1$  and  $M_2$  are fused and the base of  $R_{2+3}$  is farther toward the base of the wings. The base of costa and radius of the fore wing has a conspicuous dark stripe. The ninth dorsal segment of the male is not produced and the tenth segment is more slender than in the other species. In the types the venation is not alike in the sexes. Length to wing tips, 11 mm.

### **Molanna inconspicua** Walker

Walker, 1852, p. 71 (*Leptocerus*); Hagen, 1861c, p. 275; McLachlan, 1863c, p. 158

"Ferruginous, with pale hairs; base of the antennae testaceous; palpi and feet testaceous; abdomen blackish; wings gray, with

testaceous hair and pale veins. (From the description of Walker.)

"Length to tip of wings 12 millim. Alar expanse 23 millim.

"Hab. Georgia (Abbot). It is allied to *M. angustata*." Hagen, *l. c.*

McLachlan (*l. c.*) says, "There are three type specimens of this. One is a *Molanna*, one a *Setodes* (perhaps *ignita*), and one an insect with 2-4-4 spurs apparently pertaining to the Hydropsychidae."

Banks (1930a, p. 129) states that probably this species is the same as *Oecetis incerta* but that opinion relates perhaps to the second of the specimens referred to by McLachlan.

### ***Molanna musetta* n. sp.**

(Text fig. 55e, pl. 30, fig. 16)

This species has a very prominent furrow of scale hairs in the hind wings of the males. The venation of the fore wing is like that of *M. cinerea*; that of the hind wing is much reduced (pl. 30, fig. 16). The color pattern is like that of the other dark species; in my few specimens the gray patches are more sharply defined than in the others. The ninth segment of the male is produced dorsally. The tenth segment is somewhat like that of *cinerea* but it is narrowed much more suddenly and its ventral margin has a much more prominent tooth (text fig. 55e). Length to tip of wing 11 mm (male).

I took two specimens at Old Forge, N. Y., August 10th, and one at Canoga, N. Y., early in July.

### ***Molanna rufa* Hagen**

Hagen, 1861c, p. 276

"Rufo-fuscous, with fuscous hair; antennae and palpi rufous; feet testaceous, the anterior ones and femora rufous; abdomen fuscous; wings fuscous, with rufous hair; posterior wings fuscous; veins fuscous.

"Length to tip of wings 10 millim. Alar expanse 18 millim.

"Hab. Trenton Falls (Osten Sacken)." Hagen, *l. c.*

### ***Molanna tryphena* n. sp.**

(Text fig. 55c, pl. 30, figs. 11-13)

Immature stages. Betten, 1901, p. 564, pl. 13, figs. 1-6 (*cinerea*); Betten, 1902, p. 147, figs. 1, 2 (*cinerea*)

This species is very similar to *cinerea*. It is rather smaller, the males measuring 9-10 mm. The color is much as in *M. cinerea*, but the legs, particularly the tarsi, seem a little darker. Venation as in *cinerea*. The critical point of difference between this species and *cinerea* is that the tenth segment is deeply emarginate posteriorly, the upper lobe being rounded, the lower longer and more slender.

I have specimens of this species from Saranac Inn and from Old Forge, N. Y., and Doctor Felt has sent me specimens from Nassau, N. Y.

#### BERAEINAE Ulmer

McLachlan, 1879c, p. 490 (Rhyacophilidae, section 4); Wallengren, 1891, p. 111 (Beraeinae). Klapálek, 1904a, p. 21 (*Beraeini*); Ulmer, 1907c, p. 150; Ulmer, 1909a, p. 80; Ulmer, 1912e, p. 324, 376  
Immature stages. Ulmer, 1903d, p. 95; Thiemmann, 1905b, p. 41; Silfvenius, 1906b, p. 41; Siltala, 1907c, p. 451; Ulmer, 1909a, p. 206, 242, 305

Antennae about as long as the wings, the basal segment thick, hairy, as long as, or longer than the head. Maxillary palpi long, stout, hairy; basal segment very short, the others longer and about equal, the fifth not flexible. Spurs 2-2-4. Wings very hairy, generally of oval shape, the venation obscured; in the fore wings of the males a short furrow at the base; sometimes a furrow in the hind wings also. The venation very irregular, differing in the species and often in the sexes. Like *Molanna* in the migration of branches of the radial sector (at least  $R_5$ ) to  $M$ ; the latter vein somewhat reduced; the anterior branches of the sector with a tendency to separate toward the base and to migrate upon  $R_1$ ; the latter vein sometimes fused with  $Sc$  (page 47).

Larvae slender, the head short-elliptical to roundish. Mouthparts somewhat prominent. Labrum with the anterior margin slightly emarginate in one or two places; with three pairs of dorsal bristles; some short chitinous points on the anterior margin; bunches of lateral bristles present. Mandibles strong, chisel-shaped, with large teeth. Pro and mesonotum chitinized, of about equal width. Abdomen distinctly tapering, the constrictions between the segments not deep. First abdominal segment with tubercles. Tracheal gills in groups of not more than two, or lacking. No lateral line; instead there is a row of chitin points from segment 3 to segment 8. Prolegs stout. The apical spurs of the fore and middle tibiae not on prominences as in the Molanninae.

Pupae cylindrical, very slender. Labrum almost semicircular, with a number of bristles. No lateral fringe. Tracheal gills present in some genera, absent in others. Anal prolegs either rodlike or triangular. The pupal case closed with a membrane which has a ventral horizontal slit; the rear membrane with a very wide central elliptical slit, also horizontal in position.

Cases conical, curved tubes made of sand. In the European species the anterior closing membrane somewhat back from the end of the case, its opening on the ventral side, running practically parallel to the ventral side of the case. Rear membrane at the end of the case and its opening central and horizontal; this membrane convex.

The relationship of this subfamily to the Molanninae has been recently questioned by Ulmer (p. 114).

There are two European genera, one of which is reported for America.

**Beraea** Stephens

Stephens, 1836, p. 158; McLachlan, 1879*c*, p. 492; Ulmer, 1907*c*, p. 151; Ulmer, 1909*a*, p. 80  
 Immature stages. See subfamily references above.

Antennae fairly stout, about as long as the wings; the basal segment stout, hairy, often differing in the sexes, in one European species with a sharp inner tooth. Head often considerably broader than long, with two large posterior warts which in the male of one European species take the form of 2-segmented processes. Maxillary palpi very long, hairy, the basal segment short, the others much longer, the last one not flexible. Spurs 2-2-4. Subapicals of the hind leg near the apicals. Claws very small. Fore wings very hairy, the membrane dark, the fringe long. Fore wings oval, rarely somewhat more pointed. In the male a short basal furrow; in some species a furrow in the hind wings also. Venation (pl. 31, figs. 1, 2; see also p. 48) unlike in the sexes; no discal cell; but one or two crossveins. Hind wings shorter and narrower, the pubescence less dense. *Sc* and *R*<sub>1</sub> fused; no discal cell.

**Beraea nigritta** Banks

(Pl. 31, figs. 1, 2)

Banks, 1897, p. 31

"Length 4 mm. Head black, shining, broad, with a rather rounded ridge from eye to eye, a small pitted tubercle each side above, and two pale tubercles below the ridge near the middle; basal joint of antennae black, rest pale; palpi pale, with black hair; legs pale, mostly with white hair, but some black, a few black spines on tarsi, hind tibia very much longer than femur, spurs 2-2-4; thorax and abdomen black. Wings blackish, with pale veins and black hairs, veins indistinct, no crossveins seen, lower branch of radial sector and lower branch of cubitus forked. Abdomen with a sharp slender spur below before tip.

"Two specimens, Sea Cliff, N. Y., June." Banks, *l. c.*

I have fragments of specimens taken near Ithaca, N. Y., that agree with Banks' types. The venation alone can be figured. The tooth referred to in the original description is on the eighth segment.

**Beraea viridiventris** Say

Say, 1823, p. 160; Say, 1859, p. 170 (*Phryganea*); Hagen, 1861*c*, p. 296

"Pale fuscous, with cinereous hair; antennae pale fuscous, the base whitish; feet, head, and thorax beneath white; abdomen green; the anterior wings blackish, ciliated, beyond the middle with a few whitish spots, somewhat arranged in two bands; posterior wings black; intermediate tarsi dilated. (From the description of Say.)

"Length to tip of wings 4 millim. Alar expanse 7½ millim.

"Hab. Cincinnati, Ohio River, May; common (Say).

"Is this not *B. maculata*? [*Protoptila*]" Hagen, *l. c.*

## LEPTOCERIDAE Leach

Leach, 1815, p. 136; McLachlan, 1877, p. 293; Klapálek, 1904a, p. 23; Ulmer, 1907c, p. 129; Ulmer, 1909a, p. 84  
 Immature stages. Klapálek, 1893, p. 80; Ulmer, 1903d, p. 92; Silfvenius, 1905b, p. 33; Thienemann, 1905b, p. 46; Silfvenius, 1906b, p. 42; Siltala, 1907c, p. 461; Ulmer, 1909a, p. 206, 244, 306; Lestage, 1921a, p. 597

Antennae very slender two or three times as long as the fore wings, the basal segment thick. Maxillary palpi of both sexes 5-segmented, with outstanding hairs, the segments all long, the terminal one often flexible but never multiarticulate. No ocelli. Spurs 2-2-2, 0-2-2, or 2-2-4. Inner spurs longer than the outer. Fore wings long and narrow, the hind wings with hooks on the anterior margin for joining the wings during flight. The discal cell of the fore wing always closed; no median cell present although cell *M* might readily be mistaken for it. The veins generally rather straight across the wing. Cell *R*<sub>4</sub> apparently always absent (see under Leptocerinae). In the hind wing the discal cell present or absent; radius as in the fore wing; no crossveins between *Sc* and *R*<sub>1</sub> and these latter not fused at tip. In a few species some of the abdominal segments with slender filaments attached.

## KEY TO THE SUBFAMILIES OF LEPTOCERIDAE

- 1a Discal cell closed in the hind wing. *M*<sub>1</sub> and *M*<sub>2</sub> of the fore wing of the female separate. (No North American species.).....Triplectidinae  
 1b Discal cell not closed in the hind wings. *M*<sub>1</sub> and *M*<sub>2</sub> of the fore wing of the female fused except in the common genus *Leptocerus* and in *Pseudoleptocerus* Ulmer (W. Africa).....Leptocerinae

## TRIPLECTIDINAE Ulmer

Ulmer, 1906b, p. 105; Ulmer, 1907c, p. 129  
 Immature stages. Ulmer, 1906c, p. 1 (*Triplectides gracilis* etc.)

This subfamily is found in Asia, Australia and South America.

## LEPTOCERINAE Ulmer

Ulmer, 1907c, p. 132  
 Immature stages. Ulmer, 1903d, p. 100; Ulmer, 1906d, p. 255

(The references given above for the family refer almost exclusively to this subfamily.)

Antennae very long and slender, sometimes three times as long as the wings, those of the female somewhat shorter than those of the male, the basal segment very thick, about as long as the head. No ocelli. Maxillary palpi long, slender, and hairy. Labial palpi very small. Spurs mostly 2-2-2, the small anterior spurs rarely absent. The legs long and slender, but the anterior pair much shorter than the posterior pair. The femora, tibiae, and tarsi, as well as the spurs, with a silvery appearance due to the presence of a covering of small scale hairs. The fore wings long and commonly very narrow, covered with dense pubescence that obscures the venation. Radius of the fore wing apparently 4-branched, with *R*<sub>5</sub> fused with *R*<sub>4</sub> or with *M*<sub>1</sub> (see p. 47). Media ordinarily 2-branched, a third branch present in the females of *Leptocerus*. The stem of media fused at base with cubitus for a considerable distance. In

*Triaenodes* (q. v.) the base of *M* fused with one of the adjoining veins. Discal cell closed. Hind wing shorter than the fore wing, often much broader with a large folded anal area. Discal cell not closed.  $R_1$  and *Sc* very close together, the radial sector with the same peculiarity as in the fore wing.  $Cu_1$  and  $Cu_{1a}$  sometimes fused.

Larvae eruciform, cylindric, with but little constriction between the abdominal segments. Head elliptical, more rarely oval, the antennae relatively long, sometimes about as long as the mandibles. The labrum notched anteriorly; on its anterior margin two spurs. The right mandible with no bunch of inner bristles and left mandible with these weakly developed if at all present. At least in dark specimens a clear line extending along the sides of the epicranium ventrally. Pronotum, and commonly the mesonotum, chitinized. The hind legs very long, often three times as long as the first pair; claws long. The trochanters divided and in some genera the middle and hind tibiae also. Tubercles of the first abdominal segment very strongly developed and covered with small chitinous points. The lateral fringe is very little developed, or absent. Tracheal gills commonly single, more rarely branched, sometimes absent. The prolegs short, with short stout claws.

Pupal mouthparts peculiarly placed so that the mandibles point upwards. Posterior margin of the first abdominal segment with a plate covered with fine points on each side. Processes at the end of the body commonly long and slender, stouter in *Leptocerus*.

The cases are slender conical tubes, longer than the larvae and generally narrowed somewhat behind. They are made of fine sand grains, more rarely of vegetable matter or of silk. In *Triaenodes* the case is made of vegetable matter arranged in a spiral.

The eggs are laid in masses of gelatin, generally a large number in each mass. They are deposited on vegetation above the water, on the under surface of floating leaves, or farther beneath the surface. The middle tibiae and tarsi of the females are not dilated and there are as yet no direct observations of oviposition beneath the water but the eggs have been found in situations which indicate that this latter process must take place. The egg masses of Leptoceridae differ from those of the other Trichoptera in that they have an outer membrane of a darker color which can be removed from the rest of the mass. The egg mass of the genus *Triaenodes* is peculiar in having the egg string wound like a watch spring, the whole mass being disk shaped.

#### KEY TO THE GENERA OF LEPTOCERINAE<sup>35</sup>

<sup>35</sup> Siltala has proposed three tribes with distinctions found in larval characters: Leptocerini, including, of American genera, *Leptocerus*; Mystacidini, including *Mystacides* and *Triaenodes*; Oecetini including *Oecetis*. I am not acquainted with larvae of *Setodina* and do not know where it would go in such a classification. *Leptocella* and *Setodes* have combinations of characters not agreeing with those indicated for these tribes. Siltala includes *Setodes* in the Mystacidini but the hind tibiae are not divided.

- 1a Hind wings broadest at the base. Cells  $R_2$  and  $M_2$  of the fore wings both pedicellate .....2
- 1b Hind wings broadest near the middle. Cells  $R_2$  and  $M_2$  of the fore wings often not pedicellate.....3
- 2a Spurs 2-2-2. Radius of the hind wing not in large part obsolete. Media of the fore wings of the females three-branched or  $R_2$  and  $M_{1+2}$  separate .....*Leptocerus*
- 2b Anterior tibiae with less than two spurs. Radius of the hind wings largely obsolete. Media two-branched in both sexes. p. 263.....*Leptocella*
- 3a Main stem of media present in the fore wings.  $Cu_1$  of the hind wings with the usual accessory branch.....4
- 3b Main stem of media of the fore wings not separately present.  $Cu_1$  of the hind wing unbranched.....*Trianodes*
- 4a Apex of the fore wing not strongly inflexed when at rest. Cell  $M$  of the fore wing long but not reaching back as far as cell  $R_1$ .....5
- 4b Apex of the fore wing inflexed when at rest. Cell  $M$  (pl. 37, fig. 3) of the fore wings long, reaching back as far as cell  $R_1$ .....*Mystacides*
- 5a Veins of the fore wings markedly straight and nearly parallel. Cell  $R_2$  of the fore wing generally not pedicellate. p. 268.....*Oecetis*
- 5b Veins of the fore wings not markedly straight and parallel. Cell  $R_2$  of the fore wings pedicellate.....6
- 6a Cell  $M_2$  present in the hind wing. Crossvein  $r-m$  generally present though often faint. p. 274.....*Setodes*
- 6b Media of the hind wing unbranched. No crossveins present in the hind wings. p. 274.....*Setodina*

Of these seven genera, *Leptocerus* alone has a spur formula of 2-2-2, the discal cell of the fore wing equal to or exceeding cell  $M$  in length, and a 3-branched media in the fore wing of the females.

*Leptocella* alone has a broad hind wing in which the radial sector is largely obsolete.

*Oecetis* alone has media of the fore wing running straight for nearly the length of the wing, with  $M_3$  branching from it at right angles.

*Mystacides* alone has the wings strongly inflexed when at rest.

*Trianodes* alone has lost media of the fore wings as a separate vein.

*Setodina* alone has no crossveins in the hind wings.

*Setodes* alone lacks all the characters here mentioned for the other genera.

### **Leptocerus** Leach

Leach, 1815, p. 136; McLachlan, 1877, p. 294; Ulmer, 1907c, p. 134; Ulmer, 1909a, p. 85

Immature stages. See references under the family heading

Antennae more than twice the length of the fore wings, those of the males somewhat longer than those of the females, basal segment thick, shorter than head. Maxillary palpi hairy, the basal segment shortest, the second longest, the others unequal. Spurs 2-2-2, those of the fore legs short. Fore wings long and narrow, with heavy pubescence. Hind wings with a broad anal area. The venation (pl. 32, fig. 1) practically constant within the genus. In the fore wing  $Sc$  apparently ending shortly beyond the level of the cross

vein  $r$ , sometimes running into  $R_1$  or branching to  $R_1$  and the costal margin; the discal cell long and slender, the upper margin arched to the crossvein  $r$ , the length of the cell varying somewhat in the different species; media and cubitus fused from the base outward for a very long distance, farther in the males than in the females; media 2-branched in the males, 3-branched in the females. In the males the dorsal part of the ninth segment membranous posteriorly, and divided above. The tenth segment divided in some species and undivided in others. The penis membranous at tip and generally enclosed in a sheath longer below than above so that sometimes only a flat piece visible beneath. Within the sheath commonly a chitinous rod on either side of the penis. Claspers 2-segmented, the second segment often forming a fork with the continuation of the first. The coloration in many respects similar in many species, thus several in which the arrangement of color on the antennae and on the tarsi is the same.

Larvae somewhat conical in shape. Tracheal gills branched in both larva and pupa.

This is a large genus with most of the species in Europe and North America. The types I found difficult to examine as the genitalia are not easily recognizable and the pubescence of the wings is removed with slight rubbing. The three large species I add as new are very likely among the described species but I can not identify them with the types I have seen.

### *Leptocerus albostictus* Hagen

Hagen, 1861c, p. 276

"Luteous; antennae black, the basal half narrowly annulated with white, the basal article rufous; palpi fuscous; head with snow-white hair; abdomen fuscous; feet whitish, anterior tibiae and tarsi spotted with fuscous; anterior wings luteous, all over very finely pointed with white, and with an anal snow-white spot; veins luteous; cilia fuscous, posterior wings gray. Male.

"Length to tip of wings 11 millim. Alar expanse 21 millim.

"Hab. North America. (Collection of Hagen)." Hagen, *l. c.* p. 276.

Several specimens of what is probably this species were taken at Buffalo, June 25th-July 6th. These are like *punctatus* in having the white scales on the wings; the difference in size is marked, the claspers do not show the inner point from the side, as in *punctatus*, and the tenth segment is not so suddenly narrowed.

### *Leptocerus ancylus* Vorhies

(Pl. 31, figs. 3, 4)

Vorhies, 1909, p. 691, pl. 58, figs. 8, 13-15

Immature stages. Vorhies, 1909, p. 692, pl. 53, fig. 2, pl. 58, figs. 9-12; Lloyd, 1921, p. 96-97, figs. 166, 167

"Imago. Length of body, 5-6 mm. Expanse, male, 20-21 mm; female, 16-17 mm. Antennae, male, 20 mm; female, 10 mm. Antennae 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 coxae, 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 [*dilutus*]; 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 [preanal appendages] are plate-like, rounded at the extremities, without the long hairs on the border. Penis cover much as in *dilutus*, the ringlike thickening of the edge not so prominent in lateral view, the tip not indented; penis as in the preceding species. Inferior appendages [claspers] 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." Vorhies, *l. c.*

This species was taken in some abundance at Buffalo, July 20, 1905. The characteristic appendages which Vorhies speaks of as an additional pair are, I think, prolongations of the ventral angle of the claspers as indicated in my figure (pl. 31, fig. 4). This angle is also considerably produced in several other species as the figures will show.

Vorhies and Lloyd have both reared the species. The great difference in the larval cases described (the one tubular, the other Molanna-like) must raise question as to the identity of the materials.

### ***Leptocerus aspinosus* n. sp.**

(Pl. 31, figs. 5-10)

Antennal segments yellowish, sharply ringed with darker, sometimes with white hair at the proximal ends of the segments (probably normally so in fresh specimens). Head with white and black hair intermixed. Legs yellow with white hairs and some black spines. Wings brown with sparse white pubescence, sometimes with patches of white hair, one patch frequently at the tip of the anal veins. The tenth segment as seen from above (pl. 31, fig. 8) divided into a middle and two lateral pieces. The claspers black below and along the posterior margin, covered with long, heavy, tawny, hair. The genitalia of the male with remarkable resemblance to those of *L. variegatus* but the claspers lack the tooth present in that species.

Length, 15 mm. Buffalo, N. Y., June. Lake Forest, Ill., July 24.

**Leptocerus cancellatus** n. sp.

(Pl. 31, figs. 11, 12)

Betten, 1901, pl. 34, fig. 1 (*resurgens*)

Head, including the palpi, covered with white and fewer black hairs. Antennae 30 mm long in the male, about 15 mm in the female, the basal segment light brown, clothed with white hair, second segment very short, the succeeding segments gray at base and brown distally, the first few segments with the colors about equally distributed but the brown gradually predominating until in the distal end no gray present. In some specimens little or no gray present anywhere on the antennae; then only the ground color of light brown apparent with narrow rings of black. Thorax dark brown, almost nude. Fore wings dark brown. with sparse white pubescence; a large patch of white at the tips of the anal veins not always distinct. Veins very dark. The legs yellowish with black spines and white hair, the distal ends of the tarsal segments tipped with brown. In many specimens the white almost wholly absent from the wings. The genitalia generally yellowish. The tenth segment dorsally not divided, with a spine on each side (pl. 31, fig. 11). The clasper with a prominence of spines internally on the basal segment (pl. 31, fig. 12). Length 16 mm.

Saranac Inn, Old Forge, Buffalo and Ogdensburg, N. Y., July-August, Dead lake, Fla. April 8.

**Leptocerus dilutus** Hagen

(Pl. 31, fig. 13)

Hagen, 1861c, p. 277; Banks, 1894, p. 180 (listed from Kansas); Ulmer, 1907b, p. 45, figs. 68, 69; Vorhies, 1909, p. 688, pl. 58, figs. 1-3  
Immature stages. Vorhies, 1909, p. 689, pl. 53, fig. 3, pl. 57, figs. 22-23, pl. 58, figs. 4-7

The type of this species has recently been redescribed by Ulmer, and Vorhies has described all stages of the insect. The following is a nearly complete copy of Vorhies' description of his specimens taken at Madison, Wis.

"Imago. Length of body, 5-6 mm. Expanse, male, 18-20 mm; female, 16-17 mm. Antennae, male, 18 mm; female, 10 mm. Antennae 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 single median one) between the concavities which are found posterior to the antennae; 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 antennae, 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 coxae, 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 are plate-like, rounded at the extremities, with a border of long hairs. The 10th segment is rounded with a slight notch at the end, the border with a ring-like thickening; penis large, projecting downward from beneath the tenth segment. The claspers are long, directed strongly upward, and curve backward between the levels of the 10th segment and the praeanal 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."

Adults of this species were taken in June at Ithaca and Buffalo, N. Y., and at Lake Forest, Ill. These agree with the description quoted above. In my specimens, besides the yellowish spot on the tips of the anal veins there are similar spots following the cord of crossveins and another at the apex of the median cell. The penis has a chitinous rod at each side. The claspers have internally a rounded prominence covered with long hairs (pl. 31, fig. 13).

### *Leptocerus flavus* Banks

Banks, 1904*d*, p. 212, pl. 2, fig. 4

"Palpi yellow, more brownish toward apex; head clothed with white hair; basal joint of antennae yellowish, beyond black, the basal part of segments snow-white, except those near tip; thorax yellowish, with white hair. Abdomen in female green, in male yellowish; fore wings uniformly clothed with yellow hair, fringe yellow, all veins pale yellowish; hind wings nearly hyaline, with pale gray fringe; legs pale yellowish. Length, male, 7 mm, female, 6 mm.

"Specimens from Washington, D. C., and Falls Church, Va., at lights.

"Readily known by small size and uniformly yellow wings." Banks, *l. c.*

The type appears to have a slender ventral branch to the claspers as in *ancyllus*.

### *Leptocerus floridanus* Banks

Banks, 1903*b*, p. 242

"Head yellowish, clothed with long, white hair; pronotum with long white hair; rest of the thorax yellowish, with shorter and more sparse white hair; antennae white, narrowly annulate with dark

brown; legs yellow, with short white hair, tarsi banded on tips with brown; wings pale brown, rather densely clothed with white hair, mostly in small patches, giving the wing a marmorate appearance; apical fringe alternately brown and white; hind wings with the apical part slightly infuscated.

"Length to tip of wings 10 mm.

"One specimen from Biscayne Bay, Florida (Slosson).

"Differs from all our other species in the covering of hoary hair."  
Banks, *l. c.*

### **Leptocerus futilis** Banks

Banks, 1914*b*, p. 264, pl. 15, figs. 44, 49

"Body black, head with white hair; palpi dark, with white hair, basal joint of antennae dark, rest whitish with dark tips to joints; thorax with white stripes in front, and tufts over base of wings; legs pale. Wings dark gray, veins dark, surface clothed with very short yellowish hair, a pale spot at arculus; fork 3 extends more basad than fork 1; the three crossveins of anastomosis widely disjointed; discal cell extends hardly its width before thyridial cell.

"Expanse 21 mm.

"From Go Home Bay, Ont., 11 July (Walker)." Banks, *l. c.*

### **Leptocerus maculatus** Banks

Banks, 1898, p. 214; Sibley, 1926*b*, p. 105

"Head with a bunch of black and white hairs under and one above each eye, some white hairs on middle of vertex; palpi brown and white; antennae white, distinctly annulate with black; thorax with several groups of black and white hairs; abdomen green; legs white, tarsi all annulate with black, and the anterior tibiae black on outside, and intermediate tibiae rather blackish on outside also; fore wings clothed with black hair, with scattered white patches, most prominent on middle and basal part of wings, fringe long and black, hind wings gray, with long gray fringe; antennae scarcely twice as long as wings; palpi long; abdomen short and large, spurs 2-2-2, fore pair short but distinct; fore wings short, rounded at the tip, discal cell about length of its pedicel, first apical cell twice as long as its pedicel, the fourth apical cell has a pedicel rather shorter than itself, while the third apical arises from the middle of the pedicel of the fourth; hind wings shorter and scarcely broader than the fore pair, first apical cell long pedicellate, fourth apical cell short pedicellate, all the veins distinct. Expanse 15 mm.

"Washington, District of Columbia, August." Banks, *l. c.*

Sibley records the species doubtfully from McLean, N. Y.

### **Leptocerus mentiens** Walker

Walker, 1852, p. 71; Hagen, 1861*c*, p. 276 (*lugens*); Hagen, 1861*c*, p. 278; McLachlan, 1863*c*, p. 158; Provancher, 1877, p. 264; Provancher, 1878*b*, p. 139; Ulmer, 1907*b*, p. 43, figs. 65-67 (*lugens*)

"Fuscous; antennae black, the basal half annulated with snow-white; palpi fuscous; head with snow-white hair; feet snow-white,

base of the femora fuscous, the four anterior tarsi spotted with fuscous; anterior wings rufo-fuscous, with fuscous hair, and luteous hair intermixed, a whitish-yellow spot at the anal angle; veins fuscous; cilia paler; posterior wings gray. Male and female.

"Length to tip of wings 11 millim. Alar expanse 21 millim.

"Hab. St. Lawrence River, Canada (Osten Sacken)." Hagen, *l. c.*

This is Hagen's description of the species under the name *lugens*. As *mentiens* it is further reported from St Martin's falls, Albany river, Hudson's bay (Barnston), Washington, D. C. (Banks). Ulmer has examined the type of *lugens* in the Selys collection and has given figures of the wings and of the genitalia (*l. c.*, p. 44).

Hagen's type of *lugens* has the ninth segment showing two sharp prongs dorsally as in Ulmer's figure.

McLachlan reports (*l. c.*, p. 158) the type in the British Museum in bad condition. It seems best to accept Hagen's surmise that his *lugens* is a synonym of *mentiens* Walker.

### Leptocerus punctatus Banks

(Pl. 31, fig. 14)

Banks, 1894, p. 180 (*Mystacides*); Kellogg, 1895b, pl. 25, fig. 2 (*Mystacides*);  
Banks, 1904d, p. 212 (*Mystacides*)

"Black, with white spots. Palpi black with black hair, second joint short, third much longer, fourth a little shorter than the third, fifth long and flexible, tapering. Antennae black, basal third annulate with snow-white, basal joint black, with a white line on inner side; thorax and abdomen black; legs fuscous, tarsi white, anterior wings black, with many small white spots, most numerous near tip; posterior wings fusco-hyaline, cilia black. Spurs 1-2-2. Length, female 8.5 mm. One of female and one male, Douglass Co., Kansas, Aug. Electric light. A larger specimen has a greenish abdomen, the tarsi spotted with black, part of the basal joint of the antennae and face white; it may be different, but it is badly rubbed." Banks *l. c.*, p. 180.

Banks also reports the species from Washington, D. C., and from Maryland.

This is undoubtedly a *Leptocerus*. I have specimens from Ogdensburg, and from Ithaca, N. Y., and they agree with others of the genus in spur formula and in the proportions of the lengths of the palpal segments as the type seems not to have done.

### Leptocerus recurvatus Banks

Banks, 1908c, p. 265, pl. 19, fig. 8

"Black, clothed with white hairs; sides of thorax brown; antennae yellowish-brown, narrowly annulate with black, the subantennal tuft yellow-brown; legs yellowish, the fore pair darker; abdomen blackish

near base, pale beyond. Fore wings brownish, basal anal area paler, also costal area, venation dark brown, a rather blackish spot over ends of first apical fork, the base of the upper branch of the median brown, the rest hyaline until the anastomosis, the pedicels of forks one and three about equal in length; hind wings more hyaline, the anterior venation brown, rest paler. Expanse 22 mm.

"From Westfield, New York, June, July (Woglum)." Banks, *l. c.*

### **Leptocerus retactus** Banks

Banks, 1914*b*, p. 263, pl. 15, fig. 41

"Gray; face yellowish, with white hair; palpi dark gray; vertex dark brown; abdomen pale yellowish, darker at tip; legs pale, but tibiae rather gray. Wings gray, with yellowish brown hairs, hyaline dots near base of discal cell, and middle part of costal area hyaline, the median and anal veins for some distance narrowly lined with hyaline. Wings not very long; fore wings with discal cell very long, narrowed near tip, the veins of anastomosis much disjointed and oblique; fork 1 twice as long as pedicel, the double fork (of female) barely longer than fork 1. In hind wings the first and third forks about equal.

"Expanse 16 mm.

"From Muskoka River, Ont., 30 June, and Go Home bay, Ont., 8 Aug. (Walker)." Banks, *l. c.*

### **Leptocerus submaculus** Walker

(Text fig. 3*b*, pl. 32, figs. 1-4)

Walker, 1852, p. 70; Hagen, 1861*c*, p. 278; Ulmer, 1906*b*, p. 35, fig. 41

"Black, with black hair; antennae extremely long; palpi hairy; tibiae and tarsi testaceous; wings cinereous, the anterior ones sprinkled with white, and with three whitish spots, the one basal, the second discoidal, subcostal, and the third anal; veins black. (From the description of Walker.)

"Length to tip of wings 14 millim. Alar expanse 25 millim.

"Hab. St Lawrence river." Hagen, *l. c.*

Ulmer has examined the type (female) in the British Museum. The following is a translation of his description in so far as it is different from the original or adds to it.

"Head and thorax with white hair; antennae black, with narrow clear annulations, at least at base. Palpi blackish-brown, with gray-white hair. Legs with dark brown coxae and femora; the tibiae and tarsi yellowish brown, the tarsi (at least the anterior pair) ringed darker; all the tibiae with little spines. Fore wings rather broad, with grayish membrane covered with scattered dark brown hairs and separate white scale hairs; a small white spot on arculus, a second on the costal margin opposite the crossvein between *Sc* and the discal cell, and the appearance of a third on the costal margin opposite the

middle of cell  $R_2$ . Venation dark brown, very distinct; venation regular, the crossveins of the cord form a broken line. Hind wings clear gray, somewhat shining, with scattered clear pubescence; venation not so distinct as in the fore wings; fringes of both wings dark brown, those of the fore wing before the arculus blackish brown.

"Length of body, 7 mm, of the fore wing about 10 mm."

This species was rather abundant at Buffalo, N. Y., from June 6th to July 6th.

### *Leptocerus tarsi-punctatus* Vorhies

(Pl. 32, figs. 5, 6)

Vorhies, 1909, p. 694, pl. 58, fig. 16, 17

"Imago. Length of body, 6 mm. Expanse, 18–20 mm. Antennae 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*.

"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 visible 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." Vorhies, *l. c.* Madison, Wis.

This species was taken during July and August, at Saranac Inn, Old Forge, and Ogdensburg, N. Y. With regard to the genitalia it may be added that the slender rods beneath the tenth segment are parts of that segment, being joined to it at base; the spinelike branch of the claspers referred to by Vorhies in the description copied above, is the small second segment; the ventral angle has, I think, two spines. The penis is inclosed in a sheath within which lie also the chitinous appendages of the penis. The sheath has not been represented in my figure (pl. 32, fig. 5). The abdomen seems to retain the green color better than in most species.

**Leptocerus transversus** Hagen

Hagen, 1861c, p. 279; Provancher, 1877, p. 264; Provancher, 1878b, p. 140

Grayish-fuscous, with snow-white hair; antennae fuscous, annulated with white, the basal article fuscous; palpi fuscous, with gray hair; head and thorax fuscous, with white and fuscous hair; feet luteo-fuscous, with snow-white pile, tarsi spotted with fuscous; anterior wings fuscous, ciliated with fuscous, varied with cinereous, and with an anal cinereous spot; veins stout, fuscous; posterior wings cinereous; abdomen luteous. Male and female.

"Length to tip of wings 7-9 millim. Alar expanse 13-17 millim.

"Hab. Washington (Osten Sacken)." Hagen, *l. c.*

The wings of the type seemed brick red in some lights, except for the white spots.

**Leptocerus vanus** n. sp.

(Pl. 32, fig. 7)

Basal segment of the antennae dark brown, the succeeding segments light brown, narrowly ringed darker. Length of antennae 20 mm. Anterior warts of the head with brown and gray hair. Palpi brown, with gray hair. Legs dark brown with gray hair, the tarsi lighter and tipped with brown. The wings very dark brown. The tenth segment with a brush of large spines on the lower margin (pl. 32, fig. 7). In two specimens the basal segments of the antennae white proximally and dark distally and with a patch of white hair at the tip of the anal veins.

Length to tip of wings 10-11 mm. Buffalo, N. Y., July 20th.

**Leptocerus variegatus** Hagen

(Pl. 32, fig. 8)

Hagen, 1861c, p. 278; Banks, 1914b, p. 263, pl. 15, fig. 40 (*angustus*)

"Luteo-fuscous, with snow-white hair; antennae luteo-fuscous, the basal half annulated with snow-white, the basal article luteo-fuscous; palpi fuscous, with gray hair; head fuscous, sparingly clothed with white hair; feet gray, tarsi snow-white, spotted with fuscous; anterior wings grayish-fuscous, with brown and gray hairs, spotted with gray, especially at the apex, margin and anal angle; veins stout, fuscous; posterior wings cinereous. Male.

"Length to tip of wings 14 millim. Alar expanse 27 millim.

"Hab. Chicago (Osten-Sacken)." Hagen, *l. c.*

Length to tip of wings 12 mm, some rather smaller. Antennal segments with white hair proximally, with deep brown distally. Head with gray and dark brown hair, palpi brown with white hair. Fore legs brown with white hair, the tarsi tipped with brown; the middle legs lighter in color and the tarsi are not so conspicuously tipped with brown. The fore wings deep brown with short black hair, several patches of white hair, the largest at the tip of the anal veins, a curved line beginning a little posterior to this and running

over the crossveins and ending at the apex of cell  $R_2$ ; other indistinct spots at crossvein  $r$ , and near the base of the wing. In some specimens white hair more irregularly distributed. The genitalia quite like those of *L. aspinosus* shown in plate 31, figure 6. The only difference found being that the clasper in this species has a long slender tooth on its inner margin.

Saranac Inn, Old Forge, Ithaca and Ogdensburg, N. Y., June-August.

Hagen's type of *variegatus* and Banks' of *angustus* both show the long tooth on the clasper. Banks' specimens are from Go Home bay, Ontario, August 1st.

#### OTHER AMERICAN SPECIES

##### *Leptocerus mexicanus* Banks

Banks, 1901b, p. 368, pl. 12, fig. 6. Mexico.

##### *Leptocerus stigmaticus* Navás

Navás, 1917b, p. 8, fig. 4. New Mexico.

#### *Leptocella* Banks

Banks, 1899, p. 214; Ulmer, 1907b, p. 45; Ulmer, 1907c, p. 137; Vorhies, 1909, p. 695  
 Immature stages. Fritz Müller, 1881, p. 60, 80 (*Setodes*); Thienemann, 1909a, p. 126, fig. 9; Vorhies, 1909, p. 697

Antennae of the male almost three times as long as the fore wing, those of the female shorter, basal segment thick. Maxillary palpi long and slender; the fifth segment longer, not shorter than the second, third, or fourth, as stated in the original description of the genus, the third next in length, the others slightly shorter and subequal (pl. 32, fig. 12). Spurs 1-2-2 or 0-2-2. The fore wings long and narrow, but little broadened distally. Venation of the fore wing much as in *Leptocerus*; media, however, but 2-branched in both male and female, cell  $M$  reaching farther toward the base of the wing as compared with the discal cell than in that genus. The hind wings very broad and much folded. The venation peculiar in that most of the radial sector is obsolete; plate 32, figure 9 showing as much of that vein as found in any specimen. Ninth segment running out into long dorsal processes, the claspers rather heavy at base; the penis with a very large membranous, protrusible end and on each side a long curved chitinous rod, the latter an appendage of the penis, not of the clasper as stated in Ulmer's description (*l. c.*, p. 137). The membranous tip of the penis shown only in prepared specimens. In some species at least, long filaments on the abdomen.

The only larvae described as those of *L. albida*, reared by Vorhies, and those of *L. gemma* Fritz Müller (exotic).

Of the eastern species, *exquisita* and *albida* have not been satis-

factorily separated. Ulmer suggests that *albida* (*uvarowii*) may be a variety of *exquisita*. Vorhies refers to this and suggests the possibility of sexual dimorphism in the males. The insects that I identify as these species can readily be separated by the color in the case of well marked specimens, but each apparently varies toward the pure white condition. Aside from the color, I find differences in the male genitalia as is indicated below.

### Leptocella albida Walker

(Text figs. 33c, 37j, k, 49c; pl. 32, figs. 9-14, pl. 33, 1-8)

Walker, 1852, p. 71 (*Leptocerus*); Kolenati, 1859b, p. 249, pl. 2, fig. 24 (*Mystacides uvarowii*); Hagen, 1861c, p. 281 (*Setodes nivea*); Hagen, 1861c, p. 283 (*Setodes*); Hagen, 1861c, p. 280 (*Setodes candida*); McLachlan, 1863c, p. 159 (*Setodes*); Provancher, 1877, p. 265 (*Setodes*); Provancher, 1878b, p. 140 (*Setodes*); Kolbe, 1888d, p. 174 (*Setodes candida*); Banks, 1894, p. 180 (*Setodes albida*); Banks, 1894, p. 180 (*Setodes uvarowii*); Banks, 1904d, p. 213 (*uvarowii*); Ulmer, 1907b, p. 45, figs. 70, 71 (*uvarowii*); Vorhies, 1909, p. 695, pl. 53, fig. 1, pl. 58, figs. 21, 22, pl. 59, figs. 1, 2 (*uvarowii*)  
 Immature stages. Vorhies, 1909, p. 697, pl. 53, fig. 1, pl. 58, figs. 18-20, pl. 59, figs. 3-9 (*uvarowii*)

Vorhies has described the entire life history. I quote the greater part of the description of the adult.

"Imago. Length of body, 8-10 mm. Expanse, male, 27-28 mm; female, 23-26 mm. Antennae, male, 32 mm; female, 16-18 mm. Basal portion of antennae 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 the 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 antennae, 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 coxae. 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 ninth 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."

The species has been reported from the St Lawrence river, St Martins falls, Albany river, Hudson bay, and from Wisconsin. I have taken specimens at Buffalo and Ogdensburg, N. Y., and have reared the species from Diamond lake, Ill. The genitalia differ from those of *exquisita* in having the claspers broader at base.

### *Leptocella exquisita* Walker

(Text fig. 9d; pl. 33, figs. 9, 10)

Walker, 1852, p. 72 (*Leptocerus*); Hagen, 1861c, p. 280 (*Setodes*); Banks, 1899, p. 214; Banks, 1904d, p. 213; Ulmer, 1905d, p. 73, figs. 34, 35; Ulmer, 1907b, p. 45; Ulmer, 1907c, pl. 18, fig. 171b, pl. 37, fig. 7

The following is a translation of part of Ulmer's description (*l. c.*, p. 73).

Head yellow above, yellowish brown in front and beneath as well as on the basal segments of the antennae. Antennae three times as long as the fore wings, yellowish; from the third to about the eighteenth, the segments white proximally and brown distally; for about the same distance the articulations narrowly banded with black. Mouth parts clear yellow, sparsely clothed with white hair; maxillary palpi long and slender, the first segment small, the following three about equal, the fifth longer than the fourth; labial palpi short, slender, the second segment at least twice as long as the first, the third still longer. The basal segments of the antennae above, the dorsal surface of the head, and the pronotum with snow-white hair. The mesonotum brown with less white hair but with white scales. Mesonotum without a longitudinal furrow. Abdomen yellow at base, darker posteriorly. Thorax brown beneath. Legs yellow, the coxae brown; all the femora with fine white hairs, on the curved hind tibiae this pubescence rather long. Spurs 0-2-2. Fore wings with dense white pubescence, with dark brown narrow and broad transverse bands whose number is not constant (about 12-14), about six to eight of them from the base to the cord; the bands immediately beyond the cord often broken into spots giving the appearance of short longitudinal bands; the apical bands complete; on the posterior margin from the tip of the anals to the tip of  $M_3$  generally four dark

brown spots which may be reduced to three or two by fusion; at the wing base a large patch of white hair. Fringes long only in the region between the tip of the anal veins and the wing apex, alternately white and brownish in color. Venation clear brown, whitish in the white parts of the wings. Cell  $R_2$  somewhat longer than its pedicel, cell  $R_4$  with a very short pedicel. Hind wings white, transparent, slightly iridescent, with scattered white pubescence; fringes white. Genitalia of the male yellowish, ninth segment dorsally triangular, produced into a short point; preanal appendages very long and slender, seen dorsally thinner at the end, in lateral view the end broadened; claspers not deeply divided, the end thickened and beset with dorsally directed bristles which in part arise from small tubercles. In lateral view two strongly curved processes visible; these thickened at the tip. The last ventral segment produced; the next to the last with a bunch of bristles on a process. Length of body, 9 mm, expanse 27 mm.

Pale specimens are very likely to be confused with *L. albida*.

This species has been reported from the eastern states, from Florida to Canada. My New York specimens are dated from June 30th to August 10th. Florida specimens collected by Dr J. G. Needham are dated April 8th.

### **Leptocella pavid** Hagen

(Pl. 33, figs. 11, 12)

Hagen, 1861c, p. 282 (*Setodes*); Ulmer, 1907c, p. 138; Banks, 1904d, p. 213 (*Oecetina*); Banks, 1907c, p. 46 (*Leptocella*)

"Pale yellow, with yellow hair; antennae pale, annulated obscurely; palpi, head, thorax, abdomen, and feet pale yellow; anterior wings yellow, with yellow hair and veins, pointed with fuscous, the points small, longitudinally placed in series; posterior wings pale.

"Length to tip of wings 7 millim. Alar expanse 13 millim.

"Hab. Washington (Osten Sacken).

"The specimen is damaged." Hagen, *l. c.*

Banks reports the species from Plummer's Island, Md., in August. I have a single male of this species taken at Old Forge, N. Y., July 21st and Professor Needham has given me another from the Chipola river, Florida, April 8th. The antennae are proportionately very long (25 mm), the basal segments are half brown and half white. The spots on the wings referred to in the original description are 50 or more in number. The venation is like that of the other species. The genitalia (pl. 33, fig. 12) are also similar except that there are two large median ventral appendages representing perhaps prolongations of the ninth segment ventrally. I do not find the small tips on the ninth segment as in the other species. The claspers are broad at base and the posterior margin

is not even as in the other species. The appendages of the penis are sigmoid and very slender. As in the other species the penis has an extrusible membranous tip.

### *Leptocella piffardii* McLachlan

McLachlan, 1863c, p. 160 (*Setodes*); Provancher, 1877, p. 265 (*Setodes*); Provancher, 1878b, p. 140 (*Setodes*); Banks, 1899, p. 214

"Length of body 4 lin. of antennae 18 lin. expanse 13 lin.

"Ferruginous: Antennae very long, the joints in the basal third half yellow and half dark fuscous, the rest altogether fuscous; head yellow, clothed with white hairs; legs pale-ochreous; anterior wings whitish, with numerous gray, somewhat geminated transverse bands, and the apex clouded with gray; at the anal angle are two or three confluent blackish spots; apical cilia also blackish; posterior wings unicolorous snowy-white.

"Hab. near Halifax, Nova Scotia. B. Piffard, Esq.

"Allied to *S. exquisita*, *albida*, and *candida* (especially the first) but differs in the transverse bands being more numerous and gray instead of yellow. In all three species the anastomosis appears semicircular, owing to the arching of the adjoining veins." McLachlan, *l. c.*, p. 160.

Other American species are:

*Leptocella coloradensis* Banks

Banks, 1899, p. 215. Colorado.

*Leptocella dorsalis* Banks

Banks, 1901b, p. 368. Mexico.

*Leptocella exilis* Banks

Banks, 1905c, p. 19; Banks, 1904a, p. 110, pl. I, fig. I (*gracilis*); Colorado, New Mexico.

*Leptocella fenestrata* Banks

Banks, 1913b, p. 237, pl. 26, figs. 33, 42. Panama.

*Leptocella festiva* Navás

Navás, 1913b, p. 76, pl. 4, fig. 9. Panama.

*Leptocella gracilis* Banks

Banks, 1901b, p. 369, pl. 12, fig. 10. Mexico.

*Leptocella inornata* Banks

Banks, 1914b, p. 263, pl. 15, fig. 42 (*Leptocerus*). Texas.

*Leptocella intervena* Banks

Banks, 1914b, p. 262, pl. 9, fig. 15, pl. 15, fig. 50. Texas.

*Leptocella minuta* Banks

Banks, 1900a, p. 257. Washington, Arizona.

*Leptocella serrei* Navás

Navás, 1924b, p. 83. Costa Rica.

*Leptocella stigmatica* Banks

Banks, 1914b, p. 262, pl. 15, fig. 48. New Mexico.

*Leptocella texana* Banks

Banks, 1905c, p. 19. Texas.

### Oecetis McLachlan

McLachlan, 1877, p. 329; Banks, 1899, p. 215 (*Oecetina*); Banks, 1907a, p. 129 (*Oecetina*); Ulmer, 1907c, p. 142; Ulmer, 1907c, p. 144 (*Oecetodes*); Ulmer, 1909a, p. 100

Immature stages. Ulmer, 1903b, p. 221; Ulmer, 1903d, p. 107; Ris, 1904a, p. 370; Ris, 1904b, p. 63; Thienemann, 1905b, p. 46; Silfvenius, 1905b, p. 79; Siltala, 1907c, p. 479; Ulmer, 1909a, p. 207, 246, 309; Lestage, 1921a, p. 639

Antennae more than twice the length of the wings, those of the females shorter than those of the males; basal segment as long as or longer than the head. Maxillary palpi long and hairy, the proportionate length of the segments varying somewhat with the species. Spurs 0-2-2, or 1-2-2, the inner spur the longer. Fore wings long and narrow, the anterior and posterior margins sometimes nearly parallel. The wings hairy and the fringes long; the hairs on the wing veins often in two ranked order. The venation peculiar mainly in that the course of the veins is exceptionally straight. Media of the fore wing sometimes said to be unbranched; in reality  $M_3$  present but sharply angled (see p. 47). The males of a few of the species with some of the dorsal segments modified through the presence of the peculiar organs described on page 52.

Larvae slender, not much narrowed posteriorly. The head long, oval in shape, sharply bent downwards. Antennae slender, single segmented, with a long bristle. Pronotum and mesonotum chitinous. Length of the legs in the proportion 1:2:2½, all set with numerous hairs but not with fringes for swimming. The lateral line very fine, beginning on the third segment. Tracheal gills single on segments 2 to 8.

Pupal labrum more or less produced in the center. The mandibles slender, the distal end of the blade toothed, the middle with 3 to 4 large teeth. Anal rods very slender, longer than the last segment, thickened at base, somewhat curved outward at tip. The plate of points on the posterior margin of the first segment small.

On the whole it seems best not to recognize either of the two genera that have been set off and that affect American species. Banks (*l. c.*, p. 215) proposed the genus *Oecetina* for all the American species distinguished "by having a much longer discal cell, and in the first apical reaching the anastomosis, hind wings not very broad." Ulmer (*l. c.*, p. 142) drops this genus because the forking of  $R_{2+3}$  is variable in relation to the crossveins and because the other character (width of wings) divides the European species into unnatural groups. I may add that by measurement of my specimens I find that the hind wing of *O. ochracea* (type of *Oecetis*) is not proportionately broader than that of *O. resurgens* (type of *Oecetina*). Banks has later (*l. c.*, p. 129) amended his description by adding that "the crossvein at the end of the discal cell is considerably beyond the other crossveins." This character is nearly constant but I find some specimens of *O. incerta* in which this crossvein is exactly on

the same level as the others and many specimens in which the distance beyond is very inconsiderable. Moreover it is very considerably beyond in *O. intima* (European) and that is a form with broad hind wings. Ulmer differentiates *Oecetodes* largely on the position of crossvein *r-m* in the hind wing as suggested by Banks (*l. c.*, p. 129). This would doubtless serve better but I have specimens of a species in which the crossvein *r-m* is sometimes before the apex of cell  $M_2$ , sometimes at the apex, and sometimes upon  $M_{1+2}$ .

### *Oecetis avara* Banks

(Pl. 34, figs. 1-3)

Banks, 1895, p. 316 (*Setodes*); Banks, 1904d, p. 213 (*Oecetina*); Banks, 1907a, p. 129 (*Oecetina*); Ulmer, 1907c, p. 144 (*Oecetodes*); Sibley, 1926b, p. 105 (listed)

"Length 10 mm. Head yellowish, with gray and white hair; palpi densely clothed with gray hair; antennae cinereous, tips of the joints slightly fuscous. Wings gray hyaline, with gray hair, forming a long fringe on hind margin; five fuscous dots as follows: one at forking of radial sector, one at origin of divisiialis, one at forking of divisiialis, another at arculus, and a fifth at end of lower branch of divisiialis; three transverse gradate veinlets fuscous; upper branch of radial sector forks at the first transverse veinlet; coxae and abdomen greenish. Legs pale yellowish, with white hairs.

"One specimen, Sherbrooke, Canada, June (L'abbé P. A. Bégin)." Banks, *l. c.*, p. 316.

Banks has listed the species also from Washington, D. C., and from North Carolina. Sibley reports it from McLean, N. Y., July 25th to August 21st. I have taken this species at Buffalo, Ithaca and Ogdensburg, N. Y., July to August.

Figures of venation and genitalia are here added; that of the genitalia is not satisfactory. The spots in the wings are not always distributed as indicated in the description.

### *Oecetis flaveolata* Hagen

Hagen, 1861c, p. 282 (*Setodes*); Banks, 1899, p. 214 (*Leptocerus*); Ulmer, 1907c, p. 136 (*Oecetis?*); Banks, 1907a, p. 129

"Pale yellow, with yellow hair; antennae whitish-yellow, a little annulated with fuscous, the basal article yellow; palpi, head, thorax, and feet, pale yellow; anterior wings yellow-ochreous, with yellow hair, veins, and cilia; posterior wings cinereous. Male and female.

"Length to tip of wings 7 millim. Alar expanse 13 millim.

"Hab. Washington (Osten Sacken); New Orleans." Hagen, *l. c.*

### *Oecetis flavida* Banks

Banks, 1899, p. 216 (*Oecetina*); Banks, 1907a, p. 129 (*Oecetina*)

"Yellowish, head, thorax and palpi clothed with pale grayish hair; fore wings quite densely clothed with short yellow hair and

with gray fringes, anastomosis only a little infuscated, fore wings long and acute, discal cell only a little way beyond thyridial cell, the anastomosis being also continuous and oblique, thyridial cell almost one-half longer than discal cell, the fifth apical cell not extending upon the thyridial cell. Expanse 16 mm.

"Kissimmee, Florida, November.

"Separated from *Oe. incerta* by yellowish fore wings, with less distinct and more continuous anastomosis, and the longer thyridial cell." Banks, *l. c.*, p. 216.

### *Oecetis floridana* Banks

Banks, 1899, p. 216; Banks, 1907a, p. 129

"Grayish; antennae rather paler, annulate with brown at tips of the joints, much more than twice the length of the wings, basal joint clothed with white hair; legs yellowish-gray, spurs 1-2-2; fore wings very long and slender, acute at tips, hinder pair broader and much shorter, fore pair clothed with yellowish gray hair, and some white and black hairs along the veins, three indistinct whitish spots on the posterior apical margin, posterior margin with a fringe of yellowish gray and black hairs, all the apical cells reach the anastomosis, and are of subequal width at base, except the first which is acute, fifth apical extends a little way on thyridial, hind wings scantily clothed with yellowish hair, and a rather long yellowish-gray fringe, fork five present in hind wings, as well as three in front of it, first apical cell extending back on the discal. In the male genitalia there is a large median corneous piece, deflexed rather beyond its middle, and acute at tip. Expanse 19 mm.

"Biscayne bay, Fla. (Mrs. A. T. Slosson)." Banks, *l. c.*, p. 216.

### *Oecetis guttata* Banks

Banks, 1900a, p. 257 (*Oecetina*); Banks, 1907a, p. 129 (*Oecetina*)

"Pale yellowish; head clothed with white and pale yellow hair; legs whitish; antennae pale on base, narrowly annulate with brown, apical half darker; wings pale brown, clothed with golden scales, and with about thirty white dots, most numerous in apical part, where they usually adjoin a brown dot; fringe mostly golden, but with some brown posteriorly, anastomosis not darker than other veins; hind wings dark gray, with a brown fringe.

"Length 7 mm.

"New Brunswick, N. J. (J. B. Smith)." Banks, *l. c.*, p. 257. Washington, D. C. (Banks).

### *Oecetis immobilis* Hagen

(Pl. 34, figs. 4, 5)

Hagen, 1861c, p. 283 (*Setodes*); Banks, 1907c, p. 45 (*Leptocerus*)

"Fuscous, with luteous hair; antennae fuscous, the basal article luteous; palpi with fuscous hair; head and thorax fuscous; feet

luteous; abdomen fusco-luteous; anterior wings fuscous, with luteous hair, the margin obsoletely spotted with fuscous, ciliated with fuscous; posterior wings brown-gray, with gray cilia. Male.

"Length to tip of wings 7 millim. Alar expanse 13 millim.

"Hab. St Lawrence River, Can. (Osten Sacken)." Hagen, *l. c.*

What I regard as this species I describe as follows:

Antennae yellowish, the black annulations not very distinct. Legs light yellow. The pubescence of the fore wings rather dense and of a reddish brown color, sometimes yellowish. Scattered and not very sharply defined dark spots present, the most prominent ones forming a large patch along the cord; several scattered ones further toward the base of the wing and a series around the apical margin. In rubbed specimens these spots very little shown, if at all. Genitalia and venation as figured. The male abdomen without the fenestrations found in *O. fumosa* and *O. avara*. Length to tip of wings, male, 6 mm, female, 8 mm.

This species was rather common at Ogdensburg, N. Y., in August. I have specimens also from Winona lake, Ind.

### *Oecetis incerta* Walker

(Text figs. 5*k*, 23*b*; pl. 34, figs. 6-11)

Walker, 1852, p. 71 (*Leptocerus*); Hagen, 1861*c*, p. 278 (*Leptocerus*); Hagen, 1861*c*, p. 283 (*Setodes micans*); McLachlan, 1863*c*, p. 158 (*Setodes*); Provancher, 1877, p. 265 (*Setodes*); Provancher, 1878*b*, p. 140 (*Setodes*); Banks, 1894, p. 180 (*Setodes*); Banks, 1899, p. 215 (*Oecetina*); Banks, 1907*a*, p. 129 (*Oecetina*); Sibley, 1926*b*, p. 105

"Luteous, with fuscous hair; antennae whitish-yellow, the basal article luteous; palpi with fuscous hair; head and abdomen luteous; feet whitish-yellow; anterior wings luteo-fuscous, subnude, the disk shining purple, anastomosis fuscous, cilia long, fuscous; posterior wings obscure, entirely shining purplish, with fuscous cilia.

"Length to tip of wings 8 millim. Alar expanse 15 millim.

"Hab. Washington (Osten Sacken); Mexico (Deppe).

"Is this *L. incertus* Walker?" Hagen, *l. c.*, p. 283.

Banks (1899, p. 215) gives a short description and adds Long Island, N. Y., to the locality list.

I add figures of the venation and of the genitalia. In some specimens the male abdomen shows a small forked process on the ninth dorsal segment. The wings seem to me light brown rather than luteous. The veins are darker especially at the cord.

The species is apparently widely distributed and common. It has been taken at several places in New York State, at Waubesa lake, Wis., at Lake Forest, and at Diamond Lake, Ill. I have also received specimens from Walnut lake, Mich., and from Indiana, June-August. Dr M. L. Leonard has given me specimens from Gainesville, Fla., dated July 10th. The species commonly swarms just beneath spreading branches at dusk.

**Oecetis interjecta** Banks

Banks, 1914*b*, p. 262, pl. 8, figs. 2, 5 (*Oecetina*)

"Face yellow, vertex dark, palpi and antennae pale, latter with tips of joints narrowly black; thorax brown; abdomen pale brown, yellowish near tip; legs pale yellow. Wings gray, veins darker, a long dark cloud near the stigma; hind wings gray, with darker gray fringe. Fore wings with costal margin much curved near tip, fork 1 reaching to discal cell, veinlets of anastomosis much disjointed; hind wings with fork 1 very short, fork 3 twice as long, and fork 5 reaching nearly one-half way to base.

"Expanse 14 mm.

"From Go Home bay, Georgian bay, Ont., 23 Aug. (Walker)." Banks, *l. c.*

**Oecetis parvula** Banks

Banks, 1899, p. 215 (*Oecetina*); Banks, 1907*a*, p. 129 (*Oecetina*)

"Head and thorax brown, with gray hair; palpi gray; antennae pale, annulate with black; legs pale yellowish; abdomen greenish; wings with black hair and fringe, anastomosis brown, fore wings slender, acute at tip, discal cell projecting a little beyond thyridial cell, fifth apical not extending on thyridial cell, no distinct mark on base of discal cell, thyridial cell not much longer than discal cell. Expanse 11 mm.

"Washington, District of Columbia.

"Distinguished by its small size and short thyridial cell, smaller and more hairy than *Oe. incerta*." Banks, *l. c.*, p. 215.

The type of this species is a female. I think it is probably the same as *immobilis*.

**Oecetis persimilis** Banks

(Pl. 34, fig. 12, pl. 35, fig. 1)

Banks, 1907*a*, p. 129 (*Oecetina*)

"In appearance this species is very like unto *Oe. incerta* and *Oe. parvula*, and about intermediate in size, or as large as a small *Oe. incerta*. The wings are clothed with long gray hairs, and the anastomosis is dark brown. It belongs, however, to the other section of the genus; having in the hind wings the crossvein connecting fork 1 to fork 3; so it is more allied to *Oe. fumosa (resurgens)*. It differs, however, from that species in smaller size, lack of patches of black hair on the wings, and in that the crossvein closing the discal cell is as long as the next crossvein beyond it (plainly shorter in *Oe. fumosa*)."

"Specimens from High Island, Maryland, and from Glencarlyn, Va., in June." Banks, *l. c.*, p. 129.

The specimens at hand differ from the description only in that the clothing of the wings is wholly brown. As stated in the description, this species belongs to that section of the genus which has the

crossvein *r-m* meeting  $M_{1+2}$ ; it differs from the species of that section known to me (*avara* and *resurgens*) in having the apices of cells  $M_2$  and  $Cu_1$  of the hind wing at about the same level. The figure of the genitalia, taken from the only male specimen, is not satisfactory.

My specimens were taken at Old Forge, Nassau and Saranac Inn, N. Y., July.

The type is a female.

### *Oecetis resurgens* Walker

(Text figs. 23a, 38h, 40i-l; pl. 35, figs. 2-7)

Walker, 1852, p. 70 (*Leptocerus*); Hagen, 1861c, p. 282 (*Setodes cinerascens*); Hagen, 1861c, p. 282 (*Setodes*); McLachlan, 1863c, p. 159 (*Setodes*); Hagen, 1864b, p. 883 (*Setodes*); Banks, 1899, p. 216 (*Oecetina fumosa*); Ulmer, 1907c, p. 144, pl. 19, fig. 179 (*Oecetodes fumosa*); Banks, 1907a, p. 129 (*Oecetina fumosa*)

"Fuscous, with whitish hair; palpi and feet fulvous, a little covered with whitish hair; anterior wings fuscous, with white spots at the base, and at the disk and apex of the apical areoles; posterior wings cinereous. (From the description of Walker.)

"Length to tip of wings 16 millim. Alar expanse 30 millim.

"Hab. St. Martin's Falls, Albany River, Hudson's Bay (Barnston)." Hagen, *l. c.*, p. 282 (*resurgens*).

"Head and thorax brown, with gray hair; antennae pale, annulate with black; legs luteous, first pair darker; palpi brown, with gray hair; abdomen greenish; wings more densely clothed than other species with black hair, anastomosis black, and usually with three black spots, one at base of discal cell (always present), one at base of thyridial cell, and one in middle of hind margin of thyridial cell, the basal half of the radius is usually black, fringes gray; tip of hind wings slightly fumose. Fore wings not very acute at tip, the discal extends quite a little beyond the thyridial cell, but the latter is more than one-half longer than discal cell, the fifth apical extends quite a ways on the thyridial cell (much farther than in other species). Expanse 17 mm.

"Washington, District of Columbia, July, August." Banks, *l. c.*, p. 216.

I may add that in this species the apex of cell  $M_2$  of the hind wing is decidedly beyond that of either cell  $R_3$  or cell  $Cu_1$  (pl. 35, fig. 2). The figure of the genitalia (pl. 35, fig. 3) shows two appendages directly above the penis and its sheath. Of these the lower one appears to be membranous and is forked. The sixth and seventh dorsal segments of the male of this species has the peculiar fenestrated appearance already described.

This species was taken at Old Forge and Ogdensburg, N. Y., Lake Forest, Ill., and at Waubesa lake, Wis., July and August. Many of them were on the trunks of trees where they furnished an exceptionally good example of concealing coloration.

**Oecetis sagitta** Hagen

Hagen, 1861*c*, p. 284 (*Setodes*); Banks, 1907*c*, p. 46 (*Oecetina*)

"Luteous, with luteous hair; antennae whitish, a little annulated with fuscous; palpi with fuscous hair; head and thorax luteous; feet whitish-yellow; anterior wings luteous, subnude, ciliated with luteous, anastomosis and apical margin spotted with fuscous; posterior wings gray, the apex long, acute, narrow, ciliated with gray. Male.

"Length to tip of wings 11 millim. Alar expanse 21 millim.

"Hab. Florida (Osten Sacken)." Hagen, *l. c.*

In the hind wing of the type the crossvein *r-m* is before the apex of cell *M*<sub>2</sub>; the genitalia are like those of *incerta*. An example of the latter species is included among the types by Hagen.

**Oecetis sp.**

(Pl. 35, figs. 8-12)

Wings brownish, the veins slightly darker, except at the cord where decidedly darker. The venation peculiar in that *M* and *Cu*<sub>1</sub> of the fore wing are fused for a relatively great distance, bringing the apices of cell *M* and the discal cell at nearly the same level. In the hind wing the radial sector angled rather sharply at its point of division making cell *R*<sub>1</sub> very large, the sector branching far toward the apex of the wing. The genitalia decidedly different from those of the other species especially in having the claspers very broad. The position of crossvein *r-m* of the hind wing with respect to the apex of cell *M*<sub>2</sub> varying.

Specimens collected by Doctor Felt at Clayton, N. Y., also a female specimen from Walnut lake, Mich., and one from Old Forge, N. Y. The material is not sufficient for description.

There are four other North American species described.

**Oecetis apicalis** Banks

Banks, 1907*a*, p. 129 (*Oecetina*). Texas.

**Oecetis disjuncta** Banks

Banks, 1920*a*, p. 351, pl. 7, fig. 100, (*Oecetina*). San Gabriel Mountains, California.

**Oecetis inornata** Banks

Banks, 1907*a*, p. 128 (*Oecetina*). Arizona.

**Oecetis punctata** Navás

Navás, 1924*b*, p. 85, fig. 22 (*Oecetinella?*). Costa Rica.

**Setodes** Rambur

Rambur, 1842, p. 515; McLachlan, 1877, p. 338; McLachlan, 1884*a*, p. 39, 40; Ulmer, 1907*c*, p. 145; Ulmer, 1909*a*, p. 106  
Immature stages. Thevenet, 1871, p. 372 (*Mystacides*); McLachlan, 1877, p. 339; Struck, 1903, p. 70, pl. 3, fig. 13; Ulmer, 1903*b*, p. 210; Ulmer, 1903*d*, p. 102; Ulmer, 1909*a*, p. 251, 309; Lestage, 1921*a*, p. 650

Antennae one and one-half to two times as long as the fore wings, basal segment not longer than the head. Maxillary palpi with the length of the segments varying somewhat with the species. Spurs 0-2-2, the inner longer than the outer. Fore wings long and narrow, pointed at the apex, with dense pubescence and long fringe. Hind wings still narrower, particularly at base. The discal cell proportionately short and cell *M* long. In the hind wing the base of the radial sector sometimes obsolete.

McLachlan (*l. c.*, p. 39) divides the European species of the genus into two groups, one of which is characterized by having cell  $M_2$  of the fore wing pedicellate, and by the fact that the fold which in the hind wing runs along  $Cu_1$ , branches away from  $Cu_{1a}$  and appears like an anterior branch of the latter. Of the species known to me, *S. vernalis* Banks has cell  $M_2$  pedicellate. In this species, while the fold turns forward from  $Cu_{1a}$  it is hardly so strong as to be mistaken for a vein. In my specimens it does not run to the margin.

### *Setodes americana* Banks

Banks, 1899, p. 215; Sibley, 1926b, p. 105

"Palpi with black hair; antennae white beyond the basal joint, annulate with black; thorax dark, with white hairs; abdomen brownish; legs pale yellowish, anterior pair darker, fore wings with black hair and blackish veins, and a black fringe; in well-marked specimens some whitish dots on hind part of wing, a larger one at anal angle; hind wings gray, with long dark gray fringes; antennae very long and slender, two and one-half times as long as the wings; fore wings long and slender, acute at tip, no closed discal cell, first apical cell pedicellate, fourth apical cell acute at base, no fifth cell, hind wings rather narrow, and a little shorter than fore pair, acute at tip, three main veins, each forked, the upper branch of the first forked again near tip, first and second connected just before the first fork. Expanse 13 mm.

"Washington, D. C. July." Banks, *l. c.*

Reported from McLean, N. Y., July 25th-August 9th by Sibley.

### *Setodes autumnalis* Banks

Banks, 1907a, p. 128, pl. 9, fig. 23

"Pale yellowish throughout, clothed with pale yellowish hair, wings with golden hair; abdomen rather brighter yellow at tip. Wings very slender, both pairs acute at tips, fork 1 with pedicel as long as veinlet closing discal cell, fork 3 no longer than fork 1. In hind wings the radial sector is not distinct on basal portion. Last segment of abdomen of male is very large, upturned, and has a hairy appendage near tip, narrow at base, broad and rounded above.

"Expanse, 14 mm.

"High Island, Maryland (near Washington) 28 September.

"Readily known by pale yellow color." Banks, *l. c.*

I am inclined to think from Banks's figure that this may be the female of *S. vernalis* or of some allied species.

### *Setodes floridana* Banks

Banks, 1905c, p. 19

"Head yellowish, clothed with golden hair; palpi clothed with gray hair; antennae pale, narrowly annulate with brown; thorax pale, with golden hair; legs pale yellowish; abdomen yellowish. Wings gray, clothed with short golden hair and some black hair intermixed, the anastomosis and extreme tip darker, fringe black at tip, elsewhere gray; hind wings dusky hyaline, scarcely darker at tip, fringe very long, gray. Both pairs of wings very long, slender and acute. Expanse 13 mm.

"One specimen from Biscayne bay, Florida (Slosson)." Banks, *l. c.*

The type is a female. In the hind wing the apex of cell  $M_2$  is beyond the crossvein; the base of the radial sector is not obsolete.

### *Setodes grandis* Banks

(Text figs. 40m, 41f, pl. 36, figs. 1-6)

Banks, 1907a, p. 128, pl. 8, fig. 4; Vorhies, 1909, p. 699, pl. 59, figs. 10-12  
Immature stages. Vorhies, 1909, p. 699, pl. 53, fig. 5, pl. 59, figs. 13-18;  
Lloyd, 1921, p. 102-4, figs. 176-81

"Head and thorax dark brown, clothed with mostly white hair; palpi brown, with brown hair; basal joints of antennae 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.

"Three from New Haven, Conn., 23 June (Viereck); also from Falls Church, Va." Banks, *l. c.*

The following is Vorhies' description of the genitalia:

"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."

The immature stages are described by Vorhies and by Lloyd.

Adults of this species were collected at Waubesa Lake, Wis., and there are at hand several specimens taken at Ithaca and Ogdensburg, N. Y., Walnut lake, Mich., and one from Winona lake, Ind., in July. These differ from the original description in that the fore wings are dark brown with pubescence of much the same color with a sparse and rather uniform sprinkling of yellowish hair which is densest along the posterior margin. There is a pale spot on the tips of the anals and several white spots along the apical margin. The pedicel of cell  $R_2$  of the fore wing is not very short in my specimens; in this, Vorhies' figure agrees with mine.

### *Setodes vernalis* Banks

(Pl. 36, figs. 7-9)

Banks, 1907a, p. 127, pl. 8, fig. 3

Antennae whitish with narrow brown annulations, the basal segment yellow. Head yellow with some white hair. Palpi with yellow hair. Legs whitish. Fore wings light brown with mostly black and some golden hair. The wings dotted rather uniformly with white spots between the veins. The venation different from that of the other species mainly in that the crossvein  $r$  of the fore wing is before the middle of the discal cell. The claspers long and slender, curved inward, the tips crossing as seen from beneath (pl. 36, fig. 8). Length to tip of wings 6.5 mm.

I have two specimens from Tonawanda, N. Y., (Van Duzee), one from Old Forge and one from Ithaca, N. Y., July 29th-August 12th.

### *Setodes* sp. 1

(Pl. 36, fig. 10, pl. 37, fig. 1)

Antennal segments pale at the proximal ends, light brown distally. Head, thorax, palpi, and legs pale yellow with yellow hair. Fore wings with mostly yellow hair, some white spots toward the apex not shown in rubbed specimens. The wing membrane with purple and green reflections. Venation and genitalia as figured. Length to tip of wings 9 mm.

Three specimens from Ogdensburg, and one from Buffalo, N. Y., July.

### *Setodina* Banks

Banks, 1907a, p. 129

"A leptocerid near *Setodes*, but the last joint of the maxillary palpi is short, although a little curved; the spurs are 0-2-2; forks 1 and 3 are present in the fore wings, 1 and 5 in the hind wings; there is no crossvein in the hind wings; antennae much longer than the body, basal joint very large. Based on a tiny insect, no longer than a goodsized hydroptilid, which differs from all other Leptoceridae in the greatly reduced venation of the hind wings.

"Type: the following species." Banks, *l. c.*

**Setodina parva** Banks

Banks, 1907*a*, p. 130, pl. 9, figs. 24, 26

"A uniform dull pale gray; legs and antennae more yellowish; wings clothed with gray hairs. Fore wings quite slender; the radius and subcosta close together; the discal cell longer than the second apical cell; the crossveins are very faint, but can be seen against a strong light; hind wings with a long fringe behind, no crossveins present; in the basal part of third apical cell of the fore wings there is a small dark dot.

"Expanse, 5.5 mm.

"Three specimens from Kissimmee, Fla., in November." Banks, *l. c.*

**Mystacides** Latreille

Latreille, 1825, p. 439; McLachlan, 1877, p. 313; Ulmer, 1907*c*, p. 139; Ulmer, 1909*a*, p. 94

Immature stages. Ulmer, 1903*d*, p. 103; Silfvenius, 1905*b*, p. 68; Thienemann, 1905*b*, p. 47; Silfvenius, 1906*b*, p. 42, 43; Ulmer, 1909*a*, p. 206, 249, 311; Lestage, 1921*a*, p. 617

Antennae twice as long as the fore wings in the male, somewhat shorter in the female. Head shining, almost nude, eyes of the male very large, those of the female smaller. Maxillary palpi with very long, somewhat thickened hairs; the basal segment shortest, the third longest, the second and the fifth about equal (pl. 37, fig. 10). Spurs 0-2-2. The apices of the fore wings inflexed and a notch on the anterior margin at the point of bending. Venation alike in the sexes. Discal cell closed, crossvein *r* present; media 2-branched. Hind wing with costal hooks well developed. Crossvein *r-m* (or the part of *R*<sub>5</sub> in the ordinary position of *r-m*) the only crossvein present; cell *R*<sub>2</sub> small. Genitalia complicated, sometimes asymmetrical; the claspers sometimes with a second segment though this may be hard to distinguish; the ninth abdominal segment continued ventrally into a median process which may be divided into divergent forks.

Larvae slender, moderately narrowed posteriorly. Head, pro- and mesothorax narrower than the metathorax and the first eight segments of the abdomen. Antennae 2-segmented, as long as the mandibles. Mouth parts fairly prominent. Labrum broadly elliptical, with the anterior margin rather deeply emarginate; the lateral group of bristles present. Pronotum and mesonotum chitinous, little broader than the head. Legs long and slender; hind tibiae divided into two segments. Claws long but not stout; no spurs at ends of tibiae, next to the base of the fore legs on each side a row of bristles. Dorsal tubercle of the first abdominal segment stout, conical, the ventral ones not prominent, chitinized at the apex and set with many fine points; such points are also to be seen along the sides of the body in place of the lateral line. Tracheal gills, often hardly visible, found only at the anterior margins of the segments, always single. Prolegs with stout claws which bear two hooks each; the anal furrow bordered with very fine points.

Pupa with very small labrum which is narrower at base than

anteriorly; the margin scalloped, on each side a stout bristle. Mandibles stout. Middle tarsi with heavy fringes. Tracheal gills, when present, single and stout. Chitinous plates with hooks on the anterior margins of segments 3 to 6. Anal processes long and slender, more or less suddenly narrowed at about two-thirds of their length, forming an angle on the median edge.

The cases straight, conical, formed of sand or bits of débris, sometimes with longer pieces of plant material alongside.

There are five species reported from North America. The common species is *M. sepulchralis*, recently redescribed by Ulmer. The European *M. longicornis* has once (1899) been listed by Banks under one of its synonyms (*4-fasciata*) but does not appear in any of the later lists, although the species does occur. On the contrary, I doubt the occurrence of the European *M. nigra* which has always been listed among American forms. It does not occur in my collections which are of fairly wide distribution.

### *Mystacides canadensis* Banks

Banks, 1924, p. 448, pl. 4, fig. 47

"Black; antennae pale, the basal joint and tips of others dark; legs pale; wings blackish, darker in stigmal and costal area, venation very similar to that of *M. sepulchralis*. The male differs strongly in genital parts; the inferior process is not furcate, but simply three very minute lobes at tip, the intermediate processes are very broad at base and taper outwardly to a sharp, hardly upcurved point; the lateral process has no lower tooth. Among European species it is nearest to *longicornis* but the tip of the intermediate appendages is not so slender as in that species.

"Expanse 15 mm." Banks, *l. c.*

The specimens on which the description is based were collected in the province of Quebec in July.

### *Mystacides longicornis* L.

(Pl. 37, figs. 3-5)

Linnaeus, 1746, p. 225 (*Phryganea*); McLachlan, 1877, p. 316, pl. 34, figs. 1-3 (early references cited); Banks, 1899, p. 214 (*quadrifasciata*); Ulmer, 1909a, p. 96; Martynov, 1910b, p. 375

Immature stages. Klapálek, 1888, p. 42, fig. 15 (early references cited); Struck, 1900, fig. 41; Struck, 1903, p. 69, pl. 3, fig. 7; Ulmer, 1903d, p. 105, fig. L; Thienemann, 1904a, p. 261, fig. 18; Silfvénus, 1905b, p. 71, pl. 2, fig. 18; Thienemann, 1905b, p. 47, pl. 3, figs. 75, 78; Silfvénus, 1906b, p. 43; Ulmer, 1909a, p. 207, 249, 311

"Black. Antennae whitish (basal joint brown), in the basal portion each joint is annulated with brown in its upper third; the apical portion unicolorous, with darker sutures. Hairs of head and thorax golden-yellow; those of the palpi fuscous. Eyes blackish-brown. Legs pale yellowish, with black coxae; tibiae and tarsi with minute black spines. Abdomen brownish, with pale lateral lines. Anterior wings with the membrane grayish, densely clothed with golden-yellow pubescence, with three (often ill-defined) broad fuscous fasciae, and the

apical margin bordered by the same color, which is caused by blackish pubescence, and is not visible in the denuded wing (the third fascia covers the anastomosis); neuriation blackish; fringes fuscous. Posterior-wings smoky-gray, with darker neuriation and whitish fringes.

"(There are two extremes of variation in the coloration of the anterior wings. They may be wholly clothed with golden-yellow pubescence, without a trace of the dark fasciae; or these fasciae may be strongly marked and confluent, so that the pale portion is greatly reduced).

"In the male the 9th dorsal segment and appendages are as is usual in the genus. Upper penis-cover very broad at the base, with deflexed sides, yellowish, the apical portion forming two attenuate blades, deeply divided, straight if viewed laterally. Penis curved strongly downward, reddish-testaceous, concave above (possibly it is so in all the species). Inferior appendages in the form of an upturned, broad, brown, band-like obtuse piece, clothed with long pale hairs. The 9th ventral segment much as in *M. nigra*, but broader, the process nearly similar in form.

"In the female the 9th dorsal segment has the median lobe apparently not so deeply divided as in the other species; the superior appendages as is usual. The lateral valves somewhat intermediate between those of *M. nigra* and *azurea*. A triangular acute process between the bases of the valves ventrally.

"Length of body  $5\frac{1}{2}$ - $7\frac{1}{2}$  mm. Expanse, 16-20 mm." McLachlan, *l. c.*

Adults of this species were collected at Ogdensburg, N. Y., during August and at Diamond Lake, Ill., on May 30th. Very few of the specimens show the three fuscous fasciae of McLachlan's description. My figures of the genitalia differ a little from those of McLachlan but I think this may be due to difference in the method of preparation of the specimens. I have examined specimens from Europe kindly sent me by Doctor Ulmer.

### *Mystacides nigra* L.

(Pl. 37, fig. 6)

Linnaeus, 1746, p. 225 (*Phryganea*); Walker, 1852, p. 58 (*Leptocerus*); Hagen, 1861c, p. 277 (*Leptocerus*); McLachlan, 1877, p. 314; Provancher, 1877, p. 264 (*Leptocerus*); Provancher, 1878b, p. 139 (*Leptocerus*); Banks, 1900b, p. 472 (listed from Alaska); Banks, 1907c, p. 46; Ulmer, 1909a, p. 95. Immature stages. Klapálek, 1893, p. 95; Struck, 1903, p. 69, pl. 3, fig. 8; Ulmer, 1903d, p. 105; Thienemann, 1904a, p. 261, fig. 17; Ulmer, 1909a, p. 249, 311

"Black. Antennae blackish or brownish, with concolorous basal joint; in the basal portion the lower third (nearly the lower half, near the base) of each joint is white (occasionally the white annulation is wanting). Hairs of the head and thorax black; those of the palpi blackish-brown. Eyes liver-colored. Legs brownish; coxae

black; apices of femora and the tarsi somewhat testaceous. Abdomen fuscous, with gray lateral lines. Anterior-wings black, with a purplish metallic lustre, and an indistinct broad, median, darker transverse band; pubescence and fringes black; neuration deep black. Posterior wings slightly paler and more transparent, not metallic; pubescence blackish; fringes paler; neuration black."

"In the male the 9th dorsal segment (nearly invisible in dry examples) forms a small triangle produced into a forked lobe. Superior appendages long sub-cylindrical, slender, finger-shaped, nearly straight, blackish, and fringed with black hairs. Upper penis cover somewhat testaceous, very broad at the base with the sides deflexed, its apical portion forming two acute, nearly spiniform valves, which are very long, and slightly curved downward if viewed from the side. Penis short, blackish, obtuse, turned strongly downward. Inferior appendages very broad at the base, blackish, fringed with hairs; the lower edge produced into a claw-shaped, acute, up-curved, more or less testaceous spine, the upper edge forming a broad rounded lobe, with a deep excision on the margin between it and the spine. The 9th ventral segment rather narrow, excised on the margin on each side of the median process, which is broad, slightly dilated at the apex, and with the apical margin excised.

"The 9th dorsal segment of the female is narrow, with two median tubercles. There is a pair of superior appendages as in the male, but one-half shorter. Lateral valves yellowish, the dilated apical portion strongly produced inferiorly. The ventral plate (9th segment) blackish, excised at the apex, and in the excision is placed a swollen yellowish lobiform piece, between the bases of the lateral valves.

"Length of body, 6-6½ mm. Expanse, 17-20 mm.

"Probably distributed all over Europe, and common in summer. Siberia." McLachlan, *l. c.*, p. 315.

The fact that I have not found this species in any of my collections in the eastern states has led me to doubt its occurrence. It has, however, been listed often (not all the lists are given above in the synonymy) and McLachlan (*l. c.*, p. 314) speaks of three American species—"M. *sepulchralis* (Walk.) is very closely allied to *azurea*, but I think distinct; another species is allied to *nigra*; and *longicornis* has also its representative." Of the three here referred to by McLachlan, I have *sepulchralis* and *longicornis*; the one allied to *nigra* I have not seen. Of the latter species (*nigra*) I add a figure from European material (pl. 37, fig. 6).

### *Mystacides sepulchralis* Walker

(Pl. 37, figs. 7-10, pl. 38, figs. 1-13)

Walker, 1852, p. 70 (*Leptocerus*); Hagen, 1861c, p. 277 (*Leptocerus*); McLachlan, 1863c, p. 159 (*Leptocerus*); McLachlan, 1877, p. 314; Ulmer, 1906b, p. 39, figs. 47-49; Ulmer, 1907c, pl. 18, fig. 162b, c; Sibley, 1926b, p. 105; Martynov, 1910b, p. 376

Immature stages. Lloyd, 1921, p. 98, 100, figs. 168-70

Length to tip of wings 7½-9 mm. Antennae with the basal segments pale proximally, dark distally. Head and thorax black,

shining. Palpi black. Legs pale with a varying amount of dark pubescence, darkest toward the distal end of the femora; the tarsi commonly annulated. Fore wings dark brown to black, with bluish reflections. The tenth segment keellike in all the species, here divided into three parts posteriorly; of these parts the shortest on the left side, the two long ones constitute the right side and the shorter of these two is above the other. The penis long and slender, not so sharply decurved as in *longicornis*. The claspers heavy, 2-jointed. The process of the ninth segment long, 2-forked (pl. 37, fig. 7).

McLachlan, while at one time (*l. c.*, p. 314) identifying this species with the European *ater* (= *nigra*) later concluded that it was closely related to *azurea* although distinct from it. Ulmer has critically compared these two species, regarding them as distinct, and has given figures. I am not able to agree entirely with Ulmer's description of the genitalia of the North American species. He describes the left clasper as having a process not present on the right side. The claspers seem to me to be wholly alike (though 2-segmented). The process referred to is possibly the one which I regard as part of the tenth segment. I add a figure (pl. 37, fig. 2) of *M. azurea* from material sent me by Doctor Ulmer.

My specimens of *M. sepulchralis* were taken at many points in New York State, and at Lake Forest, Ill., June–October. Professor T. L. Hankinson sent me some from Charleston, Ill., and I have also received specimens from Gage Lake, Ind. These latter are small, measuring but  $6\frac{1}{2}$  mm to the tips of the wings.

One western species is described.

#### *Mystacides alafimbriata* Hill–Griffin

Hill–Griffin, 1912, p. 19, pl. IV, figs. 1–16 (adult and immature stages). Oregon.

#### *Trienodes* McLachlan

McLachlan, 1865*b*, p. 110; McLachlan, 1877, p. 319; Ulmer, 1907*c*, p. 140; Vorhies, 1909, p. 702; Ulmer, 1909*a*, p. 96  
Immature stages. Zaddach, 1854, p. 1–129, pls. 1–5 (*Mystacides*); McLachlan, 1877, p. 320; Ulmer, 1903*b*, p. 220; Ulmer, 1903*d*, p. 106; Silfvenius, 1905*b*, p. 68–74; Thienemann, 1905*b*, p. 47; Silfvenius, 1906*b*, p. 37; Siltala, 1907*c*, p. 472; Ulmer, 1909*a*, p. 207, 249, 310; Lloyd, 1921, p. 100–2; Lestage, 1921*a*, p. 623

Antennae more than twice as long as the wings, those of the female a little shorter than those of the male. The basal segment of the male antennae covered by a flap as described by Vorhies (quoted below). Maxillary palpi very long, hairy; first segment as long as the second, third much longer, fourth shorter than the second, the fifth but little longer or as long as the fourth. Spurs 1–2–2. Fore wings but little broadened toward the apex, very hairy, so that the venation is obscured, fringes long and heavy. The discal cell very large, crossvein *r* absent. The main stem of *media* absent either

through atrophy *in situ* or through fusion with the radial sector or more likely with  $Cu_1$ . The hind wing not very much broader than the fore wing. The stem of media here also tending to disappear. Accessory to  $Cu_1$  lacking. The genitalia rather complicated; ninth segment produced dorsally into a median piece which may be bifid, tenth segment small and membranous, penis very large, generally curved strongly and with a central membranous part at tip. The claspers with an inner segment beset with very heavy spines; a pair of extremely long curved rods at the anterior end as shown in plate 39, figure 16.

The larvae much like those of *Mystacides*. The hind legs fitted for swimming.

Pupae slender, cylindrical. Labrum semicircular with an anterior median projection. The maxilla narrowing from a broad base so that rather a sharp angle is formed where the cutting edge begins. Middle legs with swimming hairs. Anal processes consisting of long rods set with numerous bristles on the inner margins.

Egg mass peculiar in form, the string coiled like a watch spring. Cases of the larvae also characteristic, formed like those of the family Phryganeidae, i. e. of small pieces of vegetable material arranged in spiral fashion. Cases straight and much longer than the larvae.

The North American species of this genus are mostly alike in color and are subject to considerable variation. Thus the black spots on the wings seem to be variable in most of the species. Some of the species may be recognized by their color, all are well enough differentiated by the male genitalia. The venation differs slightly in respect to the position of parts of the "cord."

The following key will serve to separate the species known to me:

#### KEY TO THE SPECIES OF TRIAENODES

- 1a Apex of cell  $M_2$  of the hind wing not much beyond that of cell  $R_3$  (not farther than shown in pl. 39, fig. 7). Tip of the fore wing not strikingly dark and iridescent.....2  
 1b Apex of cell  $M_2$  of the hind wing considerably beyond that of cell  $R_3$ . Tip of the fore wing dark and iridescent.....*dentata*  
 2a Claspers pointed when seen from the side; outer point extending beyond the inner spinose part.....3  
 2b Claspers blunt, the outer branch the shorter.....sp.  
 3a Ninth dorsal segment of the male extended into a median unpaired piece..4  
 3b Ninth segment forked dorsally.....*injusta*  
 4a Tips of the claspers sharply inturned as seen from below.....*marginata*  
 4b Tips of the claspers not sharply inturned.....5  
 5a Median dorsal process reaching nearly as far posteriorly as the tip of the claspers. Length not less than 12 mm.....*ignita*  
 5b Median dorsal process not reaching nearly as far as the tip of the claspers. Length less than 12 mm.....*vorhiesi*

#### *Triaenodes dentata* Banks

Banks, 1914b, p. 261, pl. 15, fig. 45

"Yellowish gray, head and basal joint of antennae densely clothed with long yellowish hair, antennae pale, joints narrowly dark

at tips, legs pale. Wings gray, with much gray and yellowish hair, near outer margin there is much black hair, the outer fringe mostly black, deep black at outer angle, posterior fringe gray, a black spot at the arculus, and another about half way from it to base; hind wings yellowish gray, with gray fringe, venation in both pairs pale; costa of fore wings (in male) densely hairy. Venation as in *T. ignita*, but the fork 1 is still shorter.

"Expanse 18 mm.

"From Johnstown, N. Y., June (Alexander), and Hampton, N. H., July (Shaw)." Banks, *l. c.*

My own notes follow:

Antennae yellow, narrowly fringed with brown. Head, basal segments of the antennae, palpi, and legs yellow, covered with yellow hair. The fore wings brown, covered with dense yellow and brown hair; the anterior margin, particularly at base, brown, the region of the discal cell also sparsely clothed with yellow hair; a dark patch in the middle of the posterior margin, and the entire tip of the wing membrane beautifully iridescent. The fringe of the wing long and also iridescent.

I have but one female specimen of this species. The venation differs from that of the other species only in having cell  $M_2$  of the hind wing rather short in comparison with cell  $R_3$ . Ogdensburg, N. Y., July 26th.

### *Triaenodes ignita* Walker

(Pl. 39, figs. 1-3)

Walker, 1852, p. 72 (*Leptocerus*); Hagen, 1861c, p. 281 (*Setodes*); Banks, 1900a, p. 258; Betten, 1901, p. 573, pl. 34, fig. 2; Ulmer, 1907b, p. 47, figs. 72-75

"Pale testaceous, with testaceous hair; antennae snow-white, the basal article testaceous; palpi with testaceous hair; head, thorax, abdomen, and feet, pale; anterior wings testaceous-yellow, with yellow hair and cilia, a point upon the middle of the posterior margin, and another anal one, black, with black almost elevated pile; posterior wings pale. Male.

"Length to tip of wings 10 millim. Alar expense 10 millim.

"Hab. Georgia (Abbott); Washington (Osten Sacken); Mexico (Deppe)." Hagen *l. c.*

Ulmer has added figures and descriptions of the male genitalia. My identification of the species rests upon seeing Hagen's specimens so determined and upon Ulmer's figures. My specimens are larger than the original description indicates, measuring 13 mm to the wing tips. The pubescence of the fore wings has a slightly reddish tinge, along the inner margin it is yellow. The median dorsal process of the male is very long, reaching nearly as far posteriorly as the penis and the claspers. The latter are very short, the outer pointed branch extending but little beyond the inner spinose part. Color much as in *vorhiesi*.

My specimens were taken at Buffalo and at Ogdensburg, N. Y., in the middle of August.

### ***Triaenodes injusta* Hagen**

(Text fig. 5*p*; pl. 39, figs. 4-6)

Hagen, 1861*c*, p. 283 (*Setodes*); Banks, 1900*a*, p. 257 (*flavescens*); Banks, 1907*c*, p. 45; Sibley, 1926*b*, p. 105 (listed)

"Luteous, with luteous hair; antennae luteous, subannulated with fuscous; palpi with luteo-fuscous pile; feet and abdomen pale luteous; anterior wings luteous, with ochreous pile and cilia, the anterior margin at base a little obscurer; the anal angle a little fuscous, and ciliated with fuscous hair; posterior wings luteous, with pale cilia. Male.

"Length to tip of wings 12 millim. Alar expanse 23 millim.

"Hab. St. Lawrence River, Canada (Osten Sacken); Chicago (*id.*)." Hagen, *l. c.*

The species was found at Saranac Inn and at Ogdensburg, N. Y. Sibley reports it from McLean, N. Y., July 8th and August 7th. The color varies as it does in the other species. Commonly the posterior margin of the fore wing has a lighter area near the middle and there is another light area along the anterior margin nearer the base. The ninth segment is produced into a forked appendage. The claspers are very short. At the base of the slender processes of the tenth segment there is a pair of small lappets, always hard to make out and sometimes apparently absent (pl. 39, fig. 5). I have seen Hagen's and Banks' types.

### ***Triaenodes marginata* Sibley**

(Pl. 39, figs. 15, 16)

Sibley, 1926*a*, p. 80

Immature stages. Sibley, 1926*b*, p. 105, 209, pl. 9, fig. 54 pl. 11, figs. 72-81

"Length of body—male, 6.66 mm; female, 7.6 mm.

"Length to tip of wings—male, 9 mm; female, 9 mm.

"Length of palpi—male, 4 mm; female, 4.66 mm.

"Length of antennae—25 mm.

"Head yellow with white hair; a light brown wart bearing brown hairs at the inner margin of each eye. Basal segment of antennae yellow, other segments white; basal half of antennae narrowly annulate with black at base of each segment. Fore wings long and rather narrow; color reddish brown with golden hairs except for three large yellow spots covered with yellow hairs and located as follows; one on the central third of the costal margin, extending on the wing nearly to media; a band along the hind margin extending from the base of the wing to near the middle; a shorter band on the hind margin at about the level of the anastomosis. Posterior half of anastomosis white. The two spots on the hind margin of

each wing come together when the wings are folded, giving the appearance of a dorsal stripe of yellow interrupted by brown. A short fringe of yellow hairs on the outer and hind margins. Hind wings white with yellow hairs. Palpi long, densely clothed with rather short brown hair; last segment longer than any other, flexible.

"Thorax yellow with white hair. Legs pale yellow, clothed with dense white pubescence.

"Abdomen yellow to yellowish green in dried specimens. In alcoholic specimens white, sometimes with a black spot on the sides of abdominal segments 4 and 5. The female genitalia are of the type common to the genus. McLean, New York, July 6—August 27." Sibley, *l. c.*, p. 80.

This is the species to which reference is made under *vorhiesi*. I was doubtful of its being distinct, but Sibley, who had my manuscript and figures for comparison, was apparently convinced that two species are involved.

### ***Triaenodes vorhiesi* n. nom.**

(Pl. 39, figs. 7-11)

Vorhies, 1909, p. 702, pl. 53, fig. 4, pl. 60, fig. 1 (*flavescens*)

Immature stages. Vorhies, 1909, p. 703, pl. 60, figs. 2-6

Vorhies has described all stages of this species. His description of the adult follows, slightly modified to omit reference to a figure:

"Imago. Length of body, 7-8 mm. Expanse, male, 21-22 mm; female, 18-20 mm. Antennae very pale luteous with narrow brown annulations, less distinct distally. On the inner dorsal side of the basal joint of the antennae 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 covered with light luteous hairs directed forwards; 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 spinelike piece lies alongside the penis like a sheath on either side, but if this is thrown out of position it may be 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 is set 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." Vorhies, *l. c.*, Madison, Wis., June.

Adults of this species were taken at Waubesa lake, Wis., in July, and a large number also at Ogdensburg, N. Y., in the middle of August.

I have a single specimen of what is probably a nearly related species in which the claspers are incurved at the apex (pl. 39, figs. 15, 16). (See *T. marginata* Sibley).

Vorhies' material was identified as *T. flavescens* Banks (which is itself a synonym of *injusta* Hag.), but it is clearly distinct.

### **Triadenodes sp.**

(Pl. 39, figs. 12-14)

Antennae with the brown bands not as clearly shown as in other species. Pubescence of the wings somewhat reddish brown. The ninth dorsal segment of the male is not extended. The claspers are very short, the inner part extending beyond the outer (reverse in other species). Length to tip of wings 9 mm. Lake Forest, Ill., June.

Western and southern species are:

#### *Triadenodes borealis* Banks

Banks, 1900a, p. 257. Minnesota.

#### *Triadenodes delicata* Navás

Navás, 1924b, p. 84. Costa Rica.

#### *Triadenodes frontalis* Banks

Banks, 1907a, p. 127, pl. 9, fig. 11. Colorado.

#### *Triadenodes grisea* Banks

Banks, 1899, p. 214. Colorado.

## **PHRYGANEIDAE** Burmeister

Burmeister, 1839, p. 922; Hagen, 1873a, p. 377-441; McLachlan, 1874, p. 13; Klapálek, 1904a, p. 26; Ulmer, 1907c, p. 21; Ulmer, 1909a, p. 68; Martynov, 1924b, p. 209-24.

Immature stages. McLachlan, 1865b, p. 11; McLachlan, 1874, p. 14; Klapálek, 1893, p. 5; Silfvenius, 1902a, p. 16; Struck, 1903, p. 4; Ulmer, 1903d, p. 34; Silfvenius, 1903a, p. 4; Silfvenius, 1904c, p. 3; Thienemann, 1905b, p. 30; Silfvenius, 1906b, p. 27; Siltala, 1907c, p. 427; Ulmer, 1909a, p. 205, 236, 301; Lestage, 1921a, p. 546; Lloyd, 1921, p. 16

Antennae as long as the fore wings or shorter, stout, the basal segment thicker than the others but not much longer. Ocelli present. Maxillary palpi of the male four-segmented, of the female five-segmented, similar in structure in the sexes, the basal segment short. Labial palpi small, the terminal segment ovoid. Legs stout, short,

spurs 2-4-4 except in *Agrypnetes* (1-2-2). Shape of the wings and their pubescence varying a great deal with the genus. Venation subject to considerable individual variation. In the fore wings *Sc* simple or branched (subject to variation within the species); the radial sector closed and the apex of cell *R*<sub>2</sub> before the end of the discal cell; *media* three-branched in the males, four-branched in most of the females. In contrast to the *Limnephilidae* and more or less to other families, the anal veins of the *Phryganeidae* not at all parallel to the posterior margin of the wing; the first anal vein parallel to *Cu*<sub>2</sub>, the other anals bending forward to meet it (text fig. 56*a*); the union of 1st *A* with the fused tips of the other two also farther toward the wing margin than in other groups. In almost all species a crossvein between *Sc* and *R*<sub>1</sub> near the base of the wing; since these two veins are nearly or quite united at base, a little closed cell formed.

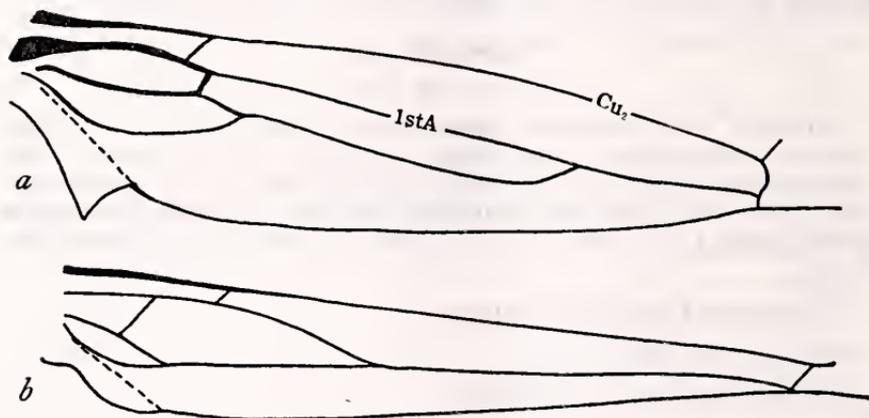


Fig. 56 Anal area of the fore wing. *a* *Phryganeidae*. *b* *Limnephilidae*

Appearance of this crossvein not constant and not noted in published figures prior to those of Ulmer (1907). In the hind wing, *media* ordinarily two-branched in the males and three-branched in the females. Ordinarily cell *M*<sub>1</sub> retained by the females but in *Neuronia concatenata* cell *M*<sub>3</sub> apparently present, although varying in size (pl. 41, fig. 2); by exception, *media* two-branched in the females, this regularly so in *Phryganea minor* (European). In many species of this family crossvein *m-cu* apparently with an anterior spur (pl. 41, fig. 1). A crossvein between *Sc* and *R*<sub>1</sub> near the base in at least one species—*Neuronia pardalis*.

Larvae suberuciform, that is, the head somewhat bent downward. The constrictions between the abdominal segments deep, the body widest at the first and second segments, tapering decidedly to the rear. Head rather long, flat, on the dorsal surface black lines along the margins of the frons and along the lateral margins of the head. Antennae short with a sense bristle, or knob, at the end, this more prominent in the youngest larvae. Labrum broad and short, the rear margin almost straight, with well-developed hooks, the anterior edge notched; several pairs of bristles along the anterior

margin and some spurs directed toward the median line. Mandibles of medium length, strong; the two cutting edges both strongly toothed, the upper one usually having three, the lower, two, teeth; the right mandible always with one or two less teeth than the left; the inner face of the mandible concave; no bunch of inner bristles ordinarily present. Of the thorax only the first segment chitinized. First and second pair of legs about equal in length, the first a little longer and stouter. Distal spurs of the fore tibiae on a prominence. Claws long; those of the fore and middle legs longer than the corresponding tarsi. Between the first pair of legs a "horn" as in the Limnephilidae. Tubercles of the first abdominal segment very prominent. Lateral line well developed. Tracheal gills single, long, and stout, the posterior ones of the lateral rows covered with fine hairs. Anal prolegs large, two-segmented, with large claws which have dorsal hooks.

Pupae with body cylindrical, the rear segments somewhat narrowed. Labrum fully as long as wide, the anterior margin rounded; in the posterior region generally three pairs of bristles, one pair of which are long; in each of the anterior lateral angles a group of five or six bristles. Mandibles long and stout, often decidedly angled. Swimming fringes very heavy on the middle legs, much lighter on the others. Pupal claws present. The notum of the first abdominal segment produced backward with a chitinous, sometimes finely serrate margin (text fig. 46*b*). Plates on hooks on the anterior margins of segments 3 (or 4) to 7, and on the posterior margin of segment 5. Lateral line on segment 3 (with often some hairs on segment 2) and under segment 8 in an interrupted circle. Tracheal gills as in the larvae. The anal processes blunt, almost square as seen from above; viewed from the side thickened at base.

Although there are, in general, no special adaptations for swimming, the adult females of this family ordinarily go beneath the surface of the water for oviposition and this process has often been observed by different students of the order. The eggs are passed from the abdomen in a round gelatinous cord which is then fastened to some support, in the form of a complete circle. In some species the eggs are laid in rounded masses, regularly so in the genus *Neuronia*.

The cases are formed of vegetable material often arranged in a distinct spiral. In North American species of *Phryganea* the case is spiral, in *Neuronia* it is not. Both ends of the case are open. In the pupal case the closing membranes are coarse sieves. Besides the membrane there is commonly a meshwork of plant material placed in the case and this may aid in taking dirt from the incoming water. Thienemann says that the cleaning of the membranes by the bristles at the ends of the body has not been actually observed but these structures are present and may be functional at least in some species.

The larvae occur only in quiet or slow-flowing water.

The family was monographed by Hagen in 1873 and but few species have since been added to the American fauna.

There is a dearth of characters by which the three North American genera can be readily separated. Banks (Trans. Amer. Ent. Soc. 19, p. 339) used the relative lengths of the discal cell and its pedicel but this character is not to be trusted. In *Neuronia semifasciata*, for example, the discal cell is quite as long as its pedicel, at least not "plainly shorter than its pedicel" as Banks' key presupposes. The following key, after Ulmer, will probably serve, although *Phryganea improba* would likely be placed in *Neuronia* by its use, and very possibly this is where it should be.

Since the preceding paragraphs were written, Martynov has published a revision of this family (1924*b*), redistributing the species into thirteen genera. I fully agree that the family is in need of reclassification and doubtless Martynov's new genera should be accepted. But the characters assigned do not always seem clearly distinctive, and in the absence of representative material it seems best to retain the older genera in this report. Some doubt is raised by a classification that would bring *Phryganea vestita*, *Phryganea improba*, and *Agrypnia curvata* into the same genus. The bibliographic citations for the species that follow will indicate Martynov's classification.

#### KEY TO GENERA OF PHRYGANEIDAE

- 1*a* Fore wings very hairy.....*Phryganea*  
 1*b* Fore wings nude or with very scant pubescence.....2  
 2*a* Fore wings short and broad; *Sc* of the fore wing often with an accessory to the wing margin (pl. 41, fig. 2). p. 295.....*Neuronia*  
 2*b* Fore wings long and narrow; no accessory from *Sc* to the costal margin. p. 303.....*Agrypnia*

#### *Phryganea* L.

Linnaeus, 1740, p. 68; Hagen, 1873*a*, p. 406, 420; McLachlan, 1874, p. 21; Ulmer, 1907*c*, p. 24; Ulmer, 1909*a*, p. 72  
 Immature stages. Lloyd, 1921, p. 28; Lestage, 1921*a*, p. 580; Gätjen, 1926

The bibliography given for the larvae and pupae of the family (p. 287) will serve to refer to descriptions of European species.

Antennae stout, not shorter than half the fore wing nor longer than two-thirds of the same. Spurs 2-4-4, rarely 0-2-2. Fore wings very hairy. Hind wings with but little pubescence. In the fore wings  $R_1$  arched at about the level of the end of the discal cell; media three-branched in the males, three- or four-branched in the females; in some species (*P. sayi* for example)  $M_4$  when present runs into  $Cu_1$  at tip (pl. 40, fig. 4). In the hind wing media commonly three-branched in the females, two-branched in the males. What appears to be crossvein *m-cu* often angled or curved and with a spur on its basal side.

Larvae as described for the family. The frons margined with black and in all but one known species with a median, black, longitudinal line. The case a spiral.

Pupae as described for the family. The chitinized rear margin of the first abdominal segment sometimes slightly emarginate.

The four eastern species known to me may be separated by the following key. There are, in addition, venational characters (as, for example, the shape of the discal cell of the hind wing) but I find these not wholly constant. The shape of the fore wing is distinctive as may be seen in text figure 57, where the wings are drawn about equal in length although *sayi* is generally much longer than the others.



Fig. 57 Outlines of fore wings of species of *Phryganea*. *a cinerea* Walker. *b deflata* Milne. *c sayi* Milne. *d vestita* Walker

KEY TO SPECIES OF PHRYGANEA

- 1a Spines on the legs black. Discal cell of the fore wing much longer than its pedicel. Anterior margin of the fore wing somewhat convex throughout its length. Crossvein *m-cu* of the hind wing generally not angled (pl. 40, fig. 4).....2
- 1b Spines on the legs yellow. Discal cell of the fore wing nearly as long as its pedicel. Anterior margin of the fore wings nearly straight. Crossvein *m-cu* of the hind wing angled and generally with a spur directed basally .....3
- 2a A prominent interrupted black line through the fore wing. Fore wings long and narrow (text fig. 57c). p. 293.....*sayi*
- 2b No prominent black line through the wing. Fore wings broader in proportion to length (text fig. 57a).....*cinerea*
- 3a Wings distinctly reticulate. p. 292.....*improba*
- 3b Not distinctly reticulate. p. 294.....*vestita*

*Phryganea cinerea* Walker

(Text figs. 1a, b; 57a; pl. 40; figs. 1, 2)

Walker, 1852, p. 4; Walker, 1860, p. 176 (*divulsa*); Hagen, 1861c, p. 252; McLachlan, 1863c, p. 156; McLachlan, 1866b, p. 275; Hagen, 1873a, p. 410; Hagen, 1873c, p. 385; Provancher, 1878b, p. 127; Martynov, 1924b, p. 213 (*Neophryganea*)

Immature stages. Hagen, 1873a, p. 439; Lloyd, 1921, p. 30-32, figs. 21, 22, 23

Head yellow with a black patch on either side of the median dorsal line, clothed with white hair. Antennae orange below, dark

above. Prothorax with long black and gray hairs, mesothorax mostly black. Legs and spurs mostly orange, the spines black, the hind legs somewhat lighter than the others; the distal ends of fore and middle tibiae decidedly darker. Fore wings brown and white, the latter in mostly round dots. Along the apical margin a series of triangular brown spots surrounding the ends of the veins. The wing darkest in the middle of the basal half, lightest from there back to the inner margin. The pubescence mostly gray; the stem of  $Cu_1$  and of  $3d A$  margined with black hairs; often a line of black hairs in cell  $R_3$  and one in  $M_2$ ; when these well marked the coloration similar to that of *P. sayi*. The hind wings pale with the tips darker. The tenth segment (male) as seen from above deeply divided, the incision being rectangular at base; arising from the basal part of the segment on each side, a dorsal lobe extending beyond the median part of the segment and covered with long spinelike hairs; also an internal lobe running from the lower distal corner and directed obliquely backward, not visible laterally; along the lower external border 7-10 short heavy spurs. Penis concealed by the tenth segment; ventrally toward the base a broad transverse piece whose upper margin is heavily toothed and concave; beneath the penis two long, stout, chitinous rods (pl. 40, fig. 1). Claspers very heavy and hairy; seen from the side (pl. 40, fig. 1), running to an upturned point, seen from below separated distally but the bases concealed by the ninth segment and slightly fused in the middle line; seen from within, the upper margin of the clasper inflexed and very hairy, the lower margin also incurved and heavily chitinized. Length, male, 20 mm. Hagen gives 20-28 mm.

According to Hagen  $M_4$  of the fore wing runs into  $Cu_1$  at tip. This varies as the vein is not present in one of the specimens described by Hagen and I have not seen it in any of the few female specimens I have.

This species has been reported from Hudson bay, Saskatchewan, Maine, Massachusetts, New York and Haiti. I have specimens from Michigan, Colorado and Illinois in addition. July to September. Some of the specimens from Colorado have *m-cu* of the hind wing somewhat angled and with a spur.

### *Phryganea improba* Hagen

Hagen, 1873a, p. 417; Hagen, 1873b, p. 293; Hagen, 1873c, p. 385; Martynov, 1924b, p. 211 (*Prophryganea*); Milne, 1931, figs. 5, 6 (*Prophryganea*).

The following is a translation of Hagen's description:

Length to tip of wings 18-21 mm. Fuscous, pale below, the head with transverse testaceous spots, hair gray; antennae fulvous, annulated with fuscous; palpi fuscous, feet testaceous, the spines yellow, the anterior and middle tibiae and all the tarsi with fuscous spots exteriorly. Fore wings gray, spotted and reticulated with fuscous,

the veins blackish fuscous; three white spots present; posterior wings gray-hyaline, the veins more obscure at apex. Genitalia like those of *P. obsoleta* (European).

Milne (*l. c.*, p. 228) has designated and figured a lectotype. I am glad to follow his choice though when I examined Hagen's collection in 1915 I chose, because of the likeness to *obsoleta*, what is now *deflata*. The material on which the original description was based was from Saskatchewan, Hudson's bay, and the Catskills. There now remains some uncertainty as to whether *improba* and *deflata* extend across the continent.

### *Phryganea sayi* Milne

(Text figs. 43*d*, 44*e*, 46*b*, 57*c*, pl. 40, figs. 4-6)

Say, 1825, p. 98, pl. 44 (*interrupta*); Say, 1859, p. 98 (*interrupta*); Hagen, 1861*c*, p. 256 (*Limnephilus? interruptus*); Hagen, 1873*a*, p. 411 (*interrupta*); Hagen, 1873*b*, p. 293 (*interrupta*); Hagen, 1873*c*, p. 385 (*interrupta*); Ulmer, 1907*c*, pl. 2, fig. 7 (*interrupta*); Vorhies, 1909, p. 654, pl. 54, figs. 1-4 (*interrupta*); Martynov, 1924*b*, p. 213 (*Neophryganea interrupta*); Milne, 1931, p. 238 (*Prophryganea*).  
Immature stages. Vorhies, 1909, p. 655, pl. 52, fig. 2, pl. 54, figs. 5, 6 (*interrupta*); Lloyd, 1921, p. 32-35, figs. 24-37 (*interrupta*); Sibley, 1926*b*, p. 104, pl. 8, fig. 37, pl. 9, fig. 55 (*interrupta*).

Head orange, with a large black median area, clothed with gray hair. Antennae orange, ringed with black. Prothorax with long gray hair. Mesothorax orange with black longitudinal stripes at the sides. Legs mostly dark brown, the spines black, segments generally lighter at their proximal ends. Fore legs darker than the others. The membrane of the fore wings dark brown and brownish yellow, the veins very dark, the tips of the veins inclosed in patches of brown. The largest patch of brown along the base of media. The pubescence very heavy, mostly black and white. A well-marked line of black hairs on the brown spot along the main stem of media, this line interrupted at the branching of media then continued through cell  $M_2$ ; sometimes a similar shorter line in cell  $R_4$ . Hind wings pale at base, somewhat darker in the apical region, particularly so far as the veins are concerned. Media three-branched in the hind wings; sometimes four-branched in the fore wings, in which case  $M_4$  fused with  $Cu_1$  at tip (pl. 40, fig. 4). The genitalia much like those of *P. cinerea*. The tenth segment as seen from above with its middle posterior margin rounded instead of straight as in *cinerea*; the dorsal lobes of the tenth segment not extending beyond the median part of the segment; the internal lobes not quite so heavily chitinized as in *cinerea*. The tenth segment distally running into two angles the upper of which has two blunt teeth, the lower of which is covered with heavy spurs. Penis with two transverse chitinous lobes on the ventral side, of these the proximal one like that of *cinerea* except the teeth upon its margin larger and a rather narrow median cleft instead of a broad concavity, the distal lobe not so heavily chitinized. Claspers not quite so heavy as in *cinerea*, less elongate; the points on the distal end more distinct and nearer together as seen from below, as seen from

the side, not quite on the same level, and therefore appearing separately, viewed internally the claspers much like those of *cinerea*.

Length to tip of wings, male 20–25 mm, female 25 mm. Expanse 40–48 mm.

The species is now reported from the shore of Lake Erie, from Massachusetts, New Jersey, Missouri, Wisconsin and Washington, D. C. I have a male and two females from New York, July 12th to August 1st, and one female from Michigan. The immature stages are described by Vorhies and by Lloyd.

### *Phryganea vestita* Walker

(Text fig. 57*d*; pl. 40, figs. 7–9)

Walker, 1852, p. 10 (*Neuronia*); Walker, 1852, p. 10 (*Neuronia commixta*); Hagen, 1861*c*, p. 253; Hagen, 1861*c*, p. 253 (*commixta*); McLachlan, 1863*c*, p. 156; McLachlan, 1863*c*, p. 156 (*commixta* reduced to synonymy); Hagen, 1873*a*, p. 418; Hagen, 1873*c*, p. 385; Ulmer, 1906*b*, p. 2, figs. 1–3; Ulmer, 1907*c*, pl. 2, fig. 5, pl. 29, fig. 7; Martynov, 1924*b*, p. 211 (*Prophryganea*)  
Immature stages. Lloyd, 1921, p. 35–38, figs. 38–46; Sibley, 1926*b*, p. 104 (listed)

Head brown above, with short black hairs, at the extreme base of the head some long black hair; antennae brown with black annulations. Prothorax brown, with short white and longer black hair. Mesothorax brown in center with short white hair, black stripes on the sides. Legs yellow, the tibiae and tarsi with bands of brown; spurs and spines yellow. Fore wings brown and brownish yellow; the posterior and apical regions darker than the anterior basal margin; the pubescence black and white and when not removed the posterior margin of the wing lighter in color than the rest of the wing, the white pubescence forming two large triangles with their bases on the posterior margin; a white fleck in cell  $M_2$  and one in each apical cell on the wing margin and extending into the fringe. Color of the fore wing varying greatly with the amount of rubbing to which the insect has been subjected. The hind wings clear with a brown tinge and the apex with a broad margin of darker brown. The apex of the fore wing distinctly emarginate at the tips of the veins beginning with  $R_4$ . Media of the hind wing three-branched in the female; the crossvein *m-cu* angled and with a spur directed basally. The ninth dorsal segment (male) concave posteriorly. The tenth segment running to a rather long point below, toward the base a prominence with stout hairs. Penis (shown not exerted in the figure) very long; truncate at the end and with a bunch of stout bristles; when exerted, several times as long as the tenth segment; for the greater part of its length appearing to be a long sack on the inner surface of which are many spurs of different lengths, and which ends internally in a slender tube (sperm duct?); doubtless this entire sac eversible. Claspers broad at base; seen from the side two blunt points distally and arising from the inner surface a slender branch which extends beyond the outer part considerably; as seen from below (pl. 40, fig. 9) also an inner ventral branch crossing its fellow

from the other side, these both visible in lateral view. Length of body, 10 mm; to wing tips, 21 mm.

Ulmer has recently (*l. c.*) described Walker's type. The description and figures show that the tenth segment is not extended in the specimen but that the penis is.

The species is reported from Georgia (type locality), Massachusetts, Washington, D. C. I have specimens from Saranac Inn and Ithaca, N. Y., from Lake Forest and Diamond lake, Ill., May 27th, July and August. Sibley reports it from McLean, N. Y., August 31st. Dr J. C. Bradley has kindly sent me a specimen from Georgia.

There are three western species described.

#### *Phryganea californica* Banks

Banks, 1907a, p. 117; Martynov, 1924b, p. 213. California.

#### *Phryganea deflata* Milne (text fig. 57b; pl. 40. fig. 3)

Milne, 1931, p. 230, figs. 3, 4, 8. Sask., Alta., Canada. (*Prophryganea*)

#### *Phryganea macdunnoughi* Milne

Milne, 1931, p. 230, figs. 1, 2, 7. Alta., Canada. (*Prophryganea*)

### Neuronia Leach

Leach, 1815, p. 136; Hagen, 1873a, p. 380, 401; McLachlan, 1874, p. 14;

Ulmer, 1907c, p. 22; Banks, 1907a, p. 118; Ulmer, 1909a, p. 70

Immature stages. Lloyd, 1921, p. 19; Lestage, 1921a, p. 572; Gätjen, 1926

Antennae stout, never shorter than one-half of the fore wing and never longer than two-thirds of the same; commonly, perhaps always, with a chitinous ring on a number of the basal segments. Legs stout, those of the females not dilated. Spurs 2-4-4; the spurs relatively short; the spines short and strong, but in some species (*N. semifasciata*, for example) the spines and spurs longer. Wings broad, the fore wings about twice as long as broad, the greatest breadth in the middle, hind wings but little shorter than the fore wings; both pairs shining, in some species with scant pubescence. Fore wings either uniformly dark or with a light background on which dark areas often form a network. The hind wings sometimes clear, sometimes dark at base, often dark spots in the apical region forming an apical band, in some species the predominant color dark leaving a band of lighter color. In the fore wing *Sc* with an accessory to the costal margin; between *Sc* and *R* generally a cross-vein near the base as in *Phryganea*; *R*<sub>1</sub> generally arched toward its tip; the discal cell commonly short in both wings. The number of apical cells different in the sexes and in the species; in the fore wing cells *R*<sub>2</sub>, *R*<sub>4</sub>, *M*<sub>1</sub> and *Cu*<sub>1</sub> always present, in the females cell *M*<sub>3</sub> sometimes present in addition. Males with cells *R*<sub>2</sub>, *R*<sub>4</sub> and *Cu*<sub>1</sub> in the hind wings; in the females cell *M*<sub>2</sub> present in addition (in *N. concatenata* it appears to be cell *M*<sub>3</sub>).

McLachlan states (*l. c.*, p. 14) that in a group of American species cell  $M_2$  is present in the males. I have not found this to be true.

The larvae can be distinguished from most of those of *Phryganea* by the fact that there is no median longitudinal black stripe on the frons.

Banks has given a key to the species reported from the United States. In the following key I have used most of the same characters but have rearranged the species so as to conform more closely to Hagen's grouping which, in so far as I know the species, seems to be natural. I must add, however, that I do not think these characters will be found at all reliable. Thus many of my specimens of *concatenata* (e. g. the one used for pl. 41, fig. 2) would fall into division 1a of the table rather than in 1b. The distance that cell  $R_2$  reaches back on the discal cell will also be found to vary. Of the species listed I have seen *angustipennis*, *semifasciata*, *postica*, *pardalis*, *ocellifera*, *stygipes*, *concatenata*, and *dossuaria*.

#### KEY TO THE SPECIES OF NEURONIA

- 1a Crossvein  $Cu_1-Cu_2$  at a considerable angle with the tip of  $Cu_2$  (see preceding paragraph) .....2  
 1b Crossvein  $Cu_1-Cu_2$  in a straight line with the tip of  $Cu_2$  or nearly so (pl. 41, fig. 2).....5  
 2a Cell  $R_2$  of the fore wing reaching upon the discal cell for at least half the length of the latter cell.....*angustipennis*, *ocellifera*, *semifasciata*, and *postica*  
 2b Cell  $R_2$  of the fore wing reaching upon the discal cell for less than half the length of the latter cell.....3  
 3a Basal half of the hind wings dark brown.....4  
 3b Basal half of the hind wings not dark brown.....*canadensis*  
 4a Length to tip of wings more than 20 mm.....*pardalis*  
 4b Length to tip of wings less than 20 mm.....*stygipes* and *ocelligera*  
 5a Cell  $R_2$  of the fore wing reaching upon the discal cell for more than half the length of the latter cell.....6  
 5b Cell  $R_2$  of the fore wing reaching upon the discal cell for less than half the length of the latter cell.....*dossuaria*, *smithi*  
 6a Fore wings marmorate with dark brown.....*concatenata*  
 6b Fore wings nearly unicolorous.....*inornata*

#### *Neuronia angustipennis* Hagen

Hagen, 1873a, p. 400; Hagen, 1873c, p. 385; Martynov, 1924b, p. 216 (*Ptilostomis*)

The following is from Hagen, *l. c.* (translated and abstracted) :

Fuscous; antennae short, mesothorax black on either side above; fore wings narrow, reticulated with fuscous, hind wings gray-hyaline, the apices obscure, with transverse fuscous spots. As compared with the other species, the yellow color of the wings is more restricted, being replaced with gray particularly in the hind wing, the males being yellow only at the apical margins.

The male genitalia simpler than those of the nearly allied species.

The penis cover a blunt cone directed downward, about twice as long as broad, formed as a plate folded together, open beneath, supported at the apex, and surrounded by a number of sharp bristles; concealing for the most part the penis sheath, extending beyond the latter but little with its ventral point. The widely separated claspers rounded and concave, with a tooth in the anterior angle, and with a long hook turned inward arising farther back and nearer the median line. Length 18 mm, alar expanse 35 mm.

The species was described from material collected in Massachusetts, northern Illinois and in Michigan, July.

### *Neuronia canadensis* Banks

Banks, 1907a, p. 118

"Head black; face with erect golden hair; posterior warts rufous, bearing rufous hair; palpi pale; antennae reddish brown; lobes of prothorax yellowish, and with long yellowish hair; thorax black, lateral lobes pale, and the scutellum rufous, with golden hair; legs yellowish, with golden hair and black spines, femora blackish on bases; abdomen black. Wings yellowish, fore pair densely irrorate with brown, a larger spot before and after pterostigma, and at ends of veins, and at arculus; venation brown; membrane finely granulate, and with sparse golden hair. Hind wings yellowish hyaline, a brown spot before pterostigma, and beyond a few brown irrorations, and dark at ends of veins. Fore wings broad, broadly rounded at tip; discal cell about three-fourths as long as pedicel; first apical cell as long on discal as width of latter, fifth not extending back as far; the arculus angulate; cross-vein from median to cubitus ends beyond forking of latter vein.

"Expanse 28 mm.

"One specimen from Guelph, Ontario, Canada (Jones)." Banks  
l. c.

### *Neuronia concatenata* Walker

(Text fig. 5r, pl. 41, figs. 2-8)

Walker, 1852, p. 8, Hagen, 1861c, p. 249 (*irrorata*); Hagen, 1873a, p. 385; Hagen, 1873c, p. 384; Ulmer, 1907c, pl. 29, fig. 5; Banks, 1908b, p. 61; Martynov, 1924b, p. 216 (*Banksiola*)

Immature stages. Hagen, 1873a, p. 441

Head brownish-yellow, the ocelli margined with black within. Antennae orange with a black chitinous ring on the basal segments (except the first two); these rings sinuous. Thorax mostly yellow, the prothorax darker. Legs and spurs yellow, the spines black. Fore wings clear yellow with very close reticulations of brown, these latter somewhat darker (not more dense) on the anterior margin; the largest brown spots on the posterior margin, one on the tip of the anals, the other a little further out. Hind wings clear, the distal part irrorated with brown, a large brown spot on the anterior margin at the level of the arch in vein  $R_1$ . Media of the fore wing three-branched in both sexes; in the hind wing two-branched in the males, three-branched in the females, the added vein apparently  $M_4$ , though

this vein not shown elsewhere in the order (pl. 41, fig. 2). The tenth segment undivided, the posterior edge emarginate; a little beyond the middle dorsally on each side a bunch of long hairs; a little further back and below, the preanal appendages which are in this case not very large prominences. The penis (pl. 41, fig. 3) enveloped at base by a sheath which runs out to a long sharp point extending beyond the penis; besides this sheath a slender appendage tipped with a brush of long stout spines, this arising ventrally and only on the right side. The claspers heavy, inturned below and with teeth on both inner and outer ventral margin (pl. 41, figs. 7, 8). Length 14-16 mm, expanse 23-32 mm.

Hagen's specimens were from Florida (or Georgia), Massachusetts and the North Red river. Banks reports the species from Newfoundland; my own specimens from various points in New York and from Lake Forest, Ill.

Hagen's specimens have cell  $M_4$  present in the hind wings of the females; in the type it is larger than in my figure but in other specimens it is about as in mine.

### *Neuronia dossuaria* Say

Say, 1825, pl. 44; Say, 1859, p. 97, pl. 44, fig. 5; Hagen, 1861c, p. 255; Hagen, 1873a, p. 383; Hagen, 1873c, p. 384; Provancher, 1877, p. 216; Provancher, 1878b, p. 128; Martynov, 1924b, p. 216 (*Banksiola*)

Head yellow except for the narrow black internal margin of the ocelli. Antennae with the basal two segments yellow, the succeeding ones black, no ring in the chitin visible, at least without clearing. Thorax yellow with some yellow hairs. Legs yellow, the spines black. Fore wings almost white with brown markings which are more widely separated than in *N. concatenata*; a large brown spot on the anterior margin at the arching of vein  $R_1$ ; the largest brown patch from the tips of the anal veins on the posterior margin, along the cord, to the apex of the discal cell with several diverging arms near and at the anterior end, one or two clear spots enclosed within this dark area, one of these at the apex of cell  $M_3$ . The hind wings nearly clear; one large brown spot just beyond the middle of the anterior margin; the apex margined with brown, deepest at the tips of the veins.

The following is an abstract of Hagen's description of the male genitalia:

The tenth segment triangular, broader than long, with long yellow hairs; the oval prominences representing the preanal appendages large, hemispherical; dorsally on the segment two black spots. The penis sheath toothlike, exceeding the tenth segment in length by half, its blunt point bent slightly upward. A bunch of stout bristles appearing to arise either from the penis or from its sheath. The claspers close together, extending but little beyond the body; seen laterally two appendages, one curved and as long as the penis sheath, the other shorter and straighter. On the margins of the seventh

and eighth ventral segments, a small median chitinous point, and on the preceding segment, also, the appearance of one.

Length to tip of wings 13 mm, expanse 25-27 mm.

The species has been reported from New Hampshire and Massachusetts. I have female specimens from Old Forge and Keene Valley, N. Y., July.

### *Neuronia ocellifera* Walker

(Pl. 41, figs. 9-11)

Walker, 1852, p. 8; Hagen, 1861c, p. 252; Hagen, 1873a, p. 400; Hagen, 1873c, p. 385; Provancher, 1877, p. 217; Provancher, 1878b, p. 128; Ulmer, 1905d, p. 61, figs. 3, 4; Martynov, 1924b, p. 216 (*Ptilostomis*)

The following is taken from Hagen's description (Hagen, *l. c.*, p. 252):

"Fulvous; antennae shorter, fuscous; thorax ciliated with fuscous-gray; wings short, fulvous, veins same color; anterior wings a little transversely irrorated with fuscous, a medial spot upon the posterior margin fuscous; disk with two whitish points; posterior wings with an angulated band, which is subapical, fuscous; feet with gray spines."

The descriptions of the male genitalia by Hagen and Ulmer may be abstracted as follows:

The tenth segment consisting of a middle piece whose broad base has two lateral chitinous processes, and the narrow distal end of which is bent downward. The preanal appendages thin, straight (not dilated at any point), shorter than the tenth segment, at the end a long thin bristle, the entire appendage not as long as the process on the tenth segment. The claspers like those of *N. semifasciata*, but the slender branch curved more ventrally. Between the widely separated claspers, the ninth segment visible; this with two prongs and the margin toothed. Length of body 16 mm, to tip of wings 20 mm, expanse 40-43 mm.

The parts described above will, I think, be recognizable in my drawings although these do not wholly agree with Ulmer's.

Hagen's types were from Massachusetts, northern Illinois and Louisiana. My drawings are from specimens given me by Dr J. T. Lloyd and collected at Batavia, N. Y., July 17th.

### *Neuronia ocelligera* Walker

Walker, 1852, p. 8, Hagen, 1861c, p. 250; McLachlan, 1863c, p. 156; Hagen, 1873a, p. 389; Hagen, 1873c, p. 385; Banks, 1907c, p. 35; Martynov, 1924b, p. 215 (*Oligostomis*)

"Black, with pale hair; tibiae piceous; wings testaceous, the anterior ones reticulated and guttated with black, posterior wings having the margin spotted with black. Male. (From the description of Walker)

"Length to tip of wings 16 millim. Alar expanse 28 millim.

"Hab. Nova Scotia (Redman)." Hagen, *l. c.*, p. 250.

From Hagen's later notes (1873) may be added that the claspers are yellow, blunt-pointed, and concave. The posterior wings are

dark at base as in *N. stygipes*. Hagen thinks that the latter species is probably a synonym.

### *Neuronia pardalis* Walker

(Pl. 42, fig. 1)

Walker, 1852, p. 7; Hagen, 1861c, p. 250; Hagen, 1873a, p. 394; Hagen, 1873c, p. 385; Provancher, 1877, p. 216; Provancher, 1878b, p. 128; Lintner, 1896, p. 298, 299, 1 fig; Martynov, 1924b, p. 215 (*Regina*)

Immature stages. Lloyd, 1915e, p. 201, 202, pl. 15, figs. 1, 2, 4, pl. 16, figs. 3, 4, 5, 8, 13; Lloyd, 1921, p. 20-22, figs. 2-8

Head golden beneath, mostly black above. Antennae black. Prothorax black with golden hair; mesothorax black with two longitudinal, golden stripes. Fore wings yellowish brown with close black reticulations; veins black. Hind wings with the basal half black except for some large yellow spots on the anterior margin; the distal half yellow except the irregular band of black along the margin, the latter widest at the apex, interrupted both anteriorly and posteriorly. Legs black, the trochanters lighter, femora of the first legs with yellow hair.

The following is an abstract of Hagen's description of the male genitalia:

Genitalia prominent; a part of them and the margin of the last segment with yellow hair. The tenth segment a short triangular cap, a little longer than broad, flat, with a shallow median groove behind, the apex somewhat pressed down. The penis sheath yellow, cylindrical, thicker than the tenth segment and twice as long. The preanal appendages on either side of the tenth segment yellow, cylindrical, curved outward, as long as the penis sheath, with stout yellow bristles at the end. The claspers set with close and long hair; extending upward, reaching beyond the preanal appendages, and suddenly narrowed distally. The last ventral segment with a projecting middle piece which has two long sharp teeth and two smaller ones. Length to tip of the wings 21-27 mm. Expanse 42-50 mm.

The species has been reported from Quebec, Nova Scotia, New York and New Hampshire. I have female specimens from Ithaca and Gloversville, N. Y., the latter sent me by Dr C. P. Alexander. Lloyd (*l. c.*) describes the immature stages.

### *Neuronia postica* Walker

(Text figs. 27i, j, k, 33b; 34f; 39; pl. 42; figs. 2-4)

Walker, 1852, p. 9; Hagen, 1861c, p. 251; Hagen, 1873a, p. 398; Hagen, 1873b, p. 294; Hagen, 1873c, p. 385; Provancher, 1877, p. 217; Provancher, 1878b, p. 129; Banks, 1904d, p. 211; Banks, 1908b, p. 61; Vorhies, 1909, p. 658, pl. 52, fig. 1, pl. 54, figs. 7-10; Martynov, 1924b, p. 216 (*Ptilostomis*); Sibley, 1926b, p. 104

Immature stages. Vorhies, 1909, p. 659, pl. 54, figs. 11-17; Lloyd, 1921, p. 22-26, figs. 9-18; Sibley, 1926b, pl. 8, fig. 36, pl. 10, fig. 68, pl. 12, figs. 93, 94

Head yellowish brown, the posterior warts and some smaller spots between the ocelli black, the warts clothed with white and brown

hairs. Antennae reddish with black annulations except at the tip (text fig. 5r); toward the tip these rings in the chitin incomplete. Thorax dark yellow with patches of yellow hairs which are black at base. Legs, spines, and spurs yellow. Fore wings orange with close reticulations of brown, the largest spot on the tips of the anals; veins not much darker than the membrane. Hind wings yellow with a brown margin and a broad, angulated, transverse band near the apex, this band confluent with the marginal one posteriorly. The tenth segment (male) notched posteriorly (pl. 42, fig. 4), the lateral margins inturned beneath and arising from these inturned margins on each side a slender rod extending just beyond the end of the segment; laterally on each side a stouter, longer appendage tipped with three bristles. The penis as in *N. semifasciata* but the projecting tips smaller. The claspers like those of *N. semifasciata*. The ninth ventral segment extending beyond the claspers; laterally running into two prongs; as seen from below the posterior margin concave, the middle of the concavity with some small blunt teeth; the inner margin next to the base of the claspers broken into a series of large, sharp teeth. Length of body 14-16 mm, to tip of wings 28 mm. Expanse, female, 47-52 mm.

There is considerable variation in the amount of brown in the hind wing and Hagen says there is a variety without the brown band.

The species is reported from Georgia, Pennsylvania, Washington, D. C., Massachusetts, Wisconsin, Newfoundland and the North Red river. I have taken it also at Lake Forest, Ill. The immature stages are described by Vorhies and by Lloyd.

### *Neuronia semifasciata* Say

(Pl. 42, figs. 5-7)

Say, 1823, p. 162 (*Phryganea*. No description); Say, 1828, p. 97, pl. 44, figs. 1, 2 (*Phryganea*); Walker, 1852, p. 9 (*fusca*); Say, 1859, p. 97 (*Phryganea*); Kolenati, 1859b, p. 198, pl. I, fig. I (*Phryganea kovalevskii*); Hagen, 1861c, p. 250; Hagen, 1873a, p. 396; Hagen, 1873c, p. 385; Provancher, 1877, p. 216; Provancher, 1878b, p. 128; Ulmer, 1905d, p. 60, figs. 1, 2; Ulmer, 1907c, pl. 29, fig. 4; Banks, 1908b, p. 61; Martynov, 1924b, p. 216 (*Ptilostomis*)

Head reddish yellow, with a black field between the ocelli; antennae reddish yellow with black annulations except at the tips. Thorax dark yellow with black patches on the anterior angles of mesothorax and metathorax; long black spines on the prothorax and mesothorax. Legs, spurs and spines yellow, the spines encircled with black at the very base. Fore wings dark yellow with dark brown irrorations. The hind wings with two dark spots on the anterior margin and a brown apical band, shown in Say's figure. Also a fuscous subapical band in some specimens (it appears in none of mine). The tenth segment as seen from the side (pl. 42, fig. 5) very large; its lower distal angle running out into a very long point directed obliquely upward; on its dorsal posterior angle on each side of the median line two or three long bristles; from the base on each side the preanal appendage

long and slender, somewhat dilated at the end which is tipped with one or two straight bristles of about a third its own length. The claspers heavy at base, with a more slender distal segment, the latter sharply bent near its base. The ninth ventral segment running beneath the clasper and extending beyond the basal segment of the latter; as seen from the side the distal end two pronged, seen from below (pl. 42, fig. 7) four teeth on its margin. The penis heavy, truncate at the end from which there emerge two brown chitinous tips. Length to tip of wings 23-28 mm.

This species is widely distributed, being known from Saskatchewan, Newfoundland, and from the eastern and northeastern United States. My own specimens are from New York, Michigan and Illinois. June, July.

I find that in some of my specimens the preanal appendages are hardly, if at all, dilated at the tip and also that some of them have two terminal bristles as described by Hagen, while others have but one as found by Ulmer.

### **Neuronia smithi** Banks

Banks, 1914*b*, p. 149, pl. 8, fig. 11; Martynov, 1924*b*, p. 216 (*Banksiola*)

"In general similar to *N. concatenata*, but the irrorations on the wing a little further apart, and much less wavy; the vertex wholly pale yellowish, the thoracic notum also pale, but rather dark each side. Venation generally as in *N. concatenata*, but the first fork does not reach half way back on discal cell (in *concatenata* much more than half way). The lower appendages of the male have the apical spine longer and less curved than in *N. concatenata*.

"Expanse 23 mm.

"From Lakehurst, N. J., 4th July (Englehart). Named in memory of the late Dr J. B. Smith." Banks, *l. c.*

### **Neuronia stygipes** Hagen

(Pl. 42, figs. 8, 9)

Hagen, 1873*a*, p. 388; Hagen, 1873*c*, p. 385; Provancher, 1877, p. 217; Provancher, 1878*b*, p. 129; Martynov, 1924*b*, p. 215 (*Oligostomis*)  
Immature stages. Lloyd, 1921, p. 26-28, figs. 19, 20; Sibley, 1926*b*, p. 104

(The species was named *stygipes* without description by Harris in Hitchcock's Report, Ed. 2, p. 582, 1835.)

Head black with a few yellow hairs. Antennae very dark brown, the articulations black, the annulations on the segments hardly visible, lighter than the segments. Thorax black, with yellow hairs on the prothorax. Legs black, the posterior femora and tibiae lighter. Fore wings yellow with fine reticulations of dark brown; from the middle of the anterior margin around the apex to the tips of the anals a regular succession of dark spots on the tips of the veins; the base of the wing darker than the rest and the fibula wholly dark

brown. In the hind wing the basal half dark brown with the anterior margin interrupted yellow; the apical half yellow with brown spots along the margin on the tips of the veins. Abdomen black with a lateral stripe which is a little lighter. The tenth segment (male) undivided; bearing on each side basally the preanal appendage which is stout and tipped with a long bristle extending beyond the segment. The penis sharply bent downward at the tip. The claspers set rather high. The ninth ventral segment seen laterally with a posterior concavity in the lower third of its margin; seen from below two blunt teeth near the middle line. Length to tip of wings 14-18 mm, expanse 26-31 mm.

Hagen's types were from Maine, New Hampshire and Massachusetts. The only specimens other than these that I have seen are those of Dr J. T. Lloyd (New York) bred in the latter part of May, and a few in the collection of the New Hampshire State Museum.

The species is probably a synonym of *N. ocelligera* Walker.

The larva is described by Lloyd (*l. c.*).

There are two other North American species.

#### *Neuronia inornata* Banks

Banks, 1907a, p. 117, pl. 9, fig. 20; Martynov, 1924b, p. 217. Minnesota.

#### *Neuronia lapponica* Hagen

Zetterstedt, 1840, p. 1061 (*Phryganea reticulata*); Hagen, 1864b, p. 852; Hagen (Schneider), 1873a, p. 382 (*stigmatica*); McLachlan, 1874, p. 16, pl. 2, figs. 1-4; Banks, 1900b, p. 467; Silfvenius, 1905b, p. 5, pl. 1, figs. 1a-d; Martynov, 1924b, p. 214. Lapland, Siberia, Kukak Bay, Alaska.

#### *Agrypnia* Curtis

Curtis, 1835, p. 540; Hagen, 1873a, p. 424, 430; McLachlan, 1874, p. 28; Banks, 1900a, p. 252 (*Agrypnetes*); Ulmer, 1907c, p. 26; Banks, 1907a, p. 122 (*Phryganomyia*)

Descriptions of the immature stages of the European species will be found in most of the references given under the family.

Antennae more slender than in *Neuronia*, and longer, being about the length of the fore wings. Spurs 2-4-4. Wings generally narrow, approaching those of the Limnephilidae in shape; the wing membrane nude, scarcely shining; in fresh specimens sometimes scant pubescence. Fore wings generally straw-yellow, sometimes with white and brown spots. The accessory from *Sc* to the costal margin not present; the crossvein between *Sc* and *R*<sub>1</sub> at base generally present; the venation alike in the sexes of some species, unlike in others, cell *M*<sub>3</sub> being present in the fore wings of the females in the latter case; crossvein *m-cu* of the hind wing angulate.

#### *Agrypnia colorata* Hagen

Hagen, 1873a, p. 424; Hagen, 1873c, p. 385; Martynov, 1924b, p. 211 (*Prophryganea*); Milne, 1931, p. 230, figs. 10-15 (*Prophryganea bradorata*)

"Male. Pale straw-colour, wings and legs immaculate and latter not at all spinose. Antennae and palpi pale brown. The tibial spurs apparently are not constant, and, while several specimens have 2-4-4,

others in equally good condition have but 0-2-2. The size also varies considerably, but the genitalia are remarkably constant. Expanse 28-34 mm.

"Female. Slightly more maculate with brownish reticulation on the anterior wings. A few small spines on the hind tibiae. Expanse 38-40 mm." Milne, *l. c.* Quebec, Man., Sask., Canada.

### *Agrypnia curvata* Banks

(Pl. 42, figs. 10-12)

Banks, 1900a, p. 252 (*Agrypnetes*); Martynov, 1924b, p. 211 (*Prophyganea*)

"Pale yellowish, clothed with short yellowish hair, veins at and near anastomosis darker, abdomen brown above; head large, three large ocelli; antennae short and stout, well separated at base; prothorax with two warts above; legs very stout, spurs very short, 2-4-4; the joints two to four of anterior tarsus very short, practically no spines, on hind legs, however, there are extremely minute ones on the tarsi; anterior tarsi do not show any fringe of hair; wings very narrow, the costal margin concave, the posterior margin convex; venation almost the same as in the European species (*Agrypnetes crassicornis*), the discal cell a trifle longer, and the posterior anastomosis rather more oblique, the anal venation is exactly the same, surface of wing nearly bare.

"Length 11 mm.

"St Anthony Park, Minnesota (Pettit). When the wings are closed the insect in side view is highest at middle and curves down each way. I place this in *Agrypnetes* on account of close correspondence in venation, in absence of spines on legs, in structure of legs, in size and color; but the spurs are plainly 2-4-4." Banks, *l. c.*

Specimens of this species were given to me by Professor Needham who found them abundantly in insect drift along Lake Michigan at Lake Forest, Ill., August 12th. The specimens seem to have been determined for Professor Needham as *Glossosoma sp.* I add description of genitalia.

The tenth dorsal segment concave posteriorly as seen from above, the angles with a few bristles; the preanal appendages with the upper posterior angle rounded, the lower bluntly pointed. The claspers heavy, the apex divided, the lower branch being the longer; in addition a slender branch which arises toward the tip and extends obliquely upward. The penis with an extrusible tip; the end of the chitinous part sharply turned downward as indicated in the figure (pl. 42, fig. 12).

I prefer to place the species in *Agrypnia* rather than in *Agrypnetes* as done by Banks. It is true that the wings are decidedly narrower and less truncate than is usual in *Agrypnia* but the spurs are different from those of *Agrypnetes*, as stated in the description. The anterior tarsal segments seem no shorter proportionately than those

of *Agrypnia*; the middle legs do not seem flattened, nor do I find on them hairs arranged in a "comblike fringe" as in *Agrypnetes*. The wings of the female are decidedly larger but of practically the same shape as those of the male.

### *Agrypnia glacialis* Hagen

Hagen, 1864*b*, p. 802; Hagen, 1873*a*, p. 426; Hagen, 1873*c*, p. 385; Banks, 1900*b*, p. 471, pl. 28, fig. 16 (*Asynarchus alascensis*); Banks, 1907*a*, p. 122 (*Phryganomyia alascensis*); Sibley, 1926*b*, p. 104; Martynov, 1924*b*, p. 211 (*Prophryganea*)

The following is an abstract of Hagen's description:

Fuscous, head blackish fuscous, the posterior warts rufous, with yellow pubescence; antennae testaceous, annulated with fuscous; palpi testaceous, feet yellow, with black spines; fore wings narrow, pale yellow, a longitudinal fascia and some brownish transverse spots; hind wings pale yellow. Length 13-15 mm; expanse 24-28 mm.

To this may be added the following from Hagen's description of some specimens that had been in alcohol:

The body brown, the head above blackish brown, with yellow hairs, antennae pale yellow, with indistinct brown rings. Feet yellow with dense, strong, black spines. Fore wings narrow, yellow, with brownish luster, nude, with strong venation of similar color; in the apical region, from the third cell on a very indistinct, square network of brown; cell *R* and cell *R*<sub>5</sub> brownish, forming a dark band through the entire wing, hardly shown in the type specimen. In one specimen a silver-white line back of this band.

The last dorsal segment (ninth) an angled, yellow lobe, longer than broad, with a row of about six yellow bristles at the apex of each arm. On either side another row of bristles apparently also on the apex of a lobe. Preanal appendages small, yellow, hardly overreaching the margin. Claspers clear brown, large, close together beneath; appearing from the side as stout lobes running upward along the margin, the end turned strongly inward, somewhat spoon-shaped, with black bristles within; before the turned end a small oblique tooth. The tenth segment conical, open beneath, the apical margin with two short, cylindrical processes, on each of which a long bristle curving upward. Great Bear lake, Labrador.

I have seen specimens of this species in Banks' collection; these are from Winnipeg. Cells *R*<sub>1</sub>, *R*<sub>4</sub> and the tip of *R*<sub>3</sub> are dark; in front the wing is pale transparent. Cells *M* and *M*<sub>2</sub> are also transparent forming the silver-white line of the description. In the fore wing, *R*<sub>5</sub> is in a straight line with *R*<sub>4+5</sub> and the crossvein *r-m* is larger than in *straminea*. The long bristles described as arising from the tenth segment may be appendages of the penis.

The type of *Asynarchus alascensis* Banks in the National Museum is partly destroyed but it seems clearly to be this species.

**Agrypnia straminea Hagen**

(Pl. 43, fig. 1)

Hagen, 1873a, p. 425; Hagen, 1873c, p. 385; Banks, 1907a, p. 122, pl. 8, fig. 6 (*Phryganomyia obscura*); Martynov, 1924b, p. 211 (*Prophryganea*)

The following is from Hagen's description:

Dull straw yellow; head bright yellow, somewhat brownish between the ocelli. Antennae yellow (so far as preserved in type). Fore wings very narrow ( $3\frac{1}{2}$  mm) and almost nude, with some brownish luster; the venation strong, the apical sectors with brownish spots. Hind wings clear. Legs almost naked, yellow, with few yellow spines.

Genitalia with some yellow hair. Preanal appendages as in *colorata*, somewhat broader. The claspers also similar but the ventral branch shorter than the upper, and the middle one still shorter. The conical tenth segment with a tooth-like prominence above near the base. Length, 15 mm, expanse, 29 mm. Saskatchewan.

I have a single specimen taken at Saranac Inn, N. Y., August 14th, which perhaps belongs here. The color answers well to the above description but unfortunately the abdomen is lacking. A figure of venation is here given (pl. 43, fig. 1).

**LIMNEPHILIDAE**<sup>36</sup>

Kolenati, 1859b, p. 29; McLachlan, 1863c, p. 171; McLachlan, 1874, p. 30; Klapálek, 1904a, p. 28; Ulmer, 1907c, p. 29; Ulmer, 1909a, p. 111; Martynov, 1914c, p. 1; 1914f, p. 173; Banks, 1916a, p. 117 (Key)

Immature stages. McLachlan, 1874, p. 31; Silfvenius, 1902a, p. 33; Struck, 1903, p. 25, 66; Ulmer, 1903d, p. 42; Silfvenius, 1904c, p. 28; Silfvenius, 1905b, p. 33; Thienemann, 1905b, p. 30; Siltala, 1906b, p. 44; 1907c, p. 486; Ulmer, 1909a, p. 207, 252, 312; Lloyd, 1915b, e; Lestage, 1921a, p. 672; Lloyd, 1921, p. 38-77

Antennae as long as or but little longer than the wings, seldom shorter; the basal segment thicker than the others, shorter or at most as long as the head. Ocelli always present. Maxillary palpi of the male 3-segmented, those of the female 5-segmented (in one anomalous Asian species the maxillary palpi 3-segmented in the female); the basal segment short, those following long, cylindrical, not abnormally formed; last segment not multiarticulate nor flexible. Labial palpi small. Legs generally long, often stout, the tibiae and tarsi generally with stout spines which are often black. Commonly a black spot on each of the trochanters. Spurs varying; the fore tibia never with more than one, and the middle never with more than three. The fore wings mostly broad, generally with very scant pubescence, though rarely a considerable covering of hair or bristles. In *Thamastes* (Asia) and *Psychoronia* both pairs of wings rudimen-

<sup>36</sup> See footnote on p. 319.

tary; in *Enoicyla* (Europe) this true of the female only. Except in certain anomalous genera the venation much alike in the different forms. In the fore wing, radius almost always normal, the discal cell very long, media 3-branched; in contrast to the Phryganeidae the anal veins parallel to the hind margin of the wing. In one subfamily (the Apataniinae) two branches of  $Sc$  present and diverging so strongly as to form a straight line from  $R_1$  to the costal margin (p. 45). In the hind wings the crossvein  $r$  absent; media commonly 3-branched in male and female; crossvein  $m-cu$  often meeting  $Cu_1$  at a point where the latter is sharply angled and giving the impression that media is 4-branched (pl. 44, fig. 2). The anal area of the hind wings greatly expanded and ordinarily with more veins than are found in any other family; the venation of this area sometimes obscured by a pencil of hairs. The tenth dorsal segment (male) often of two diverging plates; the claspers generally composed of a single segment, broadly united to the 9th segment; the preanal appendages vary greatly, rarely are they branched.

The larvae of the eruciform type, the head being bent downward and the constructions between the segments of the abdomen being very slight. The body cylindrical, widest at the first segment, the ninth segment narrower than the others. The head shorter than in the Phryganeidae, oval to roundish. The eyes upon slightly raised light spots. The antennae of a single segment each, and without terminal bristles, at least in all but the younger stages. The frons deeply emarginate on the sides. Mouthparts not prominent. The labrum with one, more rarely two, notches in the anterior margin. This sclerite with two and sometimes five bristles on each side; the first three forming a bowed line and the others when present nearer to the anterior margin; one or two pairs of heavy spines on the anterior margin. The mandibles chisel-shaped, with from three to six, generally five, rather short teeth; the inner face hollowed out and a bunch of bristles usually there present. The labium and maxillae short and very hairy; the maxillary palpi short, of about the same length as the lobe; the labial palpi well developed, of about the same length as the labial lobe. The segments of the thorax successively longer, the third being twice as long as the first. The pronotum and the mesonotum each with a chitinous shield which is longitudinally divided. On the middle of the pronotum often a group of chitinous points forming an X-shaped mark. On the anterior margin short bristles and slender hairs and on the upper surface black and yellowish bristles; the rear margin generally black; between one-third and two-fifths of the way from the anterior margin a transverse furrow darker than the ground color of the segment. The shield of the mesonotum broader than long, not overreaching the sides as does that of the pronotum; the rear margin, and particularly the posterior angles, black. On the mesonotum of the Limnephilinae six small chitinous shields; the smallest of these in the anterior part near the middle line, the second set back of the first pair and farther out, the third and largest ones lateral in position, mostly crescent-shaped (text fig.

52*p*). On the ventral surface of the prothorax a chitinous "horn" (text fig. 52*q*), present in all species known except in the genus *Neophylax*. Of the legs the middle pair the longest, the fore pair the shortest and stoutest. On the anterior margins of the tibiae and tarsi spines and on the ventral anterior margin of the tibia two stout spurs. The lateral line from the third to the seventh or eighth segment. Tracheal gills either singly or in groups of two or three, none occurring on the first segment. Three tubercles on the first segment and the ventral side of this segment covered with bristles. On the dorsal side of the ninth segment a chitinous shield covered with small spines and punctate anteriorly; on the posterior margin long bristles. The anal prolegs short, 2-segmented, the claw with a single hook.

The pupae cylindrical, widest at the sixth and seventh segments. The labrum somewhat semicircular, anteriorly emarginate; the dorsal surface raised and with a transverse furrow back of its middle line; near the anterior angles on each side, five long bristles with the tips hooked. Mandibles long, stout, the blade finely toothed. The first abdominal segment chitinized, the rear margin notched. The lateral line from the fifth segment forms an interrupted loop under the eighth. Gills as in the larvae. Dorsal plates with hooks on segments 4-7. The anal processes long and slender, the blunt tips curved outward.

Cases of the most various structure. Sometimes formed of sand, small stones, or of vegetable matter; never made of silk only. The shape cylindrical or conical, often moderately curved, more rarely strongly curved or straight; round or triangular in section, never square. The closing membranes are sieves in which the perforations occupy relatively little space, or nets in which the reverse is true.

The eggs of the Limnephilidae are laid out of water. The females are able to run rapidly upon the surface of the water but none have been observed to descend beneath the surface. The eggs are placed upon leaves or stones near the water so that they may be immersed by a rise in the water level or may be washed from overhanging leaves by rain. In a number of cases eggs have been found far removed from water so that the young larvae would have to travel some distance (several yards) before reaching their native element. The immature stages of *Enoicyla* (European) are terrestrial and the eggs may be laid far from water. The egg masses of Limnephilidae are gelatinous and for the most part they are spherical.

This is a very large family, and except for a few aberrant forms, a most homogeneous one considered from the standpoint of any one of the stages of the life history. The genera and the species are not easily defined and this applies most strongly to the immature stages.

Two subfamilies—Limnephilinae and Apataniinae—are sometimes recognized. The adults of the latter are characterized by having the

tips of *Sc* of the fore wing diverging strongly so as to form a single straight vein from  $R_1$  to the costal margin. Of North American forms *Apatania*, *Allomyia* and *Oligophlebodes* would here be included. Banks suggests Limnephilinae and Drusinae as the subfamilies, basing the distinction on the armature of the legs, the Limnephilinae having one or more distinct spines on the last segment of the hind tarsus and the first tibia spined to its base, while the Drusinae have no spines on the last tarsal segment except in a few cases and in these latter the first tibia is not spined to base. It is doubtful whether this distinction is any less artificial than the spur formula; at any rate suspicion is aroused when *Platycentropus indistinctus* and *P. maculipennis*, which I venture to include in the same genus, are placed in separate subfamilies.

The following key to the genera will doubtless be found very imperfect but the materials at hand are limited to the more important genera and even with these it is sometimes hard to find differential characters. Variability in the number of spurs will be a source of confusion in some genera. It may be noted also that certain species, like *Anabolia assimilis*, have been placed in genera with which they do not agree in spur formula and one unfamiliar with such species can not modify the key to accommodate them.

*Anabolia* and *Asynarchus* seem to me to be inadequately defined. It seems quite impossible to distinguish these genera on the characters assigned to them. I know only the species determined as *Anabolia bimaculata*.

*Algonquina* (p. 369), *Apolopsyche* (p. 370), *Clistoronia* (p. 371) and *Zaporota* (p. 339), almost wholly western in distribution, I have not been able to place. I judge the key might carry the former two to *Stenophylax*.

It is with some reluctance that I leave the genera *Stenophylax*, *Halesus* and *Platyphylax* differentiated mainly by their spur formulae. I am of the opinion that it might be better in effect to redefine Banks' *Pycnopsyche* (based on *S. scabripennis*) as having spur formula 1-3-4, 1-3-3 or 1-2-2, including in it *Stenophylax scabripennis*, *Halesus guttifer*, *H. similis*, *Platyphylax lepida* and *P. subfasciata*. Except for spur formula, these may readily be considered congeneric. I have a specimen which is undoubtedly *Halesus guttifer* yet it has spurs as in *Platyphylax*, 1-2-2. Any such rearrangement must be done with careful study of European types as well as American and less confusion will result for the present by retaining the old grouping.

There are a number of closely related genera which agree in having the fore leg of the male abnormal in several respects, having a long, black, curved spur, and having the tibia fit into a femoral groove margined with rows of black spines. These genera differ in the length of the first tarsal segment as compared with the second and in the degree of excision in the margin of the hind wing. I have left these species in three genera. Some uncertainty remains because of the varying statements regarding the tarsal segments of the males. Thus Banks describes the genus *Anabolina* as having anterior tarsi of the male "not elongated," in Ulmer's key the statement is that the first segment is longer than the second, and Döhler places *submonilifer* in the genus with the first segment half as long as the second. Banks describes a western species of *Colpotaulius* in which the black spines are lacking.

The description of *Micropterna solotarewi* (here listed under *Stenophylax*) was noted too late for inclusion of the genus in the following key. The genus has spurs, male 0-3-4, female, 1-3-4. In the males the first tarsal segment is much shorter than in the females.

## LIMNAPHILIDAE

- 1a Fore wings reaching well beyond the middle of the abdomen.....2  
 1b Wings very short, not reaching much beyond the middle of the abdomen,  
 p. 371 ..... *Psychoronia*  
 2a *Sc* of the fore wing not apparently ending in a straight crossvein running  
 from the costal margin to  $R_1$ . Discal cell of the hind wing normally  
 closed (pl. 44).....3  
 2b *Sc* of the fore wings apparently ending in a straight crossvein running from  
 the costal margin to  $R_1$  (pl. 56, fig. 5). Discal cell often not closed in  
 either pair of wings.....34  
 3a Hind wings, unless a prominent furrow of scales disturbs the venation, with  
 nine apical veins anterior to  $Cu_1$ , i.e., media with three branches (pl. 44,  
 fig. 2). Inner spur at the apex of the hind tibia of the males generally  
 not abnormal .....4  
 3b Hind wings with less than eight apical veins anterior to  $Cu_1$ , i.e., media  
 has less than three branches (pl. 55, fig. 13). The inner apical spur  
 of the hind tibia of the male is abnormally formed. Fore wings gen-  
 erally distinctly concave beyond the apex but with a convexity at the  
 tip of  $M_1$  (pl. 55, fig. 13), p. 371..... *Neophylax*  
 4a The "cord" of the fore wing not in a nearly straight line across the wing.  
 Cell  $R_2$  of the hind wing generally not pedicellate. In the males no  
 conspicuous furrow in the hind wings and no flap on the upper surface  
 of the fore wings at base.....5  
 4b The "cord" of the fore wing in a straight line (pl. 54, fig. 3). Cell  $R_2$   
 of the hind wing (male and female) pedicellate (cells  $R_4$  and  $M_1$  in the  
 female also). In the male a prominent furrow runs through the hind  
 wing and there is a flap on the base of the fore wing (text fig. 7b),  
 p. 364 ..... *Homophylax*  
 5a The distal part of  $R_1$  and  $R_2$  the fore wing not at the same time parallel  
 and strongly concave toward the tip (cf. pl. 43, fig. 2 and pl. 53, fig. 4).  
 Pterostigma of the fore wings not very conspicuous, though sometimes  
 dark; the membrane at that spot not markedly granulate. Cell  $M$  often  
 less than one-half the greatest length of the wing.....6

- 5b The distal part of  $R_1$  and  $R_2$  of the fore wing parallel and at the same time strongly concave (cf. pl. 43, fig. 2, and pl. 53, fig. 4). Pterostigma of the fore wing conspicuous; the membrane at this point granulate. Cell  $M$  half as long as the wing.....32
- 6a Postapical margin of the fore wing more or less concave (sometimes but very slightly so).....7
- 6b Margin of the fore wing beyond the apex straight or rounded, not concave .....8
- 7a Anterior margin of the fore wing not strongly convex, almost straight in the middle. Concavity of the postapical margin very well marked, generally with secondary emarginations. Hind wings not deeply incised (pl. 43, fig. 2). Vertex without distinct posterior warts. p. 312.  
*Glyphotaenius*
- 7b Anterior margin of the fore wing uniformly and rather strongly convex. Concavity of the postapical margin slight. Hind wings with a deep incision (pl. 43, fig. 4). Posterior warts on the vertex distinct. p. 314.  
*Arctocelia*
- 8a Cell  $M_1$  of the hind wing pedicellate beyond  $r-m$  (cell  $M_1$  of the fore wing sometimes so). Margin of the hind wing with a deep incision (pl. 44, fig. 2). p. 315.....*Leptophylax*
- 8b Cell  $M_1$  of the hind wing rarely pedicellate, if so, then the hind wing not very deeply incised.....9
- 9a Hind tibiae with four spurs.....10
- 9b Hind tibiae with less than four spurs.....23
- 10a Spurs 1-3-4 .....11
- 10b Spurs 1-2-4 .....22
- 11a Cell  $R_2$  of the fore wing overreaching the discal cell by a distance equal to more than twice the width of the latter. p. 356.....*Ecclisomyia*
- 11b Cell  $R_2$  of the fore wing not overreaching the discal cell by a distance equal to more than twice the width of the latter.....12
- 12a  $R_5$  of the hind wing covered with a conspicuous dark stripe. p. 316.  
*Grammotaulius*
- 12b  $R_5$  of the hind wing not darkened.....13
- 13a In the hind wing  $Sc$  and  $R_1$  are approximated near the wing margin or joined by a crossvein (pl. 44, fig. 6). p. 316.....*Astenophylax*
- 13b No crossvein or approximation between  $Sc$  and  $R_1$  near the margin.....14
- 14a Discal cell of the hind wing more than two times the length of its pedicel .....15
- 14b Discal cell of the hind wing not more than two times the length of its pedicel .....16
- 15a Cell  $R_2$  of the fore wing not overreaching the discal cell by a distance equal to the width of the latter. p. 317.....*Dicosmoecus*
- 15b Cell  $R_2$  of the fore wing overreaching the discal cell by a distance greater than the width of the latter. Genal processes prominent. p. 318.  
*Carborius*
- 16a <sup>37</sup> Fore wings narrow, the apex oblique, anterior margin nearly straight.17
- 16b Fore wings broad, the apical and the anterior margins rounded.....20
- 17a First tarsal segment of the fore leg of the male not longer than the second. Anterior spur in the form of a large, curved, black spine.....18
- 17b First tarsal segment of the fore leg of the male longer than the second. Spur of the fore leg of the male normal. p. 319.....*Limnephilus*
- 18a First segment of the fore tarsus of the male not markedly shorter than the second. p. 337.....*Anabolina*
- 18b First segment of the fore tarsus of the male markedly shorter than the second .....19
- 19a Hind wings decidedly excised beyond the apex (pl. 47, fig. 9). p. 338.  
*Colpotaulius*
- 19b Hind wings not decidedly excised beyond the apex (pl. 48, fig. 1). p. 340.  
*Rheophylax*
- 20a Preanal appendages of the male small. p. 341.....*Stenopsyche*
- 20b Preanal appendages of the male large, broad.....21

<sup>37</sup> The characters used in 16, 20, and 21 are admittedly inadequate, the genera themselves being not very clearly defined.



Antennae shorter than the wings, the basal segment as long as the head. Prothorax well developed. Spurs 1-3-4. Tibiae and tarsi with numerous spines, the last segment of the hind tarsus with black spines. Fore wings (pl. 43, fig. 2) widening toward the apex, broadly emarginate. Hind wings broad, the margin very little incised beyond the apex. In the fore wing the discal cell about one and one-half to two times as long as its pedicel.  $R_5$  of the hind wing not dark as in *Grammotaulius*. In European species the discal cell of the hind wing generally shorter than the pedicel; this not so in the one described American form.

The larvae (European species) are found in standing water. They build cases of large pieces of leaves, the dorsal and ventral parts often overreaching the sides considerably. The various types of cases made by the European species at various stages of the life history, are well described by Wesenberg-Lund (*l. c.*).

### *Glyphotaelius hostilis* Hagen

(Pl. 43, figs. 2, 3)

Hagen, 1864*b*, p. 814; Hagen, 1873*a*, p. 444

Immature stages. Lloyd, 1921, p. 43, 44, figs. 47-50; Sibley, 1926*b*, p. 107

Antennae yellow with short black hairs, the basal segment much darker. Head and prothorax brown; mesothorax brown in the middle, the sides and the patagia darker. The fore wings deeply emarginate as shown in the figure (pl. 43, fig. 2), several secondary emarginations, those nearest the apex the largest. Color of the fore wing very pale yellow clouded with brown; the costal margin almost wholly pale as far as the tip of  $Sc$ ; a rather large area including the posterior end of cell  $M_2$  mostly clear; a broad clear band obliquely across the wing from  $Sc$  to  $Cu_1$  crossing the anterior third of the discal cell and the middle of cell  $M$ ; between  $Cu_1$  and  $Cu_2$  an interrupted line of black and a similar one along the third anal vein, this latter forming the dorsal line when the wings are folded at rest; the anal region dark brown, a dark brown spot just beyond the tip of the anal veins;  $R_5$  blackened like that of the hind wing of species of *Grammotaulius*. In the hind wing the slightest indication of blackening of  $R_5$  as in that genus. The discal cell fully as long as its pedicel. Length to tip of wings 22-26 mm, expanse 42-50.

Hagen's description of the genitalia is almost wholly stated in comparisons with other species and can not easily be used. His specimens were from Saskatchewan, Great Slave lake, New England (probably White mountains) and from Michigan. I have one female from Michigan and another from Madison, Wis., June 22d. I think these doubtless belong here and the above description and the figure of the venation is from them. The figure of the genitalia is from Hagen's type. A male specimen more recently obtained shows this figure to be far from accurate.

The larva and case are described by Lloyd.

**Arctoecia McLachlan**

McLachlan, 1875*e*, p. 107; Ulmer, 1907*c*, p. 47

Antennae as long as the wings, the basal segment as long as the head. Head, pro- and mesonotum with a median longitudinal furrow. Spurs 1-3-4. Basal segment of the fore tarsi longer than the second segment in both sexes. Legs with black spines, occurring on the last tarsal as well as on the other segments. Wings slightly granulated, with very scant pubescence. In some specimens the apex of the fore wing produced and the margin excised; in others the apex shorter and the excision very slight. The anterior margin convex, more strongly so in some specimens than in others. Veins very prominent. The hind wing with the apex deeply excised. The discal cell of both wings longer than the pedicel; cell  $R_3$  of the fore wing very wide. Ventral teeth present on segments 6 and 7 in male and female, and sometimes on the fifth segment in the males.

The differences noted in the shape of the wings and the length of the apical cells are supposed to be sexual, the males being larger, with more acute wing tips. I find these variations in individuals but I do not think they are strictly correlated with sex.

**Arctoecia consocia Walker**

(Text fig. 46*a*, 48*a*; pl. 43, figs. 4-8, pl. 44, fig. 1)

Walker, 1852, p. 33 (*Limnephilus*); Hagen, 1859*c*, p. 134 (*Limnephilus*); Hagen, 1861*c*, p. 264 (*Anabolia*); McLachlan, 1863*c*, p. 157 (*Anabolia*); Banks, 1905*c*, p. 8, pl. 1, fig. 3 (*Colpotaulius medialis*); Ulmer, 1907*c*, p. 47, pl. 4, fig. 24 (*medialis*); Banks, 1907*c*, p. 37 (*Colpotaulius*); Banks, 1907*c*, p. 37 (*Colpotaulius medialis*); Banks, 1923, p. 146; Sibley, 1926*b*, p. 107  
Immature stages. Lloyd, 1921, 53-56, figs. 71-78

"Ferruginous, with pale hair; base of the antennae black; thorax with a broad black stripe; abdomen black above; feet testaceous; anterior wings testaceous, closely irrorated with whitish, the spots often confluent; veins fuscous; posterior wings subhyaline. (From the description of Walker.)

"Length to tip of wings 14 millim. Alar expanse 26 millim.

"Hab. North America." Hagen, *l. c.* p. 264.

"Head rufous, with some yellowish bristles, vertex with a short black mark on middle behind; palpi yellowish; antennae yellowish red, including basal joint; prothorax large, two and one half times as broad as long, tuberculate above, rather dull yellowish red, with a narrow, black, impressed median stripe, rest of the thorax similar in color, the black stripe extending across mesothorax, but broader; abdomen brownish yellow, paler beneath; legs pale yellowish, with black spines. Fore wings clothed with short yellow hair, indistinctly irrorated with pale brown, more distinct on anal region, costal and subcostal areas unmarked, venation red brown, very distinct; hind wings hyaline, faintly grayish at tips. The forewings are rather narrow, the outer edge oblique, the discal cell much longer than its pedicel, fork 1 barely extending upon discal

cell, fork 3 acute at the anastomosis in both wings; outer margin of hind wing strongly indented just behind end of fork 5. Expanse 27 mm." Banks, *l. c.* p. 8.

I found this species very abundant in the ravines at Lake Forest, Ill. My adult specimens vary from 12-15 mm in length to the tip of the wings, male and female. In most of them the antennae are darker toward the base.

The larva is described by Lloyd.

The species is now reported from New Hampshire, Ithaca, N. Y., Muskoka, Canada, St Paul Island, and from Lake Forest, Ill.

### **Leptophylax Banks**

Banks, 1900a, p. 252; Ulmer, 1907c, p. 37

"Spurs 1-3-4. Basal joint of antennae nearly as long as broad, antennae rather short and stout; prothorax well developed, flat above as well as the vertex of head, both traversed by a median furrow. Wings very slender, acute at tips, discal cell nearly twice as long as its pedicel, first apical cell some distance on discal cell, fifth apical short pedicellate; hind wings slender, emarginate as in *Colpotaulius*, fifth apical cell long pedicellate, first some distance on discal cell." Banks *l. c.*

The first segment of the fore tarsus is longer than the second. In Ulmer's account of this genus it is stated that the last tarsal segment of the hind leg is without spines. In the single specimen I have there is one spine on this segment on either leg.

### **Leptophylax gracilis Banks**

(Pl. 44, figs. 2-5)

Banks, 1900a, p. 252; Sibley, 1926b, p. 107, 217

"Head yellowish; a median black line on vertex, which is flat, clothed with long erect yellowish hairs, prothorax flat above, about twice as broad as long, surface tuberculate, a median black line, clothed with erect yellowish hair; antennae yellowish, apex more reddish, basal joints long, well separated; legs pale yellowish, with black spines, none on anterior face of fore tibiae, hind femora plainly shorter and stouter than middle femora, hind tibiae curved. Wings over four times as long as broad, broadest beyond anastomosis, pale yellowish hyaline, not rugulose, veins brown, a brown streak through many of the cells sometimes broken into spots, the anal margin toward base almost wholly brown, surface with scattered short yellowish hairs. Hind wings hyaline, veins yellowish. Abdomen yellowish.

"Length 16 mm.

"St Anthony Park, Minnesota (R. H. Pettit)." Banks, *l. c.*

I have this species, a single specimen taken at Grand Rapids, Mich., August 14th. It differs from the above description in two particu-

lars: the wings are not quite four times as long as wide; there are brown streaks only in cells  $Cu_1$  and  $Cu_{1a}$ , there are very faint indications of such stripes in other cells; the anal region is dark as described for the type. Figures of the male genitalia are here added (pl. 44, figs. 3-5).

Sibley reports the species from McLean, N. Y., June 23d-July 22d.

### Grammotaulius Kolenati

Kolenati, 1848b, p. 38; McLachlan, 1874, p. 37; Ulmer, 1907c, p. 38; Ulmer, 1909a, p. 116; Mosely, 1929a, p. 502, 508  
 Immature stages (specific descriptions of the European species). Ulmer, 1903d, p. 50; Silfvenius, 1904c, p. 31; Ulmer, 1909a, p. 261, 314; Lestage, 1921a, p. 722

Antennae as long as the wings, the basal segment proportionately large, somewhat longer than the head. Prothorax large. Spurs 1-3-4. Tibiae and tarsi with many spines; last segment of the hind tarsi with black spines; first segment of the anterior tarsus longer than the second. Fore wings long and narrow, the apex a little produced but not emarginate; pubescence scant. Hind wings very broad. The discal cell long in both wings, in the fore wing about twice as long as the pedicel, in the hind wing a little longer than the same; cell  $R_5$  of the hind wing a little narrower than cell  $R_3$ ;  $R_5$  rather conspicuously blackened.

#### NORTHERN AND WESTERN SPECIES

##### *Grammotaulius bettenii* Hill-Griffin

Hill-Griffin, 1912, p. 18, pl. 3, figs. 1-14 (adult and immature stages). Oregon.

##### *Grammotaulius interrogationis* Zett.

Zetterstedt, 1840, p. 1063; Hagen, 1861c, p. 254 (*Linnophilus*); Hagen, 1873a, p. 450; Ulmer, 1905a, p. 18; Mosely, 1929a, p. 508, figs. 5, 6. Greenland.

##### *Grammotaulius praecox* Hagen

Hagen, 1873a, p. 451; Ulmer, 1907c, p. 39. Great Slave Lake, Canada. Hagen thinks this may be the same as *G. interrogationis*.

##### *Grammotaulius sibiricus* McL.

McLachlan, Rev. and Syn., p. 40, pls. V, LIII, Suppl. p. IV, XVI; Martynov, 1914e, p. 205; Mosely, 1929a, p. 502. Greenland, Siberia.

Ulmer, 1907c, p. 51

### Astenophylax Ulmer

Antennae about as long as the fore wings, the basal segment as long as the head. First segment of the fore tarsus longer than the others. Spurs 1-3-4. Spines present on the last tarsal segment of the hind legs. Fore wings broadened toward the apex, the anterior margin slightly rounded. Venation well shown and, in the one American species at least, light at base, dark beyond the cord. In the hind wings  $Sc$  and  $R_1$  fused for a short distance before the tip and the small apical cell thus formed is darkened. The hind wing not much excised beyond the apex.

**Astenophylax argus** Harris

(Pl. 44, figs. 6, 7)

Harris, 1869, p. 333 (*Phryganea*); Hagen, 1873*b*, p. 295 (*Halesus*); Provancher, 1877, p. 257 (*Stenophylax*); Provancher, 1878*b*, p. 133 (*Stenophylax*); McLachlan, 1880*a*, p. XXVI (*Dicosmoecus*); Ulmer, 1907*c*, p. 51, pl. 33, fig. 5; Lloyd, 1915*b*, p. 58, pl. 6, figs. 2, 6; Sibley, 1926*b*, p. 106, 216. Immature stages. Lloyd, 1915*b*, p. 57-60, pl. 6, figs. 1, 3-5; 7-9; Lloyd, 1921, p. 57-60, figs. 79-87; Sibley, 1926*b*, p. 216.

Head yellow, the ocelli prominent because of the black margin. Antennae with the basal segment yellow, the remainder black, somewhat lighter toward the tips. Prothorax with two large warts covered with long yellow hair. Mesothorax dark brown in front with two longitudinal yellow stripes; the rear part of the segment yellow. Legs yellow with black spines and spurs, the latter somewhat reddish at their tips. On the hind legs the subapical spurs much shorter than the apicals. The fore wing with the anterior margin, including *Sc* and *R*<sub>1</sub>, almost white, the apex of the same color except for the veins; the remainder of the wing largely brown with conspicuous white stripes as follows: long interrupted ones in cells *R*<sub>1</sub>, the discal cell, and cell *R*; shorter ones in the distal end of cell *M* and in the basal ends of cells *R*<sub>2</sub>, *R*<sub>3</sub>, *R*<sub>4</sub>, *R*<sub>5</sub>, *M*<sub>1</sub> and *M*<sub>2</sub>. In the dark basal part of the wing the veins whitish, including the veins of the cord and a little beyond them; in the light apical part of the wing the veins dark brown. Hind wing transparent, with a dark area over the tip of *Sc*, and the apex very narrowly margined with brown; the veins somewhat darker toward the tip. Length to wing tips, female, 29 mm. Expanse, male, 50 mm, female, 55 mm.

Besides the venational peculiarity by which the genus has been defined it may be noted that in the fore wing the second anal vein of the fore wing and the crossvein meeting it diverge rather widely, forming nearly a straight line.

The adults are described from specimens in the New York State collection taken at Keene Valley and at North Elba, N. Y., June 20th and July 14th. I have also seen a specimen from Maine, and the species is further reported from Massachusetts.

The immature stages are described by Lloyd.

**Dicosmoecus** McLachlan

McLachlan, 1875*f*, p. 112; Ulmer, 1907*c*, p. 60

Antennae slender, hardly as long as the fore wings, basal segment shorter than the head, the other segments serrate. Spurs 1-2-2 or, more generally, 1-3-4. Spurs brown, spines black, the latter generally not present on the last tarsal segment of the hind legs; first segment of the fore tarsi longer than the second segment. Fore wings (pl. 45, fig. 1) broadly rounded, the membrane more or less granulate, pubescence generally dense, sometimes with semierect hairs, *R*<sub>1</sub> but little or not at all arched toward the tip; the discal cell long in both wings longer than the pedicel; none of the apical cells pedicellate. Preanal appendages large, sometimes with rod-like appendages on them; plates of the tenth segment close together,

probably united; claspers large, 2-segmented, the second segment movable, acute at apex, concave ventrally, the basal segment very broad and internally concave.

The species described are all western. I doubt that all are congeneric.

*Dicosmoecus atripes* Hagen

Hagen, 1875, p. 600, (*Platyphylax*); McLachlan, 1875f, p. 113 (footnote); Banks, 1904a, p. 107; Ulmer, 1905d, p. 63, figs. 11-13; Ulmer, 1907c, pl. 6, figs. 43, 44. Colorado, New Mexico.

*Dicosmoecus gilvipes* Hagen (text fig. 27 l, m, q)

Hagen, 1875, p. 601 (*Stenophylax*); McLachlan, 1875f, p. 113 (footnote). Colorado. In Hagen's collection there is a specimen from British Columbia.

*Dicosmoecus grandis* Ulmer

Ulmer, 1905d, p. 62, figs. 9, 10; Ulmer, 1907c, pl. 33, fig. 3. Washington.

*Dicosmoecus tristis* Banks

Banks, 1900a, p. 254 (*Asynarchus*); Ulmer, 1905d, p. 64, figs. 14-16 (*coloradensis*); Ulmer, 1907c, p. 60. Colorado.

*Dicosmoecus unicolor* Banks

Banks, 1897, p. 27 (*Anobolia*); Ulmer, 1907c, p. 60. Washington.

**Carborius Navás**

Banks, 1907a, p. 119 (*Allophylax*); Ulmer, 1907c, p. 52 (*Allophylax*); Ulmer, 1909a, p. 152 (*Allophylax*); Döhler, 1914, (reprint) p. 52 (*Allophylax*); Navás, 1918d, p. 362

Immature stages of the European species *Carborius dubius*. Ulmer, 1903d, p. 70 (*Stenophylax*); Ulmer, 1909a, p. 255, 313 (*Allophylax*); Lestage, 1921a, p. 703 (*Allophylax*).

"Last joint of hind tarsi without spines beneath; pterostigma not thickened nor prominent; mesothoracic strips short, not nearly one-half the length of mesothorax; fork 3 present in the hind wings; spurs 1-3-4; first apical cell reaching back on discal cell more than the width of latter; wings very broad.

"Type. *Stenophylax punctatissimus* Walker.

"Differs from *Stenophylax* in great length of the first apical cell." Banks, l. c. (*Allophylax*).

Ulmer adds that the first tarsal segment is longer than the second in both sexes, as in most of the genera.

***Carborius punctatissimus* Walker**

(Text figs. 2a; 10b; pl. 45, fig. 2)

Walker, 1852, p. 17 (*Hallesus*); Hagen, 1859c, p. 134 (*Hallesus*); Hagen, 1861c, p. 264 (*Anobolia*); McLachlan, 1871, p. 109 (*Stenophylax*); Banks, 1900b, p. 469, pl. 27, fig. 6 (*Asynarchus*); Ulmer, 1907b, p. 22, figs. 36-39 (*Asynarchus*); Banks, 1907a, p. 119 (*Allophylax*); Ulmer, 1907c, pl. 4, fig. 29 (*Allophylax*); Sibley, 1926b, p. 107 (*Allophylax*)

The following is a translation of Ulmer's description of specimens determined as this species:

"The whole body yellowish brown, including the palpi and antennae and the pubescence of the head, pronotum, and the anterior part of the mesonotum; legs, particularly the hind pair, more clear yellow, the spines black; spurs 1-3-4. Wings broad, finely granulate and rather thickly set with close-lying brownish hairs, hyaline, sprinkled with grayish brown to dark yellow, in the costal area yellowish hyaline; in the apical cells the dark spots are nearer together, the hyaline parts smaller; the apical margin brown, rounded, slightly emarginate at the veins; hind wings hyaline; veins of both wings dark yellow, fringes brown. Male genitalia yellowish brown; notum of the tenth segment bent, with short spines; preanal appendages not visible; claws of the tenth segment grown together into a plate. Penis extraordinarily large, thickened at the end and divided, with two chitinous rods which are slightly spinose; claspers large, directed upward, broad at the base, then narrowed, wider again in the middle, then narrowed, and again wider at the end and truncate. Length of body, 10 mm; expanse, 30-32 mm."

The species has the ventral angles of the genae strongly developed, forming projections easily distinguishable with a hand lens. The genitalia are as described and figured by Ulmer, the preanal appendages are not large but appear plainly in expanded examples. I have seen only the males in Hagen's collection.

The species has been reported from New York, Maryland, Nova Scotia and Alaska. In Hagen's collection are specimens from Maine and Massachusetts.

### *Limnophilus*<sup>39</sup> Leach

Leach, 1815, p. 136; Burmeister, 1839, p. 929; McLachlan, 1875*e*, p. 47; Ulmer, 1907*c*, p. 40; Ulmer, 1909*a*, p. 119.

Immature stages. For specific descriptions of European forms see references for the family.

Spurs 1-3-4. Tibiae and tarsi, including the last segment of the hind tarsus, with many black spines. Fore wings long and generally rather narrow, the costal margin somewhat rounded, the apex more or less obliquely truncate; pterostigma sometimes darkened; the pubescence generally slight. The hind wings slightly emarginate beyond the apex. In the hind wing discal cell as long as, or shorter than, its pedicel; cell  $R_5$  narrower than cell  $R_3$ . Beneath vein  $R_2$  sometimes a bunch of black bristles. On the fifth and sixth segments of the female, and the sixth and seventh of the male, often a ventral tooth. The genitalia vary greatly, the penis generally far extrusible.

<sup>39</sup> Professor Cockerell (Psyche 9, p. 124, footnote) calls attention to the fact that the generic term *Limnophilus* Burmeister is antedated by *Limnophila* Macq., 1834 (*Limnophila* Menke 1828 for Mollusca might have been added); his further statement that it is also antedated by *Limnophilus* Fitz. is based on the error of assigning Burmeister's genus to 1869 instead of to 1839. If, therefore, one regards *Limnophilus* as sufficiently distinct from *Limnophila*, Burmeister's name might stand, and this is doubtless the judgment of all the European authors who use the name in that form. I agree, however, with Professor Cockerell in the opinion that it is best to go back to *Limnophilus* Leach, 1815. The practice of the European authors is, instead, to credit the genus to Leach but to adopt Burmeister's improved form of the name.

As Ulmer (*l. c.*, p. 41) says, the characters assigned to this very large genus are more negative than positive. Several attempts at subdivision of the genus have been made but none of these is entirely satisfactory.

### *Limnephilus americanus* Banks

Banks, 1900a, p. 253

"Pale yellowish, head between antennae and basal joints of antennae beneath more reddish; thorax with a pale reddish brown stripe each side; wings yellowish hyaline, marked, chiefly in the posterior half, with light brown, before the middle of the discal cell there arises a whitish oblique mark, which cuts across the brown part, and at anastomosis another mark, which, however, does not extend completely across the brown, and before middle of the apical cells is another whitish, somewhat crescentic mark, the middle of apex of wing is hyaline, but the third cell is brown, as well as most of the subapicals; the pterostigmatic region is slightly brownish; legs pale yellowish, the spines black, except those on the anterior face of the fore tibiae, which are yellowish. Wings of moderate length, discal cell a little longer than the pedicel, first apical about its width on discal cell, fourth apical narrow at base, fifth a short distance on thyridial area, cubitals fractured at anastomosis.

"Length 14 mm.

"Idaho (C. V. Piper). One from Orono, Maine (Harvey), appears to belong to this species, but it is rather smaller and darker." Banks, *l. c.*

The types are females and I think they are the same as *L. sublunatus*.

### *Limnephilus argenteus* Banks

Banks, 1914b, p. 152, fig. 13

"Palpi brownish, face brown with black bristles; vertex dark, pale behind; antennae brownish, faintly annulate, thorax grayish brown, with black bristles and some white hairs near base of wings; abdomen black, tips of segments pale; legs pale yellowish, with black spines, no dark marks on tibiae. Wings brown, densely guttated with silvery marks, large oblique spot near the middle, several near the thyridium and in base of first subapical cell, and near base, but not extreme base, of apical cells with silvery spots, smaller silvery spots all over the wing, costal area with brown marks. Venation as in *L. gravidus*; in hind wings the fourth apical cell is plainly narrower than the second, but not acute, the crossvein from base of fork 5 up to upper median is much more convex basally, and the lower median more fractured than in *L. gravidus*. The pronotum is longer and more flat above than in that species. The hind wings are excised as in that species, and in *Colpotaulius*, but the shape of fore wings and general appearance more like *Limnephilus*.

"Expanse 35 mm.

"From Nipogon, Ont., 18th June (Walker)." Banks, *l. c.*

**Limnephilus canadensis** Banks

Banks, 1908c, p. 264, pl. 18, fig. 4

"Face brown, with yellowish and black hair, vertex brown, with stout black bristles and short yellow hairs, the discal pair between the ocelli, a pair of submedian warts behind, and an oblique one on each side near eye, all bearing long stiff black bristles. Abdomen brown, segments margined with pale behind; legs pale yellowish, with black spines, subapical spurs on hind tibiae not twice their length from tip. Wings pale, very hairy; costal area unmarked; discal area to the anastomosis brownish, with many small rounded spots, the apex and posterior region more or less brownish, and marked with pale spots, a brownish spot on the stigma. Discal cell scarcely as long as pedicel, first apical not its width on discal cell, fourth apical nearly as wide as third at base, fifth not one-half its width back of anastomosis, the tip of abdomen of the female shows above a long plate, cleft to near its apex. Expanse 21 mm.

"One from Laval Co., Canada, June 29th; another from Orono, Maine. The latter is rather more heavily marked, especially near pterostigma and along cubital vein." Banks, *l. c.*

The types are females.

**Limnephilus crassus** Banks

Banks, 1920a, p. 343, pl. 7, figs. 91, 95

"Yellowish, with yellowish hair, some brown hair each side on face and on sides of pro- and mesothorax; legs with black spines. Fore wings with pale costal space, elsewhere mostly brown, heavily mottled with pale; a large, oblique spot over thyridial cell as usual, and one in the bases of apical cells; hind wings hyaline. Ocellar macrochaetae behind ocelli, and almost as far apart as are the ocelli; radius curved at stigma; in hind wings the fourth apical cell is more than one half as wide as the third at base. The male genitalia shows a large superior plate, with two flat, divergent processes, which are brown toward tips.

"Expanse 27 mm." Banks, *l. c.* Massachusetts.

**Limnephilus despectus** Walker

(Pl. 45, fig. 3)

Walker, 1852, p. 31; Walker, 1852, p. 32 (*multifarius*); Walker, 1852, p. 33 (*perforatus*); Hagen, 1861c, p. 259; Hagen, 1861c, p. 259 (*multifarius*); McLachlan, 1863c, p. 157; (*multifarius* and *perforatus* reduced to synonymy); Hagen, 1864b, p. 838 (*perforatus*); McLachlan, 1875a, p. 90, pl. 10, figs. 1-5; McLachlan, 1876b, p. VII, pl. 27; Banks, 1908c, pl. 18, fig. 5; Banks, 1908b, p. 63; Martynov 1914c, p. 191

Immature stages. Silfvenius, 1902a, p. 68, pl. 1, figs. 15a-c, pl. 2, figs. 15d-h

"Body dark testaceous. Head and pronotum clothed with long whitish and brown hairs intermingled; eye-margins, above, silvery; posterior warts of head formed by three united tubercles, a small tubercle on each side of the disk behind the ocelli, a more prominent one on each side before the ocelli, each emitting a very strong hair, and a row of tubercles round the front of the head. Antennae yel-

lowish-testaceous, with a fine dusky ring towards the apex of each joint, and the sutures broadly paler. Palpi and legs yellowish, the latter with strong black spines. Abdomen somewhat ochreous beneath. Anterior-wings rather narrow and elongate, the apex slightly and gradually dilated, the margin not sharply truncate; the ground-color pale brownish-gray with sub-hyaline cloudings and irrorations; the costal margin to the radius, a small sub-quadrate fenestrate spot, and a larger (not well-defined) anastomosal space, and frequently a spot on the apical margin near the anal angle, sub-hyaline; a whitish hyaline dot at the thyridium; pterostigma irregular, brown, varying; there are darker fuscous spots in the area between the cubiti, and below the post-costa, and the margins are narrowly fuscous; neuration fuscous, with paler spaces, the anastomosis conspicuously fuscous; hairs of veins black, long, strong, and sub-erect on the post-costa and its basal branches; pubescence of membrane long and dense, blackish, thinner and more silvery on the pale parts; discoidal cell scarcely so long as its footstalk, all the apical cellules broad at the base, the third and fifth somewhat rounded. Posterior-wings grayish, sub-hyaline; neuration testaceous; the apical portion with slight, sparse pubescence, and the fringe evident, long on the anal portion: discoidal cell nearly as long as in the anterior, the upper branch of cubitus furcating on a level with its first third; second and fourth apical cellules truncate at base, equal, first and third angulate, longer, also equal, fifth acute, about equal to the third.

"In the male the margin of the last dorsal segment is produced in the middle into a prominence, clothed with short black setae, and this prominence is continued downward almost at a right angle, between the superior appendages, narrowing gradually, and densely clothed with short black setae. Superior appendages short, nearly oblong, yellowish, the margins darker, the apical margin truncate, oblique, and slightly excised; internally they are slightly concave, with a transverse blackish, coarsely dentate ridge, immediately below the apical margin. Intermediate appendages rather longer than the superior, in the form of two laterally broad lanceolate plates, straight and placed close together, testaceous with blackish tips and margins. Side pieces of ninth ventral segment large, yellowish, the segment continuous, but narrowed ventrally. On each side of these side-pieces is the narrow margin of the inferior appendages, ending, superiorly, in a small abrupt blackish point, scarcely prominent; there are long, distinct, blackish hairs on the margins of the side-pieces. The end of the abdomen, viewed in front, forms a large open cavity, in the middle of which are the penis-sheaths, which extend to the base of the intermediate appendages. No ventral teeth.

"In the female the ninth dorsal segment forms a small yellow triangle. Appendages placed rather close together at the base, but gradually divergent afterwards; they are rather long, sub-cylindrical, slightly dilated in the middle, the apex longly acuminate, color more or less testaceous with pale hairs. Tubular piece above divided by

an impressed line, ending in two points about the length of the appendages; laterally it is very broad, the upper edge extended into a long spine, the outer margin slightly excised; if viewed in front there is a nearly circular opening. Side pieces of ninth ventral segment triangular. Vulvar scale with a broad tongue-shaped obtuse middle lobe, and smaller and shorter side lobes. No ventral teeth.

"Length of body, 7-8 mm. Expanse, 20-22 mm.

"A comparison of these individuals with Walker's North American types (from Nova Scotia and Hudson's Bay) has not resulted in the discovery of any character whereby to separate them specifically." McLachlan, *l. c.*, p. 90.

The species has been reported from Northern Europe, Nova Scotia, Grand Lake, Newfoundland, St Martin's falls, Albany river, Hudson bay.

The following species is closely related to this and it may be the true *despectus* Walker. The European species which McLachlan identified with Walker's type has a small pointed piece (clasper) along the ninth segment that is not shown in the North American species described below. I suspect that the species next described is Walker's *despectus* and that the European form will have to be renamed. I add a figure of the genitalia of a specimen from Europe.

### *Limnephilus eminens* n. sp.

(Pl. 45, fig. 4)

Head brown with black hair. Antennae brown with lighter annulations, or sometimes uniformly yellow; short black hair on the middle of the joints. Thorax brown. Legs brownish yellow; spurs yellow, spines black; sometimes a black stripe on the first and second segments of the anterior tarsi; fore wings dark brown with white, almost silvery, areas fairly uniformly distributed, the total area of light and dark not very different. The costal area mostly white, the pterostigma generally dark; bases of cells  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_5$  and  $M_1$  white; distal ends of cells  $M_2$  and  $M_3$  white; a white spot in the middle of cell  $R$  and of cell  $M$ . The ninth dorsal segments, male, covered with spines; the preanal appendages large, somewhat acute at the lower posterior angle; the tenth segment itself divided into two long sharp blades, the upper margins of which are finely toothed; the penis of the usual type, its appendages very long and extrusible, the ends of these covered with stout spines. No teeth on the ventral segments of the abdomen. In the hind wing the discal cell about as long as its pedicel; cells  $M_2$  and  $Cu_1$  not reaching much before the middle of the discal cell. Length 12 mm. (male).

I have collected two specimens of this species at Saranac Inn, N. Y., and there are two others in the New York State Museum collected at Murray Bay, Quebec.

It is entirely possible, as already stated, that this species should be made a synonym of *L. despectus* Walker. The latter was identified by McLachlan as also occurring in Europe. The present species differs from the European in that the posterior margin of the ninth segment is not acute, and not slightly inturned (cf. pl. 45, figs. 3 and 4). If this difference is found to be constant when more specimens are studied, it will raise a doubt as to whether Walker's type of *L. despectus* agrees with this or with the European form.

### *Limnephilus extractus* Walker

Walker, 1852, p. 34; Hagen, 1861c, p. 260; McLachlan, 1876b, p. vii; Banks, 1907c, p. 36; Banks, 1908c, pl. 18, figs. 6, 7

See also *L. hyalinus* (p. 336).

"Obscure testaceous, with pale hair; apex of the antennae fuscous; palpi and feet pale testaceous; mesothorax bivittated with fuscous; abdomen fuscous above; wings dirty whitish, anterior ones with the posterior margin testaceous; veins pale testaceous. Young male. (From the description of Walker.)

"Length to tip of wings 12 millim. Alar expanse, 23 millim.

"Hab. St Martin's Falls, Albany River, Hudson's Bay (Barnston).

"May not this be *L. hyalinus*?" Hagen, *l. c.*

McLachlan (*l. c.*) in comparing *L. picturatus* (*exulans*, Iceland) with *extractus* mentions the following characters pertaining to the latter. "Body testaceous, no 'beard' on the posterior wings, the anterior wings . . . with truncate fourth apical cellule, . . . the intermediate appendages obtusely rounded at the apex." Hagen's surmise that his *hyalinus* is the same as *extractus* is therefore probably an error, as his species certainly does not have the fourth apical cell truncate.

### *Limnephilus femoralis* Kirby

Kirby, 1837, p. 253; Walker, 1852, p. 50; Hagen, 1861c, p. 260; McLachlan, 1875e, p. 72

"Black; feet testaceous, femora black; anterior wings dilute testaceous, spotted and freckled with white; posterior wings white, with the veins testaceous. (From the description of Kirby.)

"Length of body 14 millim.

"Hab. North America, latitude 65° (Richardson)." Hagen, *l. c.*

In his description of *L. nebulosus* (*l. c.* p. 72) McLachlan says, "Very likely *L. femoralis* of Kirby was only a slight variety of the same species; but I cannot trace it."

***Limnephilus indivisus* Walker**

(Text fig. 8; pl. 46, fig. 1.)

Walker, 1852, p. 34; Walker, 1852, p. 34 (*subguttatus*); Hagen, 1861c, p. 260; Hagen, 1861c, p. 261 (*subguttatus*); McLachlan, 1863c, p. 157; McLachlan, 1863c, p. 157 (*subguttatus* reduced to synonymy); Hagen, 1864b, p. 840 (*subguttatus*); McLachlan, 1875e, p. 59 (*subguttatus*); Provancher, 1877, p. 243 (*subguttatus*); Provancher, 1878b, p. 131 (*subguttatus*); Lloyd, 1915e, fig. 7; Sibley, 1926b, p. 107  
 Immature stages. Simpson, 1903b, p. 98; Lloyd, 1915e, p. 205-8, pl. 15, fig. 7; Lloyd, 1921, p. 47-51, figs. 59-66

The following are Walker's descriptions as amended in Hagen's notes:

"Pale testaceous; antennae a little obscure; anterior wings subtestaceous, sub-tuberculated, veins testaceous, pterostigma subfuscous; posterior wings hyaline.

"Length to tip of wings 15 millim. Alar expanse 28 millim.

"Hab. Nova Scotia (Redman).

"It is allied to *L. impurus*, Rambur [*L. stigma*, Curt.]." Hagen (Syn. Neur. N. Am., p. 260).

"Testaceous, with pale hair; base of the anterior wings, margin behind, and the apex subguttated with whitish, a fuscous spot at the pterostigma which is broadly surrounded with hyaline; posterior wings subhyaline.

"Length to tip of wings 12 millim. Alar expanse 23 millim.

"Hab. St Martin's Falls, Albany River, Hudson's Bay (Barnston).

"It is allied to *L. rufus* Rambur." Hagen (Syn. Neur. N. Am., p. 261).

Head and thorax yellow, with yellow hair. Antennae yellow with narrow darker annulations. Legs yellow with yellow spurs and black spines; the anterior legs with some of the segments of the tarsi with a black stripe, a similar stripe sometimes on the femur also. Fore wings yellow with brown irrorations in the posterior half and on the apex; the largest brown spot just before the apex of cell *M*<sub>3</sub> inclosing the small clear spot on vein *M*; the pterostigma somewhat darkened. In darker specimens the predominant color dark brown which then appears dotted with yellow and encloses a large pale area on the cord and an oblique one further basad; even in these specimens the anterior margin pale. The hind wing pale, the apex smoky. *R*<sub>2</sub> with a bunch of stiff bristles (the so-called "beard") at its middle point (fig. 8). The ninth dorsal segment (male) covered with black spines but not curved downward; the tenth segment consisting of a pair of pointed blades, hidden from sight by the preanal appendages; these latter large, the posterior edge somewhat dentate; the claspers present, roughly triangular in shape; the penis with very large extrusible appendages whose tips are branched and covered with very stout bristles. The abdomen toothed on the sixth and seventh ventral segments (male). Length 15 mm (male).

I took one specimen at Lancaster, N. Y., July 28th. Mr Van Duzee gave me another from Hamburg, N. Y., August 3d. Sibley reports it from McLean, N. Y., August 23d.

McLachlan (*l. c.*) in connection with his description of the European species *L. stigma* says, "The North American *L. subguttatus*, Walker is closely allied, but distinct; the intermediate appendages are very long. It possesses, as does *stigma*, the 'beard' in the posterior wings of the male." Hagen in his notes says the identity is "very possible." I have not seen males of the European species; certainly McLachlan's figures and descriptions apply well to the American species.

Lloyd has described the larva and pupa.

The species has been reported from New York, Massachusetts, Maine, eastern Canada, and Hagen's collection has specimens from Great Slave lake.

### *Limnophilus miser* McLachlan

Hagen, 1861*c*, p. 261 (*trimaculatus* Hag. *nec* Zett.); McLachlan, 1875*e*, p. 89, pl. 9, figs. 1-5; McLachlan, 1880*a*, p. VII; Ulmer, 1907*c*, p. 43

"Deep black; pronotum and wing-shoulders with long and strong silvery hairs, mixed with black; posterior warts on the head not prominent, with black hairs; face sparsely clothed with silvery hairs, the facial eye-margins narrowly silvery. Antennae fuscous, annulated with testaceous; basal joint stout for the size of the insect. Palpi dusky-testaceous. Legs testaceous, the femora usually fuscous excepting at the apex; spines few and black. Abdomen with a reddish line on each side. Anterior-wings rather narrow, gradually dilated to the apex which is very obliquely truncate; ground-color smoky-fuscous (lighter or darker according to the individual); costal margin to the radius, and as far as the pterostigma, whitish-hyaline; fenestrate spot broad and distinct, whitish-hyaline, as is also the anastomosal space, which is very large, traversed by fuscous veins, and the anastomosis also fuscous; in addition to these markings there are more or less numerous whitish-hyaline dots spread over the dark portions of the wing; pterostigma darker than the ground; neuration (excepting the sub-costa) fuscous; discoidal cell long and narrow; 4th apical cellule sub-acute at the base; hairs of veins long and black; pubescence of membrane blackish in the dark portions, silvery in the pale markings. Posterior-wings whitish-hyaline; neuration scarcely darker; pterostigma slightly dusky; fringes rather long, grayish; discoidal cell shorter; 3d apical cellule longer than the 1st, 4th sub-acute at the base; upper branch of cubitus furcating about opposite to the middle of the discoidal cell.

"In the male (the only one I have seen is in bad condition) the margin of the last dorsal segment appears to be truncate (doubtfully slightly produced in the middle). Superior appendages large, placed horizontally on each side of the dorsal margin, testaceous, the outer margin slightly rounded, the apex with a deep semi-circular excision, the lower angle of which is acute and blackish; internally there is a transverse blackish ridge extending from the lower angle to the outer margin. Intermediate appendages very large, triangular or pyramidal, pale. Side pieces of ninth ventral

segment large, with black hairs. Inferior appendages, seen from beneath, broad, short, slightly concave, yellow; the exterior angle produced into a short sharp black spine, followed, on the apical margin, by a median tooth, and this followed by another tooth forming the inner angle; the margin blackish. Penis and sheaths testaceous, arising from a deep incision on the ventral margin. No ventral teeth.

"In the female the ninth dorsal segment is not visible in dry examples. Appendages large and broad, horizontal and nearly flat, deeply furcate, the inner edge produced into a long finger-shaped process (this process usually crossing that of the opposing appendage), the outer edge terminating more obtusely and less prolonged; colour testaceous, with long fuscous hairs. (Tubular piece indistinct in my individuals.) Vulvar scale with a long, tongue-shaped, obtuse, testaceous middle lobe, and shorter inflated side lobes. No ventral teeth.

"Length of body,  $5\frac{1}{2}$ -6 mm. Expanse, 17-19 mm." McLachlan, *l. c.*

The species has been reported from Northern Europe, Iceland, St Martin's Falls, Albany River, Hudson Bay. Mosely (1929a, p. 504) adds Greenland to these localities.

#### ***Limnephilus moestus* Banks**

Banks, 1908b, p. 62, pl. 2, figs. 4, 8, 10, 11; Mosely, 1929a, p. 504, figs. 1-4 (*hingstoni*); Mosely, 1932b, p. 573

"Brown; face yellowish, vertex brown in middle; antennae pale brown, annulate with darker, basal joint not very dark; pronotum with mostly black bristles; legs pale yellowish, spines black; abdomen pale at base, black at tip. Wings brown, darker on apical part, heavily marked with pale; costal area pale, a large oblique mark across disc, base of apical cells, middle of first apical, apex of second and third sub-apicals, and a large spot behind cubitus, all pale; also many scattered, often confluent, rounded pale spots. Hind wings pale, dusky at anterior tip. A variety occurs, in both sexes, in which all the area between the median and the cubital veins is pale, and also the apical part behind the anal vein, only a few brown spots in basal part of anal region. In fore wings the discal cell is longer than the pedicel, the first apical not its width on the discal cell, the fourth very narrow at base. The superior appendages of the male are long, sub-clavate, parallel, and wide apart at base, very prominent.

"Expanse 20-24 mm.

"Many specimens from Grand Lake, Newfoundland; also from various parts of New England." Banks, *l. c.*

Mosely has described specimens from Greenland.

#### ***Limnephilus nebulosus* Kirby**

Kirby, 1837, p. 253; Walker, 1852, p. 29 (*stipatus*); Walker, 1852, p. 33 (*perforatus*, in part); Hagen, 1861c, p. 259, 261 (*subpunctulatus*, Hag. *nec* Zett.); McLachlan, 1863c, p. 157, 1875e, p. 71, pl. 10, figs. 1-5; Provancher, 1877, p. 244 (*stipatus*); Provancher 1878b, p. 132 (*stipatus*); Banks, 1900b, p. 469, pl. 28, fig. 12; Banks, 1908b, p. 63; Banks, 1908c, pl. 18, fig. 9

"Black, with white hair; antennae (at base) black mesothorax testaceous; superior wings testaceous, spotted and irrorated with

whitish, the costal area immaculate; posterior wings whitish, with testaceous veins; feet testaceous. (From the description of Kirby)

"Length of body 15 mm. Hab. North America, latitude 65°." Hagen, *l. c.*

The following is from McLachlan:

". . . . the discoidal cell of the anterior wings scarcely longer than its footstalk; the grand colour with a slightly testaceous tinge; the posterior-wings have no apical markings; discoidal cell about the length of its footstalk (the upper cubitus here also furcates at about a level with its middle); 3d apical cellule as long as the 1st and 5th, and more strongly angulate at its base.

"In the male the margin of the last segment is rounded, clothed with long black hairs, narrowly turned under and there clothed with short black setae. Superior appendages small, viewed from above oblong, fuscous, and with concolorous hairs; internally (or more properly speaking, beneath, from the position they assume) the outer margin is broadly thickened and deep black. Intermediate appendages rather longer than the superior, slender, divergent, and the tips curved slightly outward and upward, blackish, but with yellow margins and tips; seen internally they are furcate near the base, the outer branch short and broad, deep black, and not extending to the margin of the segment, the excision between the branches semicircular. Side-pieces of 9th ventral segment narrow. Inferior appendages short and broad, sub-triangular, concave within, and fringed with long black hairs. Penis yellowish, short, constricted below the apex, apical portion short and very obtuse with a small depression in the center. No ventral teeth.

"In the female the 9th ventral segment is transversely narrow, yellowish (depressed and turned downward in dead individuals). Appendages rather large, conical, yellowish, the inner edge straight, the outer edge convex, apex sub-acute, clothed with yellow hairs. Tubular piece divided to the base above, the two lateral pieces (seen from above) in the form of slender acute styles, which are isolated when viewed laterally on account of the sides being so deeply divided; lower portion short and broad, concave, the edges broadly rounded. Vulvar scale with broad obtuse middle lobe and short truncate side lobes. No ventral teeth.

"Length of body 8½-10 mm. Expanse 25-29 mm.

"Also from boreal America (lat. 65°, *Richardson*; Hudson's Bay, *Barnston*). I have compared these (all females) with those from Europe, and am convinced that all form one species; and that they are Kirby's *nebulosus* is, I think, certain. In fact it is probable that the individual indicated by *b.* in Walker's notes on *stipatus*, was Kirby's type. Very likely *L. femoralis* of Kirby was only a slight variety of the same species; but I cannot trace it. The example of *L. perforatus*, Walk., indicated as from Arctic America, is also *nebulosus*; the other type is different.

"*L. nebulosus* has a most deceptive resemblance to *pantodapus* (although always, possibly, smaller); and both are from the same European district; it is quite to be expected that *pantodapus* will also be found in boreal America." McLachlan, *l. c.*

Mosely (1929a, p. 502) records the species from Greenland.

***Limnephilus ornatus* Banks**

(Pl. 46, figs. 2, 3)

Banks, 1897, p. 27; Banks, 1900b, p. 467; Ulmer, 1907b, p. 20, figs. 30, 31, pl. 1, fig. 6; Banks, 1908b, p. 63; Ulmer, 1908e, p. 341 (listed from Japan); Nakahara, 1915, p. 95; Sibley, 1926b, p. 107; Mosely, 1929a, p. 504, 507 (*elegans*); Mosely, 1932b, p. 573, figs. 1-5; Forssluno, Ent. Tidskr., 53-57, figs a-f

"Length 20 mm. Head yellowish, clothed with whitish hair, antennae and palpi yellowish, with black hair on the former, thorax reddish, with whitish and some black hairs. Abdomen greenish, legs pale yellow, with black spines, black dot on trochanter. Wings hyaline, marked with silvery and fuscous, costal space without marks, a somewhat silvery stripe below the radius, behind this the disc is fuscous to the postcubitus, a prominent silvery stripe in the thyridial area not reaching the anastomosis, another stripe in the base of the first subapical cell, a long one in fifth, and much shorter ones in bases of third and fourth apical cells, a long silvery stripe behind the postcubitus, and the basal and anal region with some silvery hairs; basal joints of antennae about once and a half longer than broad; about nine spines basad of the subapical spurs on the hind tibiae, other tibiae thickly spined to base; anastomosis somewhat oblique, first subapical on thyridial three times as far as the first apical on discal cell, veinlet at base of the subapicals oblique, in hind wings the fourth apical cell is plainly narrower at base than the second, in one specimen the third apical is divided.

"Two females, one from Sherbrooke, Canada, (L'abbe P. A. Bégin); the other from Franconia, N. H. (Mrs A. T. Slosson). In one specimen there are a few pale spots in tips of the apical cells, and a fuscous dot in the base of the third one." Banks, *l. c.*, p. 27.

The tip of the clasper is more rounded than the figure (pl. 46, fig. 3) indicates.

My specimens of this species were taken at Saranac Inn, N. Y., and at Lake Forest, Ill., June. In the New York State collection there are also two females from Murray bay. Sibley reports it from McLean, N. Y., June 19th. Banks (*l. c.* 1900) lists the species from Popof Island, Alaska and Newfoundland (1908), and also from Hokkaido, Japan. The species occurs in Hagen's collection under the manuscript name "*L. argenteo-maculatus*, Say Coll. Harris," with specimens from Maine, Mass., and Illinois. Ulmer (*l. c.*) lists it doubtfully from Japan and gives figures of the genitalia. Mosely lists it from Greenland. I add the following notes.

Color in general as in the above description. The light areas of the fore wings located as follows: a long one bordering  $R_1$  posteriorly for most of its length, a dark stripe just back of this; in cells  $R_2$  and  $R_3$ ; in most of the region between  $Cu_1$  and  $3d A$ . The following are more decidedly silvery white: a long stripe bordering the discal cell posteriorly, the basal parts of cells  $R_5$ ,  $M_1$  and  $M_2$ ;

these stripes varying somewhat in length, that in cell  $M_3$  reaching distally to the anterior end of the one in cell  $M_1$ , the latter reaching farther toward the apex than any of the others. Besides the black line in cell  $R_1$  dark stripes in cells  $R$ ,  $R_5$ ,  $M_1$ ,  $M_2$  and  $M_3$ , immediately beyond the white stripes in those cells; another short black stripe at the base of the wing and an indistinct one back of the anal vein. The preanal appendages (pl. 46, fig. 3) large; with two branches, the upper of which is straight, the lower curving inward so that its black tip is below the upper branch as seen from above (pl. 46, fig. 2). The claspers broad at base, narrowed distally. The penis of the usual form with two extrusible appendages each tipped with a brush of stout bristles.

### *Limnephilus partitus* Walker

Walker, 1852, p. 32; Hagen, 1861c, p. 261 (placed as synonym of *trimaculatus* Zett.); McLachlan, 1863c, p. 157; McLachlan, 1875e, p. 79; McLachlan, 1880a, p. XXI

"Black, with a gray covering, clothed with pale hairs; antennae ferruginous; 1st joint black; legs ferruginous; wings colorless; fore wings with an irregular brown stripe near the hind border, this stripe is obliquely interrupted before the middle, a little beyond which it contains two colorless dots; a brown spot on the parastigma, and another on the 2nd, 3rd and 4th apical areolets; veins brown. Length of the body  $3\frac{1}{2}$  lines; of the wings 11 lines.

"Hab. St. Martin's Falls, Albany River, Hudson's Bay." Walker, *l. c.*

McLachlan (*l. c.*, p. 157) says that Hagen's identification of the insect with *L. trimaculatus* Zett. was an error.

### *Limnephilus plaga* Walker

Walker, 1852, p. 35; Hagen, 1861c, p. 263; McLachlan, 1863c, p. 157, Provancher, 1877, p. 244; Provancher, 1878b, p. 132

"Testaceous, with pale hair, and longer black pile; anterior wings pale testaceous, a large, subquadrate, fuscous spot behind the middle; the apex subreticulated with fuscous, and with two patches of fuscous. (From the description of Walker.)

"Length to tip of wings 13 millim. Alar expanse 21 millim.

"Hab. Nova Scotia (Redman)." Hagen, *l. c.*

McLachlan (*l. c.*) quotes Hagen, "Probably recently developed, and perhaps *despectus*."

Banks has a specimen which he regards as this species. It answers the description well. So far as the genitalia in this specimen are shown they are like those of *despectus*.

### *Limnephilus planifrons* Kolenati

Kolenati, 1848b, p. 56 (*Desmotaulius*); Walker, 1852, p. 36; Hagen, 1861c, p. 263; Banks, 1907c, p. 36 (*Desmotaulius*)

"Fuscous, with luteous hairs; antennae brown, annulated with luteous; head with two tubercles posteriorly, prothorax, and a double

stripe upon the metathorax, luteous; feet luteous, with black spines; anterior wings broader, luteo-fuscous, with fuscous hair, obsoletely marked with luteous; at the posterior margin the veins elevated fuscous; posterior wings luteo-hyaline.

"Length to tip of wings 14 millim. Alar expanse 25 millim.

"Hab. Greenland; Labrador (Collection of Hagen)." Hagen, *l. c.*

### *Limnephilus pulchellus* Banks

Banks, 1908*b*, p. 63, pl. 2, figs. 5, 9; Sibley, 1926*b*, p. 107, 216

"Black; antennae brownish, annulate with black, basal joint dark; pronotum with yellow bristles; femora black, rest of legs yellowish, spines black. Wings hyaline whitish, or soiled luteous, marked with dark brown; a spot on stigma, a mark occupying more than apical half of apical cells (except the first), and containing several rounded, hyaline spots, a large brown spot on subapicals, usually leaving a hyaline space in base of first, and apex of first and second, a long hyaline spot near arculus, region between anal and cubital veins, pale brown; a large spot below radial sector from its base one-third way out on the discal cell, containing a few pale spots, the radial sector, its branches, and the anastomosis heavily dark brown; usually a little brown on discal cell; and a brown triangular spot from radius to discal cell containing two hyaline spots; hind wings hyaline. Discal cell of fore wings not as long as pedicel; first apical not its width on discal. The subapical spurs of hind tibiae fully twice their length from the tip.

"Expanse 16 mm.

"Several from Grand Lake, Newfoundland." Banks, *l. c.*

Sibley lists the species from McLean, N. Y., July 22d.

### *Limnephilus rhombicus* L.

(Pl. 46, fig. 4)

Linnaeus, 1746, p. 224 (*Phryganea*); Leach, 1815, p. 136; Pictet, 1834, p. 148 (*Phryganea*); Kolenati, 1848*b*, p. 45 (*Chaetotaulius*); Walker, 1852, p. 22; Walker, 1852, p. 28 (*combinatus*); Hagen, 1859*b*, p. 76 (*Chaetotaulius*); Hagen, 1861*c*, p. 254, 255 (*combinatus*); McLachlan, 1863*c*, p. 156 (*combinatus* reduced to synonymy); McLachlan, 1875*e*, p. 48; Wallengren, 1891, p. 41; Ulmer, 1907*c*, pl. 32, fig. 4; Ulmer, 1909*a*, p. 122; Vorhies, 1909, p. 661, pl. 55, figs. 3-6; Martynov, 1914*e*, p. 187; Lloyd, 1915*e*, pl. 15, figs. 9, 13 (*combinatus*); Sibley, 1926*b*, p. 107

Immature stages. Struck, 1899, fig. 186; Struck, 1900, p. 265; Ulmer, 1901*a*, p. 224; Silfvenius, 1902*a*, p. 43; Struck, 1903, p. 34; Ulmer, 1903*b*, p. 197; Ulmer, 1909*a*, p. 207; Vorhies, 1909, p. 661, pl. 52, fig. 7, pl. 55, figs. 7, 8; Lloyd, 1915*e*, p. 203-5, pl. 15, figs. 6, 10, 14 (*combinatus*); Lloyd, 1921, p. 44-47, figs. 51-58 (*combinatus*)

"Head and thorax reddish, antennae and palpi paler; hairs golden, sparse. Legs reddish-testaceous, spines black. Abdomen above fuscous or fuscous-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-colour 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 irregular 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 anal 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 greyish 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 setae. Superior appendages very large, elongately oval, yellow, very convex externally, and with the upper and lower margins considerably rolled inward; 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 end of the abdomen, short, obtuse, straight, 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 ninth 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 ninth ventral segment conical. Vulvar scale with the median lobe longer than the lateral. A short broad triangular tooth on the middle of the sixth ventral segment, and an indication of a similar tooth on the fifth.

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

The immature stages are described by Vorhies and by Lloyd. The European larvae have also been described.

The identity of the European and American forms is well enough established by Vorhies and by Ulmer (quoted by Vorhies) and is confirmed by my own study of American and European specimens. McLachlan long ago expressed the opinion that the species were probably identical and he also pronounced *L. combinatus* Walker, a synonym.

The species has been taken in Greenland, Newfoundland, Maine, New York, Wisconsin, Saskatchewan.

Dr Lloyd tells me that the adult is salmon-pink in color when alive but that the pink color disappears soon after the insect dies.

### ***Limnephilus sackeni* Banks**

Banks, 1930*b*, p. 227, fig. 6

"Yellowish, abdomen more dull brown, spines on legs black, but a few inner ones near base of front tibiae are yellowish; hair yellowish, some black on sides of face and under antennae. Wings yellowish, fore wing with brown marks on plan of others of this section, the anal margin brown, streak through middle of wing, broken by the oblique hyaline spot beyond middle, region before and beyond anastomosis hyaline, surrounded with brown, which extends above to tip and below to the outer angle, stigma dark. Legs very slender, basal joint of tarsus of front legs about one-half of the tibia, but it is not equal to second plus third joint.

"Male genitalia has the superior appendages rather long, reaching beyond lower appendages which are slender, the intermediate appendages are curved and much more slender than usual.

"Expanse 31 mm.

"From Sault de Ste. Marie River, 8 Sept. (O. Sacken)." Banks, *l. c.*

### ***Limnephilus sublunatus* Provancher**

Provancher, 1877, p. 243; Provancher, 1878*b*, p. 131; Banks, 1908*c*, p. 263, pl. 18, fig. 10 (*macgillivrayi*)

"Head yellow, with yellow and white hairs; antennae and palpi pale yellowish; thorax yellow, with yellowish hair; abdomen brown, appendages yellowish; legs pale yellow, with black spines, a few yellow ones on front pair. Wings unmarked on anterior third, beyond yellow-brown, with an oblique thyridio-discal spot, another in base of first subapical and up to front of the anastomosis, another in base of apical cells, and one in apical part of the fourth and fifth apicals and the first and second subapical cells, all pale; a few smaller dots in the brown; hind wings hyaline, venation yellowish. In fore wings the discal cell is as long as the pedicel, the first apical scarcely its width on discal, the fifth hardly before the anastomosis;

in hind wing the second, third and fifth apicals subequal at base, the fourth much narrower. Expanse 25 mm.

"From Axton, Adirondack Mountains, New York, June 12-22nd (A. D. MacGillivray).

"Very distinct by shape of superior appendages of male." Banks, *l. c.*

In Hagen's collection there are several specimens from Fort Resolution, Great Slave lake (Kennicott) and also some of Provancher's specimens from Quebec. My notes on the coloration of the wings follow:

An oblique silvery spot across the middle of cells *R* and *M*<sub>1</sub>. A roughly triangular silvery spot with its apex in the base of cell *R*<sub>2</sub> and its base in cells *M*<sub>1</sub> and *M*<sub>2</sub>, enclosing the cord in that region; the basal and posterior parts of the wing brown, the anterior part and apex lighter; from the middle of the triangular silvery area a dark line through cell *R*<sub>4</sub> enclosing a row of lighter spots; along the margin and posterior to the dark line a broad lunate or semi-circular pale area. In Provancher's specimens in Hagen's collection a dark band in cell *R*<sub>3</sub> as well as in cell *R*<sub>4</sub> and not more than one light spot in each band. Preanal appendages bordered with black, long, but may be contracted considerably.

### *Limnephilus tersus* n. sp.

(Text figs. 5*d*, 9*h*; pl. 46, figs. 6-8, pl. 47, figs. 1-5)

Head brown with yellow and some black hair. Antennae brownish yellow with very short black hair in the middle of the segments. Mesothorax brown with two longitudinal patches of golden hair. Legs yellow, the spurs yellow, spines black. Fore wings with a pattern of white and brown; the anterior margin clear white as far back as to include the discal cell and as far distally as the end of that cell, this area including distally the bases of cells *R*<sub>2</sub>, *R*<sub>3</sub>, *R*<sub>4</sub>, *R*<sub>5</sub>, *M*<sub>2</sub> and *M*<sub>3</sub>, and the posterior end of cell *R*; a little more anteriorly an oblique continuation running to *Cu*<sub>1</sub>, back of which often another clear area. The color areas subject to much variation; the clear costal margin, at least at base, the clear spot in the middle of the disk at the cord, and the oblique clear band seemingly constant in occurrence though not in shape. No "beard" on the hind wing. The ninth segment dorsally beset with spines; the preanal appendages large, the posterior margin several times emarginate; the claspers relatively prominent, the upper posterior angle sharp; the penis with appendages whose broadened distal ends are covered with long stout bristles, these latter in two groups, the proximal ones yellow, the distal ones black; the appendages broadly joined to the penis.

Most of my specimens were collected at Old Forge (Bald Mountain pond) where the adults began to appear about August 18th. I have the species also from Ithaca, N. Y.

The following two species I can not identify and the material of neither is sufficient to serve as type.

**Limnephilus sp. 1**

(Pl. 47, fig. 7)

Head and thorax yellow, with yellow hair. Antennae of the same color with very indistinct darker rings. Legs yellow, the spurs of the same color, spines black; anterior tarsi with a black stripe in the first and second segments internally. Fore wings very pale yellow, transparent, the posterior margin a little darker. Hind wings pale. In the hind wings the apex of cell  $M_3$  before that of the discal cell. The preanal appendages rounded above, the lower posterior angle more sharply rounded. Between the preanal appendages which are slightly inturned above, a pair of black blades probably representing the tenth segment, not visible from the side. Claspers deeply concave on the upper posterior margin; the penis with two long extrusible appendages and on each of these again a rather long sharp appendage, itself bifid. The margin of the ninth dorsal segment beset with spines as in many other species, but the area so covered not large. No "beard" on the hind wing. The sixth and seventh ventral segments (male) toothed. Length 13 mm.

A single male specimen in the New York collection, labeled, "Long Lake, New York, August 19."

**Limnephilus sp. 2**

(Pl. 47, fig. 6)

I include a figure of another species of which I have only parts of one specimen collected at Ithaca, N. Y.

Other American species are:

*Limnephilus abbreviatus* Banks

Banks, 1908c, p. 263, pl. 18, fig. 8. Colorado.

*Limnephilus adustus* Banks

Banks, 1920, p. 343, pl. 7, fig. 93, Banff, Alberta, Canada.

*Limnephilus aequalis* Banks

Banks, 1914b, p. 150, pl. 9, fig. 14, pl. 10, fig. 31. British Columbia.

*Limnephilus bifidus* Banks

Banks, 1908c, p. 263, pl. 18, figs. 11, 13-15. Washington. British Columbia.

*Limnephilus clausus* Banks

Banks, 1924, p. 440, fig. 56. Colorado.

*Limnephilus cockerelli* Banks

Banks, 1900c, p. 124; Banks, 1904a, p. 107. New Mexico.

*Limnephilus coloradensis* Banks

Banks, 1899, p. 208 (*Goniotaulius*). Colorado.

*Limnephilus concolor* Banks

Banks, 1899, p. 207. Washington.

*Limnephilus consimilis* Banks

Banks, 1900a, p. 253. Colorado.

*Limnephilus elongatus* Banks

Banks, 1920, p. 344, pl. 7, figs. 92, 94, 98, 99, Fort Resolution, Great Slave lake, Canada.

*Limnephilus externus* Hagen

Hagen, 1861c, p. 257; McLachlan, Rev. and Syn. (1857), p. 56, pl. 8 (*congener*); Banks, 1899, p. 207 (*luteolus*); Ulmer, 1932a, p. 324, figs. 1-3. Washington, North Red river, Finland, Siberia. (Hagen regarded *externus* and *congener* as synonymous. This is confirmed by Tjeder (1930b) and Ulmer shows that all three species are the same.)

*Limnephilus flavastellus* Banks

Banks, 1918, p. 20, pl. 1, figs. 16, 17. Wellington, British Columbia.

*Limnephilus forcipatus* Banks

Banks, 1924; p. 439, fig. 45, Alberta.

*Limnephilus gravidus* Hagen

Hagen, 1861c, p. 257; McLachlan, 1863c, p. 156; Banks, 1899, p. 208; Banks, 1900b, p. 467; Ulmer, 1907c, p. 44 (footnote), pl. 32, fig. 5, Alaska, Vancouver, Washington. In Hagen's collection there are specimens from California, Nevada. See also *vastus*, below.

*Limnephilus griseus* L.

McLachlan, Rev. and Syn., Suppl., p. 85; Silfvenius, 1902a, p. 65; Ulmer, 1907c, pl. 31, fig. 10; Martynov, 1914e, p. 193; Mosely, 1929a, p. 507. Greenland and Alaska, the latter record very uncertain.

*Limnephilus hageni* Banks

Banks, 1930b, p. 226, figs. 7-9. Ft. Resolution, Canada.

*Limnephilus harrimanni* Banks

Banks, 1900b, p. 468, pl. 27, figs. 1, 2, Alaska.

*Limnephilus hyalinus* Hagen (pl. 45, fig. 5)

Hagen, 1861c, p. 258; McLachlan, 1863c, p. 157; Hagen, 1864b, p. 843; McLachlan, 1876b, p. VII, North Red river, Canada. (Hagen latterly regarded this as a synonym of *extractus* but McLachlan calls attention to the fact that *extractus* is described as having the 4th apical cell of the fore wing truncate while in *hyalinus* it is said to be acute.)

*Limnephilus intermedius* Banks

Banks, 1918, p. 20, pl. 1, fig. 11. Olympia, Washington.

*Limnephilus kennicotti* Banks

Banks, 1920, p. 344, pl. 5, fig. 69, pl. 7, fig. 88, Great Slave lake, Canada.

*Limnephilus kincaidi* Banks

Banks, 1900b, p. 468, pl. 27, fig. 5; Banks, 1923, p. 146. Alaska.

The type in the National Museum is largely destroyed. A male paratype has the "beard" in the wing; the type does not have this but it may be a female.

*Limnephilus morrisoni* Banks

Banks, 1920a, p. 343, pl. 1, fig. 5, pl. 3, fig. 32, pl. 7, fig. 96, Reno, Nevada.

*Limnephilus occidentalis* Banks

Banks, 1908c, p. 264, pl. 18, figs. 1, 3. British Columbia, Washington.

*Limnephilus oslari* Banks

Banks, 1907a, p. 121, pl. 9, fig. 19. Colorado.

*Limnephilus perjurus* Hagen

Hagen, 1861c, p. 258; Banks, 1900b, pl. 28, fig. 14. Alaska.

*Limnephilus productus* Banks

Banks, 1914b, p. 150, pl. 10, figs. 29, 36. Utah.

*Limnephilus radiatus* Say

Say, 1824, p. 308 (*Phryganea*); Hagen, 1861c, p. 256; Banks, 1899, p. 206. Washington.

*Limnephilus roberti* Banks

Banks, 1930b, p. 226, figs. 10-12. Winnipeg Lake.

*Limnephilus rohweri* Banks

Banks, 1908c, p. 262, pl. 18, fig. 2, Colorado.

*Limnephilus rotundatus* Banks

Banks, 1918, p. 19, pl. 1, fig. 14, Lake Tahoe, California.

*Limnephilus sansoni* Banks

Banks, 1918, p. 19, pl. 1, fig. 8, Banff, Alberta.

*Limnephilus secludens* Banks

Banks, 1914b, p. 152, pl. 9, fig. 17, pl. 10, fig. 27. Saskatchewan, British Columbia.

*Limnephilus sericeus* Say

Say, 1824, p. 309 (*Phryganea*); Hagen, 1861c, p. 256 (doubtfully referred to this genus). Northwest Territory.

*Limnephilus sitchensis* Kolenati

Kolenati, 1859a, p. 17; Kolenati, 1859b, p. 276; Hagen, 1861c, p. 263; Banks, 1899, p. 207 (*pacificus*); Banks, 1900b, p. 468, pl. 27, fig. 8, pl. 28, fig. 15; Ulmer, 1905c, p. 7, pl. 1, figs. 2, 3. Alaska, Washington, Oregon.

*Limnephilus spinatus* Banks

Banks, 1914b, p. 149, pl. 8, figs. 8, 9. Utah.

*Limnephilus tonssainti* Banks

Banks, 1924, p. 439. Haiti.

*Limnephilus vastus* Hagen

Hagen, 1861c, p. 257; Banks, 1907c, p. 37 (listed as "*=gravidus*"). Alaska.

**Anabolina** Banks

Banks, 1903a, p. 244; Ulmer, 1907c, p. 38

Prothorax extremely short. Spurs, male 1-3-4, female, 1-3-3; the inner spurs, at least of the female, much longer than the outer, very slender and somewhat curved; spines numerous; hind tarsus has spines on the last joint; anterior tarsi of the male not elongated.

Fore wings narrow, but little broadened distally, the venation as in *Limnephilus*, the discal cell long. The pterostigma is quite distinct in the fore wing. The hind wing is excised beyond the apex.

The fore leg of the males has the abnormal spur and the spines peculiar to the allied genera. The first tarsal segment of the male foreleg is equal to the second, in the female it is larger. In Ulmer's key (*l. c.*, p. 33) the first segment is said to be larger than the second.

Banks erected this genus on a western species (*diversa*). According to McLachlan's note on Walker's *perpusillus*, that species must also be included. The only small eastern species known to me that seems to answer the following description has the first segment of the male tarsus very short and accordingly falls into the genus *Colpotaulius* (*q. v.*).

### *Anabolina perpusillus* Walker

Walker, 1852, p. 35 (*Limnephilus*); Hagen, 1861c, p. 254 (*Limnephilus*); McLachlan, 1874, p. 36 (*Colpotaulius*); Banks, 1908b, p. 61 (listed from Newfoundland)

"Testaceous, with testaceous hair; antennae fulvous; anterior wings narrow, the apex a little acuminate, subttestaceous, posteriorly and the apex obscurely guttated; veins fulvous; posterior wings whitish. (From the description of Walker.)

"Length to tip of wings 7 millim. Alar expanse 13 millim.

"Hab. St Martin's Falls, Albany River, Hudson's Bay (Barnston).

"It is very closely allied to *Colpotaulius incisus* Stephens." Hagen, *l. c.*

Hagen and McLachlan (*l. c.*) referred this species to the group of *Colpotaulius* and the latter called attention to the fact that the first tarsal segment on the fore leg of the male was equal to the second in length.

One western species is recorded.

### *Anabolina diversa* Banks

Banks, 1903a, p. 244, pl. 4, fig. 5; Banks, 1904a, p. 108; Ulmer, 1907c, pl. 3, fig. 15. Arizona, New Mexico.

### *Colpotaulius* Kolenati

Kolenati, 1848b, pl. 1, p. 47; McLachlan, 1874, p. 34; Ulmer, 1907c, p. 36. Immature stages of the European species. Struck, 1899, p. 198; Struck, 1900, fig. 4; Ostwald, 1901, p. 107; Struck, 1903, pl. 1, fig. 6; Ulmer, 1903d, p. 49; Ulmer, 1909a, p. 262, 314; Lestage, 1921a, p. 707

Antennae about as long as the wings, moderately stout. Spurs 1-3-4 in male and female. In the males, the spurs of the foreleg abnormal, forming a stout, curved, black spine. Tibiae of the foreleg fitting into grooves in the femora, these grooves margined with black spines. The first segment of the male tarsus very short, that of the female longer than the second. Fore wings elongate, sometimes acute. Hind wings deeply excised beyond the apex.

Not to multiply closely related genera, I place the following species here though it does not agree with the European species in the shape of the fore wings or in the length of the discal cell.

### *Colpotaulius* sp.

(Pl. 47, figs. 8, 9)

Expanse 15 mm, male. Head brownish yellow except a circle around the ocelli. Antennae yellow, the basal segment brownish. Legs yellow except for the black spines and the usual black spot on the trochanters. Wings pale anteriorly, dark back of the cubitus; the entire apical region, cell  $M_1$  and part of cell  $Cu_1$ , crowded with pale spots. The veins dark brown interrupted by the pale spots. Venation as figured.

These notes apply to Hagen's specimen from Hudson bay and the drawings are from a specimen given me by Mr Banks, from Newfoundland. I should not hesitate to identify it as *Anabolina perpusillus* except for McLachlan's note on that species. Hagen doubtless had the same opinion for on the label of the specimen here described he wrote, "Agrees with *C. incisus* (Europe) but not with McL.'s indications for *C. perpusillus*." McLachlan's indications referred to are doubtless his statement that the first and second tarsal segments of the male of *perpusillus* are equal.

Two western species are known.

#### *Colpotaulius minusculus* Banks

Banks, 1924, p. 439, fig. 52. Colorado.

#### *Colpotaulius tarsalis* Banks

Banks, 1920a, p. 342, pl. 7, fig. 104. Colorado. (Lacks black spines on first femur.)

### *Zaporota* Banks

Banks, 1920a, p. 342.

"Related to *Colpotaulius*, but the spurs 0, 2, 2, and the pronotum short. The male palpi are very short, the second and third joints together scarcely as long as width of face from eye to eye; the front tibia faintly curved in the male, almost without spines except two close together at inner tip; front femora with short dense hair beneath; legs with few spines, last joint of hind tarsus with several distinct spines beneath; no ocellar macrochaetae; pronotum short; bristles of mesonotum in well-defined strips. Venation of type usual in family, fore wings with rounded tip, membrane not granulate; hind wings scarcely incised at end of cubitus." Banks, *l. c.*

One Alaskan species is reported.

#### *Zaporota pallens* Banks

Banks, 1920a, p. 342, pl. 7, fig. 105. Demarkation Point, Alaska.

### Rheophylax Sibley

Sibley, 1926b, p. 107.

Generic characters like those of *Limnophilus* except in the structure of the fore leg of the male; like those of *Colpotaulius* (Europe) except that the hind wing is not deeply excised and that the fore wing is less acute (pl. 48, fig. 1). Wings shaped as in *Limnophilus* and venation as in that genus. Spurs 1-3-4, male and female. In the male the fore leg abnormal in several respects. The femur has an internal groove margined with a row of very many stout, black spines; the tibia also margined with spines but these are of a much broader type (fig. 6b); the apical spur of the fore leg in the form of a long curved spine; the first segment of the tarsus shorter than any of the other segments; on the inner side of the distal end of the femur a large black bristle.

Type *Rheophylax submonilifer*.

The generic name, used in this manuscript for many years, was, with others, inadvertently validated.

### Rheophylax submonilifer Walker

(Text fig. 6b; pl. 48, figs. 1, 2)

Walker, 1852, p. 33 (*Limnophilus*); Hagen, 1861c, p. 260 (*Limnophilus*); Hagen, 1861c, p. 262 (*Limnophilus pudicus*); McLachlan, 1863c, p. 157 (*Limnophilus*); Hagen 1864b, p. 816 (*Goniotaulius pudicus*); Hagen, 1873b, p. 295 (*Limnophilus pudicus*); Provancher, 1877, p. 243 (*Limnophilus pudicus*); Provancher, 1878b, p. 132 (*pudicus*); Banks, 1907c, p. 37 (*pudicus* reduced to synonymy); Banks, 1908c, pl. 18, fig. 12, 16 (*Limnephilus*); Banks, 1908b, p. 63 (*Limnephilus*); Vorhies, 1909, p. 666, pl. 54, fig. 18, pl. 55, figs. 1, 2 (*Limnephilus*); Döhler, 1915, p. 407, figs. 15, 16 (*Anabolina*); Sibley, 1926b, p. 107

Immature stages. Vorhies, 1909, p. 667, pl. 52, fig. 4, pl. 54, figs. 19-21; Lloyd, 1921, p. 51-53, figs. 67-70 (*Limnophilus*)

Antennae very dark brown, almost black, with narrow, light annulations, the basal segment about equal to the head in length, black, with some short yellow hairs. Ocelli light in color. Head covered with long black hair. Prothorax small, with black hair; mesothorax black with two longitudinal patches of long black hair. Legs brownish yellow, the coxae with yellow hairs along the margins; spurs, except the anterior one in the male, yellow; spines black. The anterior spur of the male as described for the genus. In the male the first segment of the anterior tarsus less than one-half the length of the second segment, in the female this segment the longest. Male femur and tibia of the first legs as described for the genus. The color of the wings varying considerably. In general the predominant color a slightly brownish yellow. The apex and the middle of the wings brown with yellow spots; the veins dark brown with many yellow spots; a light area just beyond the cord and another slightly oblique band in the middle of the wing like that found in many species of *Limnephilus*; the pterostigma commonly conspicuously dark as are stripes immediately back of  $R_1$ ,  $Cu_1$  and  $3d A$ , these all interrupted with yellow. In some cases the brown

color of the wings predominates; the interrupted dark color of the veins and of the stripes back of the three veins mentioned above apparently constant characters. Long black hairs on the anal veins and on the patagia. No ventral teeth on the abdomen. The preanal appendages triangular, the apex rounded, the posterior margin slightly concave; the claspers fairly large, the upper edge concave; the penis of the type usual in the family, the appendages very slender, stiff rods with bristles particularly at the ends. Length to tip of wings, male, 12-15 mm, female, 12-15 mm.

The immature stages are described by Vorhies and by Lloyd.

This species is common and widely distributed and it seems strange that the peculiar anterior legs of the male should have escaped attention until now. The species has been reported from Newfoundland, New Hampshire, Massachusetts, New York, Washington, D. C. and Wisconsin. Hagen had specimens from Maine, Maryland, Michigan and Rhode Island; my own are from New York, Illinois and Colorado. At Lake Forest, Ill., the species occurs commonly in May and June, and again in August and September, as if there were two broods as Vorhies has suggested.

From the figure of the male genitalia I am doubtful that Döhler's material from Tennessee is of the same species.

### Stenophylax Kolenati

Kolenati, 1848b, p. 62; McLachlan, 1875f, p. 114; Banks, 1905c, p. 9 (*Pycnopsyche*); Ulmer, 1907c, p. 48; Ulmer, 1907c, p. 51 (*Pycnopsyche*); Banks, 1914b, p. 154 (*Anisogamus*); Banks, 1916a, p. 122 (*Eustenace*)  
Immature stages. Ulmer, 1903d, p. 63, 70; Silfvenius, 1902a, p. 79; 1904c, p. 61; Thienemann, 1905b, p. 31; Lestage, 1921a, p. 765

Spurs 1-3-4. The first segment of the fore tarsus longer than the second; spines generally present on the last segment of the hind tarsus, *S. divergens* and *S. antennatus* being cited as exceptions by Banks. Fore wings much broadened distally, the apex rounded or parabolic. Hind wings broad, not emarginate. In the fore wing  $R_1$  somewhat arched toward the tip. In the hind wing cell  $R_5$  as broad as cell  $R_3$ . None of the apical cells pedicellate in either wing. The larvae in swift water. The tracheal gills single.

This is a large genus and still a troublesome one even after its simplification through the erection of new genera by McLachlan (*l. c.*). I have four species which are easily separated by the shape of the ninth segment and of the genital parts. The figures of the former structures that are here given are from balsam mounts in which the parts are pressed flat; they should therefore not be taken to represent ordinary dorsal views.

Banks (Can. Ent., 46, p. 154) apparently removes *S. gentilis* together with his *Asynarchus costalis* and two new species to the genus *Anisogamus*. *S. gentilis* does not have the wings different

in shape in the sexes and since this most striking feature of *Anisogamus* is not mentioned I prefer to retain these species here.

Banks also erects a new genus *Eustenace* for *limbatus* and *gentilis*, indicated as having the discal cell not extending basad of the fork of media. I do not believe this will hold, at least not for *gentilis*.

### **Stenophylax divergens** Walker

Walker, 1852, p. 30 (*Limnophilus*); Hagen, 1861c, p. 255 (*Limnophilus*); McLachlan, 1863c, p. 156, 161

"Testaceous, clothed with pale hair; antennae ferruginous; the anterior wings closely dotted with ferruginous tubercles, the apex sub-fuscous; a broader tubercle at the base of the third apical areole; posterior wings whitish. (From the description of Walker.)

"Length to tip of wings 18 millim. Alar expanse 34 millim.

"Hab. North America." Hagen, *l. c.*

McLachlan quotes from Hagen's notes, "superior (dorsal) appendages bituberculated, bifid; app. inf. elongated adpressed, apex drawn out, fuscous."

Two specimens in the Cornell University collection and one in the New York State collection labeled, "Davidson's R., North Carolina, September 18," have been determined as this species but I believe that they represent *Stenophylax gentilis*.

### **Stenophylax flavatus** Banks

Banks, 1914b, p. 154, pl. 10, figs. 32, 33

"Yellowish with yellowish hair; palpi and antennae yellowish; ocelli rather large, no ocellar macrochaetae; legs yellow, spines black, tibia I densely spined to base, two stout spines at tip of femur I; hind tibiae of male curved; abdomen brown, the segments pale on tips. Wings uniformly pale yellowish, with yellowish veins and hair, tip of thyridial cell, and back to and lower anastomosis dark brown. In fore wings the discal cell is plainly longer than the pedicel, fork I nearly its width back on discal cell, fork 3 broad at base, lower median not fractured at base of fork 5; radius barely sinuate before stigma. Hind wings have forks I and 3. Both more acute at base than in fore wings.

"Expanse 40 mm.

"From Pisgah Forest, North Carolina, August. Resembles *Anisogamus divergens* Walk. but the male has not the black dorsal plate so characteristic of that species." Banks, *l. c.*

### **Stenophylax gentilis** McLachlan

(Pl. 48, figs. 3, 4)

McLachlan, 1871, p. 108; Provancher, 1877, p. 258; Provancher, 1878b, p. 133;

Banks, 1916a, p. 122 (*Eustenace*)

Immature stages. Sibley, 1926b, p. 107, 218, pl. 13, fig. 100-2, 109

"The whole body, including antennae, palpi, and legs, testaceous; tibiae and tarsi with black spines; eyes black. The last dorsal

segment of the abdomen is conically produced at its apex, which is black and scabrous; app. sup. small, rounded, concave internally, yellow, and fringed with yellow hairs; app. intermed. black, truncate (?); app. inf. directed upwards, yellow, fringed externally with long yellow hairs, the apex black and truncate, furnished with small teeth.

"Anterior wings elongate, broad, the apex parabolic, nearly uniformly pale yellow, almost nude, and shining, the membrane finely rugulose; inner margin (area suturalis) deeper yellow; apical margin narrowly obscure; veins yellow; the anastomosis fuscous; a whitish dot at the thyridium, and another at the arculus. Posterior wings hyaline, tinged with yellow; anterior margin deeper yellow."

"I have one male, from the White Mountains of New Hampshire, sent by Mr H. Edwards, of San Francisco. The species is allied to the European *S. hieroglyphicus*, *striatus*, etc., in which the wings are elongate, and the first apical cell in the anterior pair scarcely longer than the succeeding cells.

"Length of body, 11 mm; alar expanse, 36 mm.

"Hab. Boreal America." McLachlan, *l. c.*

Two specimens in the Cornell University collection, determined as *S. divergens*, and one in the New York State collection taken in North Carolina seem clearly to belong to this species. In Lloyd's collection is a specimen collected by Dr C. P. Alexander in Maine. I would add the following points to the description:

Besides the black markings indicated by McLachlan these specimens have a black stripe on the inner surface of the fore tarsi. The anterior margin of the fore wing is strongly convex; the margin beyond the apex is slightly indented at the veins. The wing membrane is granulate but the granulations are not more deeply colored than the rest of the membrane. The veins are slightly darker than the membrane; in the North Carolina specimen the "cord" is darker than the other veins. The penis has heavy appendages with stout bristles.

### **Stenophylax infernalis** Banks

Banks, 1914*b*, p. 154, pl. 8, fig. 7 (*Anisogamus*)

"Palpi brown, yellowish on base of the second joint; head yellowish, darker on vertex; antennae yellowish; basal joint blackish beneath; posterior warts and pronotum with yellow hair, mesonotum with dark stripe each side, but tubercles in front of base of wings are pale, with golden hair; abdomen black, but pale on venter; legs pale yellowish, black on under side of first and second joints of tarsus 1; spines black, and spurs yellowish. Leg 1 with very few spines, one at tip of femur, two or three on tibia, and small ones at tips of tarsal joints. Wings pale, the apical and posterior part brownish, with pale spots, larger pale spots beyond the anastomosis, anastomosis dark brown, membrane clothed with fine hairs. Costal area of fore wings rather broad, apical part hardly as long as in *A. disjunctus* and *A. costalis*, but venation about the same; the discal cell is hardly as long as the pedicel.

Lower median only slightly fractured at base of fork 5; in the hind wings apical cells as in the fore wings.

"Expanse 26 mm.

"From Pinnacle Mt., Fulton Co., N. Y. 15th September (Alexander). It has shorter legs than *A. disjunctus* or *A. costalis*." Banks, *l. c.*

### *Stenophylax limbatus* McLachlan

(Pl. 48, figs. 5, 6)

McLachlan, 1871, p. 108; Banks, 1916a, p. 118, 122 (*Eustenace*); Sibley, 1926b, p. 107

"Head and thorax reddish testaceous, with sparse reddish hairs; antennae testaceous, with fuscous rings; palpi yellowish; eyes black. Legs yellow, tibiae and tarsi with short black spines, a black point on each trochanter internally. Abdomen fuscous above, ochreous beneath; margin of last dorsal segment regularly concave in front, produced at the sides into a triangular tooth, the upper edge of which is excised and beset with numerous very short black spiny hairs; app. sup. small, yellow, subquadrate, truncate, fringed with yellow hairs; app. intermed. long, in the form of two closely applied straight spines, the tips of which are suddenly curved downwards; app. inf. directed upwards, projecting beyond the lateral production of the segment, yellow, truncate at the apex, and fringed externally with long yellow hairs.

"Anterior wings short and broad, much dilated at the apex; the apical margin oblique, pale testaceous, the membrane finely regulose, nearly nude, and shining; a cloud in the cellula thyridii extending also above it, and there inclosing a white dot at the thyridium; two irregular spots, one placed at the base of the second, the other in a similar position in the fourth, apical cells, and a broad apical margin which is dentate internally (being produced into an acute triangle along each apical cell) pale brown; ramus clavalis margined beneath with brown; veins testaceous, with short concolorous hairs; first apical cell longer than the second, but not inordinately so. Posterior wings hyaline, whitish, slightly yellowish at apex; veins pale yellowish; fifth apical cell scarcely reaching the anastomosis.

"I have two males, taken at St John's Newfoundland, by Mr G. F. Mathew. In the form of the wings the species approaches *S. dubius*, *punctatissimus*, [European], etc.; but the first apical cell in the anterior wing is much shorter than in those species." McLachlan, *l. c.*

I took this species at Old Forge, N. Y., and Doctor Felt sent me two males taken on Mount Marcy on July 30th.

In Hagen's collection what I regard as *gentilis* is determined as this species.

Banks makes this the type of a new genus *Eustenace* differing from *Stenophylax* in having the discal cell of the hind wing not extending before the fork of media.

**Stenophylax luculentus** n. sp.

(Pl. 48, figs. 7-12, pl. 49, figs. 1-4)

Brownish yellow, practically unicolorous; the antennae somewhat darker at base and the usual black spines present on the legs and black dots on the trochanters; the apical margin of the fore wing somewhat darkened and this darker color sometimes bordering the apical veins for a little way; a darker spot in the middle of the wing inclosing the clear spot on the median vein; dark spots also in cells  $R_4$  and  $M_1$  at base, sometimes a smaller one in cell  $R_5$ . The eighth segment of the male with the posterior margin produced into a long point directed obliquely backward and upward. The claspers furcate at the tip. The blades of the tenth segment acute at tip. The penis like that of *S. scabripennis*. Length to tip of wings 18 mm.

This species was bred at Ithaca and at Old Forge, N. Y., where the larvae were abundant in streams and in ponds. The adults emerge during the latter part of August and early in September.

It would seem likely that this rather common species would be among the described forms but I can not so identify it.

**Stenophylax mutatus** HagenHagen, 1861c, p. 267 (*Hallesus*)

"Fuscous, with fuscous hair; antennae brown, annulated with luteous; feet yellowish, with black spines, base of tibiae, as well as the middle and apex, marked with fuscous; wings fuscous, finely tuberculated, closely guttated with pale; a semicircular stripe at the anastomosis apically, and a discoidal irregular spot, pale hyaline; veins fuscous; posterior wings brownish-hyaline. Female.

"Length to tip of wings 15 millim. Alar expanse 29 millim.

"Hab. Labrador.

"The specimen is mutilated." Hagen, *l. c.*

The female type has three spurs on the hind tibiae but other specimens also from Labrador have spurs 1-3-4 male and female. The wings are dark brown with a silvery white spot in the middle of the wing extending back from the sector. There is white also at the base of cells  $R_3$ ,  $R_4$ ,  $R_5$ ,  $M_1$  and  $M_2$ . The wing has many small light spots, larger along the margin on the tips of veins, the largest on  $M_{3+4}$ .

**Stenophylax scabripennis** Rambur

(Text fig. 58a-c, pl. 49, figs. 5-8)

Rambur, 1842, p. 488 (*Limnephilus*); Walker, 1852, p. 9 (*Neuronina antica*); Hagen, 1861c, p. 265 (*Hallesus*); McLachlan, 1863c, p. 162 (*Hallesus*); Provancher, 1877, p. 258; Banks, 1905c, p. 9 (*Pycnopsyche*); Ulmer, 1907b, p. 26, figs. 45, 46, pl. 2, fig. 8 (*Pycnopsyche*); Ulmer, 1907c, pl. 4, fig. 28, pl. 33, fig. 1 (*Pycnopsyche*)

Immature stages. Lloyd, 1921, p. 60-63, figs. 88-95 (*Pycnopsyche*); Sibley, 1926b, p. 108, 219, pl. 12, fig. 95

The following description applies to the rather common eastern species which has ordinarily been identified as *scabripennis*. Ulmer's description of the type of the species is referred to below; it makes the common identification uncertain. I identify three varieties with differences in the genitalia.

Head, thorax and antennae brownish yellow; the articulations of the antennae slightly lighter than the middle of the segments. Mesothorax on each side with a patch of yellow hair. Legs yellow, with yellow spurs and black spines; the tip of the first tarsal segment of the fore legs black. Fore wings very broad, somewhat concave beyond the apex, and in this region slightly emarginate at the vein tips; membrane of the wings granulated. The color of the fore wings brownish yellow, the veins distinctly darker; the small prominences or granulations brown; the apex broadly margined with

brown; an angulate brown band following the cord from cell  $R_2$  to the apex of cell  $M_1$ ; another brown spot of varying size and shape in the middle of the wing, inclosing the transparent spot on  $M$  just before the branching of this vein. Hind wings very broad, transparent, the veins yellow; the anal region with long hairs. In the fore wing the discal cell longer than its pedicel, its anterior margin somewhat concave; the apical cells broad, cell  $R_3$  especially so. The eighth segment of the male as seen from the side with the margin produced into a large rounded lobe; the posterior margin

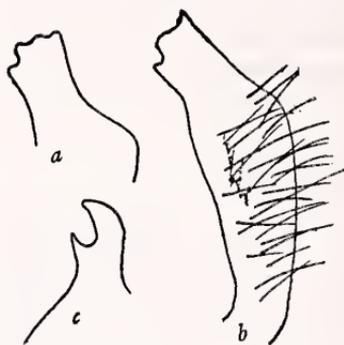


Fig. 58 Tips of the claspers of varieties of *Stenophylax scabripennis* Rambur

including the lobes set with small black spines; below, the lobe margin strongly concave posteriorly; the blades of the tenth segment may appear beyond the rounded preanal appendages; the claspers broadly joined to the ninth segment, the tip being free.

In one variety the tips of the claspers as seen from below are truncate with the internal distal angle sharply excised (text fig. 58a). A second variety has the claspers similar but the internal distal angle is produced into a sharp tip (text fig. 58b). In the third variety the clasper is calcate at the tip (text fig. 58c). The lower posterior angle of the eighth segment is more oblique in the first of these varieties than in the others.

The larva is described by Lloyd and the pupa by Sibley.

This species has been reported from Georgia, Virginia and Maryland. The New York State collection has specimens from Keene Valley, Old Forge and Saranac Inn, N. Y., July 19th–August 1st. Those from Old Forge are all of the third variety mentioned.

The species is very much like *Halesus guttifer*.

Ulmer (*l. c.*, p. 26) has given a description of Rambur's type in the Selys collection with a figure of the venation. This type is a female and the abdomen and the hind legs are lacking. Ulmer calls attention to the points of difference between this type and the form described above; these are the following:

The membrane of the fore wing is granulated only in the basal half; the discal cell is not longer, but somewhat shorter, than its pedicel (very nearly equal in Ulmer's figure); the anterior margin of the discal cell is not concave; cell  $R_2$  reaches farther basally than cell  $R_4$  (so also in my specimens); in the hind wing cell  $R_5$  is not narrowed near its base (not very evidently so in my specimens); the margin of the fore wing beyond the apex is not concave.

I of course can not decide which, if any, of the above-described varieties corresponds to this type. I find none agreeing precisely in respect to the shape and the granulations of the wings; some of those of the third variety (with calcate claspers) approach nearest. There remains, therefore, the possibility that the identification of the common eastern species with Rambur's *scabripennis* is an error.

Western American species are:

*Stenophylax antennatus* Banks

Banks, 1900a, p. 254, Washington.

*Stenophylax atripennis* Banks

Banks, 1924, p. 440, fig. 12 (*Anisogamus*). California.

*Stenophylax costalis* Banks

Banks, 1901a, p. 286 (*Asynarchus*); Banks, 1914b, p. 154 (*Anisogamus*). Washington. Banks places the species as congeneric with *gentilis* which has here been retained in *Stenophylax*. New Mexico.

*Stenophylax disjunctus* Banks

Banks, 1914b, p. 156, pl. 9, fig. 22 (*Anisogamus*). British Columbia.

*Stenophylax hesperus* Banks

Banks, 1914b, p. 152, pl. 8, fig. 6; pl. 9, fig. 21. Vancouver Island, British Columbia.

*Stenophylax solotarewi* Martynov (see page 310)

Martynov, 1913a, p. 97 pl. 6, figs. 11-14, pl. 9, fig. 13 (*Micropterna*). Cuba.

### Halesus Stephens

Stephens, 1836, p. 208; McLachlan, 1876a, p. 146; Ulmer, 1907c, p. 54; Ulmer, 1909a, p. 156

Immature stages of various European species. Silfvenius, 1902a, p. 87; Ulmer, 1903d, p. 67; Silfvenius, 1903a, p. 31; Ulmer, 1909a, p. 207, 269, 314; Lestage, 1921a, p. 785

Antennae as long as the fore wings, rather slender, the basal segment hardly as long as the head. Palpi rather slender, the fourth

segment (female) shorter than the second, third, or fifth. Legs slender. Spurs 1-3-3. First tarsal segment of the fore leg longer than the second; last tarsal segment of the hind legs with black spines. Fore wings broad, with the apex parabolic, the pterostigma generally not differentiated; the membrane of the wing often finely granulated. Discal cell long, the anterior margin straight or somewhat concave.

This is a very large genus, the European forms presenting several fairly well defined groups. Of the American forms here included, the two known to me are closely allied to *Stenophylax* and *Platyphylax*. (p. 309).

### Halesus dan Sibley

Sibley, 1926a, p. 81, 1926b, p. 107, pl. 10, fig. 71

"Length of body—10mm.

"Length to tip of wings—18 mm.

"Head, antennae and palpi yellow with ferruginous hairs. Legs yellow with black spines; spurs yellow. First two segments of fore tarsi with a longitudinal black stripe on ventral surface.

"Thorax and abdomen yellow. Fore wings yellow to brownish yellow. Three rows of fuscous spots as follow; innermost row—beginning with a spot in center of discoidal cell and continuing to hind margin of the wing; a row just beyond the anastomosis consisting of five small spots, one each in cells  $R_3$  to  $M_2$ ; a distal row beginning with a stripe in cell  $R_4$  half the length of that cell, and continuing along outer margin to hind margin where it joins the innermost row of spots.

"The general color of this species is lighter than that of *H. guttifer* and the genitalia are distinctive." Sibley, l. c.

The type material has not been examined. The species was collected at McLean, N. Y., September 21st and 22d.

### Halesus guttifer Walker

(Pl. 49, figs. 9-11)

Walker, 1852, p. 16; Hagen, 1861c, p. 266; McLachlan, 1863c, p. 162; Betten, 1901, p. 568, pl. 32, figs. 2, 5, pl. 33, fig. 2 (*Halesus sp.*); Ulmer, 1906b, p. 24, figs. 30, 31; Banks, 1907a, pl. 9, fig. 22 (*Pycnopsyche*); Döhler, 1915, p. 408 (*Pycnopsyche*).

Immature stages. Lloyd, 1921, p. 67; Sibley, 1926b, p. 107, 218, pl. 10, figs. 69, 70

Head and thorax brownish yellow. Antennae somewhat darker because of short black pubescence on the middle of the segments toward the base. Spurs 1-3-3. Legs yellow with yellow spurs and black spines; a black dot on the trochanters. Fore wings greatly broadened toward the apex, the anterior margin convex, beyond the apex slight emarginations at the vein tips. The wing membrane granulated, a little more strongly at base than at the apex. The apical margin broadly margined with brown, the patches extending farther toward the base in the middle of the cells than alongside of

the veins; brown patches in the bases of cells  $R_3$ ,  $R_4$ ,  $R_5$  and  $M_1$ . A brown spot in the middle of the wing inclosing the clear spot on vein  $M$ ; the anal region slightly darker than most of the rest of the wing. Hind wings clear, slightly darker at apex, the veins yellow. The eighth dorsal segment with the posterior part clear and in this area a patch of short spines; the posterior margin of this segment produced into a rounded, black lobe which extends across the ninth segment. The preanal appendages emarginate; the blades of the tenth segment generally visible above them. The claspers broadly joined to the ninth segment; hairy along most of their length, the tips oblique. The penis like that of *Stenophylax luculentus*.

Length to tip of wings 18–22 mm; one specimen has an alar expanse of but 28 mm.

Lloyd (*l. c.*) has reared the larvae which he can not distinguish from *S. scabripennis*, confirming what is said above (p. 309) regarding these forms.

The Hudson Bay region, New Hampshire, Tennessee, Georgia, and New Orleans, Louisiana have been reported as habitat of this species; I have it also from Saranac Inn, N. Y. and from Lake Forest, Ill.

#### *Halesus indicans* Walker

Walker, 1852, p. 23 (*Limnophilus*); Hagen, 1861c, p. 258 (*Limnophilus*); McLachlan, 1863c, p. 157

"Ferruginous; antennae paler; palpi and feet testaceous; anterior wings testaceous, margined with whitish, with a short discoidal vitta, contracted in the middle, white, drawn out into five rays towards the apex; posterior wings whitish. (From the description of Walker.)

"Length to tip of wings 18 millim. Alar expanse 38 millim.

"Hab. Georgia (Abbot).

"It is allied to *L. elegans* Curtis." Hagen, *l. c.*

McLachlan (*l. c.*) notes the spur formula and transfers the species to *Halesus*.

#### *Halesus similis* Banks

Banks, 1907a, p. 122, pl. 9, fig. 22 (*Pycnopsyche*)

"Head and thorax reddish yellow, palpi pale yellowish, antennae rather reddish yellow; legs pale yellow, with black spines; abdomen pale at base, nearly black at tip; fore wings pale yellowish, outer edge broadly bordered with brown, a brown spot in base of third apical cell, containing a darker dot, another smaller in fifth apical cell, and three discal brown spots forming a discal band like that of *P. guttifer* and *Platyphylax subfasciata*, but not quite as long; a hyaline spot on thyridium before the fork, venation pale; hind wings hyaline, venation pale. Wings shaped and veined as in *P. guttifer*. No macrochaeta back of ocelli, but hairs on the vertex, thoracic strips very short and narrow, with only five or six tubercles in each; spurs 1-3-3.

"Expanse, 30 mm.

"Two specimens from Agricultural College and Chatham, Mich., August, September.

"Very similar to *P. guttifer*, but distinct by genitalia of male." Banks, *l. c.*

#### *Halesus* sp.

(Pl. 49, figs. 12, 13)

I have two specimens of uncertain locality, probably New York, which are like *H. guttifer* except in the structure of the genitalia. The eighth segment has the posterior margin oblique, the lower angle of the dorsal half not produced; seen from above (pl. 49, fig. 13) the posterior margin is concave in the middle and on each side of the concavity is a prominence set with black spines. The claspers are pointed at the tip. The penis of the same type as that of *guttifer*. Length to tip of wings, 15 mm.

Other North American species are:

#### *Halesus formosus* Banks

Banks, 1900a, p. 255; Banks, 1904a, p. 107, pl. 1, figs. 2, 4 (*Dicosmoecus maculatus*); Banks, 1907c, p. 38, Colorado, New Mexico, Arizona.

#### *Halesus solidus* Hagen,

Hagen, 1861 c, p. 267, Mexico.

#### *Platyphylax* McLachlan

McLachlan, 1871, p. 109; McLachlan, 1875f, p. 143; Ulmer, 1907c, p. 53; Banks, 1916a, p. 118, 122 (*Allegophylax*)

Spurs 1-2-2, male and female. First segment of the anterior tarsi long in both sexes. Palpi and legs slender (typically). Last tarsal segment of the hind legs with black spines. Fore wings and general appearance much as in *Stenophylax* and *Halesus* (typically); the membrane shining and with scarcely any pubescence (typically). Male with long inferior and broad superior appendages. The apex of the abdomen of the female very obtuse, without appendages.

This genus has been defined as above by McLachlan and by Ulmer on the basis of its typical members. As indicated above (p. 309), I regard the American species here retained as probably congeneric with certain species of *Stenophylax* and *Halesus* in spite of the different spur formula.

Probably Banks' *Allegophylax* should be accepted but it has not yet been defined except in a key and its distinctions as compared to *Platyphylax* have not been indicated.

#### *Platyphylax lepidus* Hagen

(Pl. 50, figs. 4-6)

Hagen, 1861c, p. 269 (*Enoicyla*); McLachlan, 1871, p. 110; Banks, 1916a, p. 122 (*Allegophylax*); Sibley, 1926b, p. 107  
Immature stages. Sibley, 1926b, p. 217, pl. 13, figs. 96-99

"Luteo-rufous, with luteous hair; antennae fuscous, annulated with luteous, the basal article luteous; head and thorax above, rufous; feet yellowish, with black spines; spurs yellowish; anterior wings broader, rugulose, subnude, luteous, with a fuscous point in the base of the third areole; veins luteous; posterior wings luteo-hyaline. Male.

"Length to tip of wings 15 mm. Alar expanse 28 millim.

"Hab. Pennsylvania." Hagen, *l. c.*

The eighth segment of the male is emarginate as seen from above and is beset with short black spines in two groups. The claspers are suddenly narrowed into a long tip extending far above the preanal appendages. When seen from below two tips are shown (pl. 50, fig. 6).

The immature stages are described by Sibley (*l. c.*).

### **Platyphylax subfasciatus Say**

(Pl. 50, figs. 1-3)

Say, 1824, p. 308 (*Phryganea*. Listed, not described); Say, 1825, pl. 44 (*Phryganea*); Walker, 1852, p. 11 (*Neuronia* ?); Say, 1859, p. 97, pl. 44, fig. 3 (*Phryganea*); Hagen, 1861c, p. 269 (*Enoicyla*); McLachlan, 1871, p. 110; Provancher, 1877, p. 259; Provancher, 1877, p. 260 (*circularis*); Provancher, 1878b, p. 135; Provancher, 1878b, p. 135 (*circularis*); Ulmer, 1907b, p. 25, figs. 40-44; Ulmer, 1907c, pl. 33, fig. 4; Vorhies, 1909, p. 678, pl. 56, figs. 5-7; Banks, 1916a, p. 118, 122 (*Allegophylax*)

Immature stages. Vorhies, 1909, p. 679, pl. 52, fig. 5, pl. 56, figs. 8-11

The following is the greater part of Vorhies' description of the adults. The larvae and pupae are also described.

"Imago. Length of body, 15-17 mm. Expanse, 35-40 mm. Antennae 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 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 round 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 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 on 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."

The claspers are not as long pointed as in *lepidus* and are decidedly different as seen from below (pl. 50, fig. 3). The eighth segment is not emarginate posteriorly when seen from above; laterally it is produced into an upturned point (pl. 50, fig. 2).

Vorhies' specimens were from Wisconsin. Hagen reports the species from Pennsylvania and New York. My own specimens are also from New York.

One Mexican species is placed here provisionally by its author.

*Platyphylax discolor* Banks

Banks, 1901*b*, p. 367, pl. 12, fig. 9. Tacubaya, D. F.

**Asynarchus** McLachlan

McLachlan, 1880*a*, p. XXVI; Ulmer, 1907*c*, p. 47; Ulmer, 1909*a*, p. 145; Martynov, 1914*e*, p. 206

Spurs 1-3-4. Like *Limnephilus* except that the fore wings are broader and shorter. Distinguished from *Stenophylax* in having the apex of the fore wings less parabolic; in having cell  $R_5$  of the hind wings generally narrower than the discal cell and in having genitalia more on the plan of those of *Limnephilus*. The claspers never branched. The last segment of the tarsus of the hind legs generally with black spines; of the species listed below, *fumosus* cited as exception to this.

Banks more recently has placed the first and third species listed below in Wallengren's genus *Rhadicoleptus* (Can. Ent., 48, p. 118, 122).

The species described are all western.

*Asynarchus alascensis*, Banks

Banks, 1900*b*, p. 471, pl. 28, fig. 16. Alaska.

*Asynarchus flavicollis* Banks

Banks, 1900*b*, 470, pl. 28, figs. 11, 13. Alaska.

*Asynarchus fumosus* Banks

Banks, 1900*b*, 470, pl. 27, figs. 7, 9, 10. Washington, Alaska.

*Asynarchus pacificus* Banks

Banks, 1900*a*, p. 254 (*Stenophylax*). Washington.

**Anabolia** Stephens

Stephens, 1829, p. 320; McLachlan, 1875*e*, p. 101; Ulmer, 1907*c*, p. 45; Ulmer, 1909*a*, p. 141

Immature stages. Ulmer, 1903*d*, p. 60; Silfvenius, 1902*a*, p. 74; Ulmer, 1909*a*, p. 256, 314; Lestage, 1921*a*, p. 749.

Antennae as long as the wings. Spurs 1-3-4. First segment of the fore tarsus longer than the succeeding segments; last tarsal segment of the hind legs with black spines; spines also numerous on all the legs. Fore wings long, not greatly widened at the apex; the costal margin convex and the apex parabolic. The membrane mostly uniform brown in color, with very little or no granulation.  $R_1$  of the fore wing slightly curved toward the tip; the discal cell is longer than its pedicel; the apical cells long. In the hind wing cell  $R_5$  as broad as cell  $R_3$  at base. The preanal appendages very large, concave internally. No ventral teeth on the abdomen in European species; they are present in what I take to be *A. bimaculata*.

The larvae make cases of vegetable material placed rather regularly, sometimes even spirally. Ulmer says that the older larvae may add sand grains so that the case of full grown larvae is made of sand with attached pieces of vegetable material. In swift water stones or shells may be added for ballast. The American species described below (*A. bimaculata*) has not been observed to use other than vegetable material.

With regard to the European species, McLachlan says that the adults "are gregarious, appearing late in autumn." "The perfect insects emit a very strong odour when handled, and especially in copulâ." "All three species appear to have what may be called a *forma minor*, not aberrantly, but constantly; *i. e.*, in particular localities this small form only occurs." I have not had occasion to notice that any one of these three peculiarities is true for the American forms.

One western species assigned to this genus has spurs given 1-2-3 (*A. assimilis*).

### *Anobolia bimaculata* Walker

(Text figs. 33e; 36c; 46c; pl. 50, figs. 7-10; pl. 51, figs. 1-3)

Walker, 1852, p. 30 (*Limnephilus*); Hagen, 1861c, p. 263 (*Limnephilus*); Hagen, 1861c, p. 264 (*sordida*); McLachlan, 1863c, p. 157 (*sordida*); Hagen, 1864b, p. 804; Provancher, 1877, p. 258; Provancher, 1878b, p. 134; Ulmer, 1905d, p. 61, figs. 6-8

Head dark brown, palpi and antennae of the same color, the latter somewhat darker at base. Prothorax mostly black with long black hairs and with some yellow hairs on the posterior margin. Mesothorax with a broad median longitudinal band brown, with the sides black. Legs yellow, the spurs brown, the spines black. Fore wings dark brown, with uniformly distributed light dots. The veins dark brown interrupted by the white dots. The anal angle darker than the rest of the wing; an oblique white spot beginning at the apex of cell  $M_3$  and extending across cell  $M$ . The ninth segment (male) very large, the posterior part semicircular; the preanal appendages large, concave internally, the margin entire as

seen laterally; the tenth segment composed of two plates concealed by the preanal appendages and of about the same shape as seen from the side; the claspers directed obliquely upward; the penis with two appendages which are deeply furcate at the end; all the appendages brown, tipped with black. A tooth on the sixth and one on the seventh ventral segment of the male, on the fifth and sixth segments of the female. Length to tip of wings 18 mm; female but little larger.

This species was first described from material from the St Martin's falls, Albany river, Hudson bay. Hagen's specimens were from the North Red river, northern Illinois, Wisconsin and Massachusetts. Ulmer has described and figured specimens from Colorado. I reared the species at Old Forge, N. Y. In the New York State collection there is a female from Annapolis, Md., and in the Cornell University collection a male from Colorado. The genitalia of those I have seen, including the one from Colorado, differ from Ulmer's figure with respect to the shape of the appendage of the penis. If the Colorado species described by Ulmer is not the same as these, it remains a question which is *A. bimaculata*.

### **Anobolia curta** Banks

Banks, 1920a, p. 345, pl. 5, fig. 57

"Black; legs and antennae yellowish; head with black hair below, yellowish above; basal joint of antennae with golden hair; legs with black spines; between ocelli and eyes, and on middle of the mesothorax the surface is sericeous. Fore wings blackish, rather densely spotted with small patches of pale hairs, especially noticeable at the outer margin, and just before the posterior anastomosis; hind wings scarcely darkened. In general closely similar to *A. mutatus* Hagen, but the marking near upper anastomosis is scarcely distinct. The male has the upper appendages as in *A. mutatus*, but the lower pair are much shorter and not strongly mucronate (as in *A. mutatus*). It is a slightly smaller species.

"Expanse 26 mm." Banks, *l. c.* Massachusetts.

### **Anobolia modesta** Hagen

Hagen, 1861c, p. 265; McLachlan, 1876b, p. 9 (*Stenophylax*); Ulmer, 1907c, p. 48 (*Asynarchus*); Banks, 1907c, p. 39 (*Stenophylax*)

"Nigro-piceous, with black hair; antennae black, narrowly annulated with luteous; feet luteous, with black spines, femora piceous; anterior wings obtuse at the apex, fuscous, almost naked, subrugulose, sparingly irrorated with luteous, veins fuscous; posterior wings fuscohyaline.

"Male. Superior anal appendages laminated, the apex incurved.

"Length to tip of wings 14 millim. Alar expanse 26 millim.

"Hab. Labrador (Christopher)." Hagen, *l. c.*

McLachlan (*l. c.*) quotes Hagen to the effect that *A. fusorius* of Lapland may be the same. I do not think that the species identified by Banks as *modesta* and listed by him in *Stenophylax* is the same as Hagen's type.

### *Anabolia montana* Banks

Banks, 1907a, p. 119

"Head dark brown; antennae paler brown, narrowly annulate with darker; palpi yellowish; thorax brown, with a jet black stripe on each side of mesothorax, narrowly bordered with white internally. Legs yellowish; tips of tarsi and tip and middle of anterior tibiae outside blackish; spines black. Fore wings dark brown, anal field darker than elsewhere, and costal rather pale, sprinkled with many fine, pale dots much more numerous in apical part, a larger, pale oblique mark on the thyridium, and one smaller at arculus, also some spots along the outer margin; a pale geminate spot in base of the third apical cell; pterostigma slightly darker than rest of wing. Hind wings hyaline, darker near the pterostigma, and a dot in base of third apical cell. Venation very similar to *A. bimaculata*, but the fifth apical cell is scarcely as acute at base, and the discal cell a little shorter than in that species; the hind wing is less excised below the apex than in *A. bimaculata*.

"Expanse, 30 mm.

"Four specimens from Franconia, Mt. Washington, N. H., and Mt. Katahdin, Maine." Banks, *l. c.*

### *Anabolia quadrinotata* Banks

Banks, 1908b, p. 62, pl. II, fig. 14

"Head reddish brown, darker on middle of the vertex, antennae reddish, basal joint scarcely darker; palpi pale, very slender, in male the last joint is nearly as long as distance from eye to eye, the second joint but little shorter; ocelli large, twice as near to eyes as to each other; a reddish transverse wart on each side of posterior margin, bearing long hairs; pronotum inconspicuous, bilobed, with long fulvous hairs, thorax black on sides, a broad, pale, median stripe; the abdomen brown; legs yellowish with black spines; hind legs long, the subapical spurs only about one-eighth the distance before tip. Wings uniform brown, sparsely clothed with black and yellow hairs, a triangular white mark on the thyridium, and one over the arculus, a distinct black dot in base of third apical cell, and in thyridial cell behind the thyridium is a smaller black dot. Membrane distinctly rugulose; discal cell very long, more than twice as long as its pedicel, first apical not its width on discal, and fifth no farther back, fourth as wide as second or third at base; lower fork of median disjointed at the posterior anastomosis, anal cell very long and slender, basal crossvein plainly before forking of median. Hind wings grayish hyaline, darker toward tip, with a distinct black dot in base of third apical cell; discal cell very long, first and fifth

apicals only a short distance back of anastomosis, fourth fully as wide as second at base.

"Expanse 33 mm.

"Grand Lake, Newfoundland (Owen Bryant)." Banks, *l. c.*

Other North American species are:

*Anabolia assimilis* Banks

Banks, 1908c, p. 262, pl. 19, figs. 9, 10 (spurs 1-2-3). Arizona.

*Anabolia brevipennis* Banks

Banks, 1899, p. 209 (*Stenophylax*); Banks, 1907c, p. 37 (*Anabolia*), Colorado. The generic position is doubtful.

*Anabolia decepta* Banks

Banks, 1899, p. 208. Washington.

*Anabolia edwardsi* Banks

Banks, 1920a, p. 345 (*Anisogamus*). California.

*Anabolia emarginata* Banks

Banks, 1919, p. 4, fig. 1, Teller, Alaska.

*Anabolia nigricula* Banks

Banks, 1908c, p. 262, pl. 19, fig. 11. Colorado.

*Anabolia simplex* Banks

Banks, 1900b, p. 469, pl. 27, fig. 3 (*Asynarchus*); Banks, 1907c, p. 37;

Banks, 1923, p. 146. Alaska.

Muttkowski, 1915, p. 42-45, 2 figs. (larva).

### Ecclisomyia Banks

Banks, 1907a, p. 123.

"A limnephilid; no spines on last joint of hind tarsi; spurs 1-2-4; fore wings rather long, the discal cell is very long, and the first apical cell is more than twice the width of discal cell upon the latter; the outer margin is rounded; in the hind wings the fourth apical cell is not narrowed at base. Ocelli large, no macrochaeta behind them; the basal joint of antennae rather longer than usual.

"Type: *E. conspersa*, n. sp." Banks, *l. c.*

I have specimens which I take to be *E. maculosa* and *E. conspersa*. In these the spurs seem to be 1-3-4 and this is also the formula given in the specific description of *E. maculosa*. In the hind wings  $Cu_1$  and  $Cu_2$  are approximated and sometimes fused at tip.

Four western species are reported.

*Ecclisomyia complicata* Banks

Banks, 1924, p. 440, pl. 3, fig. 29, 30. Ontario.

*Ecclisomyia conspersa* Banks

Banks, 1907a, p. 123, pl. 9, fig. 14. Washington.

*Ecclisomyia maculosa* Banks

Banks, 1907a, p. 123, pl. 9, fig. 18. Colorado.

*Ecclisomyia simulata* Banks

Banks, 1920a, p. 346, pl. 7, figs. 101, 106. Reno, Nevada.

### Acronopsyche Banks

Banks, 1930b, p. 227

"Legs slender; no spines on under side of last joint of hind tarsi; spurs 1-3-3; tibia of front pair with a few spines. Basal joint of antennae moderately elongate, beyond barely crenulate; a group of two or three macrochaetae behind each ocellus. Pronotum very small. Wings very hairy, not granulate, discal cell of fore wings extremely long, fully four times as long as pedicel; radius bent at stigma, all apical cells fairly broad at base, first fork scarcely reaches back on discal cell; cubitus disjointed at posterior anastomosis, anal cell divided as usual. In hind wing the discal cell is also elongate, and the apical cells fairly broad near base. In the male the inner spur of the hind tibia is elongate, very attenuate, about twice as long as the outer spur." Banks, *l. c.*

One western species is reported.

#### *Acronopsyche pilosa* Banks

Banks, 1930b, p. 228, fig. 13. California.

### Platycentropus Ulmer

Ulmer, 1905c, p. 13; Ulmer, 1907c, p. 56; Banks, 1916a, p. 121 (*Hylepsyche*)

Antennae nearly as long as the wings, thicker than in *Halesus*. In the female the second, third and fifth segments of the maxillary palpi about equal, the third perhaps longest, the first and the fourth shorter. Spurs 1-3-3. The inner apical spur of the hind leg of both male and female larger than the outer, being widened into lancet shape, covered with bristles, the distal end with a short point. Legs with black spines, of these very few or none on the last tarsal segment of the hind legs. Fore wings with the anterior margin moderately convex, the apex not so much rounded as in *Halesus*. In the fore wing  $R_1$  arched toward the tip; the discal cell longer than its pedicel;  $2d A$  partly obsolete, not reaching the other anals distally, extending but little beyond the crossvein uniting it to  $1st A$ ; as a result very large anal cell with a very small one at its base (pl. 51, fig. 10).

The larval case is of the log-cabin type with the exterior smooth.

### Platycentropus indistinctus Walker

(Fig. 51, figs. 4-8)

Walker, 1852, p. 37 (*Limnephilus*); Hagen, 1861c, p. 265 (*Halesus amicus*); Hagen, 1861c, p. 266 (*Halesus*); McLachlan, 1863c, p. 157 (*Halesus amicus*); McLachlan, 1863c, p. 157 (*Halesus*); Hagen, 1864b, p. 817, 818 (*Halesus*); Provancher, 1877, p. 259 (*Halesus*); Provancher, 1878b, p. 134 (*Halesus*); Betten, 1901, pl. 30, fig. 3 (*Halesus*); Banks, 1908b, p. 64 (*Halesus*); Banks, 1916a, p. 121 (*Hylepsyche*)

Head and thorax brownish yellow. Legs yellow with black spines and yellow spurs (my two specimens do not have spines on the last tarsal segment of the last legs). The fore wings not concave beyond the apex, the hind wing very slightly excised. Fore wings for the most part very pale yellow; most of the area between the radial sector and vein  $Cu_2$  dark brown, excepting a light spot on  $M$  near its

branching; this dark area continued beyond the cord to the margin through cells  $R_5$ ,  $M_4$  and  $Cu_1$ ; the darkest part of the whole area that bordering  $Cu_1$  and that within cell  $R_5$ . The eighth dorsal segment produced into a long process, widened at the distal end, extending between the preanal appendages; the latter attached to the eighth segment at the side, and seen laterally of rounded contour; the tenth segment below the posterior end of the eighth, with two thick chitinous pieces above and two hairy prominences at the lower exterior angles; the claspers broadly united to the ninth segment, their tips jutting against the tenth segment; the penis with two branched appendages which are margined with long bristles and so broad that they can be wrapped around the penis.

McLachlan (1863) and Hagen (1864) both indicate that *amicus* is probably a synonym.

The species was described from St John's, Newfoundland. I took two specimens at Saranac Inn, N. Y., June 29th, August 14th.

### **Platycentropus maculipennis Kolenati**

(Text figs. 5s, 6c, 43a; pl. 51, figs. 9-11)

Kolenati, 1859b, p. 176, 280 (*Halesus*); Hagen, 1861c, p. 266 (*Halesus hostis*); Ulmer, 1905c, p. 13, pl. 1, figs. 9, 10; Ulmer, 1907c, pl. 5, figs. 36a, b, pl. 34, fig. 3; Banks, 1908b, p. 64; Sibley, 1926b, p. 106

Immature stages. Betten, 1901, p. 567, pl. 31, fig. 1, pl. 32, figs. 3, 6, pl. 33, fig. 3 (*Halesus hostis* and *H. 1*); Lloyd, 1921, p. 68, 69, figs. 102; Sibley, 1926b, p. 106, 216, pl. 13, figs. 107, 108

Head and thorax reddish. Palpi and antennae reddish yellow. Legs yellow, the spines black, the spurs reddish. Fore wings mostly yellow with prominent markings of brown as follows: the basal half of cells  $R$  and  $M$ , all of cell  $Cu_1$ , the distal end of cell  $M$ , the bases of cells  $M_2$ ,  $M_4$  and  $Cu_1$ ;  $R_5$  margined with dark brown through most of its length and this dark area irregularly widened at its anterior end so as to cross several of the apical cells, widest on their veins; the discal cell sometimes partially included in the anterior dark area. Hind wings transparent, the apex slightly more yellowish. Male abdomen with ventral teeth on segments 5, 6 and 7, with one or two smaller ones alongside of the larger ones; in the female the teeth on segments 5 and 6. Genitalia as figured (pl. 51, fig. 9). The serrate margins of the tenth segment and of the preanal appendages black.

I am practically certain that this is the species whose larva I found at Saranac Inn, N. Y., and described and figured in Bulletin 47 of the New York State Museum. The larva is described by Lloyd (*l. c.*) and by Sibley (*l. c.*).

I have only a single male specimen. The females have the abnormal spur like that of the male. The specimens in the New York collection are from Keene Valley, Lake Pleasant, Saranac Inn and Old Forge, N. Y. I have it also from Massachusetts. It was originally described from the North Red river, Canada; Hagen reports it from Illinois and Banks from Newfoundland.

**Halesochila** Banks

Banks, 1907a, p. 119; Ulmer, 1907c, p. 57

Antennae slightly serrate beneath. Spurs 1-3-3. Spines black and spurs probably also; spines not present on the last tarsal segment of the hind legs. Fore wing (pl. 52, fig. 1) not granulate, the pterostigma thickened and very prominent; the apical margin oblique. Discal cell large, the anterior margin concave distally; first apical cell broad at base;  $R_2$  somewhat convex at base in both pairs of wings. In the hind wing the crossvein  $r-m$  straight and of the same length as the crossvein of the sector.

One western species is reported.

*Halesochila taylori* Banks (pl. 52, fig. 1).

Banks, 1904c, p. 140 (*Halesus*); Banks, 1907a, p. 119; Ulmer, 1907c, pl. 34, fig. 2. British Columbia.

**Drusinus** n. g.

Antennae somewhat shorter than the wings, the basal segment shorter than the head, the other segments crenate beneath. Ocelli prominent, Prothorax not very large. Legs with yellow spurs and black spines, the latter not occurring on the last tarsal segment of the hind legs. Spurs 1-3-3 or 1-2-2, sometimes different on the two sides of the same insect; one specimen observed had spurs 1-3-4. Fore wings with the anterior margin convex, the apex rounded, slightly emarginate at the tips of the veins. The wing membrane distinctly granulate, the pubescence slight. The hind wing broader than the fore wing. In the hind wing of the male a pouch of hairs on the last anal vein, mostly between it and the wing margin. In the fore wing the discal cell longer than its pedicel; cell  $M_2$  reaching back about as far as the discal cell. The last dorsal segment of the abdomen of the male bent downward and beset with black spines. The tenth segment with the distal end upturned and acute. The penis with two large appendages whose spined ends are sharply bent. Ventral teeth on segments 5 and 6 and sometimes on 4.

I should regard this genus as synonymous with *Drusus* were it not for the fact that the pouch of hairs is at the margin of the hind wings of the male and that there are ventral teeth present.

*Potamorites virginica*, Banks, is here very doubtfully included. It has the discal cell shorter than its pedicel.

Type species—*Drusinus uniformis*.

**Drusinus sparsus** Banks

(Text fig. 28c; pl. 52, figs. 2-4)

Banks, 1908b, p. 63, pl. 2, fig. 12 (*Halesus*); Banks, 1911b, p. 350, pl. 13, fig. 25 (*Stenophylax calypso*); Banks, 1916a, p. 122 (*Drusus*)

"Head rufous, with a few black bristles, an obliquely transverse wart behind each ocellus bearing black bristles; ocelli large, about three times as near eyes as to each other; palpi pale, slender, last joint not as long as distance from eye to eye; antennae brown, annu-

late with pale, crenulate beneath, basal joint with a black mark above, thorax rufous, a blackish streak on each anterior corner, and mesoscutellum black, a tuft of black bristles near base of each wing. Abdomen brown above, yellowish beneath, legs pale yellowish, with black spines, sub-apical spurs on hind tibiae about one-fifth distance to base, no spines beneath on last joint of hind tarsi. Wings dark brown, with many rounded hyaline spots, a few of them confluent, about evenly distributed over the wing, except none in the costal area; surface very plainly scabrous; venation brown; only a few blackish hairs on wings; discal cell two and one-half times the length of pedicel, first and fifth apicals their width before anastomosis, radius somewhat sinuous near stigma, the thyridial fork of median vein arises some distance down the crossvein, lower branch of median not disjointed at anastomosis, anal cell rather short; basal crossvein at forking of median. Hind wings gray hyaline, venation brownish, discal cell twice as long as pedicel, first apical its width back on discal cell, the fifth but little before anastomosis, the fourth broad, but narrower than second at base.

"Expanse 30 mm.

"Grand Lake, Newfoundland (Owen Bryant)." Banks, *l. c.*

Banks' specimens described as *calypso* are from the Catskill mountains, June, and Long Island, N. Y., May.

I find one male specimen in the New York State Museum, taken at Murray bay, Quebec, July.

### *Drusinus uniformis* n. sp.

(Pl. 52, figs. 5-10)

Head reddish yellow, darker on vertex, with black hairs particularly on the face. The basal segment of the antennae yellow, the others broadly ringed with black. Palpi yellow. Prothorax yellow with black hair. Legs yellow, femora and tarsi darker. Wings uniform dark brown, the veins darker, the pubescence short and black. A transparent spot on the stem of media, and another at the tips of the anals. The genitalia in general as described for the genus; the appendages of the penis very peculiar; when fully extended a membranous part visible from the middle of which there arises a stout chitinous piece, bent at the end and set with stout bristles. Spurs 1-3-3. Length, male, 14 mm, female, 16 mm.

I have taken specimens at Ithaca and at Hamburg, N. Y.

This is near Banks' *virginicus* in general appearance but the discal cell is larger than in the latter, the white spot on *M* is not furcate, there are no indications of spots, and there is no gray costal fringe.

### *Drusinus virginicus* Banks

Banks, 1900a, p. 256 (*Potamorites*).

"Face reddish yellow; vertex black, behind yellowish, the antennae black; legs and palpi clear pale yellowish; tarsi darker; spines black, short; thorax and abdomen yellowish; wings uniform blackish; costal veins dark, others paler; a white dot, furcate toward base,

on the thyridium, and a smaller one at the arculus; there are indistinct traces of various hyaline dots, especially in the costal and apical regions; wing with a gray fringe, quite long on the costal margin; discal cell shorter than its pedicel; membrane faintly granulate, a larger and darker granule in the base of the third apical cell; apex of wing rather broad and rounded (not obliquely truncate); hind wings broad, uniformly gray, with a gray fringe, fourth apical cell broader than third at base.

"Length 13 mm.

"Richmond, Virginia (Mrs A. T. Slosson)." Banks, *l. c.*

### Hesperophylax Banks

Banks, 1916a, p. 118, 122

Basal segment of the antennae as long as the head, hairy. Middle of the head, including the warts, very hairy. Two hairy warts on the prothorax, two longitudinal ones on the anterior part of the mesonotum, and one median one on the posterior half of the same. Legs with yellow spurs and black spines, the latter found also on the last tarsal segment of the hind legs. Spurs 1-2-2. Wings not very greatly widened before the apex. Wing membrane not granulate. In the fore wings the discal cell longer than its pedicel, its anterior margin very slightly if at all concave; apex of cell  $M_3$  reaching not before the level of the distal third of the discal cell; cell  $M$  long and narrow, its apex overreaching cell *1st A* considerably. In the hind wing the discal cell longer than its pedicel;  $M_2$  not reaching forward as far as the discal cell; cell  $Cu_1$  not overreaching more than half of the discal cell. Preanal appendages large; the tenth segment of the male also large and upturned; the penis is slender and with appendages ending in numerous bristles; the claspers broad at base, the apex slender and directed backward.

The genus differs from *Platyphylax*, with which it agrees in spur formula, in the venational characters cited above, and in the following. The wings are not nearly so much widened toward the tips; the greatest convexity of the posterior margin comes much nearer the apex (pl. 53, fig. 1); in the fore wing the discal cell and cell  $M$  are much less wide in proportion to their length.

Banks established this new genus by referring his variety *occidentalis* to it in his key to the genera of Limnephilidae.

### Hesperophylax designatus Walker

(Pl. 52, figs. 11-13, pl. 53, figs. 1-3)

Walker, 1852, p. 24 (*Limnephilus*); Hagen, 1861c, p. 269 (*Enoicyla*); McLachlan, 1871, p. 110 (*Platyphylax*); Ulmer, 1906b, p. 20, figs. 23-29 (*Platyphylax*); Ulmer, 1907c, pl. 33, fig. 8 (*Platyphylax*); Banks, 1908c, p. 265, pl. 19, fig. 15 (*Platyphylax*); Vorhies, 1909, p. 672, pl. 55, figs. 21-23 (*Platyphylax*); Banks, 1916a, p. 122; Sibley, 1926b, p. 107; Klingstedt, 1928b, p. 179 (*Platyphylax*)

Immature stages. Marshall and Vorhies, 1905, p. 232-44 (*Platyphylax*); Vorhies, 1905a, p. 108-23 (*Platyphylax*); Vorhies, 1909, p. 674, pl. 52, fig. 9, pl. 55, figs. 24-26, pl. 56, figs. 1-4; Lloyd, 1921, p. 63-67, figs. 96-101 (*Platyphylax*)

The following is a copy of the greater part of Vorhies' description of the adult. The immature stages are described by Vorhies and by Lloyd.

"Imago. Length of body, 9-11 mm. Expanse, 26-30 mm. Antennae 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 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 antennae anterior to the eyes. Legs brownish-yellow with black spines; coxae 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 third and fourth, a stripe 1-3 to 1-2 the length of the cells; in the second and fifth, a stripe the full length; in the base of the sixth 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 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 setae, 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." Vorhies, *l. c.*, p. 672.

Vorhies' description is of material found in various localities in Wisconsin. The adults appear mostly in early spring, but a few stragglers appear throughout the summer. Hagen lists the species from St Martin's falls, Albany river, Hudson bay, Arctic America, Slave and Mackenzie rivers, Great Bear lake and Nova Scotia.

There are several closely related varieties of this species and there remains some doubt as to which of these was the one described by Walker. Besides the variety described by Vorhies (as above) Banks differentiates two western varieties—one from Colorado and farther west (var. *occidentalis*), and an Alaskan form (var. *alaskensis*). These he distinguishes by size, color, and by the shape of the preanal appendages of the male. Ulmer has also described and figured two very different types of western females but it is not known how these correspond to the male varieties. To this I may add that I found in a collection sent me from Oregon by Mrs Griffin a male differing in the shape of the preanal appendages from those described by Banks. My own communication to Vorhies (quoted by him, *l. c.*, p. 674) to the effect that there is a larger eastern species, was based on error; the specimens in the New York State collection were from Colorado. Nevertheless there is an eastern form differing from the one Vorhies described from Wisconsin. Dr J. T. Lloyd of Cornell University has given me specimens of this species reared from the bogs at McLean, N. Y. To repeat, there are known five varieties, one from New York, one from Wisconsin, one from Alaska, and at least two from Colorado and westward. I include figures of the preanal appendages of the males, copying Banks' figures of the western and Alaskan species known

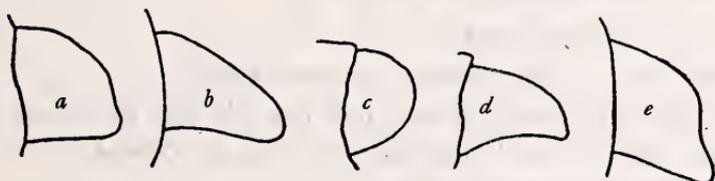


Fig. 59 (*c* and *d* after Banks). Preanal appendages of varieties of *Hesperophylax designatus* Walker. *a* New York specimens. *b* Wisconsin specimens. *c* var. *occidentalis* Banks. *d* var. *alascensis* Banks. *e* Oregon specimen

to him (text fig. 59). Allowance must of course be made for the fact that these appendages are concave internally and the outline of the margin may differ somewhat with the exact angle at which it is viewed. Ulmer has described and figured one of Walker's types, the figures agreeing with the Wisconsin variety.

Beside the western varieties of *designatus* there is one western species.

#### *Hesperophylax magnus* Banks

Banks, 1918, p. 20, pl. I, fig. 9. Palmerlee, Ariz.

### Homophylax Banks

Banks, 1900a, p. 255; Ulmer, 1907c, p. 74.

Antennae crenate, the basal segment thick, hardly as long as the head. Spurs 1-3-4, or 1-2-2 (Ulmer mentions that the one specimen he has seen has spurs 1-3-3); subapicals of the hind legs unequal; no spines on the last tarsal segment of the hind leg. Fore wings short and broad. The cord of the fore wing an almost straight line across the wing. In the hind wing the discal cell small, triangular, lying far toward the base of the wing. Cells  $R_2$ ,  $R_4$  and  $M_1$  at least sometimes pedicellate.

This genus has probably been described from female specimens. In the Cornell University collection I find a single male which probably belongs to *H. flavipennis*. It differs markedly in several respects from the female. In the fore wing the venation is like that figured for the female by Ulmer (*l. c.*, pl. 9, fig. 72); but at the base of the wing, on vein *M* there is a large semicircular flap which lies forward over the base of the sector (text fig. 7b). There are scales in this region, although I think they are not confined to the place covered by the flap. The hind wing has a broad longitudinal furrow of scale hairs obscuring the venation. At the base there are short black bristles on costa which seems to be somewhat back of the costal margin at this point. The shape of the wing is modified by having a concavity at the end of the furrow.

Three western species are reported.

#### *Homophylax crotchi* Banks

Banks, 1920a, p. 345. Victoria, Vancouver Island.

#### *Homophylax flavipennis* Banks (text figs. 7b, 10d, pl. 54, fig. 3).

Banks, 1900a, p. 255; Ulmer, 1907c, pl. 9, fig. 72. Colorado.

#### *Homophylax nevadensis* Banks

Banks, 1903b, p. 242. Nevada.

### Glyphopsyche Banks

Banks, 1904c, p. 141; Ulmer, 1907c, p. 71

Spurs 1-2-2, 1-3-3 or 1-3-4. No spines on the last tarsal segment of the posterior legs. Prothorax small. Apical margin of the fore wing distinctly and evenly excavate. Pterostigma prominent in both wings. Discal cell long in both wings, longer than its pedicel in the fore wings. The crossvein *r* present in the fore wing of one species; in the other the vein  $R_1$  sharply angled at the corresponding point.

Type of genus—*G. irrorata* (*bryanti*, Bks.).

If my determination is correct, this genus is hardly so closely related to *Glyphotaelius* as to *Chilostigma*, from which it can hardly

be distinguished except by the shape of the fore wings. These latter are proportionately longer, not so much narrowed at the base, the anterior margin less convex. Banks describes the genus as having, "fore wings distinctly and evenly excavate." In specimens I have seen, the excavation of the apical margin is not very great.

### Glyphopsyche irrorata Fabricius

(Pl. 53, figs. 4-6)

Fabricius, 1781, p. 389 (*Phryganea*); Fabricius, 1787, p. 245 (*Phryganea*); Fabricius, 1793, p. 77 (*Phryganea*); Walker, 1852, p. 30 (*Limnephilus intercisus*); Hagen, 1861c, p. 268 (*Enoicyla intercisus*); McLachlan, 1863c, p. 158 (*Limnephilus intercisus*); McLachlan, 1864a, p. 657 (*Limnophilus*); McLachlan, 1876a, p. 188 (*Chilostigma intercisus*); Provancher, 1877, p. 259 (*Ecclisopteryx intercisus*); Hagen, in Lintner, 1878, p. 85 (*Chilostigma*); Banks, 1904c, p. 141 (*bryanti*); Ulmer, 1906b, p. 7, fig. 7; Ulmer, 1907c, pl. 8, fig. 66; Martynov, 1914e, p. 263, figs. 76-79

"Head black, with some short white hair, particularly prominent near margin of eyes; palpi black; antennae yellowish brown; prothorax yellowish above, with white hair, and black hair on the sides; mesothorax dark brown, with a broad grayish-white stripe in the middle, less distinct on metathorax. Abdomen dark brown; legs dull yellowish, with black spines, the tips of tibiae and tarsal joints narrowly brown. Wings brown, darker beyond anastomosis; the costal area (and sometimes elsewhere) shows many pale irregular spots; before middle of wings there is an oblique white space between median and cubital veins. In the base of the third apical there is a very distinct circular white spot. At the margin there is a narrow white spot in the middle of each apical cell; those in the subapicals I and II are broader and nearly touch, that in the third subapical is very small; behind the anal veins are a few pale spots and streaks. The first apical does not extend back on the discal cell, and the fifth is acute or even short pedicellate at base. In the hind wings the apical part is faintly fumose, and the pterostigma a little darker.

"Expanse 38 mm.

"Two specimens from Wellington, British Columbia (Theo. Bryant)." Banks, *l. c.*

McLachlan (*l. c.*, p. 657) identified *irrorata* Fabr. and *intercisus* Walker, and Ulmer reduces *bryanti* Banks to the same synonymy. Ulmer has given (*l. c.*, 1906) additional notes on a cotype of *irrorata* from the British museum; he says that Banks' description (quoted above) answers almost word for word especially if one considers the fact that this cotype is old and the colors somewhat changed.

The species is reported from Maine, New Hampshire, British Columbia, St Martin's falls, Albany river, Hudson bay.

I have a single alcoholic specimen which belongs to this genus and probably to this species. It was given to me by Dr C. P.

Alexander, who collected it at Gloversville, N. Y., March 16th. The genitalia are difficult to make out and the figure given (pl. 53, fig. 6) can be considered only approximately correct. The markings are not well enough preserved to indicate whether this is *irrorata* or *bella*, but the habitat suggests the former.

The following western species is described by Banks as differing from *irrorata* in color and in having the first apical cell extending a little on discal cell, and the fifth apical not acute at base, although narrowed. It will be noted that *irrorata* is reported from both the East and the West.

#### *Glyphopsyche bella* Banks

Banks, 1903*b*, p. 241 (*Glyphotaelius*); Banks, 1904*c*, p. 141; Ulmer, 1907*c*, pl. 34, fig. 4. British Columbia.

#### Chilostigma McLachlan

McLachlan, 1876*a*, p. 187; Ulmer, 1907*c*, p. 69; Ulmer, 1909*a*, p. 177

Antennae slender, the basal segment bulbous, scarcely as long as the head. Maxillary palpi of the male long and slender, the third segment longer than the others; maxillary palpi of the female stout, third and fifth segments longer than the second and fourth, the fifth slender; the palpi strongly pubescent. Legs with black spines, these not occurring upon the last tarsal segment of the hind legs. Spurs 1-2-2. Fore wings long and narrow in the European species, broad in at least one of the American species; costal margin convex, the posterior margin emarginate at the tip of the anal veins. The pterostigma very plainly indicated and the wing membrane here more coarsely granulate than elsewhere. At the level of the tip of *Sc* a sharp arch in *R*<sub>1</sub> and from thereon this vein concave anteriorly; *R*<sub>2</sub> and *R*<sub>3</sub> sometimes concave at their distal ends. Wing membrane granulate with stiff semierect hairs. The genitalia not very prominent; the penis with two stout appendages.

I have found it difficult to make out the parts of the genitalia clearly and the figures are probably not wholly accurate.

#### Chilostigma areolatum Walker

Walker, 1852, p. 35 (*Limnephilus*); Hagen, 1861*c*, p. 267 (*Enoicyla*); McLachlan, 1880*a*, p. xliii

"Black-gray, with black hair; femora obscure ferruginous; anterior wings whitish, with black veins, many of the areoles with fuscous bands, the apical ones with broader bands; margins ciliated. (From the description of Walker.)

"Length to tip of wings 7 millim. Alar expanse 13 millim.

"Hab. St. Martin's falls, Albany river, Hudson's bay (Barnston).

"It is a most beautiful species." Hagen, *l. c.*

**Chilostigma coagulatum Hagen**

(Pl. 53, fig. 7)

Say, MS, (*Cryptothrix*); Hagen, 1873b, p. 296 (*Platyphylax*); Provancher, 1877, p. 260 (*Cryptothrix*); Provancher, 1878b, p. 136 (*Cryptothrix*)

This species is like *difficile* and has more recently been regarded a synonym. It differs in having the discal cell short, hardly longer than its pedicel. The tenth segment of the male is prominent, forming a pointed piece directed obliquely upward, black in color. The claspers are not produced into a long point as in *difficile*.

It may be noted that Hagen regarded the species as distinct. Lintner (10th Report, New York Com. of Fisheries, p. 85) quotes Hagen to the effect that *difficile* is "much like the first (*coagulatum*) but a little larger and the male and female have different genital parts."

I have a single specimen (data lost but doubtless from New York) which agrees with Hagen's specimens of *coagulatum*; the genitalia are figured from this specimen (pl. 53, fig. 7). Hagen's specimens are from Massachusetts, New Hampshire and Illinois.

**Chilostigma difficile Walker**

(Pl. 53, figs. 8-10, pl. 54, fig. 1)

Walker, 1852, p. 34 (*Limnephilus*); Hagen, 1861c, p. 268 (*Enoicyla*); McLachlan, 1863c, p. 158 (*Enoicyla*); Lintner, 1878, p. 85, pl. 5, fig. 2; Ulmer, 1907c, pl. 8, figs. 64a, b, pl. 34, fig. 7; Lloyd, 1915e, pl. 15, fig. 12; Sibley, 1926b, p. 108, pl. 13, fig. 106

Immature stages. Lloyd, 1915e, p. 208, pl. 15, fig. 12, pl. 16, figs. 1, 2, 6, 7, 9, 18; Lloyd, 1921, p. 70-72, figs. 106-14

Head and antennae reddish brown, the middle of the segments of the latter darker. Thorax and legs reddish brown. Fore wings brown, closely irrorated with hyaline; cell 4th *A* pale; some specimens rather pale yellow. Venation as in plate 54, figure 1. Veins dark brown interrupted by the hyaline spots. The eighth dorsal segment of the male with two patches of black spines; the preanal appendages slender, upright against the eighth dorsal segment; the tenth segment difficult to see clearly, its median blades long, up-curved at the apex, two other pieces apparently joined to these at the base on each side; these all dark in color. The penis with an extrusible tip and two stout dorsal appendages. The claspers ending in long points. Length, male 14-17 mm, female 17 mm.

The above description is from specimens from Albany and Otto, N. Y., and from West Springfield, Mass., October 25th-November 3d. I think these represent Walker's *difficile*. The description as given by Hagen after Walker seems to apply, as do also Hagen's later notes quoted by McLachlan, "Sup. lamina truncated, on each side scabrous and black; app. sup. small, inserted; app. inf. long,

acute, straight, inflated at base." There seems to be a large difference in size in the specimens in the New York collection and possibly more than one species is here included.

The immature stages are described by Lloyd and by Sibley; the latter reports the adults from October 16th to December 2d.

The species has been reported from Nova Scotia, New Hampshire, Virginia, New York and Massachusetts.

### *Chilostigma pallidum* Banks

Banks, 1899, p. 209; Ulmer, 1907c, p. 70; Sibley, 1926b, p. 108

"Head pale yellowish, with pale yellow and some scattered blackish hairs; thorax yellowish, with pale yellow hair; legs pale yellowish, spines black; abdomen brown; wings hyaline, hinder half of the apical part beyond anastomosis irrorate with pale yellow-brown markings, pterostigma very prominent, large, yellow-brown, veins yellow; hind wings hyaline; antennae rather fine and short; spurs 1-2-2; wings moderately broad; truncate at tip, the pterostigma elevated, the radius strongly curved at that point, the first apical cell at base swollen above, and not extending alongside of discal cell at all, the anastomosis being very straight, not indented by third apical, which is as broad at base as the fourth apical, fifth apical acute at base, not extending along thyridial cell, vein at base of subapicals nearly straight, the discal cell is slightly less than twice as long as its pedicel, in hind wings the fourth apical is scarcely narrowed at base. Expanse 32 mm.

"Ithaca, N. Y." Banks, *l. c.*

Besides *C. difficile* and *C. coagulatum* I have a species which may belong here but which I can not identify with any of the above, and of which, unfortunately, there is insufficient material to merit the application of a specific name.

### *Chilostigma* sp.

(Pl. 54, fig. 2)

Of this specimen there remains nothing but wings and abdomen. The venation is very different from the others, the apical cells of the fore wings short, the veins diverging; the wing apex rounded. The hind wing has an excision beyond the apex and this is followed by a convexity; the apical veins diverge here also. The genitalia seem to me wholly like those of *C. difficile*. The venation (pl. 54, fig. 2) looks like that of *Chaetopterygopsis* (Europe) but there are no stout bristles on the wings.

Other North American species of *Chilostigma* are:

### *Chilostigma alascense* Banks

Banks, 1900b, p. 471, pl. 28, figs. 19, 20 (*Halesus* ?); Ulmer, 1907c, p. 70. Alaska.

*Chilostigma praeteritum* Walker

Walker, 1852, p. 32 (*Limnephilus*); Hagen, 1861c, p. 268 (*Enoicyla*); McLachlan, 1863c, p. 158 (*Enoicyla*); Hagen in Lintner, 1878, p. 85; McLachlan, 1880a, p. xlii, pl. 55; McLachlan, 1884a, p. 15, pl. 1; Banks, 1892, p. 364 (*Ecclisopteryx*); Banks, 1907c, p. 40; Martynov, 1914e, p. 253, fig. 60-62; Banks, 1919, p. 3; Banks, 1923, p. 146. Western Canada, Alaska.

*Chilostigma subborealis* Banks

Banks, 1924, p. 441, fig. 32, Alaska, Br. Col., Alberta.

## Ironoquia Banks

Banks, 1916a, p. 121, 122

Described as differing from *Chilostigma* in having wings less broad and in having  $R_1$  scarcely bent at the stigma.

## Ironoquia parvula Banks

Banks, 1900a, p. 256 (*Chaetopterygopsis*); Ulmer, 1907c, p. 69 (*Potamorites* ?); Banks, 1916a, p. 121, 122

"Face yellowish, vertex more brownish, nearly flat, basal joints of antennae long, brown, rest of antennae yellowish, joints tipped with brown, thorax dirty yellowish, legs clear yellowish, with fine black spines, rather fewer on tibiae than usual, spurs 1-2-2; fore wings pale brownish, indistinctly irrorate with hyaline, anastomosis darker, surface distinctly rugulose, sparsely clothed with short yellow hair, a circular white spot containing a brown central dot in base of the third apical cell, veins pale, wing rather broad and short, apex rounded, discal cell nearly twice the length of its pedicel, first apical cell some distance on discal cell, fifth apical cell scarcely on thyridial cell at all, the cubital veins not fractured at posterior anastomosis; margin with a scant fringe, nearly as long on costal as on apical margin. Hind wings not much shorter than fore wings, hyaline, with yellowish veins and pubescence, a brown dot in base of third apical cell, fourth apical cell broad at base.

"Length 8.5 mm.

"New Brunswick, N. J. (Prof. J. B. Smith)." Banks, *l. c.*

## Algonquina Banks

Banks, 1916a, p. 121, 122

The genus needs further definition. From Banks's key (*l. c.*) the following characters are gathered: Spurs 1-3-4. Last segment of hind tarsus without spines. No distinct ocellar macrochaetae. Cell  $R_4$  of the fore wing acute at base.

None of the species is known to me and it is not clear whether Banks means to transfer to the genus all the species listed below that he has heretofore assigned to *Parachiona*. The type of the genus is *parvula* Banks.

**Algonquina parvula** Banks

Banks, 1905c, p. 9 (*Stenophylax* ?); Ulmer, 1907c, p. 72 (*Hypnotranus* ?);  
Banks, 1907c, p. 39 (*Parachiona*); Banks, 1916a, p. 122

"Face pale, clothed with pale hair; vertex brown, with whitish hair, behind are two large transverse yellow warts bearing yellowish hair; antennae pale, basal joint rather long, clothed above with yellowish hair; prothoracic lobes yellow, clothed with long white hair; thorax brown, with some yellowish hair; abdomen brown; legs very pale yellowish, with black spines; wings pale, veins brownish, bearing erect, black hairs; membrane with very short, fine, yellowish and blackish hair, scarcely visible, some brown marks along the median vein and apical sectors, especially prominent at thyridium and at base of the fifth apical cell; hind wings whitish hyaline, venation yellowish, rather more yellowish in the pterostigmatic region. Forewings narrow, costal area narrow, discal cell not closed, no trace of the cross-vein in either wing, first and fifth apical cells acute at base and not extending before anastomosis; radius slightly bent at the pterostigma; apical margin of wing faintly rounded; hind wings have the margin entire, the discal cell faintly closed in one wing, not in the other, first and fifth apical cells acute at base. Spurs 1-3-4. Expanse 18 mm.

"One specimen from Hampton, New Hampshire, May 17th (S. A. Shaw)." Banks, *l. c.*, p. 9.

The other species are western.

**Algonquina centralis** Banks

Banks, 1900a, p. 253 (*Asynarchus*); Banks, 1907c, p. 39 (*Parachiona*).  
Colorado.

**Algonquina pallida** Banks

Banks, 1903b, p. 242 (*Asynarchus*); Banks, 1907c, p. 39 (*Parachiona*).  
Colorado.

**Algonquina pilosa** Banks

Banks, 1907a, p. 121, pl. 9, fig. 13 (*Parachiona*). Washington.

**Algonquina signata** Banks

Banks, 1907a, p. 120 (*Parachiona*). Idaho.

**Apolopsyche** Banks

Banks, 1916a, p. 121

This genus is described as differing from the preceding in having cell  $R_4$  not acute and reaching before the anastomosis. In *Algonquina* this cell is sometimes pedicellate.

Two western species are reported.

**Apolopsyche minusculus** Banks

Banks, 1907a, p. 120, pl. 9, fig. 12 (*Stenophylax*); Banks, 1916a, p. 121.  
Washington.

**Apolopsyche pallida** Banks

Banks, 1924, p. 442, fig. 54. Manitoba.

**Clistoronia** Banks

Banks, 1916a, p. 119.

The following characters are taken from Banks' key in which the genus is erected by reference to the single western species.

Spurs 1-3-3. Vertex not with dense appressed hair. Median part of the mesonotum without bristle-bearing granules. Wings not granulate, scarcely excised. Hind wing with discal cell plainly before the median cell. Bristles on the veins longer than on the membrane of the wings.

Type species:

*Clistoronia magnifica* Banks

Banks, 1898, p. 209 (*Halesus*); Banks, 1916a, p. 119. Washington.

**Psychoronia** Banks

Banks, 1916a, p. 119, 122.

The female is described as having "wings short; anterior part not reaching tip, and posterior pair scarcely extending beyond middle of abdomen; the former broad and broadly rounded at tip, the latter much narrower and acute at tip."

The following additional characters may be gathered from Banks' key to the Limnephilidae.

Spurs 1-3-3. Vertex flat, not with dense appressed hair, posterior warts well developed. Median part of mesonotum without bristle-bearing granules. Hind wings scarcely excised; the discal cell before the fork of media.

One western species is reported.

*Psychoronia brevipennis* Banks

Banks, 1904a, p. 108, pl. 1, fig. 3 (*Psilopteryx* ?); Ulmer, 1907c, p. 63 (*Psilopteryx* ?); Banks, 1916a, p. 119. New Mexico.

**Neophylax** McLachlan<sup>40</sup>

McLachlan, 1871, p. 111; Ulmer, 1907c, p. 73

Immature stages. Vorhies, 1909, p. 669; Lloyd, 1921, p. 72

Antennae as long as the fore wings, the basal segment longer than the head. Ocelli present. Spurs 1-2-4, 1-3-4, or 1-2-2. Legs with black spines but none present on the last tarsal segment of the hind legs. In the male the inner subapical spur of the hind leg very small (text fig. 6d); the inner apical spur of the same leg bulbous at base and with a broad leaf-like structure in the axil; spurs of the female normal. Fore wings (pl. 55, fig. 13) hairy; narrow at base, widened toward the apex; beyond the apex the margin has two concavities, the convexity between them being at the tip of  $M_1$ . In the fore wing  $R_1$  arched near the tip; the discal cell long. In the hind wing  $Sc$  and  $R_1$  close together as far as about the level of the base of cell  $R_2$ , from there on diverging,  $R_1$  strongly concaved and nearer to  $R_2$  than to  $Sc$ ; in the females the sector and media of

<sup>40</sup> See Addendum, p. 473.

the hind wing normal, the latter two-branched; in most males the sector normal, though swung rather far into the wing, but in one species (possibly only as an individual variation)  $R_{2+3}$  and  $R_{4+5}$  separated basally, the latter joining  $M$  (pl. 56, fig. 1); media apparently disappears in part in the males with no sure indications of its fusions, apparently the base with  $R_{4+5}$ ; the anal veins of the hind wing in part obsolete. The male with ventral teeth on one or two of the segments.

Larvae eruciform with the head very sharply turned downward and concealed by the prothorax (text fig. 60). Frons with a deep lateral emargination far toward the apex. Labrum twice indented along the anterior margin, with a conspicuous oblique row of heavy bristles on either side. Ventral "horn" present on the prosternum in at least some species. Metathoracic shields as typical for the family but the two median pairs small. Legs about equal in length, the anterior ones somewhat stouter than the others, the claws with a very long basal spur. Dorsal tubercle of the first abdominal



Fig. 60 Head and thorax of *Neophylax* sp.

segment low and inconspicuous. Gills few and simple. Ventral segment 3, 4 and 5 with elliptical chitinous rings. Lateral fringe extends over segments 3-7.

Pupal antennae as long as or slightly longer than the body. Wings reaching to the end of the fourth abdominal segment. Posterior border of the last segment a straight ridge with black spines. Pupal claws present. Anal processes slender, the ends somewhat hooked and dentate.

The larval case consists of a straight tube of small stones with larger stones at the sides, much resembling a *Goera* case though more slender. Both ends of the case are closed by stones; between these and the ventral wall of the case there are broad bands of brown silk with longitudinal slits between.

The relationship of this genus to the Apataniinae is somewhat uncertain. McLachlan (*l. c.*, p. III) says, "It should probably be placed near *Apatania*, with which it agrees in spur formula and densely pubescent anterior wings," and Ulmer (*l. c.*, p. 73) says that the genitalia are similar to those of *Apatania*. There is some resemblance in venation also. On the other hand, the most striking venational characters of the Apataniinae are lacking; moreover, the larvae are not much narrowed posteriorly, and the chitinous shield of the prosternum which Silfvenius (*Acta Soc. pro Fauna et Flora Fennica*, 27, No. 2, p. 28, 70) says is present in the Limnephilinae and absent in *Apatania*, is present in *Neophylax* also. The meta-

thoracic shields characteristic of the Limnephilinae are also present, though the median ones are small.

Whatever may be the relation between *Neophylax* and the Apantiniinae there can be no doubt that *Neophylax* strongly resembles the Goerinae in many important characters. In the adults this relationship is not very strongly suggested but the following larval characters may be noted: The head is bent down and largely concealed in the prothorax; its surface is rough with minute blunt chitin points. The labrum is not strongly chitinized along the anterior margin and the anterior angles have numerous bristles. The maxillary lobe is rudimentary. The pronotum is large and is shaped like that of the Goerinae except that the lateral anterior margin is rounded, not acute. The supporting plate of the middle leg is long. The basal spur of the claws is so long that its tip is as far out as the tip of the claw itself. Most striking of all is perhaps the case of the well-known *Goera* type. On the other hand, a striking difference is that the gills are few and simple.

Five species are known to me, all from New York State. Of these, two (not included here) are in the collection of Dr J. T. Lloyd, collected and bred at McLean, N. Y. In addition I regard two species of my own collection as new, one of these described below. The fifth I identify as *N. autumnus* Vorhies.

The abnormal spur of the male doubtless occurs throughout the genus though it is not mentioned in any of the descriptions. Vorhies has shown that the number of spurs is subject to variation. I find that the same is true of the teeth on the ventral segments of the males.

Perhaps it may be worth while to add that the study of the genitalia of this genus is difficult; more than in most forms is the appearance affected by slight changes in direction of view. The ventral views are more reliable than the lateral ones.

### *Neophylax autumnus* Vorhies

(Pl. 55, figs. 1-3)

Vorhies, 1909, p. 669, pl. 55, figs. 9-14; Sibley, 1926b, p. 106, 214

Immature stages. Vorhies, 1909, p. 670, pl. 52, fig. 3, pl. 55, figs. 15-20;

Lloyd, 1921, p. 76, 77, figs. 121-23; Sibley, 1926b, p. 106, 214, pl. 13, figs. 104, 105

The following is the greater part of Vorhies' description of the adult. The immature stages are described by Vorhies and by Lloyd.

"Imago. Length of body, 5-7 mm. Expanse, male, 15-17 mm; female, 16-18 mm. Antennae, 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 antennae 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, tibiae 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." Vorhies, *l. c.*

Vorhies' specimens were taken in restricted habitats, near Madison, Wis.

Two specimens agreeing with this description were sent to me by Dr C. P. Alexander, taken at Gloversville, N. Y. There is some difference between Vorhies' figure of the ventral view of the claspers and that here given (pl. 55, fig. 2) but this is doubtless due

to slight differences in the angles from which the structures are viewed. The spurs in these specimens certainly number 1-2-4 but the facts cited by Vorhies show that this does not vitiate the determination of the specimens.

I am strongly inclined to identify the species with McLachlan's *concinus*. It is the only one I know in which the genitalia at all resemble McLachlan's figure. The discrepancy in the description with regard to the ventral abdominal teeth is of no importance. Vorhies kindly examined his specimens for me and found that seven out of 17 had the tooth on the sixth segment as in McLachlan's description. If the species are not identical, both occur in New York State.

### *Neophylax concinnus* McLachlan

McLachlan, 1871, p. 111, pl. 2, figs. 3a-3; Hagen, 1873b, p. 296; Provancher, 1878a, p. 134; Provancher, 1878b, p. 134<sup>3</sup>; Patten, 1884, p. 1-54 (embryology); Banks, 1904d, p. 211; Ulmer, 1907c, pl. 8, figs. 69, 70; Banks, 1924, pl. 4, fig. 58; Sibley, 1926b, p. 106, 214  
Immature stages. Lloyd, 1921, p. 72-76, figs. 115-20

"Length of body 7 mm. Alar expanse 20 mm.

"*Head* (with the antennae, palpi) and *thorax* testaceous; occiput, basal joint of antennae, and prothoax clothed with testaceous, with an admixture of fuscous, hairs; and there is a fringe of similar hairs on the facial margin of the eye-sockets; eyes dark coppery. *Legs* testaceous, the posterior tibiae paler; tibiae and tarsi, with few, short, black spines; spurs reddish-testaceous. *Abdomen* pale whitish testaceous; on the antipenultimate ventral segment is a very small, reddish-testaceous, triangular tooth, and on the penultimate segment a much larger tooth; appendices testaceous; app. sup. small, rounded, and ear-shaped, extending a little beyond the cavity of the last segment; app. intermed. placed close together, proceeding from under the middle of the upper margin of the segment, nearly straight, and flattened laterally; when viewed from the side each appendage is seen to be dilated at the base, then with the upper margin excised to the apex, which is obtuse; app. inf. inserted close together on the ventral margin, band-like, curved strongly inward, forming a deep incision when viewed from beneath, the apex obtuse.

"*Anterior wings* fulvous, thickly clothed with short, procumbent, fuscous pubescence, the apical half irrorated with many small and indistinct whitish dots; inner margin with three yellow spots, viz. an elongate one at the base, a long triangular one about the middle, and a small one before the anal angle; the pubescence in the spaces between these spots is darker, almost blackish fuscous; apical fringe alternately fuscous and whitish; veins testaceous, the costal margin at the base, and the basal portion of the radius, ciliated with fuscous. *Posterior wings* subhyaline, slightly smoky; the fringes at the anal angle very long, silky, and whitish.

"I received one male example from Mr J. Angus, of the State of New York." McLachlan, *l. c.*

Hagen, *l. c.* says that the spine on the abdomen of the male is as long as the segment on which it stands. I doubt, however, that Hagen correctly determined the species; all of his specimens are placed under *concinus*, and the first one is the species here described as *consimilis*.

### **Neophylax consimilis n. sp.**

(Text figs. 26*g*, 400; pl. 55, figs. 4-12)

Antennae as long as the fore wings, yellow, the basal segment hairy. Head, thorax and first abdominal segment brownish yellow; remainder of the abdomen brown above, yellow beneath. Legs yellow, with black spines, but few of the latter on the tibiae; some of the tarsal segments of the hind legs with black stripes externally. Fore wings brown and white, the color distributed as follows: anterior margin brown, area toward the middle of the wing brown with numerous white dots, these fewer toward the apex; the inner margin with three white areas, one long basal one, a triangular one in the middle, and a small one hardly separated from the latter by the posterior part of the cord; the whitish area including most of cells  $R_5$ ,  $M_1$  and  $M_2$ , inclosing also a prominent brown spot on the tip of  $M_1$ . The fringe of the wing colored like the areas which it borders. Hind wings smoky with a few indistinct white dots along the apical margin, sometimes pale and showing no dots. On the seventh ventral segment of the male a plate, sometimes divided, and on the sixth segment a shorter tooth. Length to tip of wings, female, 12 mm; expanse, male, 24 mm.

I reared this species at Old Forge, N. Y., July 9th-17th. In the New York collection there are two specimens from Elizabethtown, August 27th. These do not have the light colored area with the inclosed dark spot in the postapical region.

### **Neophylax fuscus Banks**

(Text figs. 10*e*, 60, 61; pl. 55, fig. 13, pl. 56, figs. 1-3)

Banks, 1903*b*, p. 242; Sibley, 1926*b*, p. 215, pl. 13, fig. 103

"Head black, with black hair; antennae yellowish, basal joints long, brown; thorax black, with mostly black hair; abdomen brown, legs pale yellowish, with a few black spines. Spurs 1-2-2. Wings dark brown, indistinctly irrorate with pale; hind wings dusky; venation of both pairs brown. Shape of wings and venation much as in *N. concinns*; the pterostigma prominent, and radius strongly bent at this point. In hind wings the apical cells are variable, as in *N. concinns*. Length to tip of wings 9 mm.

"Agricultural College, Michigan, September 25 (Pettit); and Franconia, N. Hamp. (Mrs. Slosson)." Banks, *l. c.*

This species is somewhat like *consimilis* in color, but the spots on the fore wings are much fainter as are the light areas along the posterior margin; in none of the specimens do I find a light area in

the postapical region. In the hind wings of the male (text fig. 61b)  $R_{2+3}$  and  $R_{4+5}$  have separated basally so that the discal cell reaches to the base of the sector. The genitalia are very different from those of all the other species. Length to tip of wings, male, 9 mm.

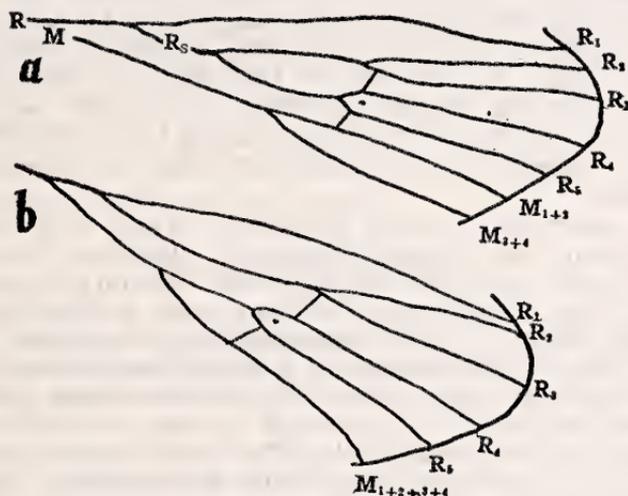


Fig. 61 Radii of the hind wing of *Neophylax fuscus* Banks (female). *b* Same of the male

Four specimens from Ogdensburg, N. Y., September 13th–17th, collected by C. W. Howard.

### *Neophylax ornatus* Banks

Banks, 1920a, p. 346

"Yellowish, with pale yellowish hair, some brown hair on sides of face and on sides of the pro- and mesothorax. Legs with black spines. Fore wings with pale yellowish hair, more golden near front margin, with large patches of white, and some black hairs toward tip and in two large patches behind. The white is in the apex of each apical cell and on base of second and third cells, the first and second subapical cells are nearly all white, leaving a dark line, much wider near tip, between them, the third subapical partly pale; a large pale area from behind discal cell, widening out behind, and another over the basal anal region. Hind wings pale, fringes nearly white. In structure and venation similar to *N. concinnus*.

"Expanse 27 mm." White Mountains, New Hampshire.

Two western species are reported.

### *Neophylax occidentis* Banks

Banks, 1924, p. 441, pl. 4, figs. 51, 58. Nevada.

### *Neophylax sinuatus* Navás

Navás, 1917b, p. 10, fig. 4. Montana.

### *Apatania Kolenati*

Kolenati, 1848*b*, p. 75; McLachlan, 1876*a*, p. 209; Klapálek, 1889*a*, p. 241, 242; Morton, 1902*a*, p. 150; Ulmer, 1907*c*, p. 75; Ulmer, 1909*a*, p. 180  
Immature stages. Ulmer, 1903*d*, p. 74; Silfvenius, 1904*c*, p. 70; Ulmer, 1909*a*, p. 255, 270, 313

Antennae slender, basal segment as long as the head. Spurs 1-2-4. First tarsal segment of the fore leg longer than the second. Fore wings long and narrow, but little widened distally. Venation well shown, especially  $R_1$ ; cell  $M_1$  of both pairs of wings generally pedicellate. Preanal appendages either not visible, or long and branched; tenth segment in the form of a long beak, curved ventrally; claspers two-segmented, sometimes very long; no ventral teeth on the abdomen.

Larvae somewhat narrowed posteriorly. Head very broad oval, almost circular, bent sharply downward. Antennae short, with a fine bristle on the end of the single segment. Mouth parts prominent. Mandibles large, chisel-shaped, without teeth, with a large bunch of internal bristles. On the metanotum the two middle chitinous shields of the ordinary pattern of Limnephilinae lacking, only the lateral ones being present; often the entire anterior part of the mesonotum chitinized. The claws of the legs very short, curved, with a long, curved, basal bristle. The outer sides of the femora and tibiae with more bristles than in the Limnephilinae. No chitinous shield on the posterior margin of the prosternum.

Pupal mandibles with the blade medially convex to near the tip. The cases conical, made of sand grains.

Of this genus some species are parthenogenetic.

### *Apatania incerta* Banks

(Pl. 56, figs. 4-6)

Banks, 1897, p. 28; (*Enoicyla*); Banks, 1907*c*, p. 40

"Length 8 mm.; alar expanse 14 mm. Black, tips of the femora, the tibiae, and bases of the hind tarsi yellowish; wings blackish, black veined, with black bristles on the veins, surface sparsely clothed with black hair, a faint hyaline spot at the arculus; hind wings are grayish with a blackish fringe. Legs with small black spines; spurs 1-2-2, discal cell nearly as long as the pedicel, closed obliquely beyond the anastomosis; first apical cell acute at base, fifth not reaching the anastomosis, the others nearly equal at base; radius curved at the pterostigma; subcosta ends in a cross-vein in front of the pterostigma; in the hind wings the first apical is long pedicellate, and the fifth does not reach the anastomosis.

"One from Sherbrooke, Canada, May (Bégin); one from Franconia, N. H. (Slosson), and several from Sea Cliff, New York, April." Banks, *l. c.*

Probably the same as *pallida* Hagen.

The figures are from a specimen given me by Mr Banks.

*Apatania nigra* Walker

Walker, 1852, p. 83 (*Potamaria*); Hagen, 1861c, p. 270 (*Enoicyla*); McLachlan, 1863c, p. 158

"Black, with black pile; beneath, a little clothed with luteous hair; antennae rather short; breast grayish; apices of the abdominal segments, base of the tarsi, the tibiae ferruginous; wings blackish, clothed with black pile. (From the description of Walker.)

"Length to tip of wings 9 millim. Alar expanse 16 millim.

"Hab. St. Martin's Falls, Albany River, Hudson's Bay (Barnston)." Hagen, *l. c.*

McLachlan (*l. c.*) adds that "the inferior appendages are long, straight, needle-shaped, acutely pointed."

*Apatania pallida* Hagen

Hagen, 1861c, p. 270

"Black, with luteous pile; antennae black; feet pale, with black spines, femora fuscous; anterior wings luteo-hyaline, and the veins same color, with luteous pile and cilia; posterior wings hyaline. Male.

"Length to tip of wings 8 millim. Alar expanse 15 millim.

"Hab. St. Lawrence river, Canada (Osten Sacken)" Hagen, *l. c.*

There is a single specimen in Hagen's collection, not spread.

*Apatania stigmatella* Zett

Zetterstedt, 1840, 1066 (*Phryganea*); McLachlan, 1867b, p. 57 (*frigida*); McLachlan, 1876a, p. 213, pl. 23; Morton, 1902a, p. 155, figs. 4-6; Banks, 1908b, p. 61, 64; Martynov, 1914b, p. 30, figs. 7-11; Martynov, 1925b, p. 13

"Generally similar to *A. wallengreni*. (I have seen no examples in good condition as to pubescence.)

"In the male there are no true superior appendages. Intermediate appendages not long, broadly dilated in a triangular manner when viewed laterally, and excised below the apex; colour dusky testaceous; the lower edge with distant hairs. Between the appendages (seen from above) there are two short, slender, straight, and parallel processes, not so long as the appendages; below these (internally) there are two strong piceous spines with their tips turned outward; and again, still more inferiorly are two more slender spines, turned inward, and meeting at the tips, which may be regarded as penis sheaths. Inferior appendages very long, the basal joint stout, cylindrical, gradually dilated, blackish, and with long blackish hairs; second joint testaceous, abruptly turned inward in the form of an acute claw, broad at its base." McLachlan, *l. c.*, p. 213.

Morton, *l. c.* adds the following regarding the female:

"The ninth segment large, when viewed from above, pointed in the middle of the posterior margin, but the segment in dry examples is not always easy to separate from the tubular piece, which above is divided into two sections pointed at the apex, the points being usually visible even in dry specimens. The vulvar scale has usually the appearance of having the apex truncate, but the scale in these

insects is very slightly chitinized, and the form may therefore vary a little; the character, nevertheless, seems real. There are no side lobes. The sides of the segments seen from beneath are slightly produced, the angle being followed by a shallow excision.

"In all the preparations the side blades are rather indistinct; the central triangular piece is elongated as in *A. wallengreni*, while the foot-shaped piece has the 'heel' very narrow in all the preparations." Morton, *l. c.*

The species is reported from northern Europe and Great Slave lake, Canada (McLachlan); Banks lists it from Newfoundland. Martynov (1914c) has redescribed the species in his comprehensive review of the subfamily Apataniinae.

Six northern species are described.

*Apatania arctica* Bohem

McLachlan, Rev. and Syn., p. 216; Martynov, 1914c, p. 47; Mosely, 1929a, p. 502; Mosely, 1931a, p. 34. Greenland.

*Apatania canadensis* Banks

Banks, 1924, p. 442, fig. 50. Manitoba.

*Apatania groenlandica* Kolbe

Kolbe, 1912, p. 41. Greenland.

*Apatania hirtipes* Curtis

Curtis, 1835, p. 64 (*Tinodes* ?); Curtis, 1836, p. 288 (*Tinodes*); Hagen, 1861c, p. 295 (*Tinodes*); McLachlan, 1871, p. 139. Arctic America.

*Apatania mongolica* Martynov

Martynov, 1914c, p. 44, figs. 33-36. Alaska.

*Apatania shoshove* Banks

Banks, 1924, p. 442, figs. 35, 43. Yellowstone National Park.

### Allomyia Banks

Banks, 1916a, p. 120, 122.

Described in Banks' key to the Limnephilidae as differing from *Apatania* in having the spurs 1-3-4 and the discal cell of the hind wing closed.

There is one western species.

*Allomyia tripunctata* Banks (text fig. 26i, pl. 57, fig. 2, 3)

Banks, 1900b, p. 472, pl. 27, fig. 4 (*Apatania*); Ulmer, 1907c, p. 72 (*Hypnotranus* ?); Banks, 1907c, p. 41 (*Apatania*); Banks, 1916a, p. 120. Yakutat, Alaska.

### Oligophlebodes Ulmer

Ulmer, 1905d, p. 66; Ulmer, 1907c, p. 73

Antennae slender, the basal two segments thicker, the second short, the distal part crenate beneath. Maxillary palpi of the female with the second, third and fifth segments about equal, the fourth and the first successively shorter. Spurs 1-3-3. Tibial spines not very

numerous, none on the last tarsal segment of the hind leg. Radius of the fore wing apparently ending in a transverse vein running from the costal margin to  $R_1$ ; discal cell very long; none of the apical cells pedicellate. In the male the second anal vein not reaching the margin, running only to the crossveins uniting it to *1st A* and *3d A*. In the hind wing of the female the venation normal; cell  $Cu_1$  short pedicellate; in the male hind wing the homologies obscure; apparently  $R_{4+5}$  separated from  $R_{2+3}$  as is the case in the male of at least one species of *Neophylax*. The corneous point usually marking cell  $R_4$  lacking and no other indication present of the location of the branches of the sector, of  $M$ , and of  $Cu_1$ ; the veins of the anal angle normal. On the anterior margin of the hind wings hooks, much like those in the Leptoceridae.

There is one western species described.

*Oligophlebodes minuta* Banks (pl. 56, fig. 7)

Banks, 1897, p. 28 (*Halesus*); Banks, 1904a, p. 107 (*Halesus*); Ulmer, 1905d, p. 66, fig. 20 (*coloradensis*); Ulmer, 1907c, p. 74, pl. 9, fig. 71. New Mexico, Colorado.

Reference may here be made to the undescribed genus of which I found a male in a collection made by Dr C. C. Adams in Montana. The single male specimen (alcoholic) has the characters listed in the key to the family and in addition has a remarkable abdominal appendage unlike anything so far found in any other species (pl. 57, figs. 2, 3, text fig. 26i)<sup>41</sup>.

### SERICOSTOMATIDAE

McLachlan, 1876b, p. 221; Klapálek, 1904a, p. 27 (reprint); Ulmer, 1907c, p. 78; Ulmer, 1909a, p. 181; Ulmer, 1912e, p. 268  
Immature stages. McLachlan, 1876b, p. 221, 222; Klapálek, 1893, p. 38; Ulmer, 1903d, p. 76; Silfvenius, 1905b, p. 10, 31; Thienemann, 1905b, p. 32; Silfvenius, 1906b, p. 55; Siltala, 1907c, p. 523; Ulmer, 1909a, p. 207, 271, 314; Lestage, 1921a, p. 826

Antennae generally as long as or shorter than the fore wings; the basal segment large, often longer than the head, sometimes longer than the body, of diverse shapes, hairy, sometimes with spines or scales; the other segments short, often hairy or with small spines. Ocelli absent except in *Nosopus* and *Plectrotarsus* (the latter exotic). The head sometimes with stout scale hairs or broad scales like those on the basal segment of the antennae. Maxillary palpi of the males most diverse in form, often clothed with scales, with not more than three segments (p. 20); not infrequently directed upward so as to mask the face. In one exotic genus (see p. 21) a sucking proboscis formed. Spurs generally 2-2-4 or 2-4-4, more rarely 2-2-2, 2-3-3, 1-4-4, 1-3-4, 1-2-4, or 1-2-2. The legs short, those of the female not dilated (fore tarsus dilated in *Nosopus*). Wings generally very hairy or with scale hairs so that the venation is obscured. In some genera furrows of scale hairs in one or both wings. The venation varying a great deal with the genera, and in some subfamilies unlike in the sexes.

<sup>41</sup>The species referred to is *Allomyia tripunctata* Banks.

The larvae eruciform, the constrictions between the segments of the abdomen slight. Antennae rudimentary. Pronotum chitinized, mesonotum partially chitinized, metanotum with small plates of chitin if with any. Lateral line very faint or absent. Tracheal gills commonly present, single or in small bunches. The ninth segment with chitinous plates. Anal prolegs short, two-segmented.

As McLachlan says (Rev. and Syn. p. 221), this family "has justly been called 'the curiosity shop' of the Trichoptera, for vagaries of form are the rule and not the exception." Almost every student of the order has called attention to the fact that this family is very far from homogenous whether considered from the standpoint of the adults or of the immature stages. In fact the abnormal palpi of the male constitute about the only common character of great importance. There are four fairly well-defined subfamilies the adults of which may be separated by the following key. The immature stages are carried down to subfamilies in the general key (p. 117).

SERICOSTOMATIDAE<sup>41a</sup>

- 1a Middle tibiae with less than four spurs.....2  
 1b Middle tibiae with four spurs.....3  
 2a Hind tibiae with less than four spurs.....BRACHYCENTRINAE  
 2b Hind tibiae with four spurs. p. 289.....SERICOSTOMATINAE  
 3a Cells  $R_2$ ,  $R_4$ ,  $M_1$  and  $Cu_1$  present in both pairs of wings. Hind wings broad at base. Discal cell of the hind wing open. p. 293.....GOERINAE  
 3b Cells  $R_2$ ,  $R_4$ ,  $M_1$  and  $Cu_1$  not all present, at least in the hind wing (cell  $M_1$  generally lacking in the hind wing). Hind wings narrowed at base. Discal cell generally closed. p. 396.....LEPIDOSTOMATINAE

BRACHYCENTRINAE Ulmer

McLachlan, 1876b, p. 253 (Sericostomatidae, Section 3); Klapálek, 1904a, p. 27, reprint, (*Brachycentrini*); Ulmer, 1907c, p. 89; Ulmer, 1909a, p. 191  
 Immature stages. Ulmer, 1903d, p. 85; Klapálek, 1893, p. 55 (Sericostomatidae, Section 3); Thieneman, 1905b, p. 35; Silfvenius, 1906b, p. 61; Siltala, 1907c, p. 540; Ulmer, 1909a, p. 208, 275, 318; Lestage, 1921a, p. 857

Antennae about as long as the fore wings, slender, the first segment as long as or somewhat longer than the head; standing rather far apart. No ocelli. Maxillary palpi of the female five-segmented; those of the male three-segmented. The latter hairy, generally pressed up against the face, the first segment often shorter than the others. Spurs 2-3-3, 2-2-2, 2-4-4, 1-2-4, or 1-4-4. The fore wings broad, the hind wings much shorter but not commonly much narrower. Abundant pubescence but no furrows of scale hairs. The discal cell always closed in the fore wings and open in the hind wings. The venation different in the sexes, media of the fore wing and the radial sector of the hind wing having each one less branch in the male than in the female. In the hind wing of either sex but one crossvein *r-m*. The claspers with no inner process. Egg masses very frequently found on the end of the abdomen of the females.

Larval head oval to round. Eyes large. The frons rather long,

<sup>41a</sup> The key needs revision because of the different spur formulae more recently reported for *Brachycentrus*.

with sharp lateral emarginations; gula trapezoidal; labrum wider than long, notched anteriorly, with strongly developed lateral bristles and stouter ones on the anterior margin. The mandibles short, chisel-like, with three teeth, the dorsal bristles near the base and an inner bunch of bristles present. The maxillae and labium thick-set and rather long, the tips of the palpi and of the lobes close together. The basal segment of the maxillary palpus with a bunch of bristles on the outer side. The prothorax and the mesothorax chitinized, the latter not wholly so but bearing four chitinous plates. The first abdominal segment without tubercles. Lateral line lacking or very fine. Tracheal gills lacking or in small groups. Prolegs short, two-segmented, the claws with one or two small hooks.

Pupal labrum obtusely triangular to semicircular. Maxillary palpi shorter than, or but little longer than, the labial palpi, not stouter. Middle legs with swimming fringes. The dorsal plates either in the usual position (on the anterior margins of segments 3-7 and on the posterior margin of segment 5) or the rear margin of segment 5 bordered throughout its length with a row of spines. The anal processes somewhat shorter than the last segment and curved slightly upward.

## KEY TO THE GENERA OF BRACHYCENTRINAE

- 1a Spurs 2-3-3, 1-4-4 or 2-4-4.....*Brachycentrus*  
 1b Spurs 2-2-2 .....
- 2a  $R_1$  of the fore wing arched just beyond the level of the apex of cell  $R_2$ . Cells  $R_4$  and  $M_1$  present in the hind wings of the female. Maxillary palpi of the male short as in *Brachycentrus* (pl. 57, fig. 6). p. 387  
 .....*Oligoplectrum*
- 2b Radius of the fore wing not strongly arched. Cells  $R_4$  and  $M_1$  lacking in the hind wings of the females. Maxillary palpi of the males long, reaching to the end of the first antennal segment. p. 388.....*Micrasema*

**Brachycentrus Curtis**

Curtis, 1834, p. 216; McLachlan, 1876a, p. 253; Provancher, 1877, p. 261 (*Sphinctogaster*); Ulmer, 1907c, p. 90; Ulmer, 1909a, p. 192; Banks, 1911b, p. 355; Lestage, 1921a, p. 861

Immature stages. See references under the family and the subfamily

Antennae slender, about as long as the fore wings, inserted far apart, the basal segment hairy, about as long as the head. Maxillary palpi of the male cylindrical, very hairy, reaching scarcely to the base of the antennae; second segment longer than the first or the third. Maxillary palpi of the female long, the third segment the longest. Pronotum very small, with two hairy warts. Mesonotum very large. Spurs 2-3-3 (Banks gives 2-4-4 for *B. lutescens*). Media of the fore wing and the radial sector of the hind wing each with one less free branch in the male than in the female. In some species at least the seventh ventral segment of the male with a rounded plate (pl. 57, fig. 4).

The larvae fairly stout, but slightly narrowed toward the posterior end. The middle and hind femora each bordered with a row of fine points with longer and stouter spines at intervals. The claws stout, as long as the tarsus, but little curved. The lateral line fine, above it in each segment a number of chitinous points. Tracheal gills single on the ventral side, branched above. Chitin plates on the last segment crescent-shaped, brown, the rear margin with numerous

bristles. Prolegs with stout claws, the latter with two hooks. The posterior margin of the last segment between the prolegs on each side produced into a fingerlike process (pl. 59, figs. 2, 3).

Pupal labrum triangular, with one pair of bristles on the anterior margin and with five pairs of stouter ones about the middle. Plates of hooks on the anterior margins of segments 3-7 and on the posterior margin of segment 5. The latter are divided.

The cases, at least at first, square in section. Those of the pupae sometimes with the sides rounded. Both ends of the pupal case closed with perforated membranes.

### **Brachycentrus fuliginosus** Walker

(Pl. 57, figs. 4-9; pl. 58, figs. 1, 2)

Walker, 1852, p. 88; Hagen, 1861c, p. 272; Hagen, 1861c, p. 272 (*incanus*); McLachlan, 1864a, p. 658 (footnote); Provancher, 1877, p. 261; Provancher, 1878b, p. 137; Ulmer, 1907c, pl. 10, fig. 89a; Banks, 1911b, p. 355 (*incanus*)

"Black, with hoary hair; antennae long, ferruginous, apices of the abdominal segments, and the legs testaceous; palpi testaceous, with the apex blackish; the anterior wings grayish-fuscous, veins ferruginous; posterior wings cinereous. (From the description of Walker.)

"Length to tip of wings 14 millim. Alar expanse 26 millim.

"Hab. St Martin's Falls, Albany River, Hudson's Bay (Barnston)." Hagen, *l. c.*, p. 272.

The following is Hagen's own description of the female (*incanus*):

"Black; sparingly clothed with hoary hair; antennae black, feet pale, femora black; anterior wings long, grayish-hyaline, with some luteous spots, and sparse luteous pile; veins gray; posterior wings grayish-hyaline. Female.

"Length to tip of wings 13 millim. Alar expanse 24 millim.

"Hab. Washington, April (Osten Sacken).

"It is similar to *B. subnubilus* Curtis." Hagen, *l. c.*

Of this species I have a number of males given to me by Professor J. H. Comstock who collected them on the St Lawrence river, May 28th. I add the following notes:

Antennae brown, the basal segment darker. Head and thorax black with some black and mostly yellowish hair. Palpi dark brown. Abdomen and legs black, except the tibiae and tarsi which are light brown; legs with yellowish pubescence which is long on the coxae. Wings light brown, darkest along the anterior margin; some light yellow hairs scattered over the wings, forming an indistinct spot at the tips of the anal veins. The apical fringe dark brown. The seventh abdominal segment with a rounded ventral plate. The superior appendages obtusely pointed as seen from above, more rounded as seen from the sides; the claspers slender. Length to tip of wings 10 mm.

### **Brachycentrus lateralis** Say

Say, 1823, p. 161 (*Phryganca*); Say, 1859, p. 171 (*Phryganca*); Hagen, 1861c, p. 274 (*Dasytoma*); Banks, 1907c, p. 42; Ulmer, 1907c, p. 93 (*Micrasema* ?)

"Black, above with cinereous hair, beneath with plumbeous hair; antennae and mouth pale; feet whitish; abdomen black, with a lateral pale stripe, and the apices of the segments pale; appendages white; wings whitish, the anterior ones spotted with fuscous, a common spot on the middle of the inner margin, and several near the tip somewhat arranged into a band, the costal one of which is larger; posterior wings white, immaculate. (From the description of Say.)

"Length to tip of wings 10 millim. Alar expanse 18 millim.

"Hab. 'Shippingsport, Kentucky, Ohio River; they appeared in very great numbers at the banks of the Ohio on the 21st of May; judging from the small space of about half a mile on the Indiana side of the river, where I had the opportunity to see them, their number could have been but little inferior to that of *P. numerosa*, which occurred a few days before, but of which a specimen was now rarely to be seen' (Say).

"May it not belong to *Brachycentrus*?" Hagen, *l. c.*

### *Brachycentrus lutescens* Provancher

Provancher, 1877, p. 262 (*Sphinctogaster*); Provancher, 1878b, p. 137 (*Sphinctogaster*); Banks, 1905c, p. 12, pl. 2, fig. 18 (*Sphinctogaster*); Ulmer, 1907c, p. 91

The following is Banks' redescription of this species. The spur formula given (2-4-4) is unique for the subfamily; possibly the number varies within the species.

"Head black, with a few long white hairs; antennae and palpi pale; thorax pale yellow, an oblong spot in middle of base, and a spot each side of base of wings, dark brown, long yellow or white hairs in tufts; abdomen brown above, yellowish below; legs pale yellow. Head transverse, antennae at base widely separated, the basal joints not very long, not longer than vertex; antennae scarcely as long as wings; vertex with a median carina, and an elongate wart each side near posterior margin. Spurs short, 2-4-4; subapical pair on middle tibiae plainly beyond second third, in hind tibiae they are six times nearer to tip than to base; hind tibiae swollen near tip and curved, much longer than femur. Middle tibia shorter than femur. Abdomen compressed, in male swollen below, and obliquely truncate at tip. Wings pale yellowish, with short, sparse pale hair, venation of fore wing as figured, in hind wing the discal cell is open, and there are no furrows. There are a few small spines on middle and hind tibiae. Expanse 20 mm.

"Three specimens from Ithaca, New York.

"The shape of the male abdomen is peculiar, but the broad head and widely separated antennae are of more generic importance." Banks, *l. c.*

The specimens on which Banks' description is based do not seem different from *fuliginosus*, and Provancher's type may very likely be the same. The females of *fuliginosus* are larger and paler than the males and answer the description well.

**Brachycentrus nigrosoma** Banks

(Pl. 58; figs. 3-10; pl. 59, figs. 1-3)

Banks, 1905c, p. 12 (*Sphinctogaster*); Ulmer, 1907c, p. 91, pl. 10, fig. 89b, pl. 11, fig. 91

Immature stages. Lloyd, 1915d, p. 81, 1 pl; Murphy, 1919, p. 154; Lloyd, 1921, p. 82-87, figs. 133-48; Sibley, 1926b, p. 105

"Similar in structure to *S. lutescens*. Differs in having palpi dark, basal joint of antennae black and black haired, beyond pale, with brown tips to joints. Thorax deep black; femora of legs black, except extreme tips; abdomen brown. Wings rather darker than *S. lutescens*, with gray fringe. More black hairs on vertex. Expanse 24 mm.

"One female from Ithaca, New York." Banks, *l. c.*

Lloyd has reared specimens collected at McLean, N. Y., May and June and well described all the stages. On his specimens the brown wings have a covering of short black hair with some yellow; there is a small light spot at the tip of the anal veins.

The species can be distinguished from *fuliginosus* by the figures of the genitalia.

**Brachycentrus numerosus** SaySay, 1823, p. 160 (*Phryganea*); Say, 1859, p. 170 (*Phryganea*); Hagen, 1861c, p. 273 (*Dasystoma*); Banks, 1907c, p. 42; Ulmer, 1907c, p. 93 (*Micrasema*?)

"Black, with cinereous hair; antennae as long as the body, pale fuscous, the basal article black, hairy; palpi pale fuscous; head short, black, densely covered with cinereous hair; thorax black, with cinereous hair; feet pale fuscous; abdomen black, the apices of the segments pale rufous, lateral line rufous; wings whitish-brown, immaculate, veins fuscous. (From the description of Say.)

"Length to tip of wings 12 millim. Alar expanse 23 millim.

"This species appears in vast numbers early in May, from the 7th to the 9th of that month, on the Ohio River. Having a white appearance when flying, they might be compared to flakes of snow in a moderate fall of that meteor. (Say.)

"May it not belong to *Brachycentrus*? Can it be *B. fuliginosus*?" Hagen, *l. c.*

**Brachycentrus signatus** FabriciusFabricius, 1781, p. 389 (*Phryganea*); Fabricius, 1787, p. 245 (*Phryganea*); Fabricius, 1793, p. 76 (*Phryganea*); Hagen, 1861c, p. 250 (*Neuronia*); McLachlan, 1863c, p. 156; McLachlan, 1864a, p. 658

"P. alis griseo fuscis, margine postico flavo striato.

"Habitat in America septentrionali. Mus. Dom. Banks.

"Parva, caput cum antennis fuscum. Alae griseo fuscae, nitidae flavo maculatae at margine postici flavo striato." Fabricius, *l. c.*, p. 76.

McLachlan (1864a) says that the type is in very bad condition and that he is unable to say whether it is the same as *B. fuliginosus* or not.

**Brachycentrus** sp.

(Pl. 59, figs. 4-6)

Mrs Nelson F. Davis has sent me alcoholic material of a species occurring at Lewisburg, Pa. I add figures of the genitalia which are plainly different from the species described.

Two western species are described.

*Brachycentrus occidentalis* Banks

Banks, 1911*b*, p. 355, pl. 13, fig. 32. British Columbia.

*Brachycentrus similis* Banks

Banks, 1907*a*, p. 124, pl. 9, fig. 21. Colorado.

**Oligoplectrum** McLachlan

McLachlan, 1868*b*, p. 297; McLachlan, 1876*b*, p. 257; Ulmer, 1907*c*, p. 91; Ulmer, 1909*a*, p. 194

Immature stages. Klapálek, 1893, p. 59; Ulmer, 1903*d*, p. 88; Ulmer, 1909*a*, p. 277, 319; Lestage, 1921*a*, p. 872

Characters in general as in *Brachycentrus*. The antennae of the female slightly shorter than those of the male; the apical portion of the antennae obsoletely serrate within. The male maxillary palpi have the basal segment shorter, the others longer than in *Brachycentrus*; the maxillary palpi of the female with a short basal segment, the second and the third longer than the others. Spurs 2-2-2. Fore wings rather long, narrow, and hairy. Posterior wings narrower than in *Brachycentrus*.

The larval case a slender straight tube, tapering greatly to the posterior end; the cases attached gregariously to stones.

Not having seen the one described American species, I give a drawing only of the venation of the male of a European species (pl. 59, fig. 7).

**Oligoplectrum americanum** Banks

Banks, 1899, p. 210.

"Head and thorax brown, above on vertex long yellowish hair arising in groups; antennae pale, annulate with brown; palpi with yellow and black hairs; legs yellowish, with short yellowish hair and short yellow spurs, 2-2-2; wings gray, with a pale spot at anal angle, and one in tip of first subapical cell, indistinct ones in tips of first and second apical cells, pterostigma darker than elsewhere, rather blackish basad of pale anal spot, hind wings uniform gray; abdomen blackish, with short whitish hairs in rings; antennae rather shorter than wings, stout, basal joint stout, scarcely as long as head; face concave, with a median ridge; palpi of male cylindrical, slender, upcurved and near the face; head rather broad; fore wings moderately broad, discal cell short, not one-third the length of its pedicel, radius bent suddenly at beginning of pterostigma, cross-veins at base of subapicals very oblique; hind wings about as broad, but much

shorter than fore pair, discal cell open, not even narrowed; abdomen short; appendages short, a superior median emarginate plate covering them from above. Expanse 18 mm.

"Franconia, New Hampshire (Mrs A. T. Slosson)." Banks, *l. c.*

### Micrasema McLachlan

McLachlan, 1876*b*, p. 259; Ulmer, 1907*c*, p. 92; Ulmer, 1909*a*, p. 195

Immature stages. Klapálek, 1893, p. 63; Ulmer, 1903*d*, p. 88; Thienemann, 1905*b*, p. 36; Silfvenius, 1905*b*, p. 26; Silfvenius, 1906*b*, p. 61; Ulmer, 1909*a*, p. 208, 277, 319; Lestage, 1921*a*, p. 878

Characters in general as in *Oligoptectrum*. The basal segment of the antennae somewhat longer than in that genus, the maxillary palpi of the male much longer so that their apices reach up to the distal ends of the first segments of the antennae. The fore wings broad, oval, with dense pubescence.  $R_1$  curved but not sharply bent; cell  $R_4$  generally longer than in *Oligoptectrum*, and cell  $M_1$  never sessile. In the hind wing cell  $R_4$  lacking in both male and female, cell  $M_2$  also lacking in the males, that is, media unbranched. In *M. exiguum* (European) vein  $Cu_{1a}$  lacking in the female.

The larvae slender, narrower behind. The labrum emarginate in front, rounded at the corners; on the forward third three pairs of stout bristles with a bunch of whitish feather-bristles between. The mandibles with three or four teeth. No tracheal gills. The lateral line represented by a row of chitin points. Claws of the prolegs with two hooks.

The cases curved, made of silk or of fine sand. The pupal case closed at either end by a perforated membrane; in the anterior membrane the meshes of the sieve thinner than the surrounding part.

At least one species was taken at Old Forge, N. Y., but no male specimens (pl. 60, figs. 1, 2). Mr A. R. Park has collected a species at Enfield Falls, New York. Dr J. C. Bradley has sent me a male specimen from Georgia, not complete enough for description (pl. 60, fig. 3).

### Micrasema charonis Banks

Banks, 1914*b*, p. 266, pl. 8, fig. 3, pl. 15, fig. 47, 51

"Jet black; head and thorax with black hair; legs rather brown; abdomen with rather long, erect hairs above; spurs very short, not as long as width of the joint. Venation as figured; maxillary palpi long, slender, upcurved, reaching to tip of basal joint of antennae, sparsely hairy.

"Expanse 10 mm.

"From Black Mts., North Fork Swannanoa River, North Carolina, May. The first record of this genus from the United States." Banks, *l. c.*

### Micrasema falcatum Banks

Banks, 1914*b*, p. 265, pl. 15, fig. 52

"Brown; palpi yellowish; antennae dark at base; head and thorax with gray hair; abdomen black, with white hair; legs pale, with white hair. Wings brown, with scattered yellowish and black hairs;

venation similar to that of *M. charonis*; discal and median cross-veins interstitial, fork 1 reaching back on discal cell further than in *M. charonis*, and fork 2 has a very much longer pedicel, longer than the discal cell.

"Expanse 10 mm.

"From Great Falls, Virginia, 12th May." Banks, *l. c.*

Two western species are reported.

*Micrasema rusticum* Hagen

Hagen, 1868*d*, p. 272 (*Dasystema*); Banks, 1907*c*, p. 42 (*Oligoptectrum*).  
Saskatchewan.

*Micrasema scissum* McLachlan

McLachlan, 1884*a*, p. 26, pl. 3, figs. 1-4; Martynov, 1910*b*, p. 360, figs. 9-11. St Lawrence (or Clark's) Island, Behring Strait.

**SERICOSTOMATINAE** Ulmer

McLachlan, 1876*b*, p. 222 (Sericostratidae, Section 1); Klapálek, 1904*a*, p. 27, reprint (Sericostratini); Ulmer, 1907*c*, p. 80; Ulmer, 1909*a*, p. 197. Immature stages. Klapálek, 1893, p. 38 (Sericostratidae, Section 1); Ulmer, 1903*d*, p. 78; Thienemann, 1905*b*, p. 32; Siltala, 1907*c*, p. 524, 529; Ulmer, 1909*a*, p. 208, 278, 320; Lestage, 1921*a*, p. 918

Antennae about as long as the fore wings, stout, with short segments. The basal segments of the male antennae greatly enlarged so as to appear as lobes on the head (p. 25). Maxillary palpi 5-segmented in the female, the segments long and hairy (the hairs not in distinct rows as in Leptoceridae). In the male the palpi commonly said to be 3-segmented. The terminal segment a large broad structure curved closely in front of the face and locking into the basal segments of the antennae. Labial palpi large, those of the male stouter than those of the female. Spurs 2-2-4. Wings rather long, distinctly broadened apically. No furrows of scale hairs but the pubescence dense so that the venation is obscured. The venation alike in the sexes. In the fore wing always a discal cell, commonly rectangular or trapezoidal in shape. Cells  $R_2$ ,  $R_4$ ,  $M_1$  and  $Cu_1$  present and all sessile, the first one generally reaching far back on the discal cell. No median cell. The hind wing much shorter than the fore wing but about as great in width as the latter. The discal cell not always present; cells  $R_2$ ,  $M_1$  and  $Cu_1$  present. The abdomen without ventral teeth. The genitalia large.

The larvae stout, broadest at the metanotum. The head practically vertical in position, oval as seen from above. The antennae small and having sense bristles. The labrum broadly heart-shaped and joined to the frons by a long connecting membrane. The anterior margin with a small incurvature. The upper surface with three bristles on each side, the outermost being almost on the margin; besides the lateral bristles three pairs on the anterior margin. The mandibles short, thick, and chisel-like; viewed from above, three-sided and when seen from the inside, two teeth shown on each side of the central tooth. A bunch of inner bristles present. The maxillae more elongate than in the other subfamilies; the palpi distinct and about equal to the lobes in length. Two bristles on

the cardo. The labial palpus 2-segmented and with three sense rods two of which are composed of 2 segments while the third is simple. The prothorax chitinized, the mesothorax almost membranous, with small chitinous spots. No prosternal "horn." The hind legs twice as long as the fore legs; all of them are covered with numerous long hairs. Fore tibiae with two distal spurs, other tibiae with none. The abdominal segments separated by slight constrictions. The tubercles of the first segment low and broad. Along the lateral line rows of chitin points which are more evident on the eighth segment. The tracheal gills on the anterior part of segments 2-8 small and short, standing in groups; on both anterior and posterior parts of segments 3-7 lateral gills of a broader type standing singly. Groups of gills also occur in the middle of the dorsal and ventral sides of the first segment. The prolegs short, closely united with the last abdominal segment; the claws very stout, formed of two or three hooks.

Pupal mandibles directed upward; their bristles nearer the middle than the base. Labrum semicircular, the anterior margin produced; four or more pairs of bristles in front, three pairs behind. The fringe of long hairs sometimes present on the middle tarsi (*Sericostoma*) or it may be wholly absent (*Notidobia*). Plates of hooks on the anterior margins of segments 3-7 and on the posterior margin of segment 5. Tracheal gills on the anterior part of the segments. The anal appendages very broad at base, curved dorsally, and beset with hairs basally.

The larval cases conical, curved, made of fine sand; the rear end closed with a membrane which has a central circular opening. The pupal case with a membrane provided with a vertical slit at the rear end of the case. The anterior membrane not at the very end of the case; its opening horizontal and nearer the ventral side.

While the male maxillary palpi have commonly been described as 3-segmented, Cummings (1914) shows that there is but a single segment, the basal pieces representing cardo and stipes.

This subfamily is largely European in distribution. The American species in it are insufficiently known and have been subjected to considerable juggling. So far as I can judge from the figures and from the types I have seen, they are all included in one genus, *Agarodes*, with *grisea* Banks as type. I have seen all the species except those of Ulmer, McLachlan, and Walker described below, and of these all except the last may be placed definitely by the figures. Not one life history is recorded for North American species.

#### **Agarodes** Banks

Banks, 1898, p. 217; Ulmer, 1907c, p. 85; Banks, 1914b, p. 264 (*Psiloneura*)

Antennae of the female with a stout basal segment as long as the head. The basal segment of the male antennae enormously developed (text fig. 5n), extending backward over the head and

having a small lobe on the inner side. The maxillary palpi of the female 5-segmented, the basal segment short and thick, of the remainder, the third, fourth, fifth and second successively longer. The maxillary palpi of the male 3-segmented (p. 21) and upturned so as to mask the face. Of the labial palpi the third segment rather thick. Legs with dark spines. Spurs 2-4-4. The venation (pl. 60, fig. 4) much like that of allied genera, except in the anal veins. In the fore wing cell  $R_2$  not reaching to the apex of the discal cell; cell  $M_1$  reaching but little back of the crossvein  $r-m$ ;  $Cu_{1a}$  and  $Cu_2$  fused at tip. The second anal vein lacking at base and the first one not always complete. In the hind wing the discal cell is closed; the anterior branch of the first anal vein apparently incomplete, at least in the specimens examined.

The genus was first described as belonging to the Rhyacophilidae but the venation leaves no doubt of its position in this subfamily. The confusion regarding the segments of the palpi resulted, I think, from the fact that the males were described as belonging to another genus. In the figure of the venation given in Ulmer's catalogue (1907) a spur runs basad from crossvein  $m-cu$  without basal connection; this is of course an abnormality.

#### Agarodes americana Banks

Banks, 1900a, 256 (*Notidobia*); 1904d, p. 212 (*Notidobia*)

"Head black, with tufts of black hair from the warts on the vertex; maxillary palpi flattened and upcurved, masking the face, yellowish white, with short whitish hair; antennae black, basal joint yellowish below, not elongate; thorax black, with black hair; legs light brown, middle and hind tibiae and tarsi paler, spurs 2-2-4; abdomen black; the genitalia yellow; wings blackish, with much black and a little yellow pubescence; hind wings blackish, with dark gray fringe, discal cell closed, that of fore wings open; inferior appendages long, sickle-shaped, upcurved, slender at base.

"Length 12 mm.

"Falls Church, Virginia, June." Banks, *l. c.*

In the type the genitalia appear similar to those of *A. grisca* but the claspers seem narrower and the median ventral appendages are also slender; the latter have each a short dorsal branch.

This species may be a synonym of *crassicornis* Walker.

#### Agarodes crassicornis Walker

Walker, 1852, p. 113 (*Hydropsyche*); Hagen, 1861c, p. 271 (*Sericostoma*); McLachlan, 1876b, p. 225 (*Notidobia*); Ulmer, 1907c, p. 85 (*Notidobia*); Banks, 1907c, p. 41 (*Sericostoma*)

"Ferruginous, with lurid hair; antennae stout, longer than the body, articles paler at their bases; palpi and feet testaceous; wings cinereous, with fulvous pile; anterior wings with a hyaline spot at the

base of the apical areoles; veins fuscous. (From the description of Walker.)

"Length to tip of wings 11 millim. Alar expanse 20 millim.

"Hab. Georgia (Abbot)." Hagen, *l. c.*

McLachlan saw the type of this species and says "*crassicorne*, Walk., transferred to this genus (*Sericostoma*) by Hagen, is more allied to *Notidobia*, and is not a true *Sericostoma*."

I have seen only Hagen's specimens which he regarded as this species.

### **Agarodes distincta** Ulmer

Ulmer, 1905*d*, p. 67, figs. 21-23.

The following is a translation of practically all of Ulmer's description:

Head black, with gray hairs. Mask clear brown with black pubescence; mesonotum dark brown, shining, metanotum somewhat more clear, abdomen blackish brown. Antennae dark brown, about as long as the fore wings. Spurs 2-2-4; spurs proportionately short, those of each pair about the same in length. Wings gray with brown pubescence, the fringes also brown. Venation regular. The genitalia of the male yellowish brown to dark brown. Preanal appendages rod-like, slightly thickened at the tips, directed laterally; the tenth segment deeply cleft, diverging distally, curved at the ends so as to form two sharp corners. Laterally and ventrally of this, the two parts of the claspers visible. Laterally the main branch of the clasper small at the base, widening in the middle and beyond and becoming somewhat narrower at the end; the lesser branch of the clasper directed upward against the tenth segment. The penis close against the ventral surface of the tenth segment separating from the latter at the distal end.

Length of body 6-7 mm. Expanse 20 mm.

Two males, Maine, North America. Packard in Vienna Museum.

This species is perhaps the same as *grisea*. My figures of the latter are not unlike those of Ulmer's in respect to the parts most easily seen.

### **Agarodes grisea** Banks

(Text fig. 5*n*; pl. 60, figs. 4-8)

Banks, 1899, p. 218; Ulmer, 1907*c*, p. 86, pl. 10, figs. 82*a*, *b*; Banks, 1911*b*, p. 356, pl. 12, figs. 18, 20 (*Schisopelex lobata*); Banks, 1914*b*, p. 264, pl. 9, fig. 12 (*Psilonoura moesta*)

Antennae of the male with the basal segment greatly enlarged (text fig. 5*n*); in the female this segment as long as the head; pubescence of the antennae black. Head brown, the posterior ward covered with long black hair. Mesothorax dark brown, prothorax lighter. Legs yellowish, the first pair darker; spurs yellow, spines black. Wings brown with short pubescence which is somewhat lighter, and with a slight sprinkling of gray; veins darker brown.

Genitalia as figured (pl. 60, figs. 6-8). The claspers each with a median branch serrate along the inner margin.

A few specimens were taken at Ogdensburg and Clayton, N. Y., June 18th. The species has also been reported from other points in New York and from Massachusetts and New Hampshire.

The type is a female and there is a possibility that it belongs with the male type of *americana*. In that case the latter name would be displaced by *grisea* and what is here described and figured as *grisea* would become *lobata*.

Other American species are:

*Agarodes assimilis* Banks

Banks, 1907a, p. 124, pl. 8, fig. 8 (*Notidobia*). California.

*Agarodes griseola* McLachlan

McLachlan, 1871, p. 112, pl. 2, figs. 4, 4a, 4b, 4c. (*Notidobia*). California.

*Agarodes hesperus* Banks

Banks, 1914b, p. 266, pl. 8, fig. 10 (*Schizopelex*). Utah.

*Agarodes nigricula* McLachlan

McLachlan, 1871, p. 113, pl. 2, figs. 5, 5a. (*Notidobia*). California.

#### GOERINAE Ulmer

McLachlan, 1876b, p. 239 (*Sericostomatidae*, Section 1); Klapálek, 1904a, p. 27, reprint (*Goerini*); Ulmer, 1907c, p. 86; Ulmer, 1909a, p. 182  
Immature stages. Klapálek, 1893, p. 47 (*Sericostomatidae*, Section 2); Ulmer, 1903d, p. 81; Thienemann, 1905b, p. 34; Silfvenius, 1905b, p. 15-21; Silfvenius, 1906b, p. 60; Ulmer, 1909a, p. 315; Lestage, 1921a, p. 831

Antennae about as long as the fore wings, basal segment longer than the head, sometimes twice as long, stout, hairy, the other segments very short. Maxillary palpi of the male apparently 3-segmented, the first two segments very short, the third long, hairy and curved upward, lying close against the face. Maxillary palpi of the female 5-segmented, slender, the first two segments short and hairy. Spurs 2-4-4, the inner spurs little or no longer than the outer. Wings short and broad, without scales except in the longitudinal furrows which in some genera traverse the wings (usually the hind pair) of the males. Except as disturbed by the furrows of scale hairs the venation the same in the sexes. The discal cell of the fore wing long and narrow as also the apical cells; the anal cells rather long; cells  $R_2$ ,  $R_4$ ,  $M_1$  and  $Cu_1$  present in both wings. In the hind wings the discal cell not closed; crossvein  $r-m$  the only one present. The preanal appendages long; the claspers divided into two branches. The sixth abdominal segment with a row of ventral spurs.

The larvae stout, cylindrical, but little narrowed behind. Head broad oval, vertical, fitting telescopically into the pronotum. Eyes large, situated on dark prominences. The frons broad in front, much narrower behind, the anterior margin notched, the whole resembling the frons of the Limnephilidae; there are many bristles,

three large ones on each side anteriorly. The labrum trapezoidal, almost square; the anterior margin deeply notched; the larger chitinous part with several pairs of stout bristles and the anterior margin covered with bunches of fine hairs. The mandibles blade-like, with a sharp, toothless edge; inner bristles and the two dorsal bristles present. The short maxillary palpi and flat lobe directed away from the labial lobe. The labial palpi prominent. Both labrum and maxilla hairy and the maxillary palp with a bunch of bristles on the basal segment. The pronotum only wholly chitinized; this sclerite strongly emarginate so as to present a sharp angle on either side (pl. 61, fig. 7); the prosternum with the horn present and the posterior margin of the segments somewhat chitinized. On the mesonotum two or three pairs of chitinous shields, a large median pair, the others smaller and followed laterally by the very strongly developed supporting plates of the legs. The mesosternum with a pair of chitinized spots near the posterior margin. The metanotum membranous and with three or four pairs of shields. Legs stout, the claws strongly curved and with a long basal spur reaching nearly to the tip of the claw. The abdominal segments separated by deep constrictions. The first segment with three tubercles; ventrally a transverse row of stout bristles with a chitinous shield anterior to it. Tracheal gills set in groups of three or four. Lateral line present, prolegs small, 2-segmented, the claws stout, with or without minute hooks.

Pupae stout, spindle-shaped, with a short head. The labrum (text fig. 43*b*) roughly rectangular with the anterior margin formed of three curves; in each of the two emarginations a fine bristle, five longer bristles with curved tips vertically on either side. The mandibles (pl. 61, fig. 8) small and finely toothed. On the first abdominal segment (text fig. 46*c*) two tubercles set with numerous hairs. Chitin plates on the posterior margins of segments 3 to 7 and on the posterior margin of segment 5. Tracheal gills much as in the larvae. The anal processes (text fig. 48*f*) long curved rods, bent at the ends.

Cases very slightly tapering tubes which have stones or coarse sand grains fastened to the sides. The forward end of the pupal case closed by a stone which is fastened to the case by a number of bands of silk wider apart ventrally than dorsally. The caudal end commonly closed by a membrane which has a ventral horizontal row of openings; occasionally the rear opening closed after the manner of the other end.

In Europe the larvae of species of this subfamily are known to be parasitized by *Agriotypus armatus* and the cases of larvae thus parasitized may be recognized by the ribbonlike process which extends from the case (p. 104). This has not been seen in American species but the larvae of these have not yet been much studied.

This subfamily is represented in America by at least one genus and perhaps by a second.

KEY TO THE GENERA OF GOERINAE<sup>12</sup>

- 1a In the fore wing of both male and female the distal end of cell  $Cu_{1a}$  is rounded and naked. No furrow of scale hairs in the fore or hind wings of the males (pl. 61, fig. 1).....*Goera*
- 1b Cell  $Cu_{1a}$  of the fore wing not rounded suddenly at the distal end. A furrow of scale hairs in the hind wings of the males. p. 396.....*Silo*

**Goera Leach**

Leach, 1815, p. 126; McLachlan, 1876b, p. 240; Ulmer, 1907c, p. 87; Ulmer, 1909a, p. 183

Immature stages. See references under the subfamily

Maxillary palpi of the male 3-segmented, the basal two segments very short, the third long and flexible so that the end can be turned back to reach the socket of the basal segment; hairy, and closely applied to the face. Maxillary palpi of the female with the basal two segments short, the other three long, the fourth somewhat shorter than the third and the fifth. The end of cell  $Cu_{1a}$  of the fore wing suddenly rounded and this area more or less nude. The anal area of the hind wing strongly developed. The preanal appendages long; the tenth segment (male) divided into four rods.

The description given for the larvae of this subfamily is based largely upon this genus and need not be repeated here.

I have seen two species of *Goera*, one of which I collected at Old Forge (pl. 61, figs. 1-6), and another in Dr J. T. Lloyd's collection, taken at Ithaca, N. Y. The type of *calcarata* Banks is a female which I can not connect specifically with these.

**Goera calcarata Banks**

Banks, 1899, p. 211; Carpenter, 1933, p. 37, figs. 8, 13

Immature stages. Lloyd, 1921, p. 80-81, figs. 129-32; Sibley, 1926b, p. 106

"Head yellowish, with yellowish hair, some black hair below eyes; palpi and antennae pale yellowish; legs pale yellowish, the spines reddish brown, distinctly contrasting with the pale tibiae; thorax and abdomen dark, former with pale yellowish hairs; wings hyaline, veins yellowish, with black hairs, shorter yellowish hairs on the surface of the wings. Head broad; basal joints of antennae longer than head, widely separated at base, between them and rather above is a double wart, and two large, broad, low warts on vertex near each eye, fore wings moderately long, rather pointed, hind pair much shorter, not broader than fore pair, and with a long fringe toward base, discal cell of fore wings short, indistinctly closed, fifth apical cell pedicellate, veinlet at base of subapicals very oblique, area interclavialis enlarged at tip (as in the European species), in hind wings the discal cell is open, not even constricted, fifth apical cell pedicellate. Expanse 20 mm.

"Sea Cliff, New York, July." Banks, *l. c.*

I have added figures (pl. 61, figs. 1-6) of the adults of the species taken at Old Forge, N. Y., July 7th-29th, which may possibly be *calcarata*, the type of the latter being a female, and of

<sup>42</sup> See Addendum, p. 473.

larvae from Ithaca, N. Y. In the males collected at Old Forge the abdomen has the usual row of spines on the sixth ventral segment, and in addition there are on the seventh segment a pair of shorter spines. Those on the sixth segment number about ten. Length to wing tips 9 mm.

### **Goera fuscula** Banks

Banks, 1905*a*, p. 216; Banks, 1905*c*, p. 11, pl. 2, fig. 17

"Maxillary palpi with golden or tawny hairs; antennae dull black; labial palpi pale on basal part, black beyond; vertex black, golden hairs on the posterior warts; thorax black, some golden hairs form a median stripe on the mesonotum; abdomen dull black; wings uniformly clothed with blackish hairs, venation darker; legs pale brownish, the posterior tibiae and tarsi paler. Ventral comb of two rather long median teeth, and three each side much smaller. Venation as usual in the genus. Expanse 22 mm.

"One male from Black Mountain, North Carolina, May 21st (Beutenmüller)." Banks, *l. c.*, p. 11.

### **Silo** Curtis

Curtis, 1833, p. 188; McLachlan, 1876*b*, p. 244; Ulmer, 1907*c*, p. 88; Ulmer, 1909*a*, p. 185

Immature stages. See references under the subfamily

Maxillary palpi of the male 3-segmented, the basal two segments short, the third long, extrusible, with club-shaped hairs. Maxillary palpi of the female as in *Goera* but the terminal segment more slender. The cell  $Cu_{1a}$  (pl. 61, fig. 10) not rounded at the end as in *Goera*. The male with a furrow of scale hairs in the hind wing.

Larval cases like those of *Goera* but the lateral extensions of the case generally not so heavy.

There is one American species doubtfully retained in this genus.

### **Silo griseus** Hagen

Hagen, 1861*c*, p. 273

"Brownish-gray, with fuscous hair; antennae brownish-gray, the apex sub-annulated with lurid; head, and thorax above, rufescent; feet pale, the posterior ones and the spurs fuscous; anterior wings narrow, brownish-gray, hairy, with long cilia; posterior wings cinereous. Male.

"Length to tip of wings 6 millim. Alar expanse 11 millim.

"Hab. Trenton Falls (Osten Sacken)." Hagen, *l. c.*

The type seems to be correctly placed in the genus. In the fore wing cell  $Cu_1$  (5th) is very small.

### **LEPIDOSTOMATINAE** Ulmer

McLachlan, 1876*b*, p. 270 (Sericostomatidae, Section 4); Klapálek, 1904*a*, p. 28, reprint (*Lepidostomini*); Ulmer, 1907*c*, p. 100; Ulmer, 1909*a*, p. 187  
Immature stages. Klapálek, 1893, p. 70 (Sericostomatidae, Section 4); Ulmer, 1903*d*, p. 89; Thienemann, 1905*b*, p. 40; Ulmer, 1909*a*, p. 208, 274, 317; Lestage, 1921*a*, p. 886

Antennae about as long as the fore wings, the basal segment differing greatly in the genera and the sexes, generally much longer than the head, sometimes as long as or even longer than the body. The basal segment always very hairy and sometimes with scale hairs of different types, or hooked spines; the other segments short and broad, rarely with long hairs, often with dark rings in the chitin (p. 25). The male maxillary palpi various; almost always curved upward against the face, very hairy, or covered with scales. In the female the maxillary palpi 5-segmented, the first segment short, the second longer than the fourth. The labial palpi not unusual except in *Nosopus* where they are very large. Spurs 2-4-4, except in *Nosopus* (male) in which the formula is 1-4-4. The wings generally very hairy, often with scale hairs in the males. Sometimes a furrow of scales through the hind wings; often also a furrow along subcosta of the fore wings. This latter furrow varying in prominence, being most developed in *Olemira* in which case the anterior margin is reflexed upon the wing. The fibula well developed on the fore wing. The hind wings more narrow at base, the lobe with much the same appearance as the fibula of the fore wing. The venation varying greatly in the males. In the hind wings the radial sector 4-branched in the females and 3-branched in the males; according to Ulmer (1911c, p. 24, footnote) *Eremopsyche* Banks and *Atomyiodes*, Ulmer, the latter from Costa Rica, the only genera in the subfamily having a four-branched sector in the male hind wing.  $Cu_1$  with the usual accessory in the females, this lacking in the males. In the males  $Cu_2$  often obsolete except near the base, or wholly lacking. The crossvein which in the females joins  $Cu_{1a}$  and  $Cu_2$  generally oblique in the reverse direction therefore joining the stem of  $Cu_1$ , sometimes rather far toward the base (cf. cv in pl. 62, figs. 1 and 7). The preanal appendages, if present, small prominences beset with hairs; the claspers very large, often 2-segmented, the inner surface of each carrying a rodlike process at base.

The larvae cylindrical, the head broad-elliptical or broad-oval to roundish. The labrum wider in front than behind, its anterior margin notched, the upper side with generally four bristles on each side and with lateral bristles and hairs well developed. The mandibles short, chisel-like, with three or four teeth; an inner bunch of bristles present. The maxillae and labium very short and thick. The maxillary palpus but little longer than the broad, flat lobe; the labial lobe a much flattened cone with distinct palpi. The pronotum chitinized, almost rectangular in shape, the mesonotum with only the forward part chitinized; sometimes a median rectangular chitinous shield; the metanotum membranous with few chitinous spots. Prosternal "horn" present but short. Fore legs stout, the others longer and slenderer; fore tibiae with two, the others with one distal spur. First abdominal segment with lateral tubercles only. The strictures between the segments evident but not deep. Lateral line hardly visible, beset with fine hairs. Tracheal gills single. The prolegs short and stout, 2-segmented, the claw with one hook on its convexity.

The pupal labrum small, semicircular, the anterior margin with a blunt emargination. Middle tarsi either with slight fringes or somewhat dilated and with long swimming hairs in two rows. Lateral line very well developed. The hind margin of the first segment produced on each side into a process covered with chitinous points. Tracheal gills present or absent. No anal processes but blunt posterior lobes bearing long bristles.

The cases either curved tubes of sand, tapering behind, or square in cross section, made of vegetable material, and narrowed very little behind. In the pupal case the anterior end closed with a sieve-membrane. In front of this a stone (or several small stones) fastened either to the membrane or to the edge of the case. An opening between the stone and the case, mainly on the ventral side.

This is a large subfamily of peculiar and interesting forms. The females in so far as they are known are surprisingly alike considering the marked differentiation of the males. The following key applies only to the males. It has not been found possible to include in it the recently described genera *Neothremma*, *Arcadopsyche*, *Neuropsyche* and *Oligopsyche*.

KEY TO THE GENERA OF LEPIDOSTOMATINAE<sup>43</sup>

(For male specimens only)

- 1a Labial palpi and the first tarsal segment of the fore leg not abnormally large. Spurs 2-4-4 or 1-4-3.....2  
 1b Labial palpi and the first tarsal segment of the fore leg greatly dilated. Spurs 2-4-4. p. 411.....*Nosopus*  
 2a The cells of the anterior half of the fore wing not very unusually wide; venation posterior to the radial sector not very greatly reduced.....3  
 2b The cells of the anterior half of the fore wing very wide; venation of the posterior part of the wing very greatly reduced (pl. 65, fig. 9). p. 410.....*Notiopsyche*  
 3a Neither fore nor hind wings with a furrow of scales; anterior margin of the fore wings not reflexed nor with a conspicuous row of stiff hairs pointing backward.....4  
 3b A furrow of scales in one or both pairs of wings, or if no furrow is present the anterior margin of the fore wing is reflexed or at least there is a conspicuous marginal row of stiff hairs directed backward...10  
 4a Maxillary palpi short, forming an elliptical plate whose dorsal margin is produced into a triangular tooth (Porto Rican species, pl. 61, fig. 11). p. 399.....*Atomyiodes*  
 4b Maxillary palpi not as described in 4a.....5  
 5a Cell  $M_2$  of the fore wing reaching back as far as the apex of the discal cell. p. 399.....*Atomyia*  
 5b Cell  $M_2$  of the fore wing not reaching back as far as the apex of the discal cell.....6  
 6a Cell  $Cu_1$  of the fore wings large.....7  
 6b Cell  $Cu_1$  of the fore wings very small (pl. 63, fig. 3). p. 404...*Theliopsyche*  
 7a In the fore wing the transverse vein between  $Cu_1$  and  $Cu_2$  or 1st  $A$  joins the free part of  $Cu_{1a}$ . An undescribed western genus not otherwise referred to in this report.  
 7b The transverse vein between  $Cu_1$  and  $Cu_2$  or 1st  $A$  meets the stem of  $Cu_1$ ...8  
 8a The transverse vein referred to above meets  $Cu_1$  at a point more than three-fourths of the way from the base of  $Cu_1$  to the apex of cell  $Cu_1$ , the distance from this crossvein to the apex of cell  $Cu_1$  is not greater than the length of the crossvein  $m-cu$  (pl. 62, fig. 8). p. 400.....*Mormomyia*

<sup>43</sup> See Addendum, p. 473.

- 8b The transverse vein meets  $Cu_1$  at a point less than three-fourths the way from the base of  $Cu_1$  to the apex of cell  $Cu_1$ ; the distance from this crossvein to the apex of cell  $Cu_1$  is greater than the length of crossvein  $m-cu$  (pl. 63, fig. 1).....9
- 9a Spurs 1-4-3. p. 401.....*Alepomyia*
- 9b Spurs 2-4-4. p. 402.....*Alepomyiodes*
- 10a No furrow of scales in the hind wing.....11
- 10b A furrow of scales in the hind wings.....12
- 11a Cell  $M_2$  of the fore wing reaching back as far as the apex of the discal cell. Costal margin very hairy. p. 405.....*Eremopsyche*
- 11b Cell  $M_2$  of the fore wing not reaching as far back as the apex of the discal cell. Anterior margin of the fore wing strongly reflexed. p. 405.. *Olemira*
- 12a No small closed cell in the anal area of the fore wing. Wings very broad. p. 407.....*Phanopsyche*
- 12b Venation of the anal area of the fore wing reduced and forming a small closed cell near the base. p. 408.....*Lepidostoma*

### Atomyiodes Ulmer

Ulmer, 1911c, p. 23

Antennae shorter than the wings, rather stout; the basal segment short, little if any longer than the head, cylindrical, with long erect hairs; the succeeding segments short, at first but little thinner than the basal segment but gradually becoming more slender; the pubescence scant and fine. Toward the tip the antennae slightly dentate internally. Maxillary palpi of the male short, forming an elliptical plate with dorsal margin produced into a triangular tooth near the base; the palpi with their inner faces pressed close together and their length exceeding the diameter of the eye but little; the outer and anterior margins with long hairs set rather closely. Spurs 2-4-4, the inner but little longer than the other, in the apical spurs of the hind tibiae a greater difference in length; the subapical spurs of the middle legs in the middle of the tibiae, those of the hind legs at the end of the third quarter. Legs strong, hind legs longer than the middle. Fore wings rather broad, somewhat produced at the apex. *Sc* curved at base, straight toward the tip; the discal cell narrow, not nearly as large as cell *M*; cells  $R_2$ ,  $R_4$  and  $Cu_1$  present, all sessile; an oblique transverse vein from  $Cu_1$  to the anals leaving the former just before the middle of cell *M*. The pubescence thick, more scalelike along the anterior margin; in cell *R* a narrow furrow of scale hairs. Hind wings but little shorter and narrower than the fore wings. Discal cell shorter than in the fore wings; cells  $R_2$  and  $R_4$  present and sessile.

The genus is closely related to *Atomyia* Banks and to *Eremopsyche* Banks, differing mainly in the structure of the maxillary palpi.

One Costa Rican species is reported.

*Atomyiodes bispinosa* Ulmer (pl. 61, fig. 11)

Ulmer, 1911c, p. 25, figs. 10-13. Costa Rica.

### Atomyia Banks

Banks, 1905c, p. 11; Ulmer, 1907c, p. 104

Basal segment of the female antennae much longer than the head, the thread not ciliate. Maxillary palpi of the female 5-segmented, the third segment longest, the first shortest (pl. 62, fig. 5); the

male maxillary palpi (pl. 62, fig. 6) long, clubshaped, and hairy, the segments not clearly distinguishable. In the female the segments of the labial palpi nearly equal in length; in the male the first segment shorter than either of the other two. Wings rather slender. In the fore wing, radius normal in both sexes; media 2-branched in the male, 3-branched in the females;  $Cu_2$  normal in the females being joined to  $Cu_{1a}$  by a crossvein, in the males  $Cu_2$  obsolete beyond the base turning forward into  $Cu_1$ , the position of the crossvein shifted so as no longer to meet  $Cu_{1a}$ , but oblique in the other direction and joining the stem of  $Cu_1$ . Possibly the crossvein wanting, and this apparent one really a part of  $Cu_2$  having lost its connection with its base through fusion with  $Cu_1$ . In the hind wing the venation practically alike in the sexes except the radial sector 4-branched in the females and 3-branched in the males, and  $Cu_1$  branched in the females and simple in the males.

### *Atomyia modesta* Banks

Banks, 1905a, p. 217; Banks, 1905c, p. 12, pl. 2, figs. 21, 25; Ulmer, 1907c, pl. 13, figs. 115, 116; Döhler, 1915, p. 411, fig. 19, 20

"Maxillary palpi dark gray, labial palpi blackish; basal joint of antennae black, beyond pale, narrowly annulate with dark; head black, gray hairs in front, yellowish above from the warts; thorax brown, yellowish tufts at base of the fore wings; abdomen dark brown above, yellowish beneath; legs pale yellowish. Wings gray, sparsely clothed with blackish hairs; venation mostly yellow-brown, fringes dark gray, rather long, especially so on the posterior margins. Preapical spurs on hind tibiae once and one-half their length before tip; preapical spurs of middle tibiae about twice their length before tip, and nearly as close to base. Discal cell much narrowed before the tip, about half as long as its pedicel. Expanse 14 mm.

"Specimens from Black Mt., North Carolina, May (Beutenmüller)." Banks, *l. c.*

The figures here added are from specimens kindly sent by Doctor Beutenmüller.

Döhler adds notes on specimens from Tennessee.

One western species is reported.

### *Atomyia unicolor* Banks

Banks, 1911b, p. 357, pl. 12, fig. 21 (*Mormomyia*). California.

### *Mormomyia* Banks

Banks, 1907a, p. 127; Ulmer, 1907c, p. 104.

Antennae as in *Atomyia*, the basal segment of the male antennae not very long or curved. Maxillary palpi of the male appressed to the face, covered with long hairs and not with scales. In the fore wing of the male  $Sc$  more or less strongly curved near the base and toward the tip; cell  $M_2$  not back as far as the apex of the discal cell; the crossvein  $m-cu$  oblique, the anterior end toward the tip

of the wing;  $Cu_2$  lacking or only the base left; the crossvein between  $Cu_1$  and the anals oblique, the anterior end inclining toward the base of the wing; this last named crossvein reaching  $Cu_1$  at a point more than two-thirds of the way from the base of that vein to the apex of cell  $Cu_1$ . In the female the fore wing with a 3-branched media; cell  $M_2$  reaching to the apex of the discal cell; crossvein  $m-cu$  nearly transverse to the long axis of the wing. In the hind wing of the male the accessory branch to  $Cu_1$  lacking.

### Mormomyia vernalis Banks

(Pl. 62, figs. 8, 9)

Banks, 1897, p. 29 (*Mormonia*); Banks, 1907a, p. 127; Ulmer, 1907c, pl. 13, fig. 117, pl. 14, fig. 118; Sibley, 1926b, p. 106

"Length 10 mm. Head pale below antennae and clothed with black hair, above dark and with yellowish hair; palpi with black hair above, pale beneath, in male more yellow hair on head and palpi; basal joints of antennae pale, with white appressed hair and longer black, rest of antennae fuscous, annulate with pale; thorax black, with yellow and some black hair. Legs pale, darker on outside of basal joints. Abdomen dark, in female ventral segments margined with pale, in male whole venter pale. Wings gray, clothed with yellow and longer black hair, a larger whitish spot near middle of posterior margin, variable in extent, basad of the spot the wing is often darker than elsewhere, fringe whitish at this point, beyond black; hind wings gray, long fringe at base gray, darker beyond; basal joint of antennae scarcely longer than head, plainly shorter than in *M. [Lepidostoma] togata*; spurs 2-4-4; wings rather slender, hind pair not broader than fore pair, discal cell closed in both, in fore wings it is about one half as long as the pedicel; the subcostal vein is very wavy; the last dorsal segments of the male abdomen bear a dense brush of hair, dark in middle, pale at ends.

"Sea Cliff, N. Y.; common near streams, March, April, and May." Banks, *l. c.*

Reported from McLean, N. Y., May 31st, by Sibley, and Banks adds Tyron, N. C., to the records of occurrence (Can. Ent., 46, p. 266).

The claspers (pl. 62, fig. 9) have a long dorsal spur; seen from above the spur is crescent shaped and armed with stout teeth.

### Alepomyia Banks

Banks, 1908b, p. 64

"Basal joints of male antennae moderately long and heavy, longer than length of vertex, wide apart at base, as in *Brachycen-trus*; maxillary palpi of male upcurved and appressed to face, densely clothed with broad scalelike hairs; labial palpi dependent, long and slender; venation as figured; in fore wings but four (male) apical cells, fork three being absent, the discal cell closed in both pairs, the anal vein not running into branch of cubital, but con-

nected back to cubitus a long way before the fork; hind wing with but two apical cells, like *Acrunoecia*. Spurs large and long, 1-4-3 (male); I can see but one subapical on hind tibiae, while the two sub-apicals on middle tibiae are very distinct.

"By the distant antennae it is allied to *Brachycentrus* and others of that group, differs from all in but four apical cells, and in anal running into margin, also in the spur formula. Similar in many points of venation to *Crunoecia* and *Acrunoecia*, but the distant antennae, spur-formula and anal venation distinguish it from these and allied forms." Banks, *l. c.*

### *Alepomyia bryanti* Banks

Banks, 1908*b*, p. 65, pl. 2, figs. 1, 2, 13.

"Head brown, vertex with some white hair; palpi with black hairs on outer side near base, yellowish near tip and above, two very large longitudinal warts on vertex, one each side near eye, and behind each eye is a smaller curved transverse wart, all bearing yellowish hairs; basal joint of antennae yellowish brown, marked with brown, rest of antennae pale, marked with brown in front near base; thorax and abdomen brown; legs pale yellow, with yellowish spurs. Wings brownish, some black hairs along the veins, the stigmal region in both pairs rather heavily marked; venation as figured. The hind tibiae are very long and slender, the spurs are large, the subapical one scarcely twice its length before tip.

"Expanse 14 mm.

"Four males from Grand Lake, Newfoundland." Banks, *l. c.*

### *Alepomyiodes* Sibley

Sibley, 1926*b*, p. 106

Antennae of the male with a very long basal segment distinctly curved over the head, and on the under surface a groove of stout scale hairs; the first few of the succeeding segments each with a chitinous ring near the distal end. The female antennae with the basal segment longer than the head but not as long as in the males. Maxillary palpi of the male upturned against the face and thickly covered with a variety of scale hairs; these in the form of broad flat plumes with varying lengths of stem, in some of them the stem, many times as long as the flat plume. The female maxillary palpi 5-segmented, the first two segments short, the fourth, second, and fifth successively longer. The labial palpi of the male longer than those of the female; in both cases the basal segment short, the other two equal. Spurs 2-4-4. The fore wing (pl. 63, fig. 1) of the male rather strongly convex anteriorly. The subcosta wavy; media two-branched, the apex of cell  $M_2$  reaching about to the middle of the discal cell; cell  $Cu_1$  reaching to about the same level as  $M_2$ ; the crossvein between these two cells transverse to the long axis of the wing;  $Cu_2$  obsolete except at base; the crossvein between  $Cu_1$  and 1st  $A$  very long and oblique so that it strikes the stem of  $Cu_1$  before its middle (not quite so far back in one species referred here). The hind wing of the male narrow at base, much widened toward

the tip. The radial sector 3-branched;  $Cu_{1a}$  absent. The venation of the female quite like that of *Atomyia*; the shape of the hind wing agreeing however with that of the male in its breadth and in its convex anterior margin.

Type *A. wisconsinensis*, Vorhies.

Very probably the genus is synonymous with *Alcpomyia* Banks; it is placed separate here because of spur formula and this may prove to be variable.

### *Alpomyiodes wisconsinensis* Vorhies

(Pl. 62, figs. 10, 11, pl. 63, fig. 1)

Vorhies, 1909, p. 685, pl. 57, figs. 1-5 (*Lepidostoma*); Sibley, 1926b, p. 106  
Immature stages. Vorhies, 1909, p. 686, pl. 52, fig. 8, pl. 57, figs. 5-10  
(*Lepidostoma*)

"Imago. Length of body, 4-5 mm. Expanse, 13-15 mm. Antennae grayish-black above, fulvous beneath with a blackish process near the middle of each segment; this process consists of 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 antennae, another larger pair above the eyes extending diagonally across the head, and a third pair on the sides of the head behind the eyes; these, and two pair of warts on the prothorax and the wing calosities, 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 antennae are somewhat flattened within. Viewed from above, the disk projects somewhat forward between the bases of the antennae, 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 ninth 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 penis sheaths. The penis is bifid at the tip." Vorhies, *l. c.*

I have two specimens taken at Old Forge, N. Y., June 26th and August 3d, which are, I think, identical with the above although

Vorhies makes no note of the striking form and iridescence of the male maxillary palpi of his specimens. The convexity of the anterior margin of the fore wing of the male reminds one somewhat of *Olemira* (see below) but this region does not seem to be reflected as in that genus. The species is listed from McLean, N. Y., May 31st by Doctor Sibley.

### *Alepomyiodes* sp.

(Pl. 63, fig. 2)

I have fragments of what is perhaps another species, taken at Pike, N. Y. The wings of this specimen are figured (pl. 63, fig. 2). Here the fore wing is not as strongly convex as in the above species; the crossvein *m-cu* is more oblique, and the crossvein between *Cu*<sub>1</sub> and 1st *A* joins the former somewhat farther from the base of the wing.

### *Theliopsyche* Banks

Banks, 1911b, p. 356

"Venation similar to *Micrasema*, but fork 3 of hind wings is present; spurs 1-2-4 in male, 1-4-4 in female. Antennae wide apart at base, in male the basal joint longer than width of head, in female very much longer; maxillary palpi of male upcurved, bristly, covering the face; four warts on vertex, small one each side in front, and a long transverse one each side behind. In the fore wings the discal cell is long and closed; but in the hind wings open." Banks, *l. c.*

I think the spurs are 2-4-4 and that the genus belongs in the Lepidostomatinae. The maxillary palpi of the male are not broad, the basal segment is very short, the second somewhat longer than the third, the three together shorter than the labial palpi and a little stouter.

### *Theliopsyche parva* Banks

(Pl. 63, fig. 3)

Banks, 1911b, p. 356, pl. 12, fig. 16

"Blackish; antennae black; labial palpi white; vertex and thorax with black bristles. Wings uniform blackish brown, with black hair, long on veins, fringe very long, dark; the arculus and cross-vein from the radial sector to median are whitish hyaline. Legs rather pale, the spurs short, hardly three times as long as width of tibiae, the subapical pair of the hind tibiae not twice their length before the apical pair. In the female the radial sector of hind wings forks twice at one place.

"Expanse 8 to 9 mm.

"From Woodworth's lake, Fulton county, N. Y., 23 June (Alexander)." Banks, *l. c.*

**Eremopsyche** Banks

Banks, 1901*b*, p. 367, pl. 12, figs. 13, 14; Ulmer, 1907*c*, p. 110; Ulmer, 1911*c*, p. 24 (footnote)

"Spurs 2-4-4; basal joint of antennae long, densely hairy, maxillary palpi of male long, recurved, densely hairy, labial palpi slender, pendulous; no groove in hind wings; costal margin of fore wings thickly hairy, with the appearance of being recurved, discal cell closed in both wings, in fore wings rather long, in hind wings short.

"Probably closely related to *Lasiocephala*, but no cilia on antennae, and the basal joint simple." Banks, *l. c.*

Ulmer (*l. c.*) adds the fact that males of the genus have the radial sector four-branched in the hind wings.

The type of the genus is the following Mexican species.

*Eremopsyche frontalis* Banks

Banks, 1901*b*, p. 367, pl. 12, figs. 13, 14; Ulmer, 1907*c*, pl. 15, fig. 134. Mexico.

**Olemira** Banks

Banks, 1897, p. 29; Ulmer, 1907*c*, p. 109

Basal segments of the antennae longer than the head. In the male broad scales on the basal segment. The next succeeding joints short and thick, with black rings in the chitin. The maxillary palpi held upward against the face and covered with very large scales; these not with long slender stems as in *Alepomyiodes*. The fore wing (male) covered with scales. A furrow along *Sc* formed by the folding of the anterior margin (cell *C*). This furrow filled with scale hairs, and in addition a row of stout hairs bordering the subcosta on either side. The margin so completely reflexed that superficial examination of some specimens might not disclose the fact. Media 2-branched. The crossvein between *Cu*<sub>1</sub> and *Cu*<sub>2</sub> far back, about midway on *Cu*<sub>1</sub>. In the hind wing the radial sector 3-branched and *Cu*<sub>1a</sub> lacking as in allied genera. The venation of the female normal.

**Olemira americana** Banks

Banks, 1897, p. 29; Ulmer, 1907*c*, pl. 15, fig. 131

"Length 9 mm. Black, legs yellowish, anterior pairs darker toward the tips; basal joint of antennae blue-black, with black hair, beyond yellowish; palpi black, in male forming a beak between the antennae and clothed with blue-black hair; wings gray, anterior pair clothed with yellowish pile, veins dark, long black fringe on basal half of hind pair; fore wings little more than three times as long as broad, rounded at tip, hind pair not broader than fore ones, broadest beyond the middle, also rounded at tip; in male the costal region of fore wings is reflexed on the upper surface of wing, reaching to near the middle, its under surface (which appears above) is naked; both branches of radial sector forked in the fore wings, only upper in hind wing; discal cell in fore

wings many times longer than broad, narrowed at tip, shorter in hind wings; apex of male abdomen with a short horn, and before it a bilobed median carina.

"One male, several females, Sea Cliff, N. Y., July." Banks, *l. c.*

Banks reports the species also from Massachusetts and Virginia (Can. Ent., 46, p. 256).

### *Olemira costalis* Banks

(Pl. 63, fig. 4, pl. 64, figs. 1-5)

Banks, 1914*b*, p. 265, pl. 10, fig. 34; Sibley, 1926*b*, p. 106 (listed)

"Brown; palpi covered with long, dense, black hair; antennae brown, basal joint black beneath; vertex pale in middle, vertex and the thorax with some yellow hair; legs yellowish; wings gray, nearly uniformly colored, fringes darker. In male the costal area is swollen and reflexed over the wing, just as in *O. americana*, except that this reflexed part is only about one-half as wide as in *O. americana*; venation as in that species, but in the hind wings the discal cell is a little longer; genitalia similar to that of *O. americana*.

"Expanse 15 mm.

"From Woodworth's lake, Fulton county, N. Y., 19 August (Alexander)." Banks, *l. c.*

This species was taken at Ogdensburg, N. Y., during August. In these the males do not exceed 8 mm to the tips of the wings. All the legs are dark externally, the hind pair least so. The fore wings are brown, covered with brown and gray scales, the gray predominating, the fringe long, mostly gray. The genitalia are like those of allied genera particularly resembling those of *Phanopsyche grisea*.

### *Olemira pictilis* Banks

Banks, 1899, p. 211 (*Mormonia*); Ulmer, 1907*c*, p. 109

"Head brown, with some black hairs on front and long yellow hair above; palpi pale, with yellowish pubescence; antennae black, faintly annulate with pale, basal joint black haired; thorax dark, with yellow and black hair; abdomen brown, the ventral segments margined with pale; legs pale yellowish, with yellowish spines; wings gray, with yellowish and black hairs and a gray and black fringe, a dark cloud over anastomosis, hind border narrowly dark to the anal angle, where there is a whitish spot, apical margin with elongate whitish spots between the veins, darker on veins, hind wings uniform gray, with gray fringe. Antennae short, fine, basal joint about as long as head, spurs 2-4-4, subapical pair on hind leg much beyond the middle; wings moderately long, apex rounded, hind pair but slightly shorter, discal cell in both pairs closed, in fore pair indistinctly, the cell (in both pairs) elongate, but much shorter than its pedicel.

"Expanse 15 mm.

"Franconia, New Hampshire (Mrs A. T. Slosson)." Banks, *l. c.*

Ulmer (*l. c.*) surmises that the above description must be from a female specimen.

There is one Mexican species described.

*Olemira mexicana* Banks

Banks, 1901*b*, p. 367. Mexico.

**Phanopsyche** Banks

Banks, 1911*b*, p. 357

Antennae stout, about as long as the fore wings, the basal segment (male) as long as the head, clothed with hairs, not with scales; the succeeding segments short, covered with dense short hair. Head with long hair particularly on the posterior warts. Male maxillary palpi upturned and covered with scales. The palpus thickest in the middle and the long tapering end recurved; long hairs on the thickened arch which is thus farthest from the basal connection with the head. Fore wings (male) broad, with dense pubescence, only the fibula clothed with dense scale hairs. A subcostal furrow with long hairs toward the base of the wing. Hind wings broad, with a curved furrow of scale hairs running from base to tip much as in *Lepidostoma*. Fringe heavy on both wings. The venation greatly modified by the furrow in the hind wing. In the male, media of the fore wing 2-branched,  $Cu_2$  not partly obsolete as in some of the preceding genera; the crossvein connecting  $Cu_1$  and  $Cu_2$  inclined obliquely backward meeting  $Cu_1$ , at a point whose distance from the apex of cell  $Cu_1$  is equal to the length of the crossvein itself. In the hind wing the cells anterior to the furrow unusually broad. The discal cell reaching nearly to the base of the wing;  $R_4$  and  $R_5$  fused as in the other genera except that in this case they remain separate at the base of the discal cell, thus forming a closed cell around the little corneus point which marks cell  $R_4$ ; the venation posterior to the furrow reduced to simple veins.

**Phanopsyche grisea** Banks

(Pl. 64, figs. 6-12)

Banks, 1911*b*, p. 357, pl. 12, figs. 17, 19, 22; Carpenter, 1933, p. 36, fig. 17  
Immature stages. Sibley, 1926*b*, p. 106, 212, pl. 9, fig. 45-53

Head with mostly yellow hair. Basal segment of the antennae with yellow hair and a few longer black ones exteriorly; the succeeding segments yellow beneath, blackish above. Maxillary palpi with long black scale hairs, not with broad scales. Legs yellow, darker on the outside especially of tibiae and tarsi. Wings brown, densely covered with mostly black and with brown hair; the long hairs in the subcostal furrow black; also a row of black hairs on  $Cu_1$ ; the area enclosed by the dotted line in plate 64, figure 10, clothed with white hair. Ventral side of the abdomen and the genitalia yellow, upper half of the abdomen dark with very long hairs on the posterior margins of the segments. The female resembling the male in general but the venation (pl. 64, fig. 6) like that of the females of the other genera.

Taken at Ogdensburg, N. Y., August.

Sibley (*l. c.*) describes the immature stages collected at McLean, N. Y.

Banks' original description of the species based on material from Woodworth's lake, Fulton county, N. Y., does not differ much from the above except that the patch of white hair on the inner margin of the fore wing is not mentioned.

### Lepidostoma Rambur

Rambur, 1842, p. 493; McLachlan, 1876*b*, p. 273; Banks, 1899, p. 212 (*Pristosilo*); Ulmer, 1907*c*, p. 110; Ulmer, 1909*a*, p. 189

Immature stages of the European species—*Lepidostoma hirtum*. Morton, 1885, p. 43; Klapálek, 1893, p. 75; Struck, 1903, pl. 2, fig. 15; Ulmer, 1903*d*, p. 90; Silfvenius, 1905*b*, p. 29; Siltala, 1907*c*, p. 544; Ulmer, 1909*a*, p. 208, 275, 318

Antennae somewhat longer than the fore wings; the basal segment in the male but little longer than the head, very thick, covered with long hairs besides the numerous fine, straight spurs on the ventral side and the broader scale hairs on the inner surface; the basal segment in the female about twice as long as the head, covered with long hairs but without spurs or broad scale hairs. Maxillary palpi of the male thick, covered with scales and with stout hairs, and carried closely in front of the face. Fore wings of the male covered with scales, otherwise almost without pubescence except on the veins at the base of the wing; at the humeral angle a bunch of thick scale hairs. The venation of the male is considerably reduced; the radial sector 3-branched, media 2-branched, the remaining veins much modified;  $Cu_1$  has no accessory, between it and  $Cu_2$  there is a crossvein near the base forming a little cell which is characteristic for the genus (pl. 65, fig. 4). In the female, the venation of the fore wing nearly normal; cell  $M$  smaller than in the other genera, the apices of cell  $M_2$  and  $Cu_1$  and the crossvein  $m-cu$  being far toward the base of the wing.

In the hind wing the radial sector 3-branched in the male, normal in the female,  $Cu_{1a}$  lacking in the male, normal in the female. The venation of the hind wing of the male highly modified and the homologies uncertain even in the region of the radial sector. In the fore wing of the male a furrow between the subcosta and  $R_1$  and in the hind wing a deep curved furrow running mostly along media; scales also over much of the wing.

The larvae at first build smooth conical cases of sand; the older larvae have cases which are built of vegetable material and are square in cross section.

### Lepidostoma pallidum Banks

Banks, 1897, p. 29; Banks, 1907*c*, p. 43; Ulmer, 1907*c*, p. 111

"Length 8 mm. Yellowish, clothed with pale yellow hairs; head somewhat more reddish; veins of the wings pale; legs and spurs pale yellow; antennae with basal joint much longer than the head, slender, not very densely clothed with hairs of moderate length, longer yel-

low hair above on head; wings long and slender, pointed at tip, posterior pair but little shorter than anterior pair; both branches of the radial sector forked, the upper branch of cubitus forked, all in the same region of wing; discoidal cell in fore wings several times longer than broad, closed; thyridial area closed; cubitus connected to post-cubitus before middle and toward tip, in both cases the veinlet continues across to the next vein; spurs 2-4-4.

"Several specimens from Ithaca, N. Y.," Banks, *l. c.*

The type is a female.

### **Lepidostoma togatum** Hagen

(Text figs. 5 q, t., pl. 65, figs. 1-8)

Hagen, 1861c, p. 273 (*Mormonia*); Provancher, 1878a, p. 135; Provancher, 1878b, p. 136<sup>2</sup> (*Mormonia*); Banks, 1899, p. 212 (*Pristosilo canadensis*); Banks, 1904d, p. 212; Ulmer, 1907d, p. 111

"Brownish-gray; with luteous hair; antennae pilose, pale yellow, annulated with fuscous, the basal article long, brownish-gray, hairy; palpi and feet pale; abdomen fuscous; anterior wings narrow, fuscous, with luteous hair, veins fuscous, with fuscous pile; posterior wings cinereous. Female.

"Length to tip of wings 9 millim. Alar expanse 16 millim.

"Hab. Washington; St. Lawrence river, Canada (Osten Sacken)."  
Hagen, *l. c.*

The following is Banks' description of the male.

"Gray, palpi, face and basal joints of antennae with yellowish-gray scalelike hairs, and the latter with longer yellowish hair, rest of antennae pale yellow; vertex and thorax with groups of long pale yellowish hairs; legs yellowish; abdomen fuscous, appendages yellowish; wings gray hyaline, with gray hairs and yellow-gray scalelike ones on costal area of fore pair and over whole of hind pair, fringe gray, interrupted with black; antennae rather short and stout, basal joint longer than head; legs rather short, subapical spurs on hind and intermediate pairs much beyond the middle; wings rather narrow, discal cell long, narrowed at tip, about as the pedicel, apical cells about as long, first apical much longer, discal cell of hind wings shorter, about as long as its pedicel, apical cells twice as long; inferior male appendages long, forcipate upcurved. Expanse 14 mm.

"Sherbrooke, Canada, June (Bégin)." Banks, *l. c.*

This species was taken at Ogdensburg, N. Y., on the St Lawrence during the early part of August, the specimens nearly all female. Dr J. C. Bradley has sent me specimens collected at Clayton, Ga. (altitude 2000 feet), May 20th-25th. In both male and female there are dark annulations in the chitin near the distal ends of the first few segments (except the basal) of the antennae. The tenth segment in the male is produced into two long pointed pieces, in the middle dorsally there is a chitinous prominence. The penis is

curved downward. The claspers are curved as seen from below; they each bear three slender processes, two basally and one distally; of these only the larger basal one can readily be seen from the side. The claspers are covered with long stout hairs.

The specimens in Hagen's collection are all females except one from Slave lake, which probably does not belong here; a specimen of *Phanopsyche* is also included by error.

There are two western species described. The types are females.

#### *Lepidostoma cinereum* Banks

Banks, 1899, p. 210 (*Silo*); Banks, 1907c, p. 43; Ulmer, 1907c, p. 111. California.

#### *Lepidostoma stigma* Banks

Banks, 1907a, p. 125, pl. 8, fig. 10. Colorado.

### Notiopsyche Banks

Banks, 1905c, p. 11; Ulmer, 1907c, p. 103; Carpenter, 1933, p. 34

"Maxillary palpi short, broad, flattened, erect, and appressed to face; labial palpi extremely long and slender; basal joint of antennae porrect, longer than head; two spurs on tibia 1, others lost, probably 4-4; discal cell in both wings closed; forks 1, 2, and 3 in fore wings of male; forks 1 and 3 present in hind wings. Fore wings of male very broad, costal area very broad, but the median area is still broader, the median and cubital veins close together and bent toward the posterior margin." Banks, *l. c.*

### *Notiopsyche carolina* Banks<sup>44</sup>

Banks, 1911b, p. 356, pl. 13, fig. 28

"Pale yellowish throughout; antennae with the apex of each joint above broadly marked with brown; basal joints mostly with gray hair, but not as dense as in *N. latipennis*. Wings with short, sparse, yellowish hair, and with scattered longer black hairs, especially on the veins, and along the margin, the apical fringe quite long, and the apical half of fore wings distinctly infuscated, and a blackish patch just beyond the discal cell. Basal joint of antennae very slender, much longer than the width of the head, rest of antennae rather serrate above, and hairy beneath; long erect gray hair on head and pronotum. Wings rather short and broad, the discal cell ends but little beyond middle of the wings, and is about as near to hind as to costal margin; the small cell in middle of hind margin is three times as long as broad.

"Expanse 12 mm.

"From Southern Pines, North Carolina, 23 April (Manee). Very similar to *N. latipennis* in general, but much smaller and longer, less hairy joints of antennae." Banks, *l. c.*

<sup>44</sup> See Addendum, p. 473.

*Notiopsyche latipennis* Banks

(Pl. 65, fig. 9)

Banks, 1905a, p. 216; Banks, 1905c, p. 11, pl. 2, figs. 20, 27; Ulmer, 1907c, pl. 13, fig. 114 (*mexicana*); Carpenter, 1933, p. 35, fig. 14

"Face gray, with short gray hair; vertex darker, with longer yellowish gray hair; basal joint of antennae clothed inside with black hairs, longer below; elsewhere with gray hair, rest of antennae pale, annulate with black, and below with short, erect bristles; prothorax with gray hair above, rest of thorax yellowish; abdomen brown, tip and genitalia yellow; legs pale yellow; wings gray, with yellow-gray hairs, sparse and appressed; along costal margin are longer, darker hairs, pointing back over costal region; venation pale brown; hindwings grayish, venation darker, some scattered yellowish-gray hair on membrane; cubitus with two apical branches, apparently no anal veins; discal cell nearly three times as long as its pedicel, narrowed near tip; cross-vein between radial sector and median is oblique. Expanse 20 mm.

"One male from Black Mt., North Carolina. June (Beutenmüller)." Banks, *l. c.*, p. 11.

*Nosopus* McLachlan

McLachlan, 1871, p. 114; Ulmer, 1907c, p. 102

"Head densely clothed with long hairs; antennae not so long as the wings, moderately stout, the apical half subserrate internally, basal joint nearly twice the length of the head, strong, hirsute, the succeeding joints short and transverse; eyes small and round; maxillary palpi very small, somewhat clavate, directed upwards and lying closely applied against the face, clothed externally with long and strong hairs; labial palpi very large and long, densely clothed with scales, the basal joint short, second very long, compressed and dilated, third about as long as the second, and equally broad at the base, but gradually acuminate toward the apex. Legs: anterior pair abnormally constructed as follows:—the coxa elongate, and ordinary; the trochanter small and cup-shaped; femur long, moderately slender, gradually diminishing from base to apex; tibia very short, subovate, truncate, and dilated, slightly scaly, armed with one stout, claw-shaped spur; first joint of tarsi enormously dilated, twice the length of the tibia, sulcate internally, the lower surface densely furnished with waxy-looking scales; succeeding tarsal joints short and small, gradually diminishing in length and thickness; intermediate and posterior legs slender, and of the ordinary form, each tibia furnished with an apical and subapical pair of long and equal spurs. Abdomen short and somewhat stout; inferior appendages short, curved.

"Anterior wings oval, rather densely clothed with short hairs, the fringes somewhat long; the subcosta and radius nearly straight, parallel; discoidal cell narrow, closed by a straight veinlet; cellula thyridii very long, extending nearly to base, and reaching to the middle of the discoidal cell, closed by a straight veinlet; a veinlet unites the lower fork of the ramus discoidalis with the ramus thyriifer, placed level with that closing the discoidal cell; an oblique veinlet

beneath the middle of the cellula thyridii unites this with the cubitus anticus; seven apical cellules; the first extending along one third of the upper edge of the discoidal cell, third shorter than the first, but longer than the second, fourth equal to the second, fifth longer than the first, extending to a level with the middle of the discoidal cell. Posterior wings moderately long, gradually dilated to beyond the middle, apex parabolic, costal margin with a short inturned fringe, anal portion with very long fringes; subcosta and radius united for some distance, afterward separating and diverging; discoidal cell small, subtriangular, closed by a straight veinlet; a second veinlet unites the lower edge of the discoidal cell to the ramus subdiscoidalis; lower branch of the ramus discoidalis simple; ramus subdiscoidalis simply and longly furcate.

"A genus abundantly distinct by the enormous labial palpi, and very abnormal structure of the anterior legs, the aborted tibia and enormous first tarsal joint in these legs being very remarkable; the mass of scales on the surface of this strange tarsal joint has, at first sight, the appearance of a waxy secretion, but resolves itself into waxy-looking scales under a high power. The genus is evidently a near ally of *Mormonia* (*Lepidostoma*); and nature would seem to have selected this group as one in which she can best display her wealth of forms. In this group is also exhibited a more or less constant tendency to substitute a scalelike clothing for hairs in the male sex. In the typical species of *Mormonia* (*M. hirta*) this clothing pervades almost the entire insect; in *Nosopus* it is concentrated, so to speak, upon the labial palpi and the abnormal tarsal joint. It is possible, nay, almost certain, that the female will be found to have ordinary palpi and the usual slender anterior legs; and, in all probability, 2-4-4 spurs; for one spur may be reasonably supposed to be aborted in the anterior male tibiae." McLachlan, *l. c.*

There are two anterior spurs in the male although one of them is small.

One California species is reported.

*Nosopus podager* McLachlan (Pl. 65, fig. 10)

McLachlan, 1871, p. 116, pl. 2, figs. a-c. California.

### Arcadopsyche Banks

Banks, 1930a, p. 129

"A Sericostomatid in the section of *Crunoecia*. Antennae widely separate at base, basal joint greatly elongate and enlarged, near tip curved downward, densely clothed with mostly erect, long hair. Vertex with a tuft of long hair each side from a tubercle near the eye; palpi (of male) recurved, densely clothed with long-stalked scales, forming a great mask over face; spurs 2-4-4. In fore wings the costal area is very broad, the discal cell slender, forks 1, 2 and 5, fifth connected beyond the forking to branch of medius; anal vein does not connect out to fork 5; the second anal (or axillary) runs into anal long before tip. In hind wings the venation is similar

to *Crunoecia*, but discal cell closed and smaller, and the apparent fork 3 not as wide at tip.

"Related to *Olemira* by palpi and antennae, and with very similar venation in both wings, but lacks scales on fore wings, and the reflexed costal area." Banks, *l. c.*

### Arcadopsyche prominens Banks

Banks, 1930a, p. 129, figs. 1, 8, 10

"Scales of palpi gray, iridescent and rather bluish at tips; hair on basal joint of antennae mostly deep black, but some white, beyond the antenna is pale, narrowly annulate with dark; vertex with mostly gray, but some black hair; thorax with mostly black hair; abdomen black toward tip, pale on base and beneath; legs pale, tibiae and tarsi darker outside. Wings fumose, with darker veins; short hair mostly yellowish, but some dark, large black patch just behind end of discal cell, smaller patches in area beyond, and some along anal margin; outer fringe largely black, but some patches of pale hair. Hind wings fumose, with darker fringe. Discal cell nearly as long as pedicel, lower branch of medius and fork 5 equally far basad, long cross-vein from fork 5 to branch of medius, very short cross-vein from anal to cubitus, and placed much before the base of discal cell. Expanse 19 mm.

"From Cape North, Cape Breton, Nova Scotia, 7 August." Banks, *l. c.*

### Neothremma Banks

Banks, 1930b, p. 229

"A Sericostomatid; the maxillary palpi of the male recurved, short, last joint with a long dense fringe on lower inner side; basal joint of antennae elongate; ocelli present, but rather small, spurs 1, 3, 4. Venation fairly regular in both sexes, in general similar to that of *Silo*; the discal cell long, forks 1 and 2 back on discal cell, forks 3 and 5 also present; in the hind wing forks 1, 2 and 5 present, and the discal cell closed. Eyes not hairy." Banks, *l. c.*

Two western species are described.

#### *Neothremma alicia* Banks

Banks, 1930b, p. 229, fig. 4, 5. Colorado.

#### *Neothremma deceptiva* Banks

Banks, 1907a, p. 125, pl. 8, fig. 1 (*Thremma*); Banks, 1930b, p. 229. New Mexico.

### Sericostomatid sp.

(Pl. 67, figs. 6-11)

Reference may be made here to a species of which I have fragmentary material and which does not appear to belong to any of the four subfamilies of Sericostomatidae.

Antennae about as long as the wings and moderately stout; the basal segment not much if any longer than the head. Maxillary palpi very peculiar, small, not very hairy, and closely appressed

to the face and therefore easily overlooked; the second segment arising from the first before the tip of the latter, the third shortest and only half as thick as the others. The labial palpi considerably larger, the drawings (pl. 67, figs. 8, 9) being on the same scale. The discal cell indistinctly closed in both wings; in the hind wing the crossvein *m-cu* indistinctly indicated. Upon the whole the venation (pl. 67, fig. 6) resembling that of the Goerinae but different in having the anal veins of the fore wing not so nearly parallel to the wing margin, in the hind wing in having indications of the two crossveins, *r<sub>3</sub>-r<sub>4</sub>* and *m-cu* in the relations of the anal veins, and in that the anal area is not quite so much expanded. Spurs 1-4-4. The spur of the fore leg small and on each side of it a spine like those at the ends of the tarsal segments. The genitalia very characteristic; the claspers 2-segmented, the proximal segment with long hairs on the posterior and lower margins and the distal segment beset with short black spines at the end; several long spines visible from below, extending between the bases of the claspers and apparently arising from the ventral surface of the penis. Length to tip of wings 6 mm.

One damaged male specimen taken at West Falls, N. Y., July 15th.

#### GENERA OF UNCERTAIN POSITION

Besides the genera ordinarily listed in the preceding families there are a number whose relationships are obscure. These have been classified with the Sericostomatidae largely because of the fact that the male maxillary palpi (in all except *Philanisus*, an Australian genus) have less than five segments and may be otherwise more or less abnormal. Of these genera one is reported with North American species. For this genus (*Helicopsyche*) Ulmer and Martynov have each described a new subfamily, a procedure suggested before by Thienemann (1905*b*, p. 37).

#### HELICOPSYCHINAE Ulmer

Ulmer, 1912*e*, p. 304; Martynov, 1912*a*, p. 1

Spurs 2-2-4, 2-2-2, or 1-2-2. Antennae not longer than the fore wings except in the exotic genus *Tetanonema*; basal segment about as long as the head, or longer. Head with two prominent warts. No ocelli. Maxillary palpi of the male 3-segmented, the basal segment very short, the others long and cylindrical. Maxillary palpi of the female 5-segmented, the first segment very long, the second but half as long. Femora of the middle legs longer than those of the hind legs, the converse is true of the tibiae. Abdomen with long dense hairs; on the ventral side of the sixth segment a median projection, or "tooth," usually present. The wings clothed with fine and rather long hair generally concealing the venation. Discal cell long; the first apical cell (*R<sub>2</sub>*) reaching upon the discal cell for some distance; apical cells *R<sub>2</sub>*, *R<sub>4</sub>* and *Cu<sub>1</sub>* present in the fore wing; *R<sub>5</sub>* sharply angled near its base, the angle sometimes obliterating the crossvein *r-m*. Posterior wings narrow. Venation more or less

reduced; no closed discal cell; cell  $R_2$  very short. In some species the fore wing partly covered with scales. The preanal appendages small, the claspers large, often two-lobed.

Martynov indicates that the term "Helicopsychinae" was first used by Ulmer in 1906 (Notes from the Leyden Mus., 27, p. 104) and again in 1910 (Zool. Anz., 36, p. 452, 453) but not used in his later catalog. The two descriptions of the subfamily came very close together but that of Ulmer is, I believe, slightly earlier.

### Helicopsyche Hagen

Hagen, 1866a, p. 244, 245; Hagen, 1866b, p. 252; McLachlan, 1876b, p. 266; McLachlan, 1880a, p. lix; Ulmer, 1907c, p. 93; Ulmer, 1912e, p. 305; Martynov, 1912a, p. 3; Betten, 1913, p. 65-73  
 Immature stages. Hagen, 1864a, p. 121-30; Packard, 1869, p. 160; McLachlan, 1880a, p. lx; Felber, 1908b, p. 473-78; Vorhies, 1909, p. 681; Lestage, 1921a, p. 910

Antennae about as long as the fore wings in the male, sometimes shorter than the female fore wings; the basal segment longer than the head, hairy beyond the basal segment. The antennae differing in the sexes, those of the male being considerably thicker and sometimes differing in color also (p. 417). The posterior warts of the head very large. Maxillary palpi of the male 2-segmented, the segments long and equal, the first segment curved backward; in the female the segments successively shorter, the first being very long. The labial palpi alike in the sexes, the basal two segments equal, the third rather short and broad. Spurs 2-2-4; the outer spur of the fore leg very small. Wings hairy, the venation obscured. The anterior margin of the hind wing convex at the middle, somewhat concave just beyond; the corneous points usually marking cell  $R_4$  in both wings apparently not present in the American species. Along the anterior margin of the hind wing hooks such as are present in the Leptoceridae. In the fore wing, (pl. 66, fig. 1) the discal cell long; cell  $R_2$  reaching upon the discal cell for some distance;  $R_5$  branching from  $R_4$  almost at right angles, the crossvein  $r-m$  in line with the distal part of  $R_5$  so that this vein appears to arise from  $M_{1+2}$  (p. 46); media 3-branched; cell  $Cu_1$  small, the crossvein joining it to  $Cu_2$  in longitudinal position. In the hind wing (pl. 64, fig. 1) the radial sector three-branched, cell  $R_3$  very small; media two-branched; crossvein  $m-cu$  generally very indistinct or not shown. In some specimens the male with a broad line of scales on the disk of the fore wing and at the base of the hind wing (not reported in any North American species). The sixth (not seventh as stated by McLachlan) ventral segment of the male with a small tooth. The female with a row of stout hairs across this segment but not a tooth (McLachlan states that the tooth is present in both sexes). The third, fourth and fifth ventral segments of both male and female with a chitinous network giving a fenestrated appearance much as in the dorsal segments of the males of some species of *Oecetis* (p. 52). The tenth dorsal segment arched directly over the penis; the latter membranous at tip; the preanal appendages small, rounded knobs; the claspers heavy, their posterior and ventral

margin with numerous small prominences on each of which there is a long stout hair, the basal portion greatly thickened and beset with very stout spines and with some longer hairs.

The larval mandibles stout, roughly triangular in shape (text fig. 37g); the labrum (text fig. 36f) with three bristles on each side anteriorly, its anterior edge with two emarginations and covered with hairs on the ventral surface. The pronotum (pl. 66, fig. 10) strongly chitinized, the mesonotum less so; the metanotum soft but with several chitin plates in the middle anterior region, besides one above the base of each of the hind legs. Legs progressively longer, the first two with distal spurs on the tibiae. The first abdominal segment with a large dorsal tubercle and on each side of this a plate of small spines. The tracheal gills very small and few. The prolegs heavy, with many hooks ventrally (pl. 67, fig. 2).

The pupal labrum with three hairs anteriorly and two posteriorly on each side. The first and second pairs of legs provided with fringes for swimming; no pupal claws. The first abdominal segment not chitinized strongly and without spines and hooks. Dorsal plates of hooks on the anterior margins of segments 3-6 and on the posterior margin of segment 5, the plates narrow and each with but two hooks. At the rear end of the body two short stout processes covered with long hairs. A few inconspicuous gills at the sides of the first abdominal segments.

The case made by this genus is the now well-known spiral sand case which was at first taken to belong to a snail. Sometimes the sand grains used for the case are of about equal size, in some cases they are progressively larger toward the anterior opening. The rear (dorsal) end is left open and I have found no sieve membrane in the larval case. The cases which I collected in November had a little more than one complete coil, those of the pupa have about two and one-half or two and three-fourths coils. The pupal case is closed in front with a membrane which has a vertical slit (text fig. 49a). The rear membrane (text fig. 49b) has many openings and lies at about the end of the first coil. McLachlan has given an interesting account of the discovery of the connection between the larvae and the adults. The peculiar cases have received frequent notice and many of them have been given specific names.

Of the two eastern species described I reduce *H. annulicornis* to synonymy for the reason that it seems to me to be differentiated on characters which are simply those which distinguish the female sex. The spur formula of *annulicornis* is given as 1-2-4 but certain of the spurs are often abnormally small or practically wanting in this genus.

Lea (1834, p. 105) in describing the case as a snail shell says, "The apex of all the specimens which I have had the opportunity

of examining is broken. The operculum was observed in two specimens sufficiently perfect to exhibit a striated horny structure."

The venation of this genus has been commented on above (p. 46). Considering the isolated position of the genus (there are two closely allied genera in Brazil) it is interesting to note that it presents certain characters found in other families than the one which the genus has always been joined. Thus in the fore wing it shows stages in the fusion of  $R_5$  with *media*—a tendency shown also in the Molanidae and I think also exhibited in the Leptoceridae—some of the abdominal segments have the fenestrated appearance heretofore reported only in *Oecetis* (Leptoceridae), and, finally, it has the hooks on the anterior margin of the hind wings as is the case in the Leptoceridae, Molannidae, and the Macronematinae.

### *Helicopsyche borealis* Hagen

(Text figs. 5*w*, 19*b*, 36*f*, 37*g*, 49*a*, *b*; pl. 66, figs. 1–10, pl. 67, 1–5)

Hagen, 1861*c*, p. 271 (*Notidobia*); Hagen, 1866*b*, p. 253 (*Notidobia*); McLachlan, 1876*b*, p. 238, 269, pl. 29, fig. 4; Provancher, 1878*a*, p. 134 (*Notidobia*); Provancher, 1878*b*, p. 136<sup>2</sup> (*Notidobia*); Banks, 1904*d*, p. 212, pl. 2, fig. 12, (*annulicornis*); Ulmer, 1907*c*, pl. 11, fig. 98; Vorhies, 1909, p. 681, pl. 56, figs. 12, 13

Immature stages. Hagen, 1864*a*, p. 130 (*glabra*); Packard, 1869, p. 160, 161, fig. 32; Vorhies, 1909, p. 682, pl. 52, fig. 6, pl. 56, figs. 12–22; Lloyd, 1921, p. 77, figs. 124–28; Sibley, 1926*b*, 106 (listed)

"Imago. Length of body 5–6 mm. Expanse, male, 12–13 mm, female, 16–17 mm. Antennae 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 curl apart at the tips. Palpi of female 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 (unless 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 incision 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 ninth ventral segment of the male has a median rounded excision. A brown lobe or tooth is present on the sixth ventral segment, not on the seventh, as McLachlan and Ulmer state for the genus. McLachlan's figures of *H. sperata* appear to indicate it on the sixth, and of *revelieri* on the seventh." Vorhies, *l. c.*

The species was collected by Vorhies at Lake Mendota, Lake Menona, Devil's Lake, and Trout Lake, all in Wisconsin.

I have collected all stages of this insect from a small stream running in the ravine at the mouth of which the Great Lakes Naval Training Station of the Great Lakes is now placed, near North Chicago, Ill. These specimens agree closely with Vorhies' description. I add the following notes and indicate slight differences from the above:

The antennae of the male are yellow, those of the female have dark pubescence on each segment and are decidedly more slender (text fig. 5w). The tenth segment is slightly emarginate posteriorly, it is thickly set with small spines, and has a median thickened line of chitin, but I think it is not divided as described for the European forms. The penis lies directly beneath the tenth segment, partially concealed in the concave lower surface of the latter; the dorsal part of the distal end of the penis is membranous and extrusible. The claspers are as described above but the shape varies a great deal.

This species has now been reported from Canada, Washington, D. C., New York, Virginia, Maryland, Wisconsin and Illinois. Dr H. Garman sent me larvae, possibly of another species, from Kentucky. My specimens which are from various localities show considerable variation particularly in size, and also in the shape of the claspers.

There are four western and southern species described and two from the West Indies.

*Helicopsyche arizonensis* Banks

Banks, 1907a, p. 125. Arizona.

*Helicopsyche californica* Banks

Banks, 1899, p. 210. California.

*Helicopsyche lutea* Hagen

Hagen, 1861c, p. 271 (*Notidobia*); McLachlan, 1876b, p. 238. St Domingo.

*Helicopsyche mexicana* Banks

Banks, 1901b, p. 368, pl. 12, figs. 7, 8. Mexico.

*Helicopsyche minima* Bremi

Bremi, Mitt. naturf. Ges. Zurich, 1848, p. 61.

Hagen, Stett. Ent. Z., 25, p. 125. Porto Rico.

*Helicopsyche montana* Felber

Felber, 1912, p. 46-48, figs. 1-9. Mexico.

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<sup>1</sup> The preparation of this bibliography has been very greatly facilitated by the fact that exceptionally good bibliographies are given by writers on the Trichoptera. Special mention may be made of those appearing in Ulmer 1903*d*, 1907*c*, 1908*a*, 1911*d*, Siltala 1906*b*, 1907*c*, and Thienemann 1905*b*. Ulmer's *referate* (1911*d*, 1912*a*, 1919*a*, *b*, 1920*a*) is invaluable; it abstracts all the literature for the periods covered.

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**ADDENDUM**

A paper by Dr F. M. Carpenter (*Psyche*, 40: 32-37, figs. 1-17), published after this report is in type, includes the following new genera and new species.

*Rhyacophila montana*, l. c., p. 42, fig. 10. N. Car. Tenn.

*Phylocentropus carolinus*, l. c., p. 43, fig. 9. N. Car.

*Neophylax mitchelli*, l. c., p. 32, fig. 1. N. Car.

*Pseudogoera*, l. c., p. 37 (*Goerinae*)

*Pseudogoera singularis*, l. c., p. 38, figs. 2, 12. N. Car.

*Oligopsyche*, l. c., p. 36 (*Lepidostomatinae*). The genotype is *O. (Notiopsyche) carolina*.

*Neuropsyche*, l. c., p. 38 (*Lepidostomatinae*)

*Neuropsyche tibialis*, l. c., p. 39, figs. 3, 15, 16. N. Car.



## LEGENDS FOR THE TEXT FIGURES

- Fig. 1 Head of *Phryganea cinerea* Walker. *a* Side view. *b* Front view of mouth parts
- Fig. 2 *a* Genal process on the head of *Carborius punctatissimus* Walker. *b* Labium of *Macronema zebratum* Hagen
- Fig. 3 Palpi of adult Trichoptera. *a* Maxillary palpus of *Macronema zebratum* Hagen. *b* Same of *Leptocerus submacula* Walker. *c* Same of *Rhyacophila fuscula* Walker. *d* Tip of *c* enlarged. *e* Tip of *d* enlarged
- Fig. 4 *a* Head of *Pseudostenopsyche sugens* Döhler (after Döhler). *b* Mouth parts of *Dipseudopsis* sp.
- Fig. 5 Antennae of adult Trichoptera. *a* Dorsal view of head of *Rhyacophila* sp. showing bases of antennae, the ocelli, and the so-called warts. *b* *Protophila maculata* Hagen (base and tip). *c* *Agraylea multipunctata* Curtis. *d* *Limnephilus tersus* n. sp. (base and tip). *e* *Macronema zebratum* Hagen (base and tip). *f* *Diplectrone modesta* Banks. *g* *Hydropsyche alternans* Walker. *h* *Plectrocnemia* sp. *i* *Phylocentropus placidus* Banks. *j* *Potamyia flava* Hagen. *k* *Oecetis incerta* Walker. *l* *Leptocerus* sp. (base and tip). *m* *Hydromanicus truncatus* Betten. *n* *Agarodes grisea* Banks. *o* *Dinarthrella* sp. *p* *Trianenodes injusta* Hagen. *q* *Lepidostoma togatum* Hagen (female). *r* *Neuronia concatenata* Walker. *s* *Platycentropus maculipennis* Kolenati. *t* *Lepidostoma togatum* Hagen (male). *u* *Orthotrichia* (?) *pictipes* Banks. *v* *Goera* sp. *w* *Helicopsyche borealis* Hagen
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- Fig. 34 Types of gulae. *a* *Rhyacophila fuscula* Walker. *b* *Mystrophora americana* Banks. *c* *Hydropsyche alternans* Walker. *d* *Molanna* sp. *e* *A* Polycentropid. *f* *Neuronia postica* Walker
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- Fig. 39 The prosternal "horn" of *Neuronia postica* Walker
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- Fig. 48 Anal processes of pupae. *a* *Arctoeicia consocia* Walker. *b* *Hydropsyche alternans* Walker. *c* *Phylocentropus* sp. (female). *d* *Phryganea sayi* Milne. *e* *A* Lepidostomatid. *f* *Goera* sp.
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- Fig. 52 (After Krafka). Illustrating larval characters used in the table
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- Fig. 61 Radius of the hind wing of *Neophylax fuscus* Banks (female). *b* Same of the male

## EXPLANATION OF PLATES

## PLATE 1

- 1 Pupa of *Rhyacophila fuscata* Walker
- 2 Larva of *Mystrophora americana* Banks
- 3 Pupa of *Hydropsyche* sp.
- 4 Pupal case of *Agraylea multipunctata* Curtis
- 5 Case of *Psilotreta frontalis* Banks
- 6 Case of *Hesperophylax designatus* Walker
- 7 Closing membrane of a Limnephilid case

## PLATE 2

- 1 Case of *Molanna* sp.
- 2 and 3 Front and rear membranes of a Leptocerid pupal case
- 4 Case of *Helicopsyche borealis* Hagen
- 5 and 6 Front and rear membranes of pupal case of *Helicopsyche borealis* Hagen
- 7 Case of *Platycentropus* sp.
- 8 Pupal case of *Neophylax* sp.
- 9 Pupal case of *Neophylax* with membrane ruptured

## PLATE 3

- 1 One type of larval case of *Arctoecia consocia* Walker
- 2 Cross section of 1
- 3 Case of *Anabolia bimaculata* Walker
- 4 Case of *Limnephilus rhombicus* L.
- 5 Case of *Astenophylax argus* Harris
- 6 Egg cluster of *Hydropsyche*
- 7 Egg ring of *Phryganea*

## PLATE 4

- 1 Larva of *Stenophylax luculentus* n. sp.
- 2 Case of *Neuronia* sp.
- 3 Case of *Phryganea* sp.
- 4 Case of *Ganonema nigrum* Lloyd
- 5 Case of *Brachycentrus nigrosoma* Banks
- 6 Pupal case of a Limnephilid

## PLATE 5

*Rhyacophila andrea* n. sp.

- 1 Fore and hind wings
- 2 Male genitalia in lateral view
- 3 Male genitalia in dorsal view

*Rhyacophila carolina* Banks

- 4 Fore and hind wings
- 5 Male genitalia in lateral view
- 6 Male genitalia in dorsal view
- 7 Penis as seen obliquely from above

## PLATE 6

*Rhyacophila fuscata* Walker

- 1 Male genitalia in lateral view
- 2 Male genitalia in ventral view
- 3 Male genitalia in dorsal view
- 4 Chitinous piece suspended in the tenth male segment
- 5 Female abdomen in ventral view

## PLATE 6 (Continued)

*Rhyacophila lobifera* n. sp.

- 6 Fore and hind wings
- 7 Male genitalia in ventral view
- 8 Maxillary and labial palpi
- 9 Male genitalia in lateral view
- 10 Female abdomen in dorsal view
- 11 Right mandible of pupa
- 12 Left mandible of pupa
- 13 Larval proleg
- 14 Fifth ventral abdominal segment with lobes

## PLATE 7

*Rhyacophila nigrita* Banks

- 1 Fore and hind wings
- 2 Male genitalia in dorsal view
- 3 Male genitalia in lateral view
- 4 Penis in lateral view
- 5 Penis in dorsal view

*Rhyacophila torva* Hagen

- 6 Fore and hind wings
- 7 Male genitalia in lateral view
- 8 Penis in dorsal view
- 9 Penis in lateral view

*Rhyacophila* sp. 1

- 10 Male genitalia in lateral view
- 11 Male genitalia in dorsal view

*Rhyacophila* sp. 2

- 12 Male genitalia in lateral view
- 13 Male genitalia in dorsal view

## PLATE 8

*Atopsyche tripunctata* Banks

- 1 Fore and hind wings

*Psilochorema mimicum* McLachlan (New Zealand)

- 2 Fore and hind wings

*Apsilochorema indicum* Ulmer (India)

- 3 Fore and hind wings (after Ulmer)

*Mystrophora americana* Banks

- 4 Fore wing
- 5 Hind wing
- 6 Male genitalia in lateral view

## PLATE 9

*Mystrophora americana* Banks (cont.)

- 1 Male genitalia in dorsal view
- 2 Male tenth segment seen from beneath
- 3 Middle appendages from above
- 4 Middle appendages from beneath
- 5 One of the intermediate appendages lying beside the penis
- 6 Labrum of larva
- 7 Pronotum of larva

- 8 Prosternum of larva
- 9 Mandible of the larva
- 10 Last segment and prolegs of the larva in dorsal view
- 11 Last segment and proleg of the larva in lateral view
- 12 Mandible of the pupa
- 13 Labrum of the pupa
- 14 Larval leg

*Mystrophora* sp.

- 15 Male genitalia in dorsal view
- 16 Male genitalia (tenth segment) in lateral view
- 17 Claspers in ventral view

## PLATE 10

*Agapetus comatus* McLachlan (Europe)

- 1 Fore and hind wings

*Agapetus minutus* Sibley

- 2 Fore and hind wings
- 3 Male genitalia in lateral view
- 4 Clasper in ventral view
- 5 Male tenth segment in dorsal view

*Ptilocolepus granulatus* Pictet (Europe)

- 6 Wings

*Agraylea multipunctata* Curtis

- 7 Labrum of larva
- 8 Frons of larva
- 9 Antenna of larva
- 10 Left half of the pronotum of the larva
- 11 Right mandible of the larva
- 12 Left mandible of the larva

## PLATE 11

*Agraylea multipunctata* Curtis (cont.)

- 1 Third leg of the larva
- 2 First leg of the larva
- 3 Male abdomen and genitalia from below
- 4 Fore and hind wings
- 5 Mandible of the pupa

*Allotrichia pallicornis* Eaton (Europe)

- 6 Fore and hind wings

## PLATE 12

*Protoptila maculata* Hagen

- 1 Fore and hind wings
- 2 Maxillary and labial palpi
- 3 Male genitalia in dorsal view
- 4 Male genitalia in ventral view
- 5 Male genitalia in lateral view

*Orthotrichia americana* Banks

- 6 Fore and hind wings
- 7 Male genitalia in lateral view
- 8 Right side of the upper appendage
- 9 Dorsal view of the same
- 10 Male abdomen and genitalia in ventral view

## PLATE 12 (Continued)

*Polytrichia confusa* Morton

- 11 Fore and hind wings
- 12 Male genitalia in ventral view
- 13 Male appendages in dorsal view
- 14 Male appendages in lateral view

## PLATE 13

*Ithytrichia clavata* Morton

- 1 Male genitalia in ventral view
- 2 Male genitalia in lateral view
- 3 Fore and hind wings

*Hydroptila consimilis* Morton

- 4 Male genitalia in lateral view
- 5 Male genitalia in ventral view
- 6 Male genitalia in dorsal view
- 7 Fore and hind wings
- 8 Penis

*Hydroptila delineata* Morton

- 9 Male genitalia in lateral view

*Hydroptila spatulata* Morton

- 10 Male genitalia in lateral view
- 11 Male genitalia in ventral view

*Hydroptila waubesiana* n. sp.

- 12 Male genitalia in dorsal view

## PLATE 14

*Hydroptila albicornis* Hagen

- 1 Male genitalia in lateral view
- 2 Male genitalia in dorsal view
- 3 Base and tip of antenna

*Oxyethira grisea* n. sp.

- 4 Fore and hind wings
- 5 Male genitalia in lateral view
- 6 Male genitalia in dorsal view
- 7 Male genitalia in ventral view
- 8 Tip of antenna

*Oxyethira coercens* Morton

- 9 Male genitalia in lateral view
- 10 Male genitalia in ventral view

## Unnamed species (probably new genus)

- 11 Male genitalia in lateral view
- 12 Fore and hind wings
- 13 Base and tip of antenna
- 14 Maxillary palpus
- 15 Male genitalia in ventral view
- 16 Male genitalia in dorsal view

## PLATE 15

*Neotrichia collata* Morton

- 1 Fore and hind wings
- 2 Maxillary and labial palpi

*Philopotamus americanus* Banks

- 3 Fore and hind wings
- 4 Male genitalia in lateral view
- 5 Male genitalia in dorsal view
- 6 Maxillary and labial palpi

*Philopotamus distinctus* Walker

- 7 Male genitalia in lateral view
- 8 Male genitalia in dorsal view
- 9 Left mandible of the larva
- 10 Right mandible of the larva
- 11 Base of the first larval leg
- 12 Larval frons

*Dolophilus breviatus* Banks

- 13 Fore and hind wings
- 14 Maxillary and labial palpi

## PLATE 16

*Dolophilus breviatus* Banks (cont.)

- 1 Male genitalia in lateral view
- 2 Male genitalia in dorsal view
- 3 Base of first larval leg
- 4 Larval frons
- 5 Tip of female abdomen

*Chimarra aterritima* Hagen

- 6 Fore and hind wings
- 7 Maxillary and labial palpi
- 8 Male genitalia in lateral view (upper appendages omitted)
- 9 Base of first larval leg

*Chimarra lucia* n. sp.

- 10 Base and tip of antenna
- 11 Male genitalia in lateral view (upper appendages omitted)
- 12 Male genitalia in ventral view

*Chimarra socia* Hagen

- 13 Male genitalia in lateral view (upper appendages omitted)

*Parapsyche apicalis* Banks

- 14 Male genitalia in lateral view
- 15 Male genitalia in dorsal view
- 16 Maxillary and labial palpi
- 17 Male genitalia in ventral view
- 18 Base of antenna

## PLATE 17

*Parapsyche apicalis* Banks (cont.)

- 1 Fore wing
- 2 Hind wing

*Diplectrona modesta* Hagen

- 3 Male genitalia in dorsal view
- 4 Male genitalia in lateral view
- 5 Sternite of the larval prothorax
- 6 Wings
- 7 Frons of the larva

## PLATE 18

*Hydropsyche alternans* Walker

- 1 Fore and hind wings
- 2 Male tenth segment from above
- 3 Penis
- 4 Labrum of the pupa
- 5 Male genitalia in lateral view
- 6 Right mandible of pupa
- 7 Left mandible of pupa

*Hydropsyche chlorotica* Hagen

- 8 Maxillary and labial palpi
- 9 Male genitalia in lateral view

*Hydropsyche codona* n. sp.

- 10 Penis
- 11 Tenth segment of the male in dorsal view
- 12 Male genitalia in lateral view

## PLATE 19

*Hydropsyche incommoda* Hagen

- 1 Male genitalia in lateral view
- 2 Male genitalia in dorsal view
- 3 Larval mandibles
- 4 Penis in dorsal view
- 5 Penis in ventral view

*Hydropsyche phalerata* Hagen

- 6 Fore and hind wings
- 7 Male genitalia in lateral view

*Hydropsyche scalaris* Hagen

- 8 Male genitalia in dorsal view
- 9 Penis in side view
- 10 Penis in dorsal view
- 11 Base of antenna
- 12 Male genitalia in lateral view

*Hydropsyche venularis* Banks

- 13 Male genitalia in lateral view
- 14 Male genitalia in dorsal view

*Hydropsyche recurvata* Banks

- 15 Male genitalia in lateral view

## PLATE 20

*Hydropsyche* sp. 1

- 1 Male genitalia in dorsal view
- 2 Male genitalia in lateral view

*Hydropsyche* sp. 2

- 3 Male genitalia in lateral view

*Hydropsyche* sp. 3

- 4 Male genitalia in dorsal view
- 5 Male genitalia in lateral view

*Hydropsychodes sordida* Hagen

- 6 Penis
- 7 Male genitalia in lateral view

*Hydropsychodes analis* Banks

- 8 Male genitalia in lateral view
- 9 Fore and hind wings
- 10 Maxillary and labial palpi
- 11 Right mandible of larva
- 12 Left mandible of larva
- 13 Larval frons

*Hydropsychodes speciosa* Banks

- 14 Male genitalia in lateral view

*Potamyia flava* Hagen

- 15 Fore and hind wings

## PLATE 21

*Potamyia flava* Hagen (cont.)

- 1 Male genitalia in lateral view
- 2 Base of antenna
- 3 Clasper

*Smicridea divisa* Banks

- 4 Fore wing
- 5 Maxillary palpus
- 6 Hind wing

*Rhyacophylax signatus* Banks

- 7 Fore wing (after Banks)

*Macronema zebratum* Hagen

- 8 Fore wing, showing typical color areas
- 9 Maxillary palpus
- 10 Base of antenna
- 11 Male genitalia in dorsal view
- 12 Male genitalia in lateral view
- 13 Fore and hind wings
- 14 A hook from the costal margin of the hind wing
- 15 Labrum of the pupa

## PLATE 22

*Macronema zebratum* Hagen (cont.)

- 1 Tracheal gill of larva
- 2 Hooked scale hair from the head of the pupa
- 3 Part of the middle leg of the adult
- 4 End of the abdomen of the pupa, ventral view
- 5 End of the larval abdomen with prolegs and rectal blood gills
- 6 Right mandible of the pupa
- 7 Left mandible of the pupa

*Neureclipsis parvula* Banks

- 8 Male genitalia in lateral view

*Neureclipsis crepuscularis* Walker

- 9 Fore and hind wings
- 10 Maxillary and labial palpi
- 11 Base and tip of antenna
- 12 Middle leg of female
- 13 Male genitalia in lateral view

## PLATE 23

*Neureclipsis parvula* Banks

- 1 Fore and hind wings

*Phylocentropus placidus* Banks

- 2 Male genitalia in lateral view
- 3 Maxillary palpus
- 4 Male genitalia in dorsal view
- 5 Fore and hind wings
- 6 Pupal mandible
- 7 Pupal labrum
- 8 Dorsal view of tip of pupal abdomen

*Acrocentropus lucidus* Hagen

- 9 Fore and hind wings
- 10 Male genitalia in dorsal view
- 11 Base of antenna
- 12 Male genitalia in lateral view
- 13 Male genitalia in ventral view
- 14 Maxillary palpus

## PLATE 24

*Plectrocnemia canadensis* Banks

- 1 Fore and hind wings
- 2 Male genitalia in lateral view
- 3 Male genitalia in ventral view
- 4 One of the preanal appendages with median prongs
- 5 Male genitalia in dorsal view
- 6 Base of antenna
- 7 Maxillary palpus
- 8 Labial palpus

*Holocentropus* sp. 2

- 9 Male genitalia in lateral view

*Polycentropus* sp. 1

- 10 Fore and hind wings
- 11 Maxillary palpus
- 12 Male genitalia in lateral view

*Holocentropus flavus* Banks

- 13 Fore and hind wings
- 14 Male genitalia in lateral view
- 15 Inner view of clasper
- 16 Preanal appendage with median prong

## PLATE 25

*Holocentropus* sp. 1

- 1 Male genitalia in lateral view

*Nyctiophylax vestitus* Hagen

- 2 Fore and hind wings
- 3 Male genitalia in dorsal view
- 4 Male genitalia in lateral view
- 5 Inner view of preanal appendage
- 6 Labial palpus
- 7 Maxillary palpus
- 8 Penis
- 9 Male genitalia in ventral view

*Lype griselda* n. sp.

- 10 Fore and hind wings
- 11 Maxillary palpus
- 12 Male genitalia in ventral view
- 13 Male genitalia in lateral view

*Psychomyia flavida* Hagen

- 14 Fore and hind wings
- 15 Female abdomen in lateral view
- 16 Female abdomen in ventral view

## PLATE 26

*Ganonema nigrum* Lloyd

- 1 Fore and hind wings
- 2 Male genitalia in dorsal view
- 3 Base of antenna
- 4 Male genitalia in lateral view
- 5 Maxillary and labial palpi
- 6 Larval labium, maxillae, and gula
- 7 First larval leg
- 8 Second larval leg
- 9 Third larval leg
- 10 Larval frons and labrum
- 11 Inner view of larval mandible
- 12 Larval proleg
- 13 Dorsal view of rear end of larval abdomen
- 14 Larval mandibles viewed from above

## PLATE 27

*Ganonema nigrum* Lloyd (cont.)

- 1 End of pupal abdomen in lateral view
- 2 End of pupal abdomen in dorsal view
- 3 Dorsal view of first abdominal segment of pupa
- 4 Pupal labrum
- 5 Dorsal plates of the fifth segment of the pupa
- 6 Pupal mandible

*Notiomyia mexicana* Banks

- 7 Fore and hind wings (male)
- 8 Maxillary palpus of the male

*Nerophilus californicus* Hagen

- 9 Fore and hind wings

*Psilotreta frontalis* Banks

- 10 Clasper of the male
- 11 Upper appendages seen from below

## PLATE 28

*Namamyia plutonis* Banks

- 1 Fore and hind wings (female)

*Psilotreta frontalis* Banks (cont.)

- 2 Maxillary and labial palpi of the male
- 3 Maxillary and labial palpi of the female
- 4 Base of antenna

## PLATE 28 (Continued)

- 5 Fore and hind wings (female)
- 6 Fore and hind wings (male)
- 7 Male genitalia in lateral view
- 8 Male genitalia in ventral view

## PLATE 29

*Psilotreta frontalis* Banks (cont.)

- 1 Rear end of larval abdomen
- 2 Larval pronotum and base of leg (anterior margin to the left)
- 3 Larval frons
- 4 Larval labium and maxilla
- 5 Left mandible of the larva
- 6 Right mandible of the larva
- 7 Inner view of pupal mandible
- 8 Dorsal view of the pupal mandible
- 9 Pupal labrum
- 10 Dorsal hook on anterior margin of segment 5 of the pupa in side view
- 11 Dorsal hook at the posterior margin of segment 5 of the pupa in dorsal view
- 12 Dorsal view of one side of the first three segments of the pupa
- 13 Anal appendages of the pupa

*Marilia flexuosa* Ulmer

- 14 Fore and hind wings (after Ulmer)

*Molanna cinerea* Hagen

- 15 Fore and hind wings of the female

## PLATE 30

*Molanna cinerea* Hagen (cont.)

- 1 Male genitalia in lateral view
- 2 Male genitalia in ventral view
- 3 End of larval abdomen
- 4 Left mandible of the larva
- 5 Larval frons and labrum
- 6 Pupal mandible
- 7 Pupal labrum
- 8 Dorsal view of end of pupal abdomen
- 9 Right mandible of the larva
- 10 Base of antenna

*Molanna tryphena* n. sp.

- 11 Fore and hind wings of the male
- 12 Maxillary palpus
- 13 Labial palpus

*Molanna blenda* n. sp.

- 14 Fore wing of the male
- 15 Hind wing of the male

*Molanna musetta* n. sp.

- 16 Hind wing of the male

## PLATE 31

*Beraea nigritta* Banks

- 1 Fore wing of the female
- 2 Tip of fore wing of the male

*Leptocerus ancylus* Vorhies

- 3 Claspers seen from below
- 4 Male genitalia in lateral view

*Leptocerus aspinosus* n. sp.

- 5 Fore and hind wings (female)
- 6 Male genitalia in lateral view
- 7 Fore wing (male)
- 8 Male genitalia in dorsal view
- 9 Maxillary and labial palpi
- 10 Base of antenna

*Leptocerus cancellatus* n. sp.

- 11 Male genitalia in lateral view
- 12 Inner view of clasper

*Leptocerus dilutus* Hagen

- 13 Male genitalia in lateral view

*Leptocerus punctatus* Banks

- 14 Male genitalia in lateral view

## PLATE 32

*Leptocerus submacula* Walker

- 1 Fore and hind wings
- 2 Male genitalia in lateral view
- 3 Male genitalia in ventral view
- 4 Male genitalia from above

*Leptocerus tarsi-punctatus* Vorhies

- 5 Male genitalia in lateral view
- 6 Male genitalia from above

*Leptocerus vanus* n. sp.

- 7 Male genitalia in lateral view

*Leptocerus variegatus* Hagen

- 8 Two views of the clasper

*Leptocella albida* Walker

- 9 Fore and hind wings of the male
- 10 Male genitalia from above
- 11 Male genitalia in lateral view
- 12 Maxillary and labial palpi
- 13 Base of antenna
- 14 Pronotum and first leg of larva

## PLATE 33

*Leptocella albida* Walker (cont.)

- 1 Larval frons
- 2 Larval labrum
- 3 Pupal labrum
- 4 Third leg of the pupa
- 5 Antenna of the larva
- 6 Dorsal view of anal appendages of the pupa
- 7 Labium and maxilla of the larva
- 8 Pupal mandible

## PLATE 33 (Continued)

*Leptocella exquisita* Hagen

- 9 Fore and hind wings of the male
- 10 Male genitalia in lateral view

*Leptocella pavidata* Hagen

- 11 Fore and hind wings of the male
- 12 Male genitalia in lateral view

## PLATE 34

*Oecetis avara* Banks

- 1 Fore and hind wings
- 2 Male genitalia in lateral view
- 3 Maxillary palpus

*Oecetis immobilis* Hagen

- 4 Fore and hind wings
- 5 Male genitalia in lateral view

*Oecetis incerta* Walker

- 6 Fore and hind wings
- 7 Male genitalia in lateral view
- 8 Palpi
- 9 Base of antenna
- 10 Male genitalia from above
- 11 Claspers from below

*Oecetis persimilis* Banks

- 12 Male genitalia in lateral view

## PLATE 35

*Oecetis persimilis* Banks (cont.)

- 1 Wings

*Oecetis resurgens* Walker

- 2 Wings
- 3 Male genitalia in lateral view
- 4 Male genitalia in dorsal view
- 5 Male genitalia from beneath
- 6 Mandible and antenna of first stage larva
- 7 Labrum of first stage larva

*Oecetis* sp. 1

- 8 Wings of female
- 9 Wings of male
- 10 Palpi
- 11 Male genitalia in dorsal view
- 12 Male genitalia in lateral view

## PLATE 36

*Setodes grandis* Banks

- 1 Fore and hind wings
- 2 Male genitalia in lateral view
- 3 First leg of larva
- 4 Larval labrum
- 5 Anal prolegs of the larva in dorsal view
- 6 Larval frons

*Setodes vernalis* Banks

- 7 Fore and hind wings
- 8 Claspers from beneath
- 9 Male genitalia in lateral view

*Setodes* sp.

- 10 Fore and hind wings

## PLATE 37

*Setodes* sp. (cont.)

- 1 Male genitalia in lateral view

*Mystacides azurea* L. (Europe)

- 2 Male genitalia in lateral view

*Mystacides longicornis* L.

- 3 Fore and hind wings
- 4 Male genitalia in ventral view
- 5 Male genitalia in lateral view

*Mystacides nigra* L. (Europe, possibly America)

- 6 Male genitalia in lateral view

*Mystacides sepulchralis* Walker

- 7 Male genitalia in dorsal view
- 8 Male genitalia in lateral view
- 9 Anal processes of the pupa in dorsal view
- 10 Male palpi

## PLATE 38

*Mystacides sepulchralis* Walker (cont.)

- 1 Larval labium and maxillae
- 2 Larval gula
- 3 Larval frons
- 4 Rear end of larval prothorax from above
- 5 First larval leg
- 6 Second larval leg
- 7 Third larval leg
- 8 Larval mandible
- 9 Larval mandible
- 10 Pupal mandible
- 11 Rear end of larval abdomen from beneath
- 12 Pupal labrum
- 13 Larval labrum

## PLATE 39

*Triaenodes ignita* Walker

- 1 Male genitalia in lateral view
- 2 Genitalia in dorsal view
- 3 Claspers from beneath

*Triaenodes injusta* Hagen

- 4 Male genitalia in lateral view
- 5 Male genitalia from above
- 6 Claspers from beneath

## PLATE 39 (Continued)

*Trianodes vorhiesi* n. nom.

- 7 Fore and hind wings
- 8 Maxillary and labial palpi
- 9 Claspers from beneath
- 10 Base of male antenna
- 11 Male genitalia in lateral view

*Trianodes* sp.

- 12 Claspers from beneath
- 13 Male genitalia in dorsal view
- 14 Male genitalia in lateral view

*Trianodes marginata* Sibley

- 15 Male genitalia in lateral view
- 16 Claspers from beneath

## PLATE 40

*Phryganea cinerea* Walker

- 1 Male genitalia in lateral view
- 2 Claspers in ventral view

*Phryganea deflata* Milne

- 3 Male genitalia in lateral view

*Phryganea sayi* Milne

- 4 Fore and hind wings (female)
- 5 Claspers from beneath
- 6 Male genitalia in lateral view

*Phryganea vestita* Walker

- 7 Palpi
- 8 Male genitalia in lateral view
- 9 Claspers in ventral view

## PLATE 41

*Phryganea vestita* Walker (cont.)

- 1 Fore and hind wings (female)

*Neuronia concatenata* Walker

- 2 Fore and hind wings (female)
- 3 Penis
- 4 Maxillary palpus (male)
- 5 Labial palpus (male)
- 6 Tenth segment from above (male)
- 7 Claspers from beneath
- 8 Male genitalia in lateral view

*Neuronia ocellifera* Walker

- 9 Male genitalia in lateral view
- 10 Male abdomen from beneath
- 11 Male genitalia from above

## PLATE 42

*Neuronia pardalis* Walker

- 1 Male genitalia in lateral view

*Neuronia postica* Walker

- 2 Male abdomen from beneath
- 3 Male genitalia in lateral view
- 4 Tenth dorsal segment from beneath

*Neuronia semifasciata* Say

- 5 Male genitalia in lateral view
- 6 Male abdomen from above
- 7 Male abdomen from beneath

*Neuronia stygipes* Hagen

- 8 Fore and hind wings
- 9 Male genitalia in lateral view

*Agrypnia curvata* Banks

- 10 Fore and hind wings
- 11 Male genitalia from above
- 12 Male genitalia in lateral view

## PLATE 43

*Agrypnia straminea* Hagen

- 1 Fore and hind wings

*Glyphotaelius hostilis* Hagen

- 2 Fore and hind wings
- 3 Male genitalia in lateral view

*Arctoecia consocia* Walker

- 4 Fore and hind wings
- 5 Pupal labrum
- 6 Pupal mandible
- 7 Anal appendages of pupa
- 8 Larval proleg

## PLATE 44

*Arctoecia consocia* Walker (cont.)

- 1 Male genitalia in lateral view

*Leptophylax gracilis* Banks

- 2 Fore and hind wings
- 3 Male genitalia from beneath
- 4 Male genitalia from above
- 5 Male genitalia in lateral view

*Astenophylax argus* Harris

- 6 Fore and hind wings
- 7 Male genitalia in lateral view

## PLATE 45

*Dicosmoecus atripes* Hagen

- 1 Fore and hind wings

*Carborius punctatissimus* Walker

- 2 Fore and hind wings

## PLATE 45 (Continued)

*Limnephilus despectus* Walker

- 3 Male genitalia in lateral view (European specimen)

*Limnephilus eminens* n. sp.

- 4 Male genitalia in lateral view

*Limnephilus hyalinus* Hagen

- 5 Fore and hind wings (male)

## PLATE 46

*Limnephilus indivisus* Walker

- 1 Male genitalia in lateral view

*Limnephilus ornatus* Banks

- 2 Male genitalia in dorsal view  
3 Male genitalia in lateral view

*Limnephilus rhombicus* L.

- 4 Male genitalia in lateral view

*Limnephilus* sp.

- 5 Male genitalia in lateral view  
(This figure was introduced by error and may be disregarded)

*Limnephilus tersus* n. sp.

- 6 Male genitalia in lateral view  
7 Anal appendages of the pupa  
8 Larval frons and labrum

## PLATE 47

*Limnephilus tersus* n. sp. (cont.)

- 1 Fore and hind wings  
2 Larval labium and maxilla  
3 Pupal mandible  
4 Pupal labrum  
5 First segment of pupal abdomen

*Limnephilus* sp. 2

- 6 Male genitalia in lateral view

*Limnephilus* sp. 1

- 7 Male genitalia in lateral view

*Colpotauius* sp.

- 8 Fore wing  
9 Hind wing

## PLATE 48

*Rheophylax submonilifer* Walker

- 1 Fore and hind wings  
2 Male genitalia in lateral view

*Stenophylax gentilis* McLachlan

- 3 Male genitalia from beneath  
4 Last dorsal segment of the male (flattened)

*Stenophylax limbatus* McLachlan

- 5 Male genitalia in lateral view
- 6 Last dorsal segment of the male (flattened)

*Stenophylax luculentus* n. sp.

- 7 Rear end of larval abdomen
- 8 Male genitalia in lateral view
- 9 Penis
- 10 Last dorsal segment of the male (flattened)
- 11 Markings of the larval head
- 12 Larval frons and labrum

## PLATE 49

*Stenophylax luculentus* n. sp. (cont.)

- 1 End of pupal abdomen in lateral view
- 2 Pupal mandible
- 3 First segment of pupal abdomen
- 4 Pupal labrum

*Stenophylax scabripennis* Rambur

- 5 Fore and hind wings
- 6 Male genitalia in lateral view
- 7 Last dorsal segment from the side
- 8 Same from above (flattened)

*Halesus guttifer* Walker

- 9 Male genitalia in lateral view
- 10 Last dorsal segment from the side
- 11 Same from above (flattened)

*Halesus* sp.

- 12 Male genitalia in lateral view
- 13 Last dorsal segment from above (flattened)

## PLATE 50

*Platyphylax subfasciatus* Say

- 1 Fore and hind wings
- 2 Male genitalia in lateral view
- 3 Clasper

*Platyphylax lepidus* Hagen

- 4 Last dorsal segment (flattened)
- 5 Male genitalia in lateral view
- 6 Clasper

*Anabolia bimaculata* Walker

- 7 Male genitalia in lateral view
- 8 Fore and hind wings
- 9 Markings of larval head
- 10 Male genitalia in ventral view

## PLATE 51

*Anabolia bimaculata* Walker (cont.)

- 1 Pupal labrum
- 2 Pupal mandible
- 3 First abdominal segment of pupa

## PLATE 51 (Continued)

*Platycentropus indistinctus* Walker

- 4 Male genitalia in lateral view
- 5 Penis
- 6 Hind leg with abnormal spur
- 7 Pupal mandible
- 8 Pupal labrum

*Platycentropus maculipennis* Kolenati

- 9 Male genitalia in lateral view
- 10 Fore and hind wings
- 11 Pupal mandible

## PLATE 52

*Halesochila taylori* Banks

- 1 Fore and hind wings

*Drusinus sparsus* Banks

- 2 Tenth segment from above
- 3 Same from the side
- 4 Male genitalia from beneath

*Drusinus uniformis* n. sp.

- 5 Fore and hind wings
- 6 Male genitalia in lateral view
- 7 Claspers from beneath
- 8 Tenth segment from the side
- 9 Same from above
- 10 Penis from above

*Hesperophylax designatus* Walker

- 11 Male genitalia in lateral view
- 12 Penis
- 13 Male palpi

## PLATE 53

*Hesperophylax designatus* Walker (cont.)

- 1 Fore and hind wings
- 2 Pupal labrum
- 3 Pupal mandible

*Glyphopsyche* sp., probably *irrorata* Fabr.

- 4 Fore wing
- 5 Hind wing
- 6 Male genitalia in lateral view

*Chilostigma coagulatum* Hagen

- 7 Male genitalia in lateral view

*Chilostigma difficile* Walker

- 8 Male genitalia in lateral view
- 9 Same from beneath
- 10 Pupal labrum

## PLATE 54

*Chilostigma difficile* Walker (cont.)

- 1 Fore and hind wings

*Chilostigma* sp.

- 2 Fore and hind wings

*Homophylax flavipennis* Banks

- 3 Fore and hind wings (male)

## PLATE 55

*Neophylax autumnus* Vorhies

- 1 Male genitalia in lateral view
- 2 Same from beneath
- 3 Venation of part of the hind wing (male)

*Neophylax consimilis* n. sp.

- 4 Male genitalia in lateral view
- 5 Plate on the seventh ventral segment of the male
- 6 Larval frons and labrum
- 7 Male genitalia from beneath
- 8 Larval leg
- 9 Larval mandible
- 10 Pupal mandible
- 11 Pupal labrum
- 12 Anal processes of the pupa

*Neophylax fuscus* Banks

- 13 Fore and hind wings (female)

## PLATE 56

*Neophylax fuscus* Banks (cont.)

- 1 Fore and hind wings (male)
- 2 Male genitalia in lateral view
- 3 Male genitalia from beneath

*Apatania incerta* Banks

- 4 Male genitalia in lateral view
- 5 Fore wing
- 6 Hind wing

*Oligophlebodes minuta* Banks

- 7 Fore and hind wings (female)

## PLATE 57

*Oligophlebodes minuta* Banks (cont.)

- 1 Fore and hind wings (male)

*Allomyia tripunctata* Banks

- 2 Fore and hind wings
- 3 Male genitalia in ventral view

*Brachycentrus fuliginosus* Walker

- 4 Male genitalia in ventral view
- 5 Plate on ventral segment 7 of the male
- 6 Male palpi
- 7 Male genitalia in dorsal view
- 8 Male genitalia in lateral view
- 9 Fore and hind wings (female)

## PLATE 58

*Brachycentrus fuliginosus* Walker (cont.)

- 1 Fore and hind wings (male)
- 2 Palpi of the female

*Brachycentrus nigrisoma* Banks

- 3 Larval frons
- 4 Larval labrum
- 5 Male genitalia in lateral view
- 6 Male genitalia from above
- 7 Half of the larval mesonotum
- 8 Half of the larval metanotum
- 9 First leg and half of larval pronotum
- 10 Second leg of the larva

## PLATE 59

*Brachycentrus nigrosoma* Banks (cont.)

- 1 Chitinous plates at the base of the third larval leg
- 2 Rear end of larval abdomen (dorsal)
- 3 Same (ventral)

*Brachycentrus* sp.

- 4 Ventral plate
- 5 Male genitalia in lateral view
- 6 Same from above

*Oligoplectrum maculatum* Fourc. (Europe)

- 7 Fore and hind wings (male)

## PLATE 60

*Micrasema* sp. (New York)

- 1 Palpi of the female
- 2 Fore and hind wings of the female

*Micrasema* sp. (Georgia)

- 3 Fore and hind wings of the male

*Agarodes grisea* Banks

- 4 Fore and hind wings of the male
- 5 Female maxillary palpus
- 6 Male genitalia from below
- 7 Male genitalia from above
- 8 Male genitalia in lateral view

## PLATE 61

*Goera* sp. (Old Forge, N. Y.)

- 1 Fore and hind wings of the male
- 2 Base of antenna
- 3 Labial palpus
- 4 Male genitalia in dorsal view
- 5 Male genitalia in ventral view
- 6 Male genitalia in lateral view

*Goera* sp. (Ithaca, N. Y.)

- 7 Dorsal view of larval thorax
- 8 Pupal mandible
- 9 Larval frons and labrum

*Silo pallipes* Fabr. (Europe)

10 Fore and hind wings

*Atomyiodes bispinosa* Ulmer

11 Head showing abnormal palpi (after Ulmer)

PLATE 62

*Atomyia modesta* Banks

1 Fore and hind wings of the female

2 Male genitalia in lateral view

3 Same in ventral view

4 Base of antenna

5 Palpi of the female

6 Palpi of the male

7 Fore and hind wings of the male

*Mormomyia vernalis* Banks

8 Fore and hind wings of the male

9 Clasper

*Alepomyiodes wisconsinensis* Vorhies

10 Male genitalia in lateral view

11 Same in ventral view

PLATE 63

*Alepomyiodes wisconsinensis* Vorhies (cont.)

1 Fore and hind wings of the male

*Alepomyiodes* sp.

2 Fore and hind wings of the male

*Theliopsyche parva* Banks

3 Wings of the male

*Olemira costalis* Banks

4 Wings of the female

PLATE 64

*Olemira costalis* Banks (cont.)

1 Wings of the male

2 Male genitalia in ventral view

3 Male genitalia in lateral view

4 Base of antenna (scales not shown)

5 Labial palpus

*Phanopsyche grisea* Banks

6 Wings of the female

7 Male genitalia in lateral view

8 Claspers from above

9 Penis

10 Wings of the male

11 Palpi of the female

12 Base of antenna

## PLATE 65

*Lepidostoma togatum* Hagen

- 1 Wings of the female
- 2 Male genitalia in lateral view
- 3 Male genitalia in ventral view
- 4 Wings of the male
- 5 Male palpi
- 6 Female palpi
- 7 Base of male antenna
- 8 Base of female antenna

*Notiopsyche latipennis* Banks

- 9 Fore wing (after Banks)

*Nosopus podager* McLachlan

- 10 Wings (after McLachlan)

## PLATE 66

*Helicopsyche borealis* Hagen

- 1 Wings
- 2 Palpi of the female
- 3 Base of the antenna
- 4 Palpi of the male
- 5 Clasper (inner view)
- 6 Male genitalia in lateral view
- 7 Clasper from beneath
- 8 Larval frons
- 9 Larval labium and maxilla
- 10 Markings on the mesothorax and metathorax of the larva

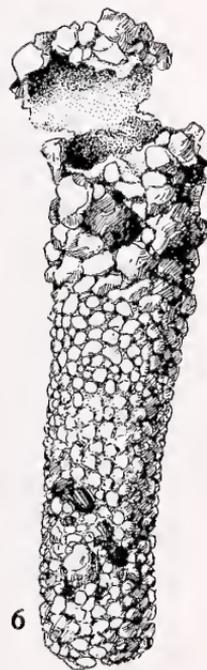
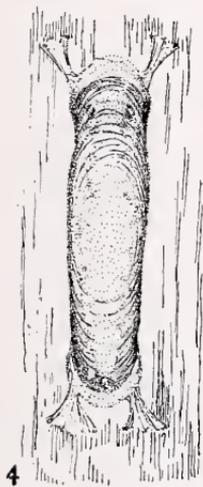
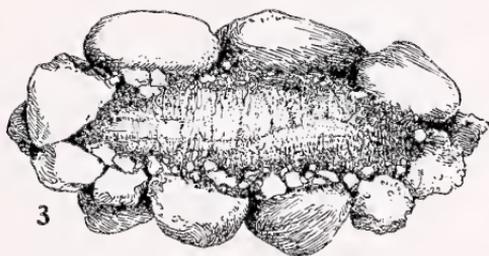
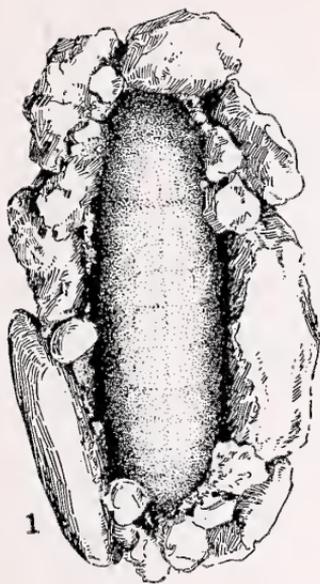
## PLATE 67

*Helicopsyche borealis* Hagen (cont.)

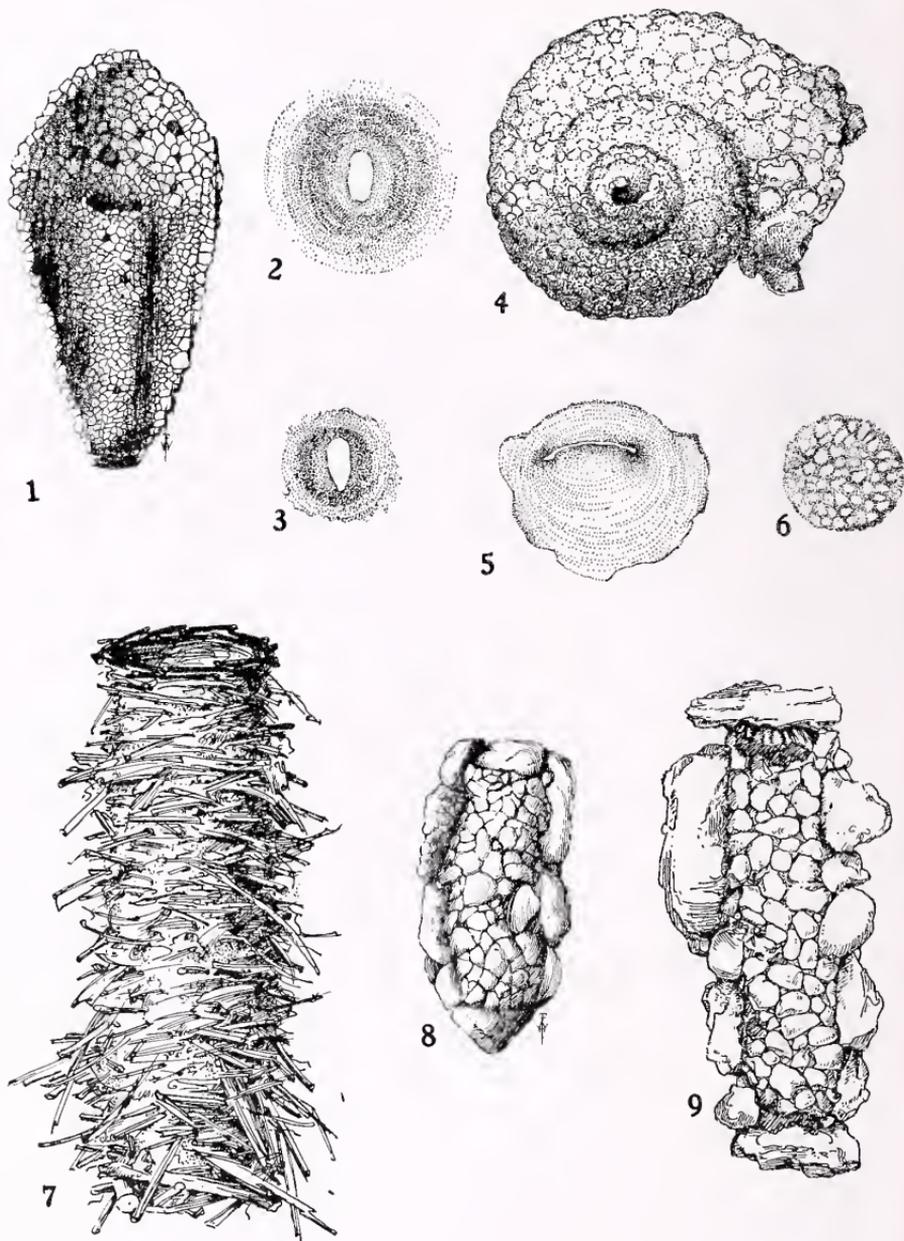
- 1 Pronotum and first leg of the larva
- 2 Proleg of the larva
- 3 Pupal mandible
- 4 Pupal labrum
- 5 Rear end of pupal abdomen (dorsal view)

## Undescribed species of an undescribed Sericostomatid genus

- 6 Wings
- 7 Base of antenna
- 8 Male maxillary palpus
- 9 Male labial palpus
- 10 Male genitalia in lateral view
- 11 Male genitalia in ventral view

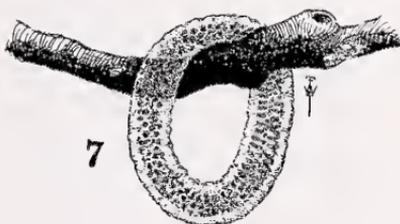
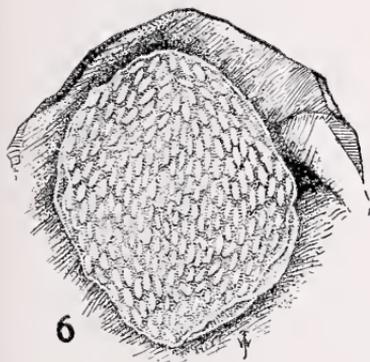


Larva; Pupae; Cases

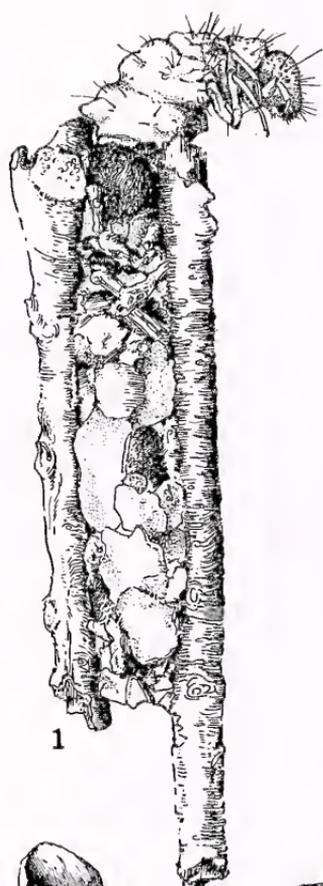


Cases

[502]



Cases and Eggs



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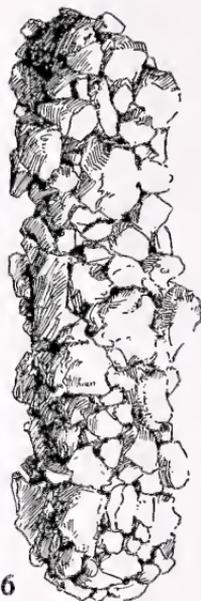
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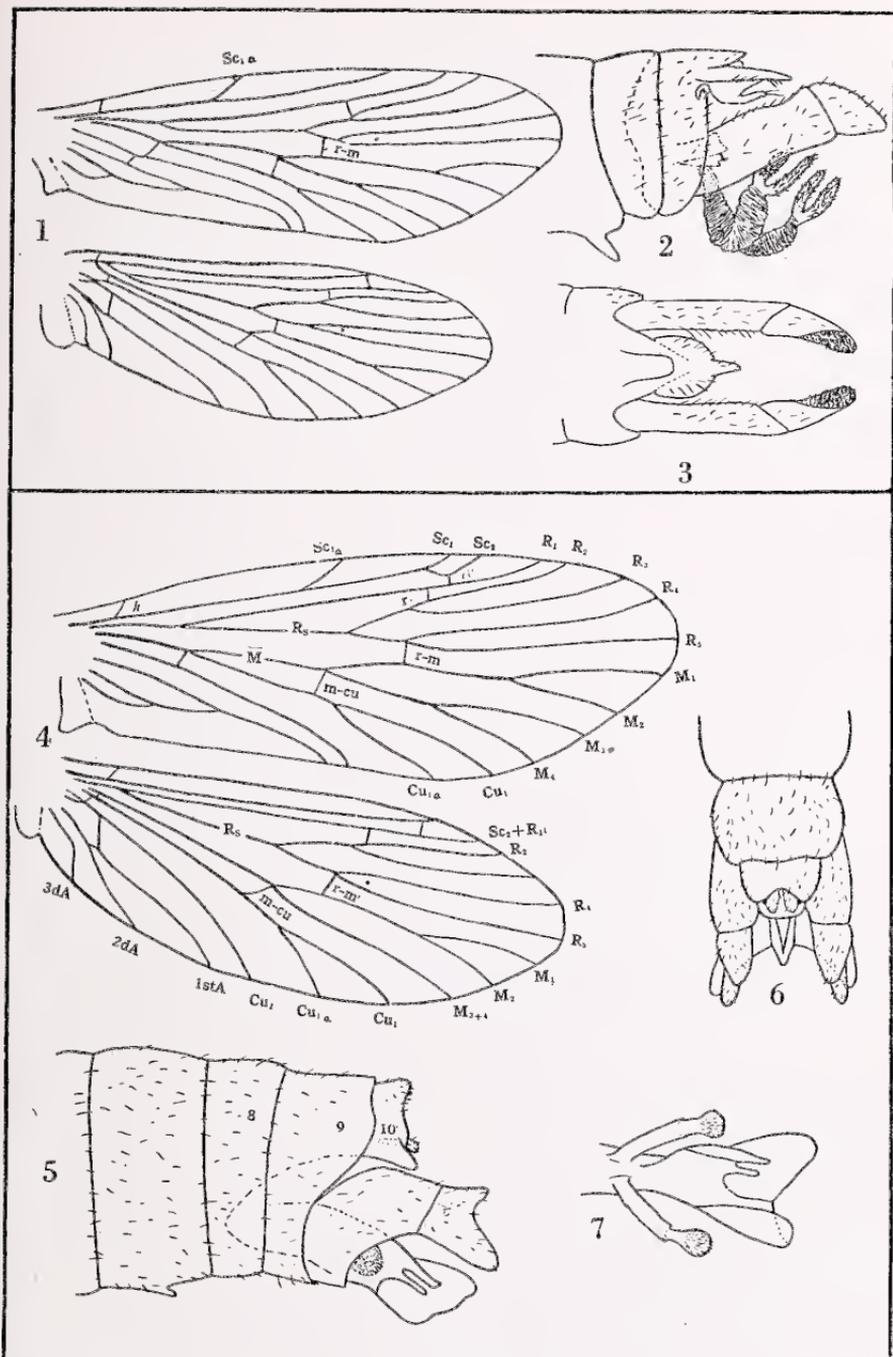
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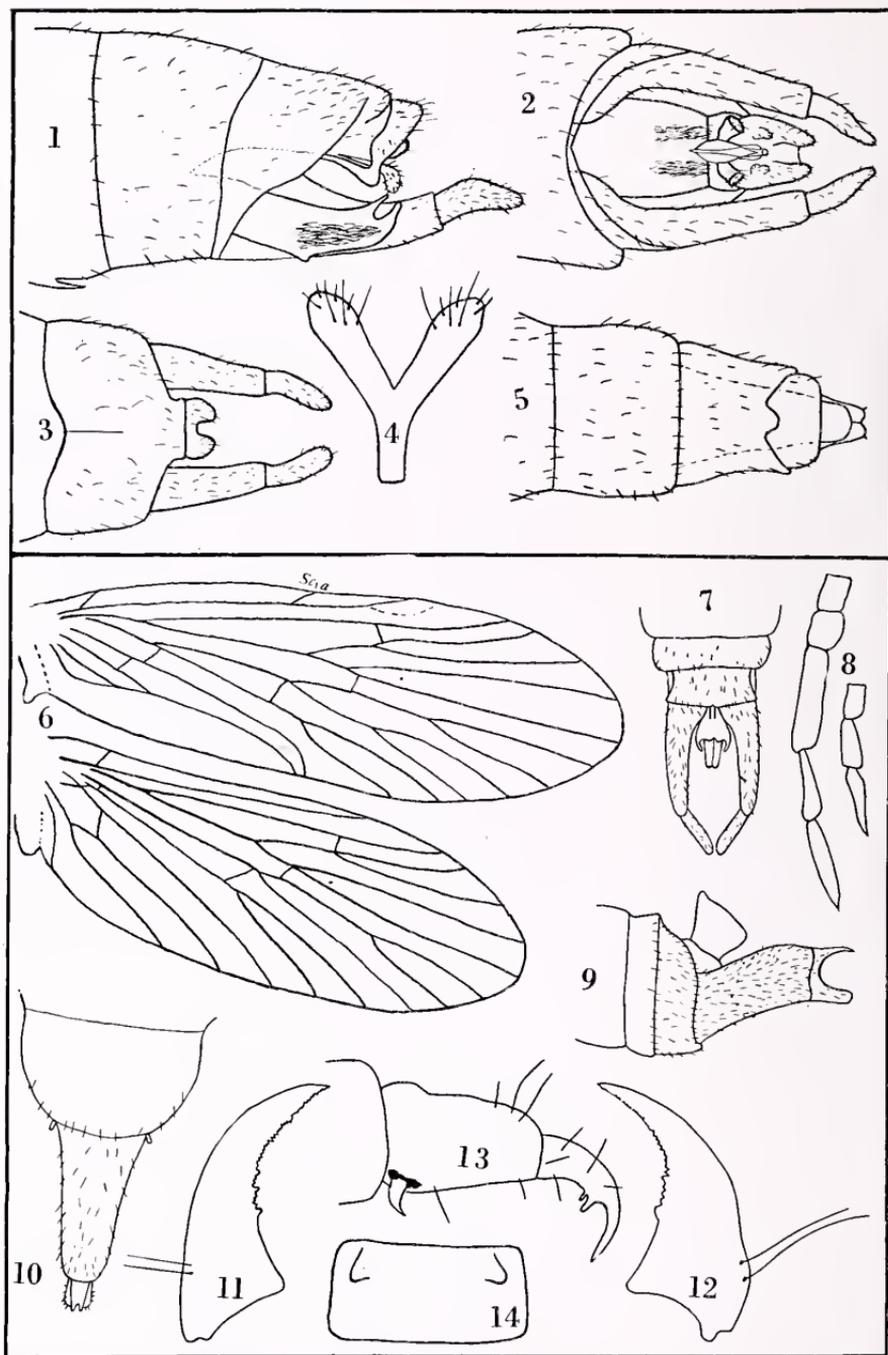
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Cases

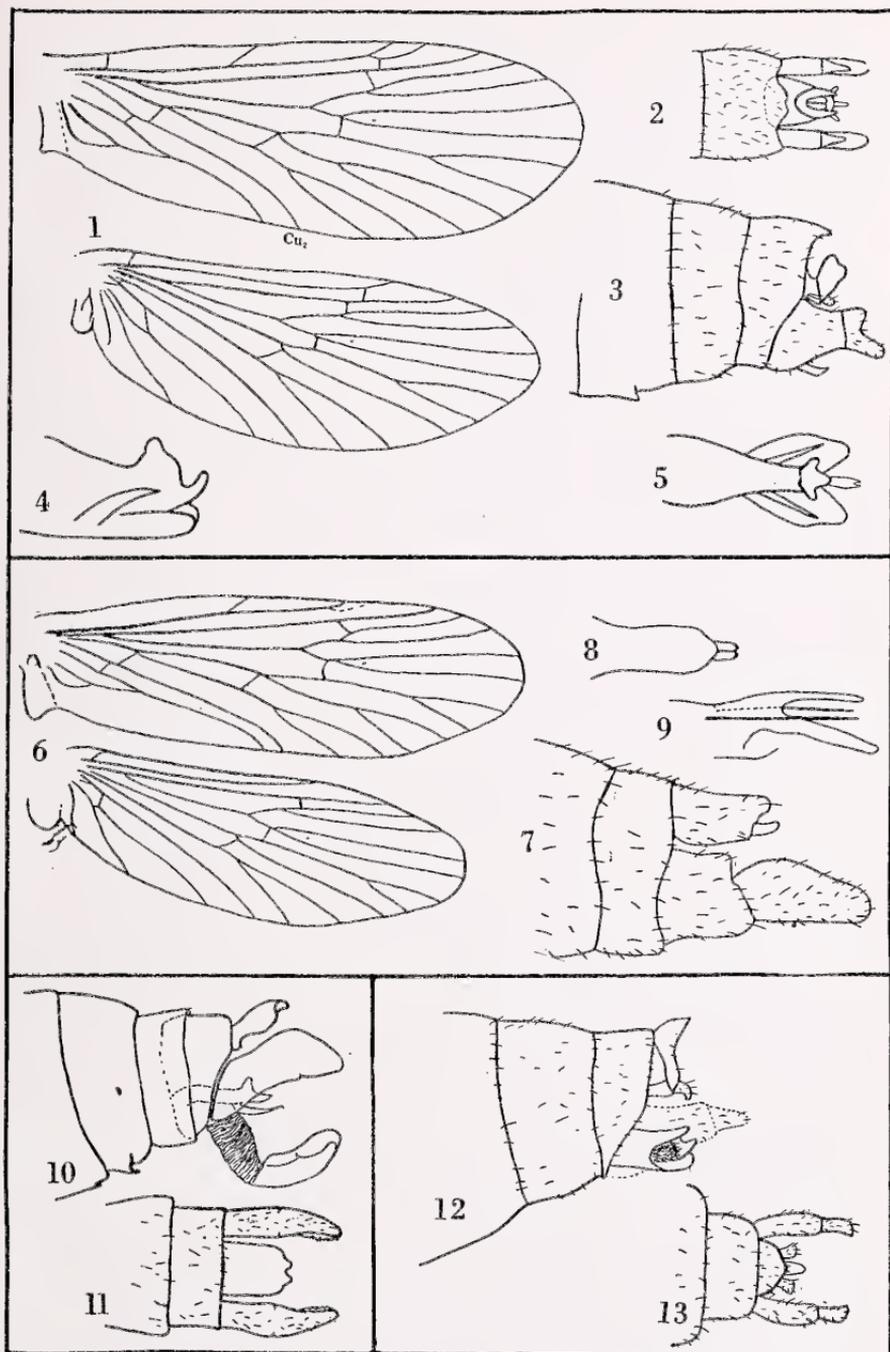
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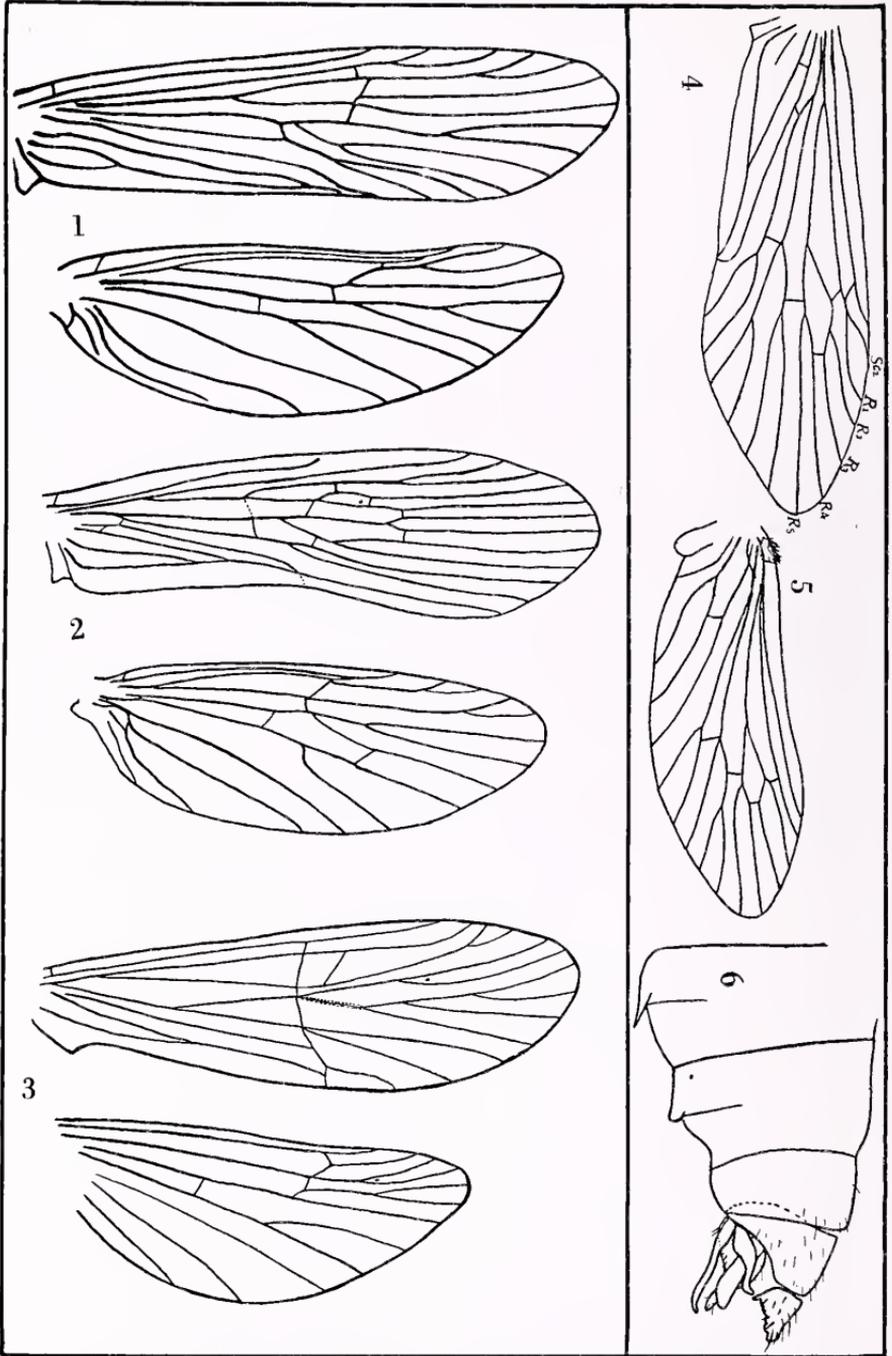
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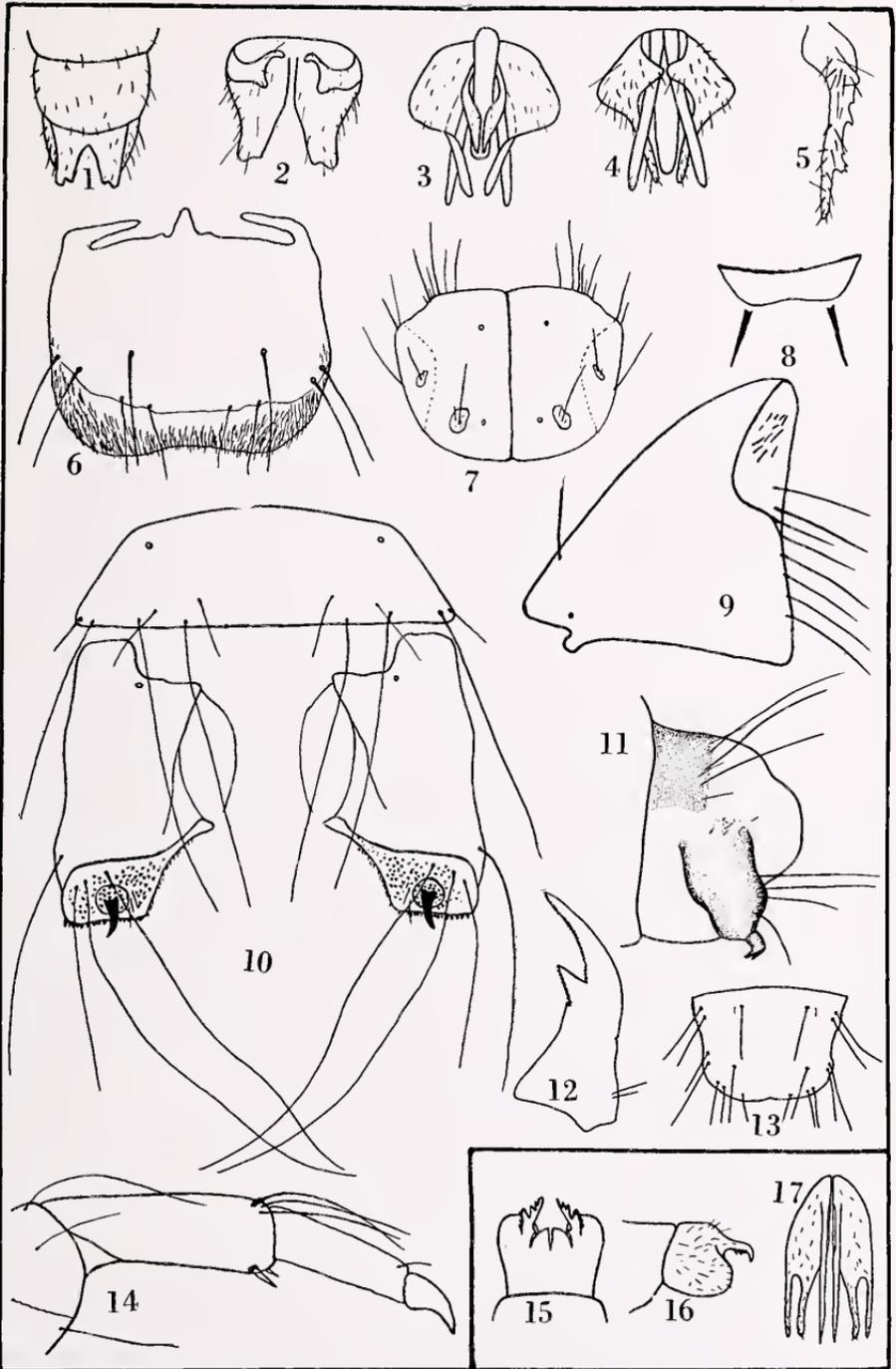
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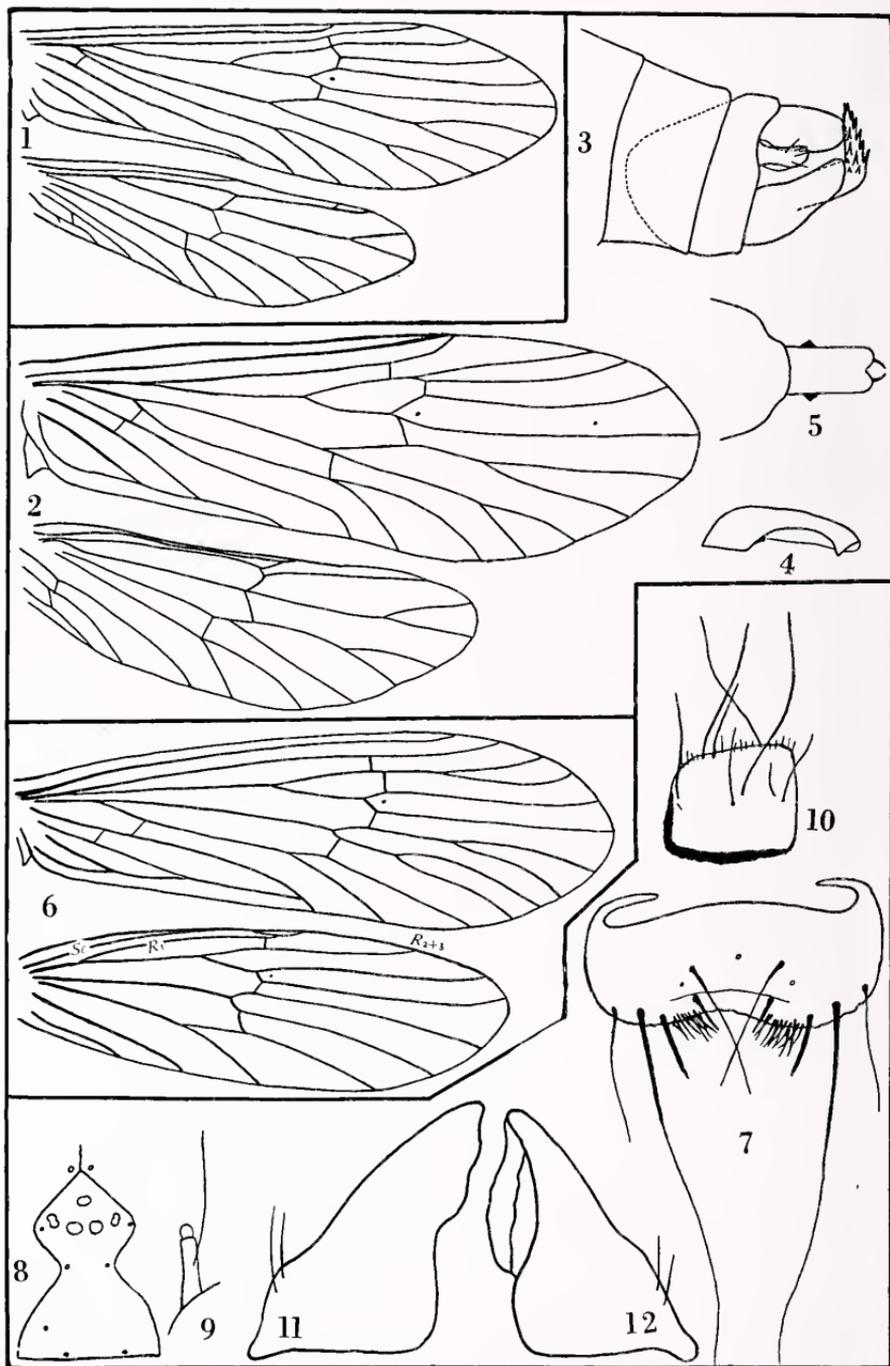
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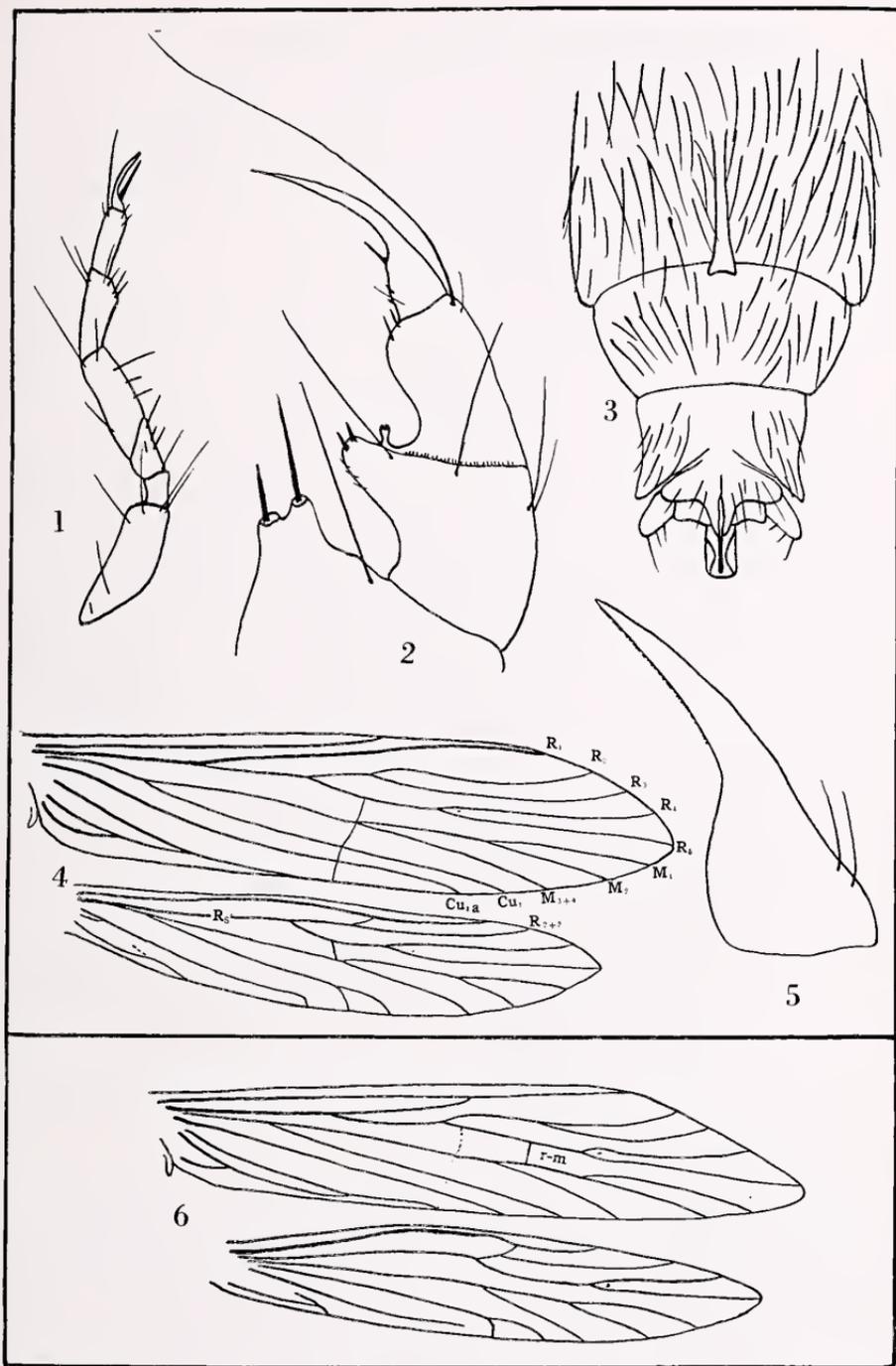
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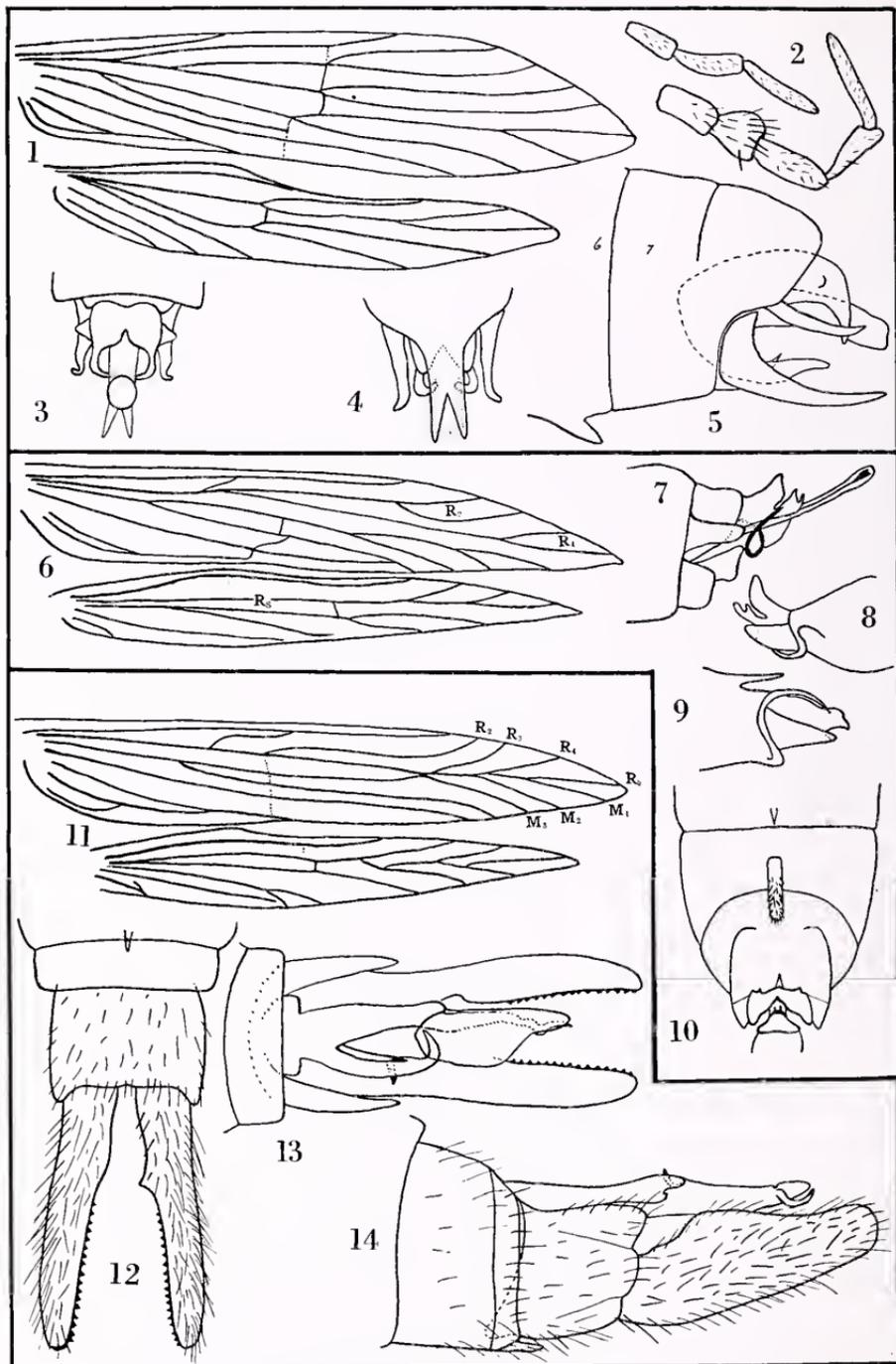
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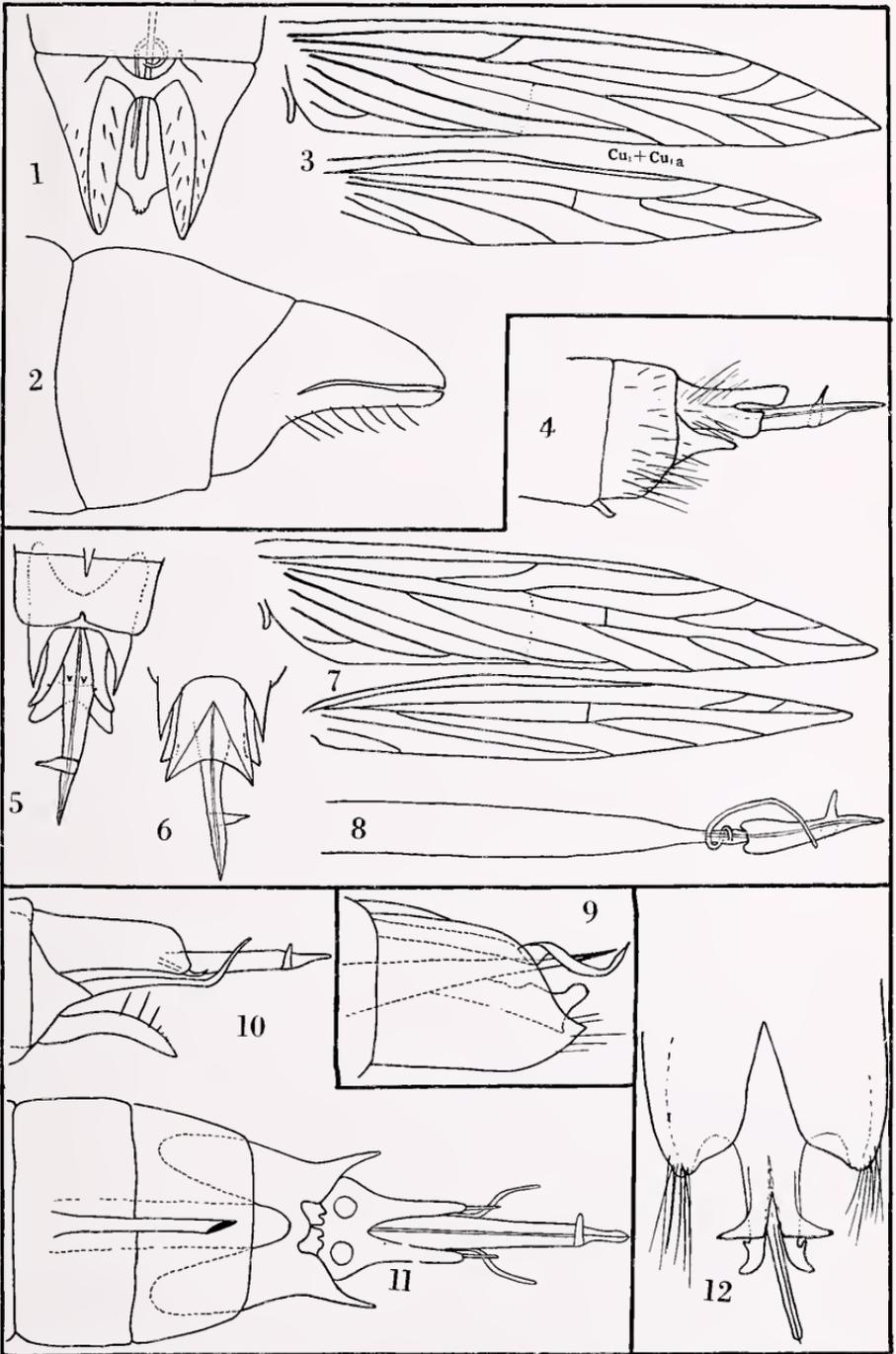
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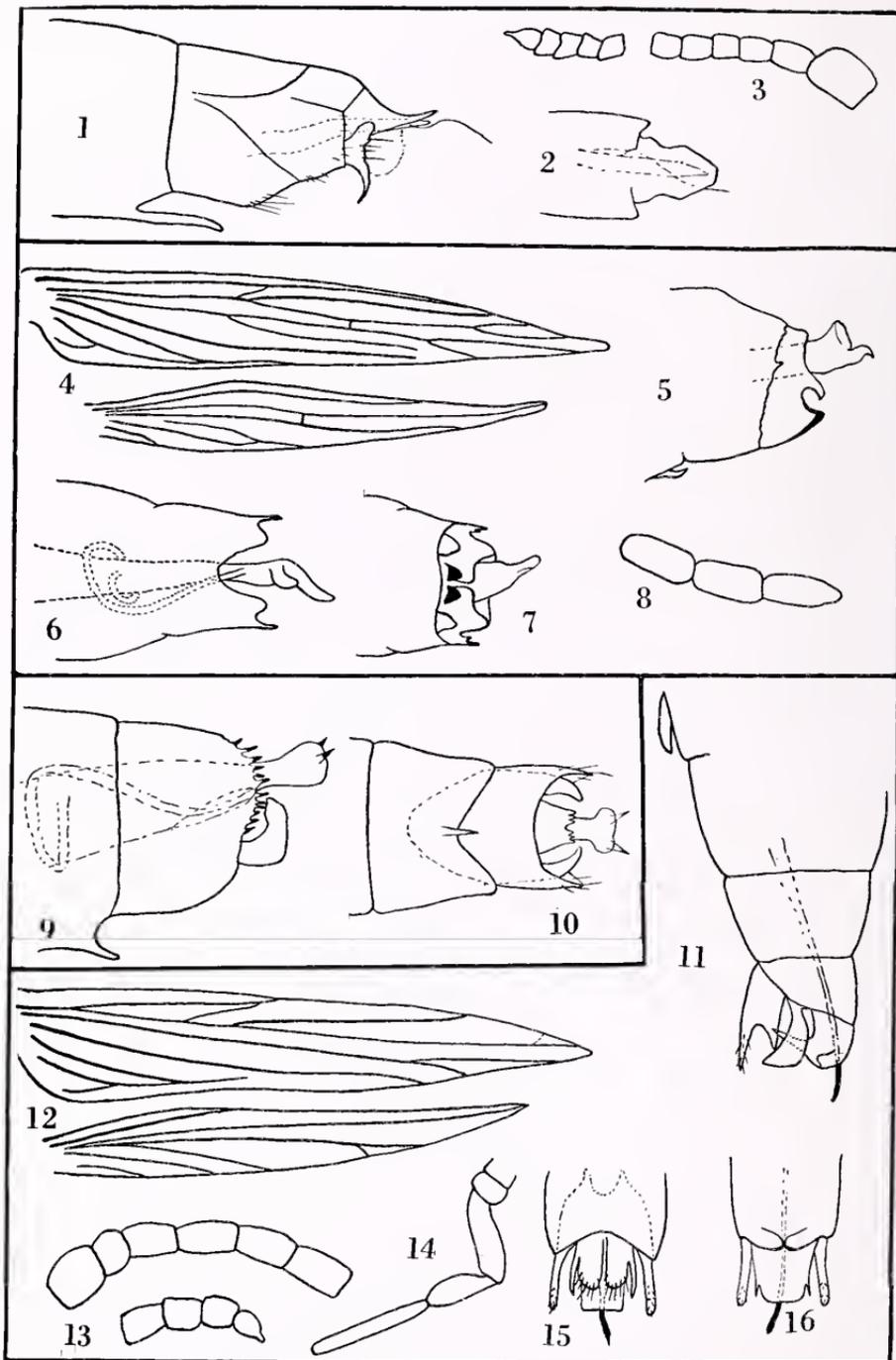
*Agrylea; Allotrichia*



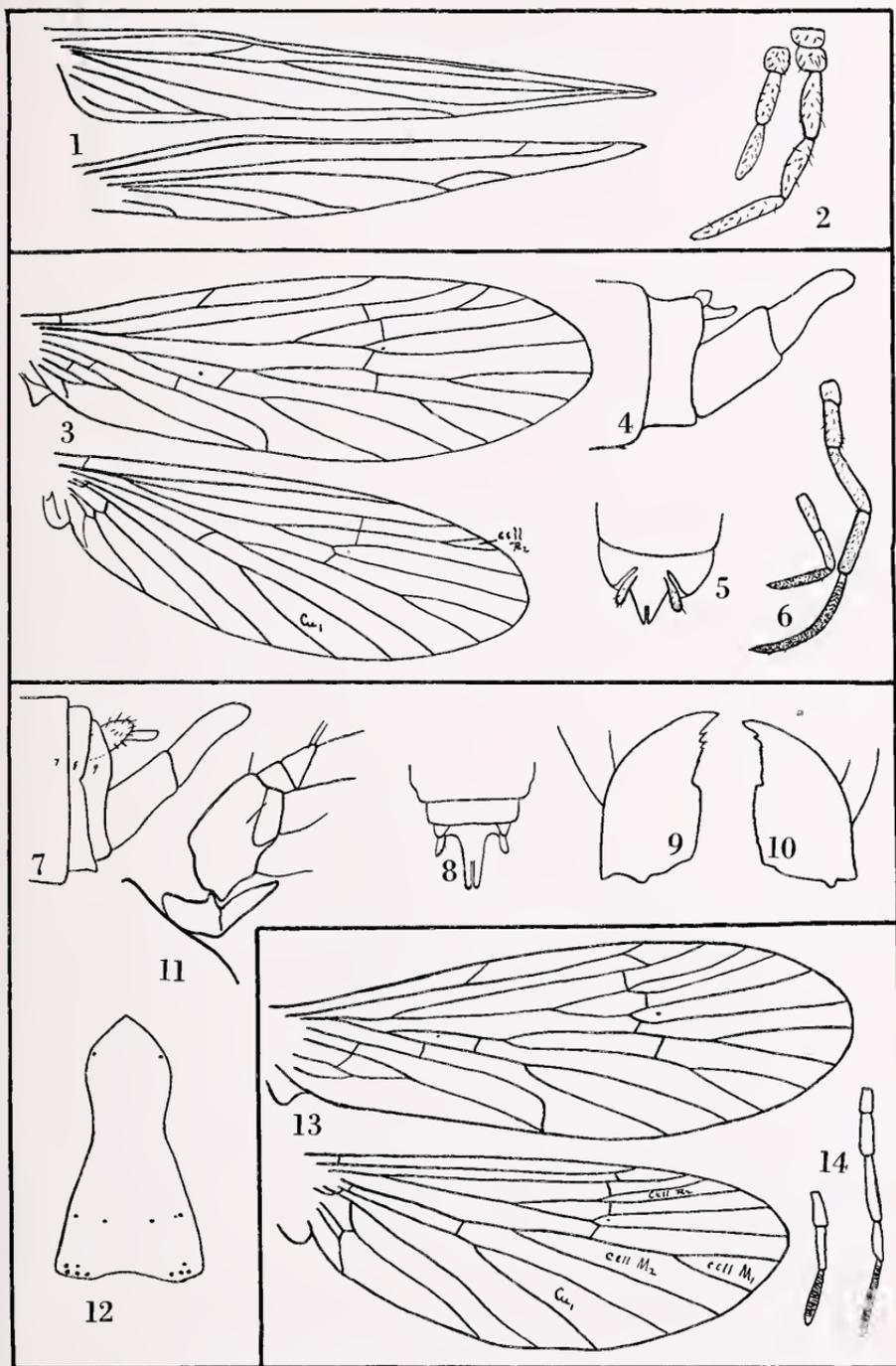
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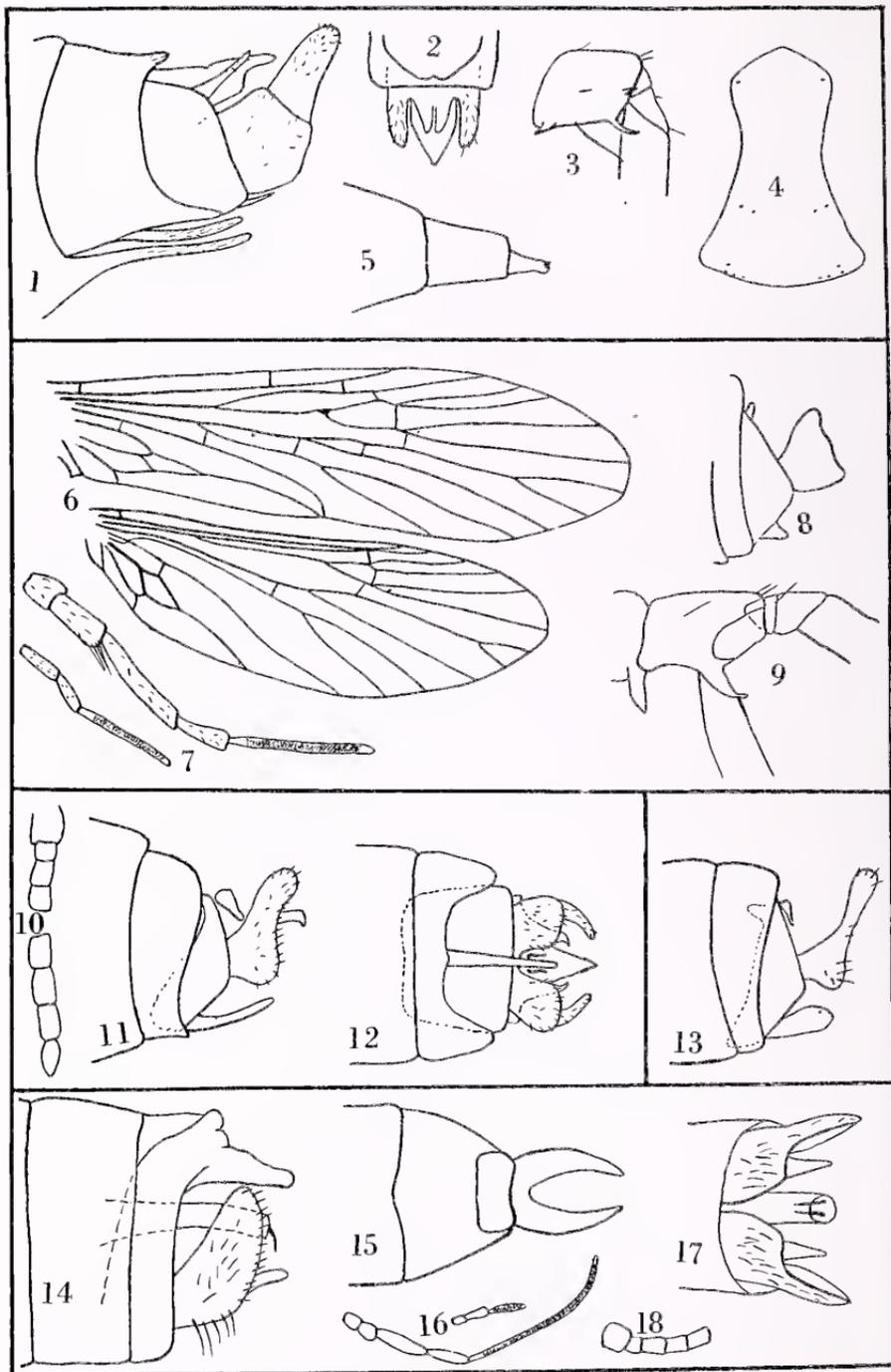
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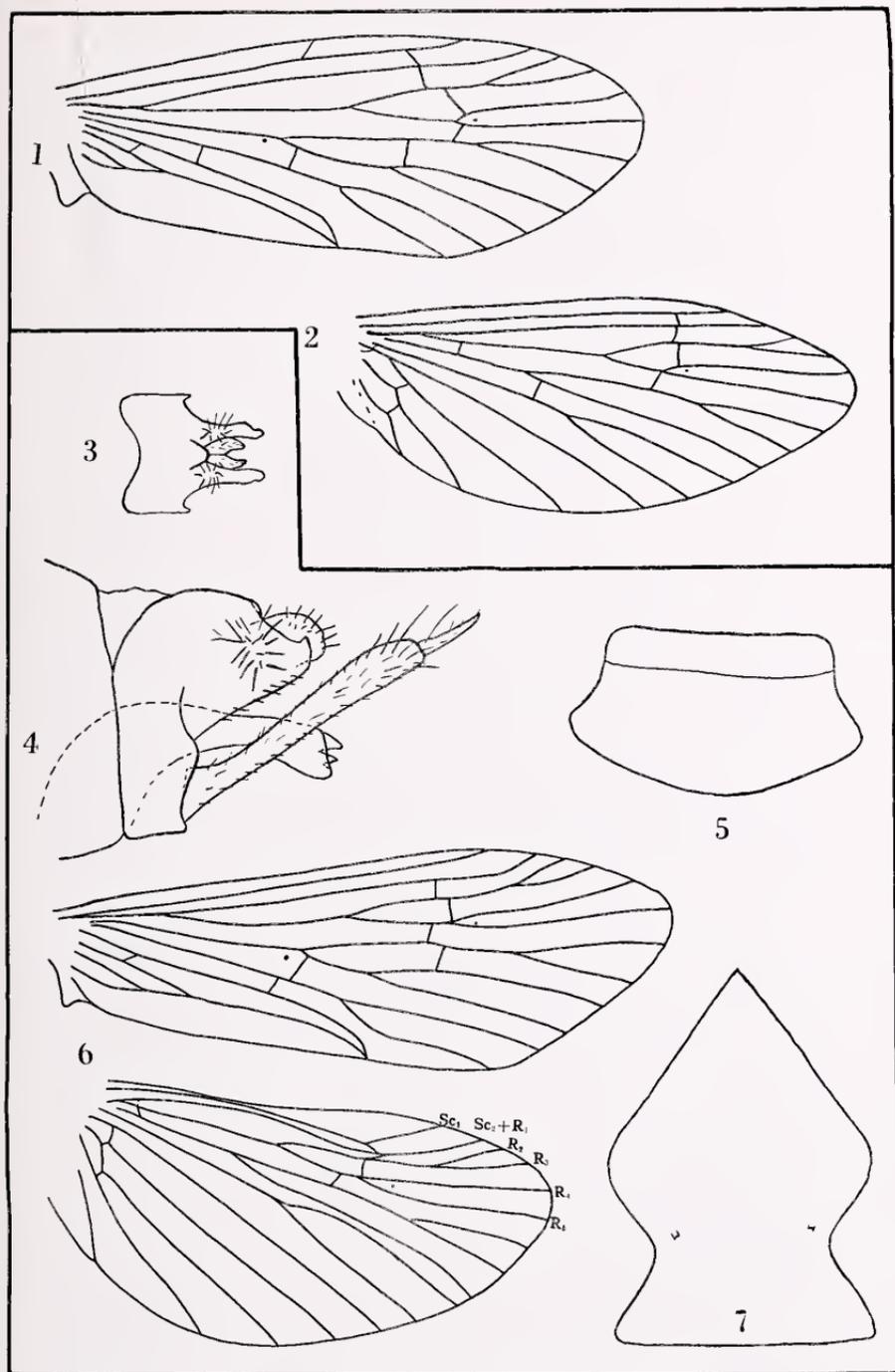
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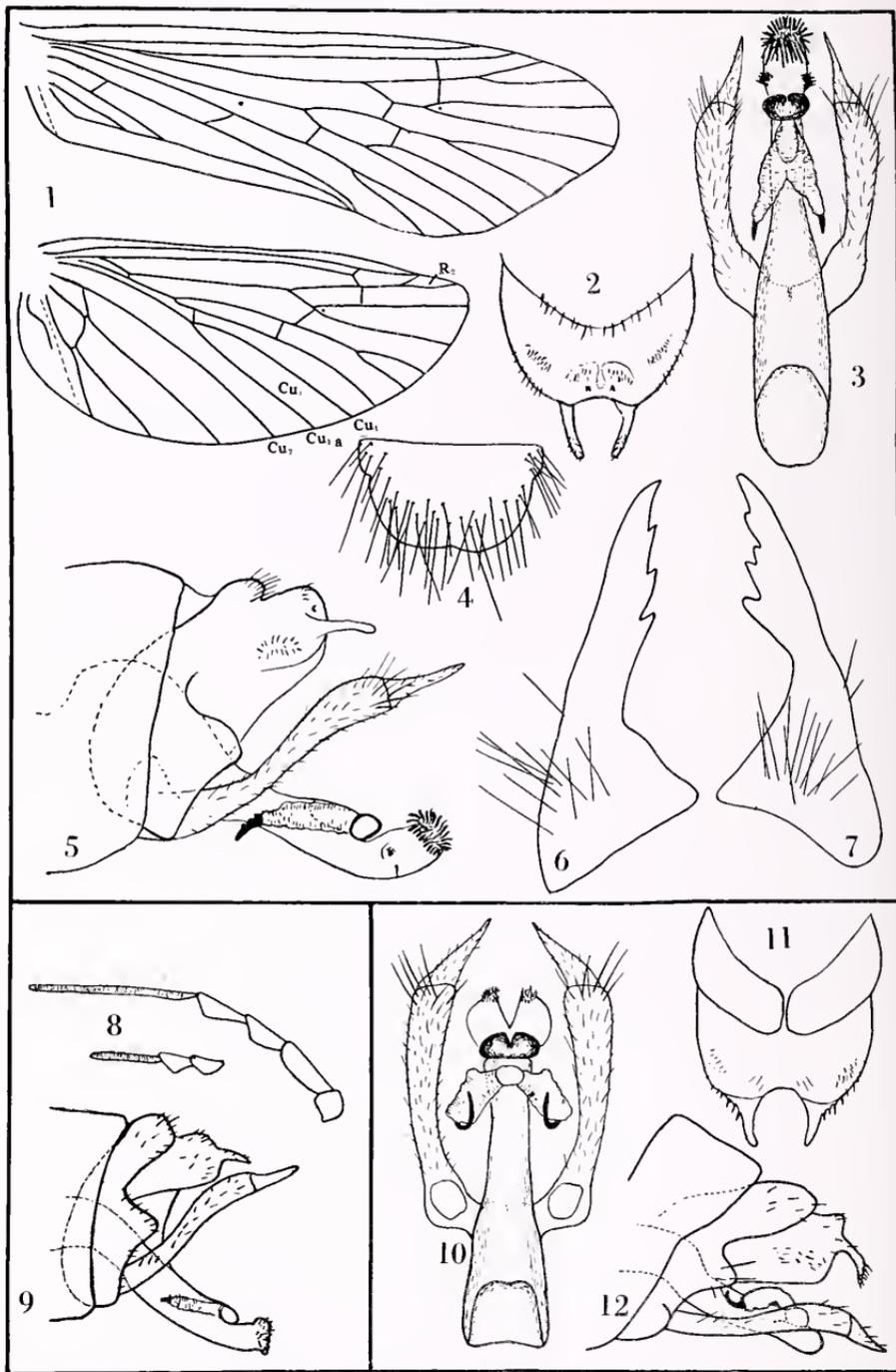
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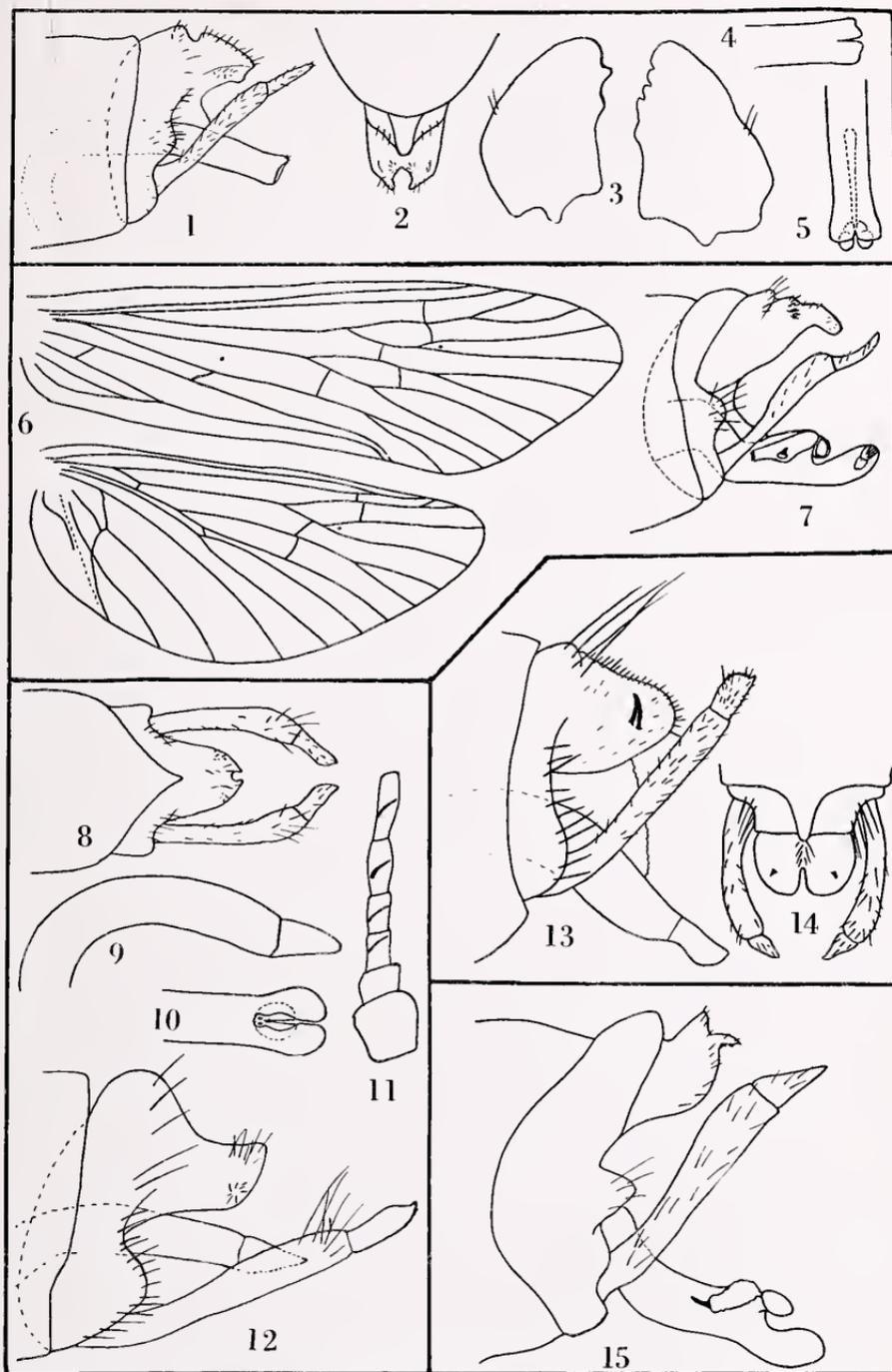
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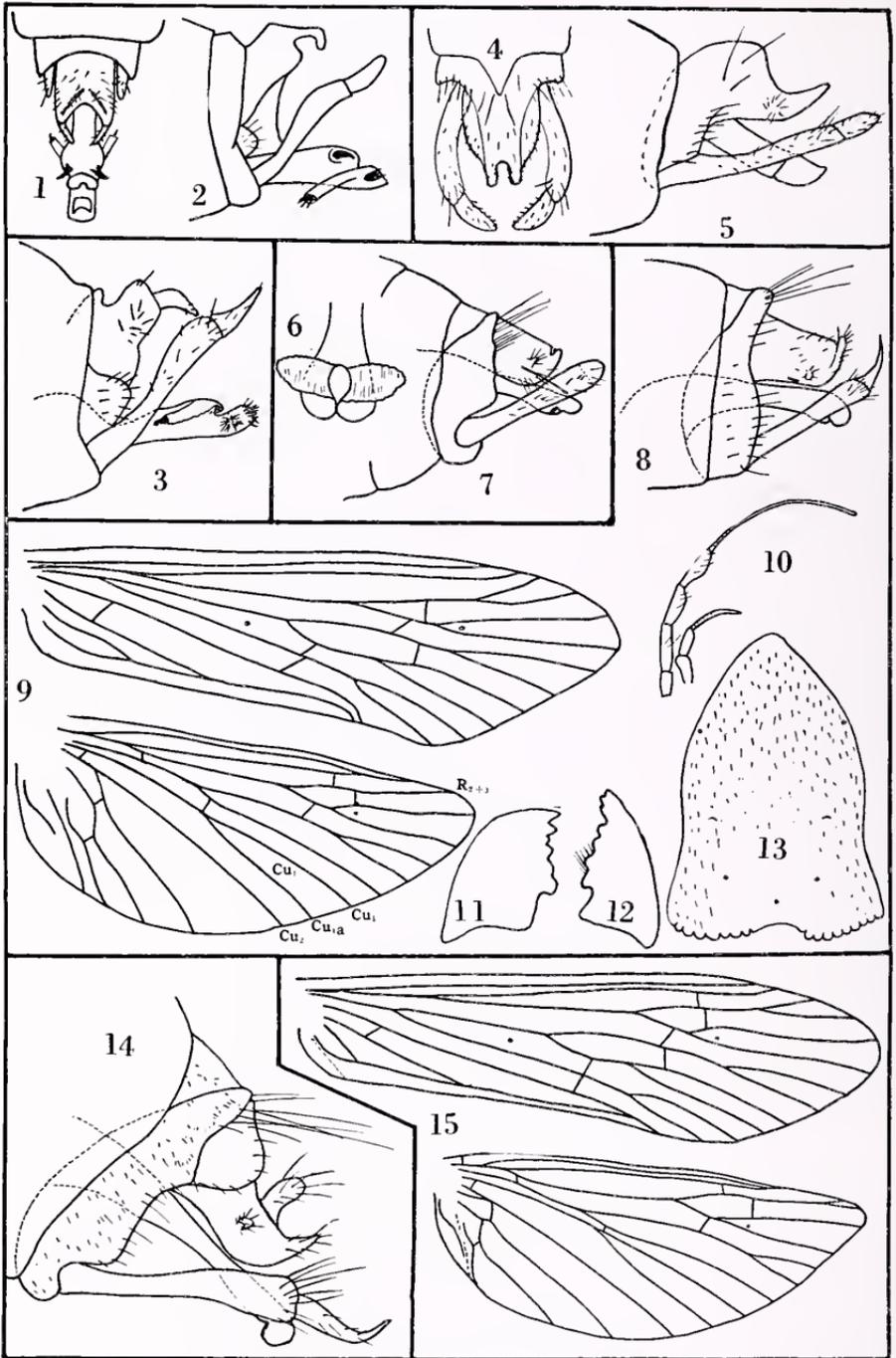
*Parapsyche; Diplectrona*



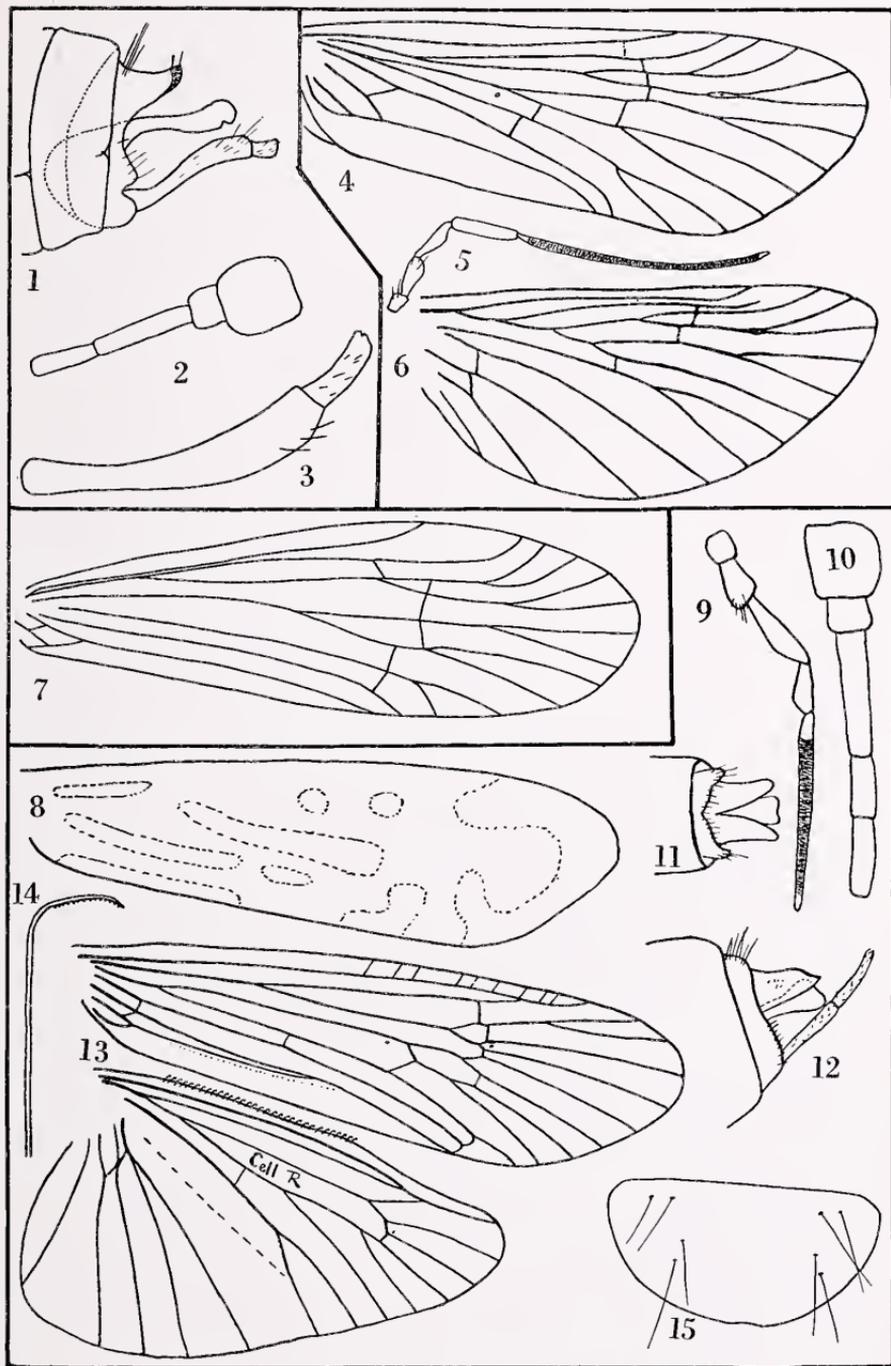
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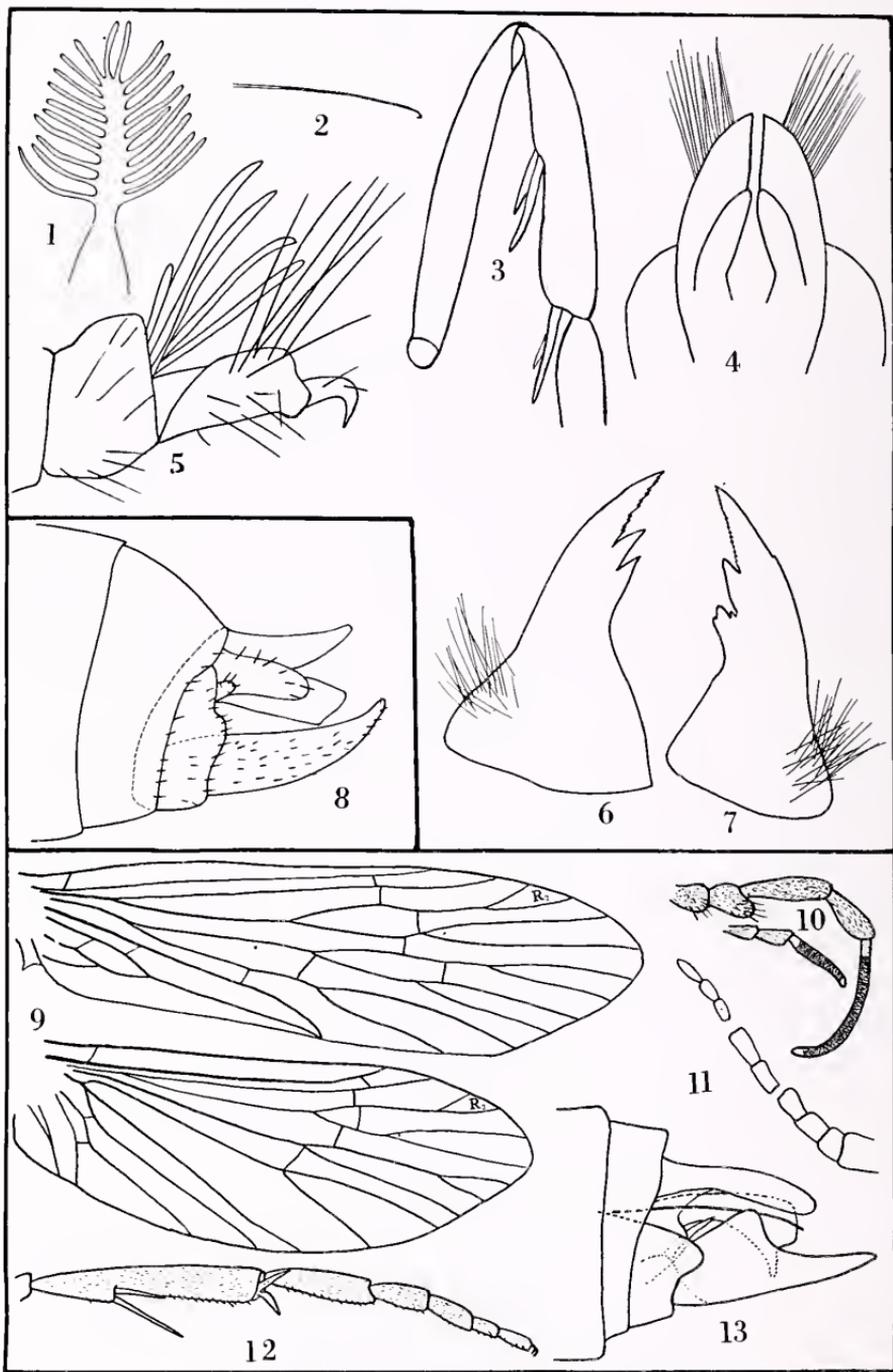
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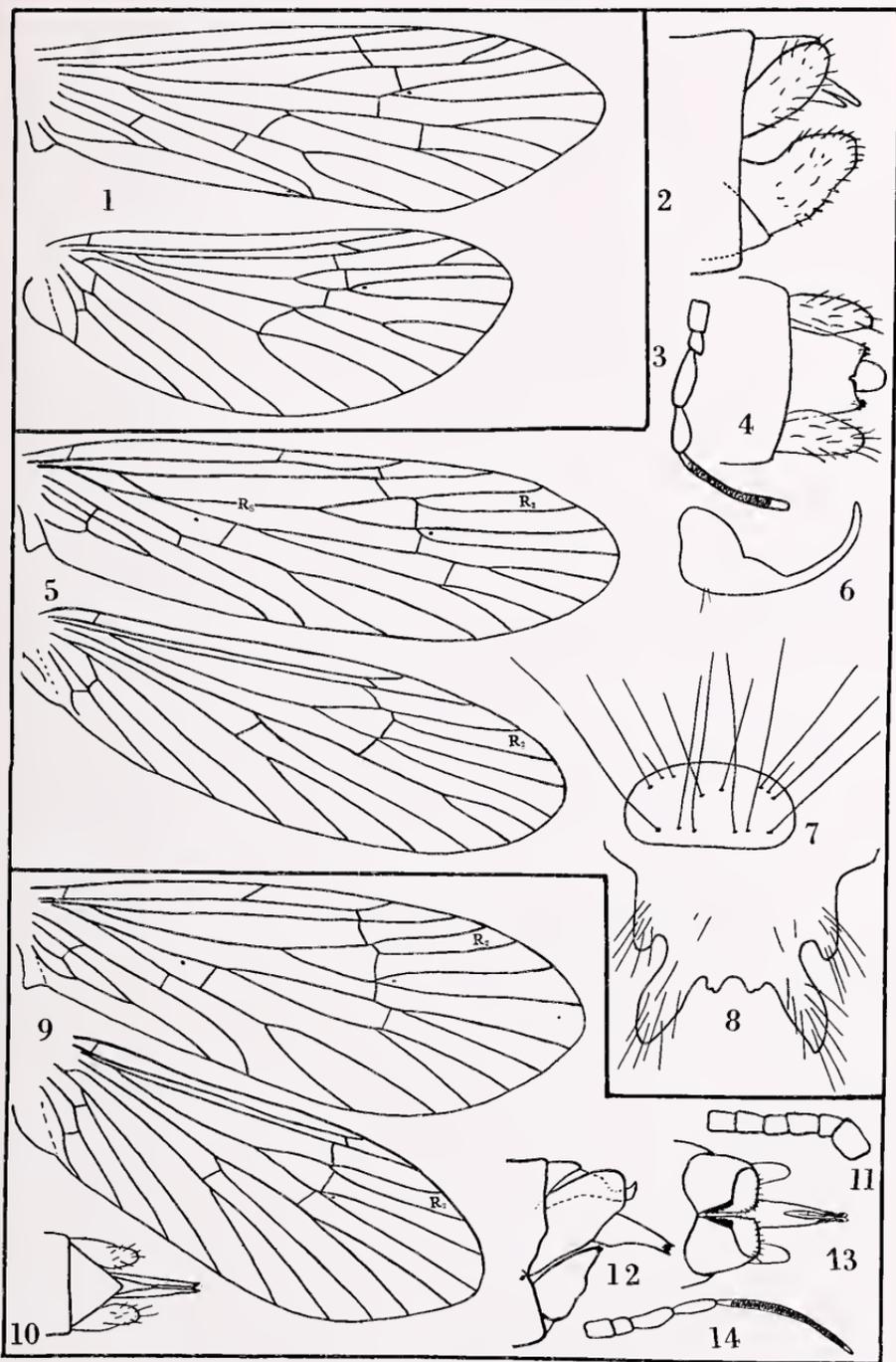
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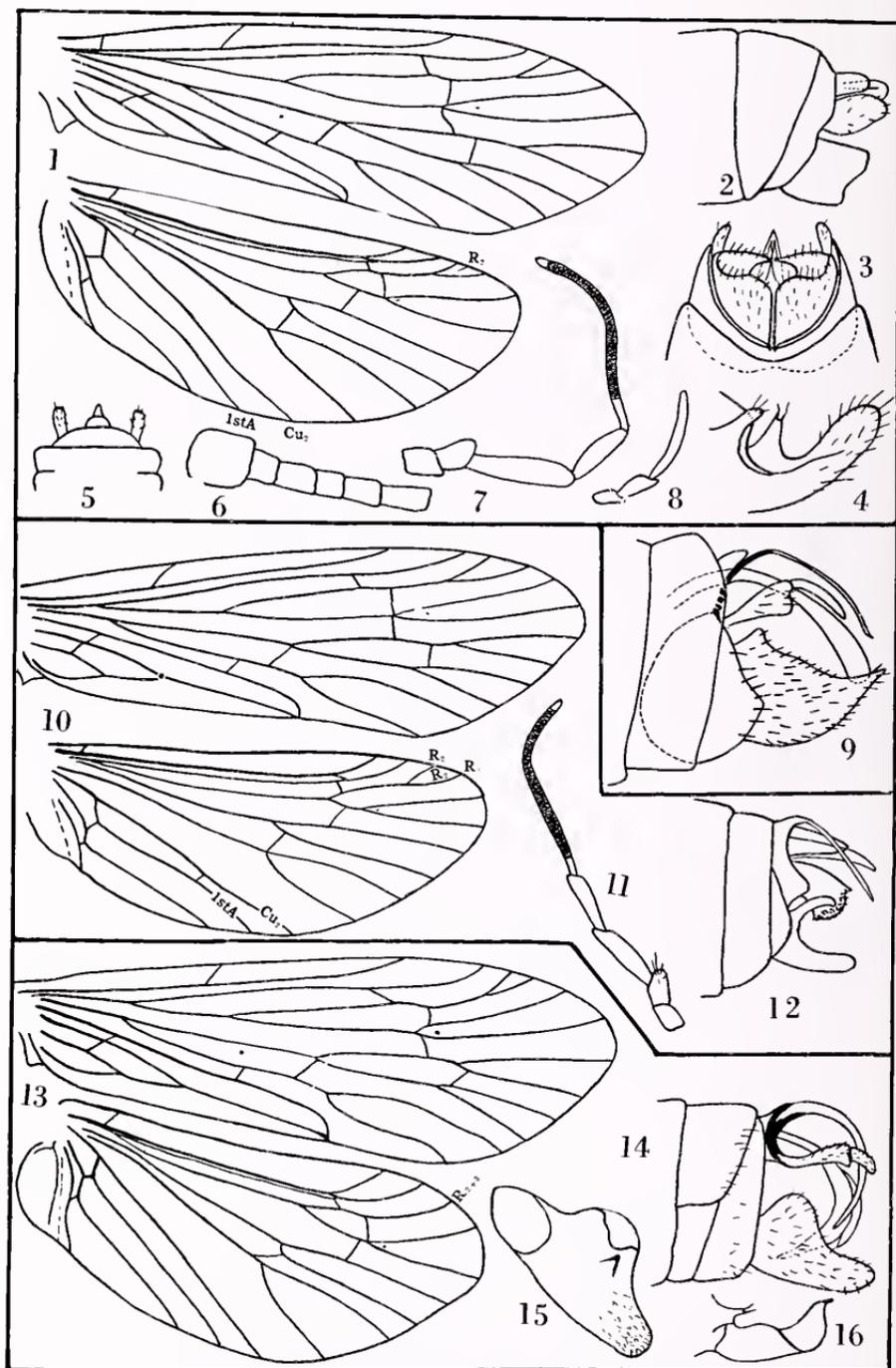
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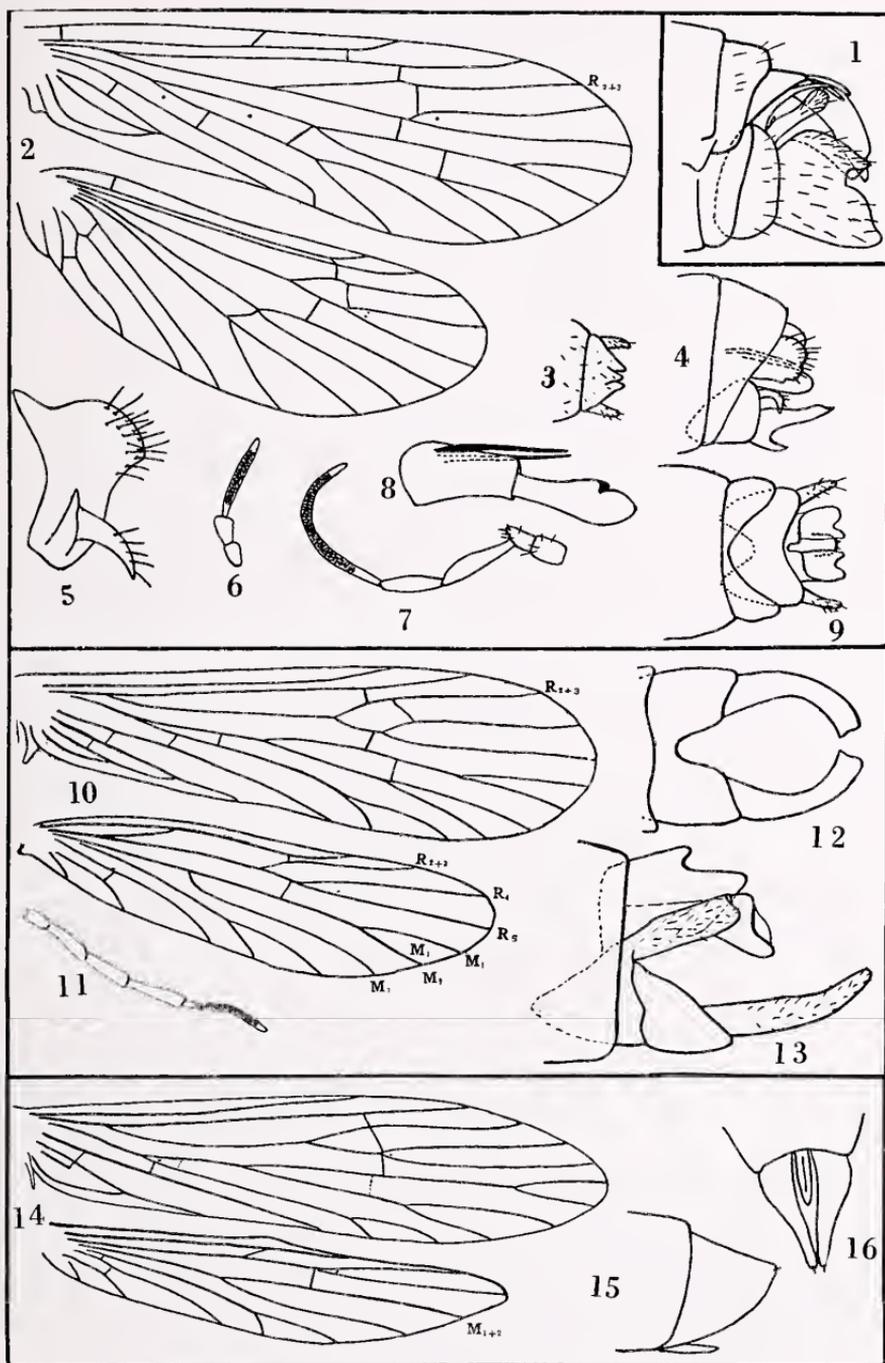
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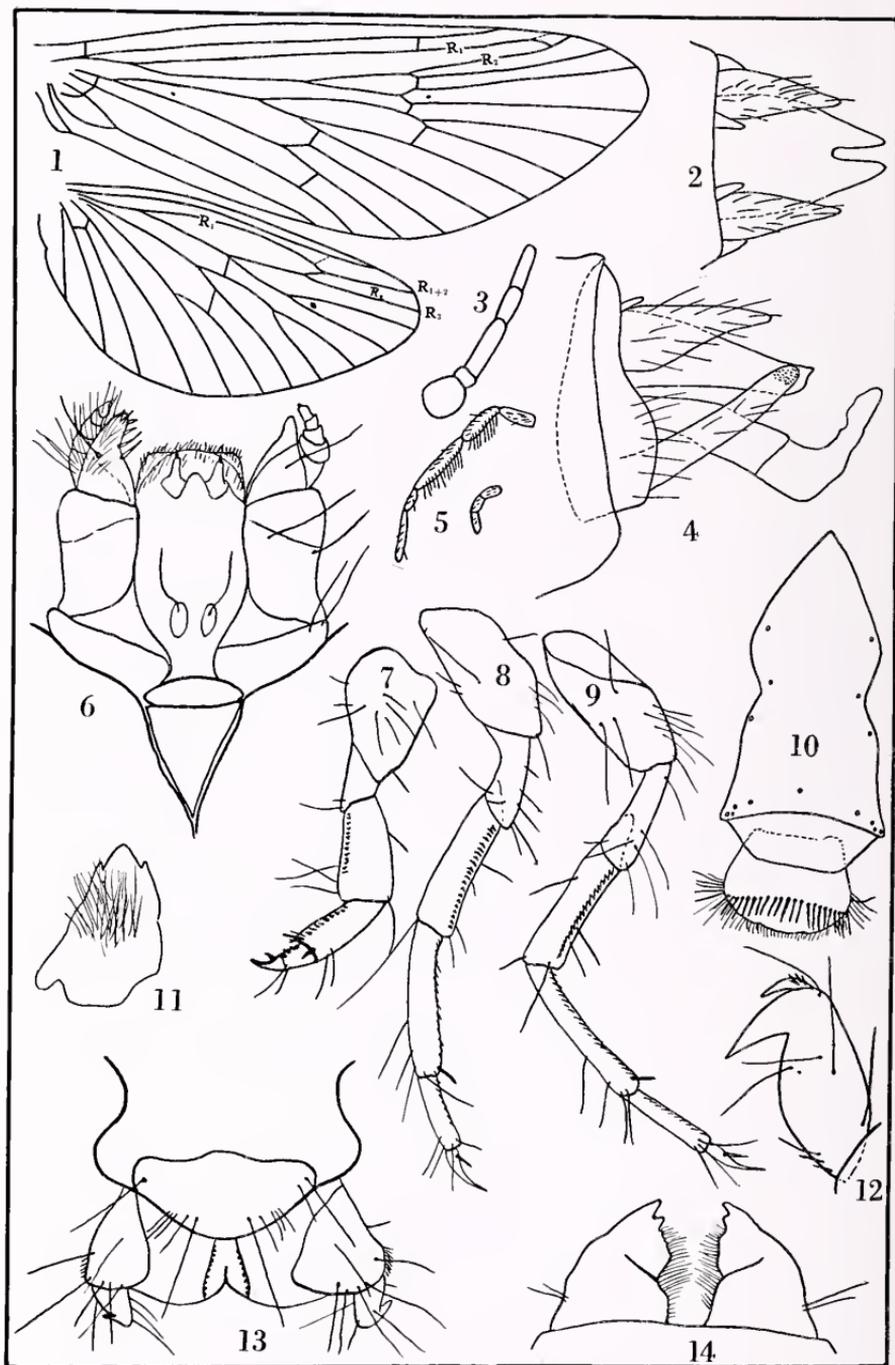
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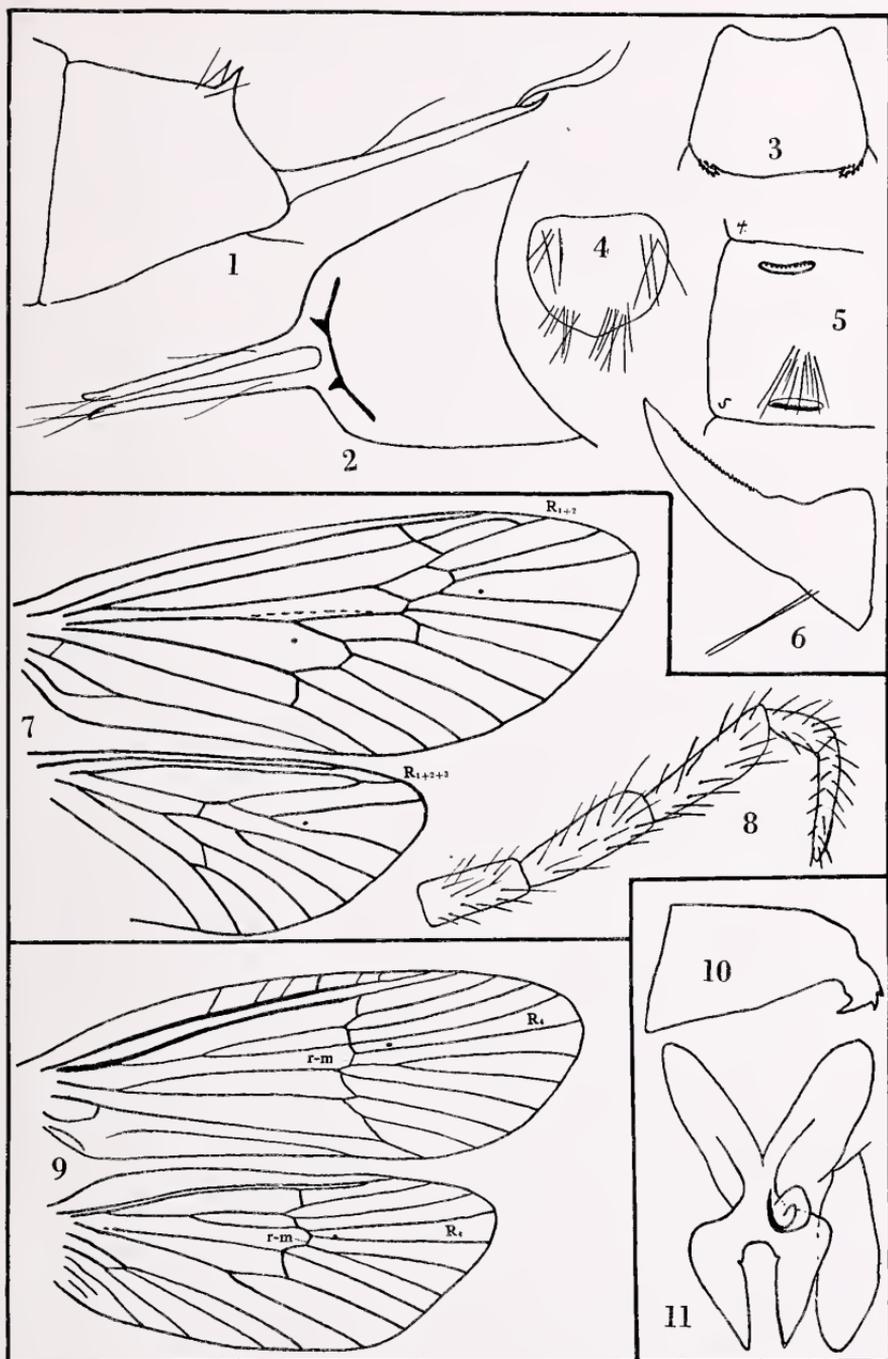
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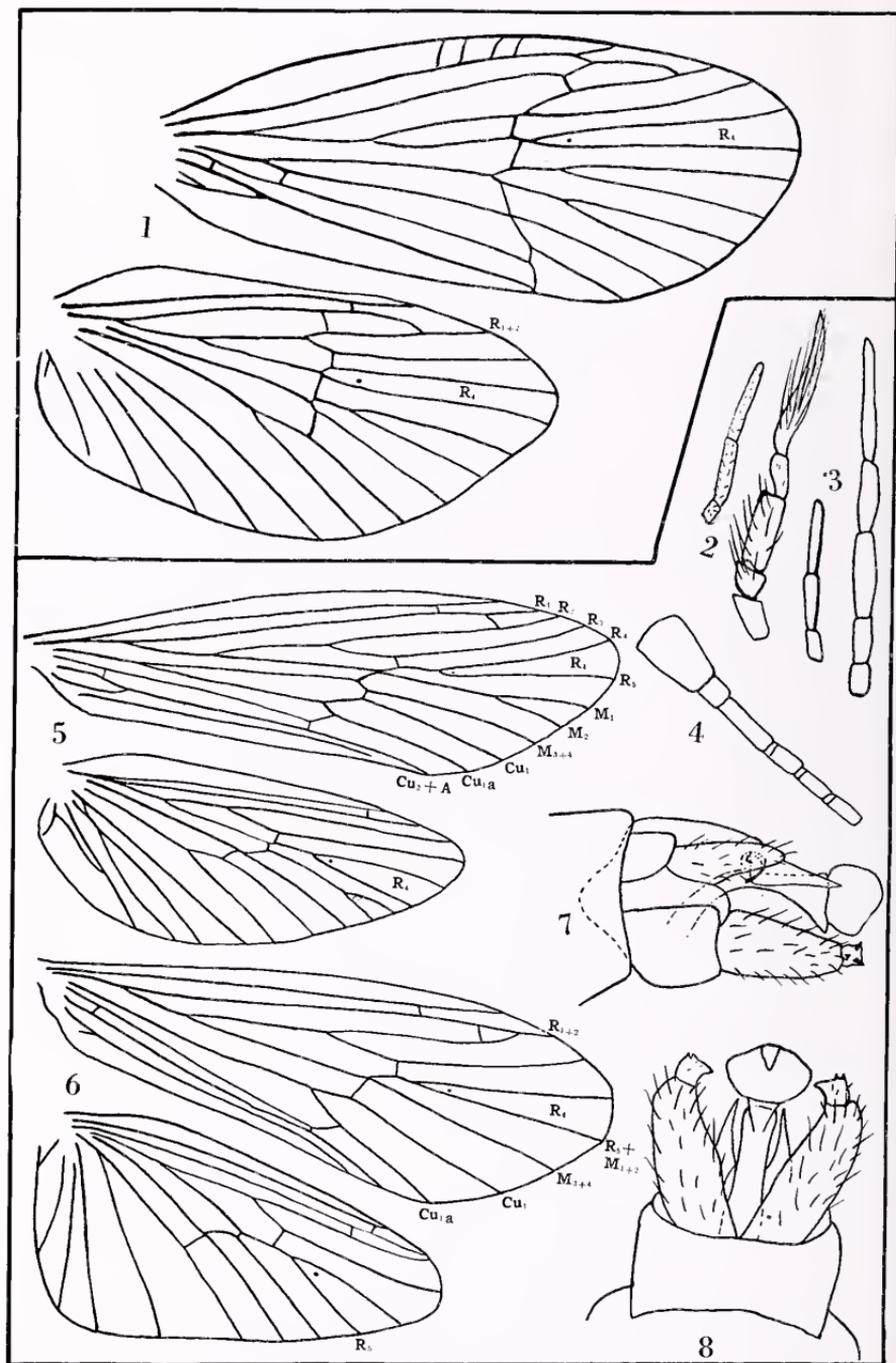
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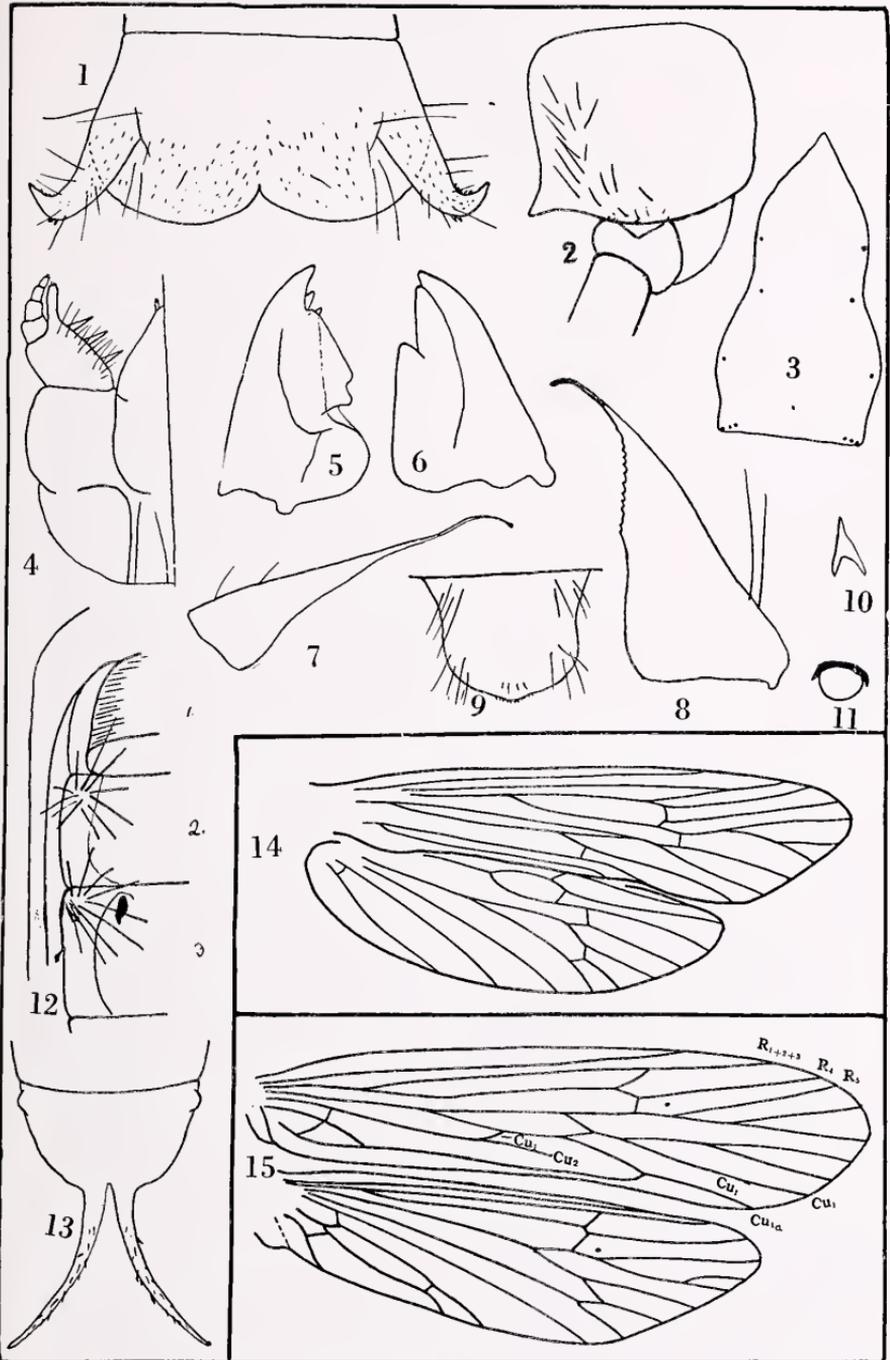
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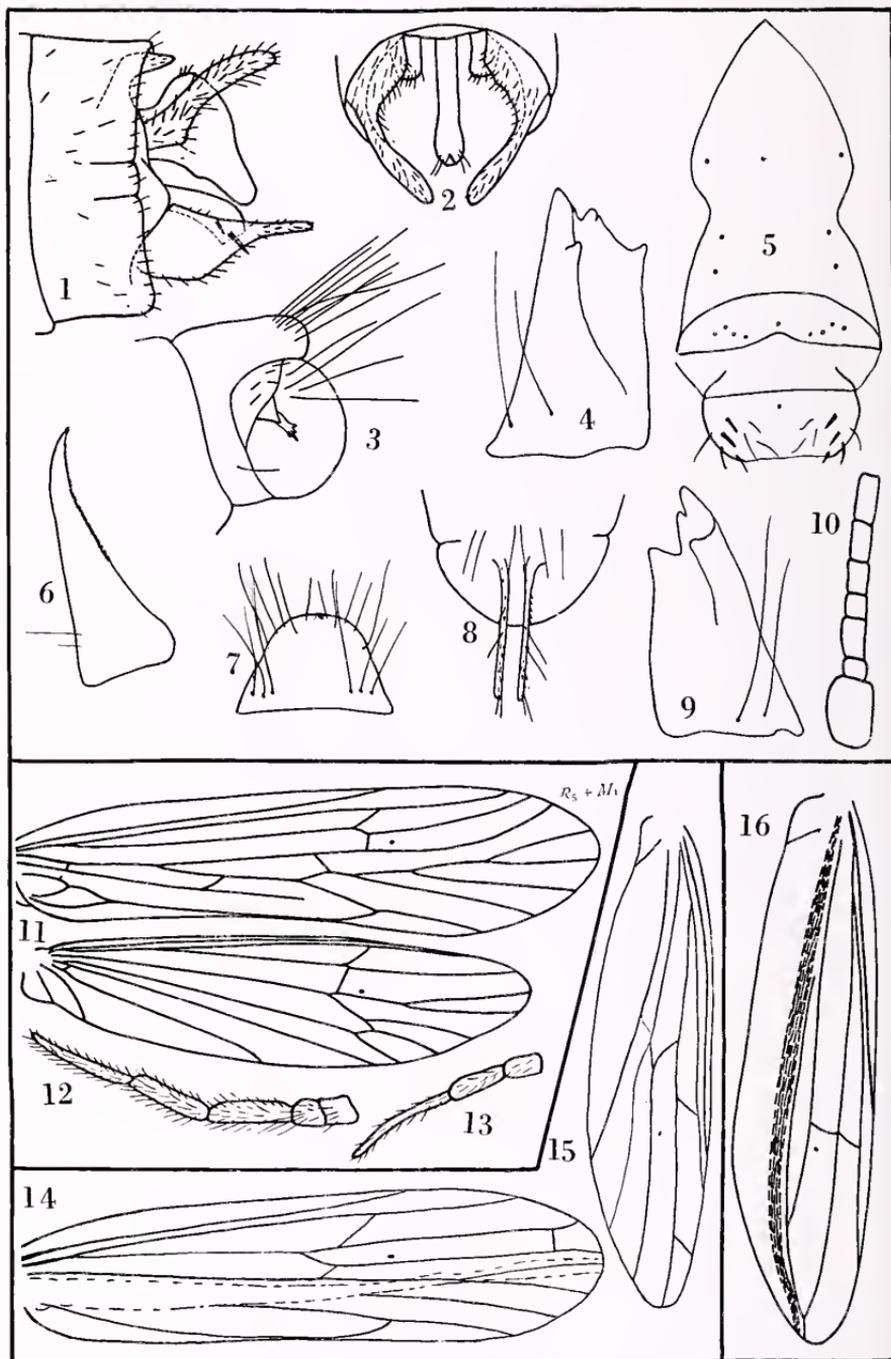
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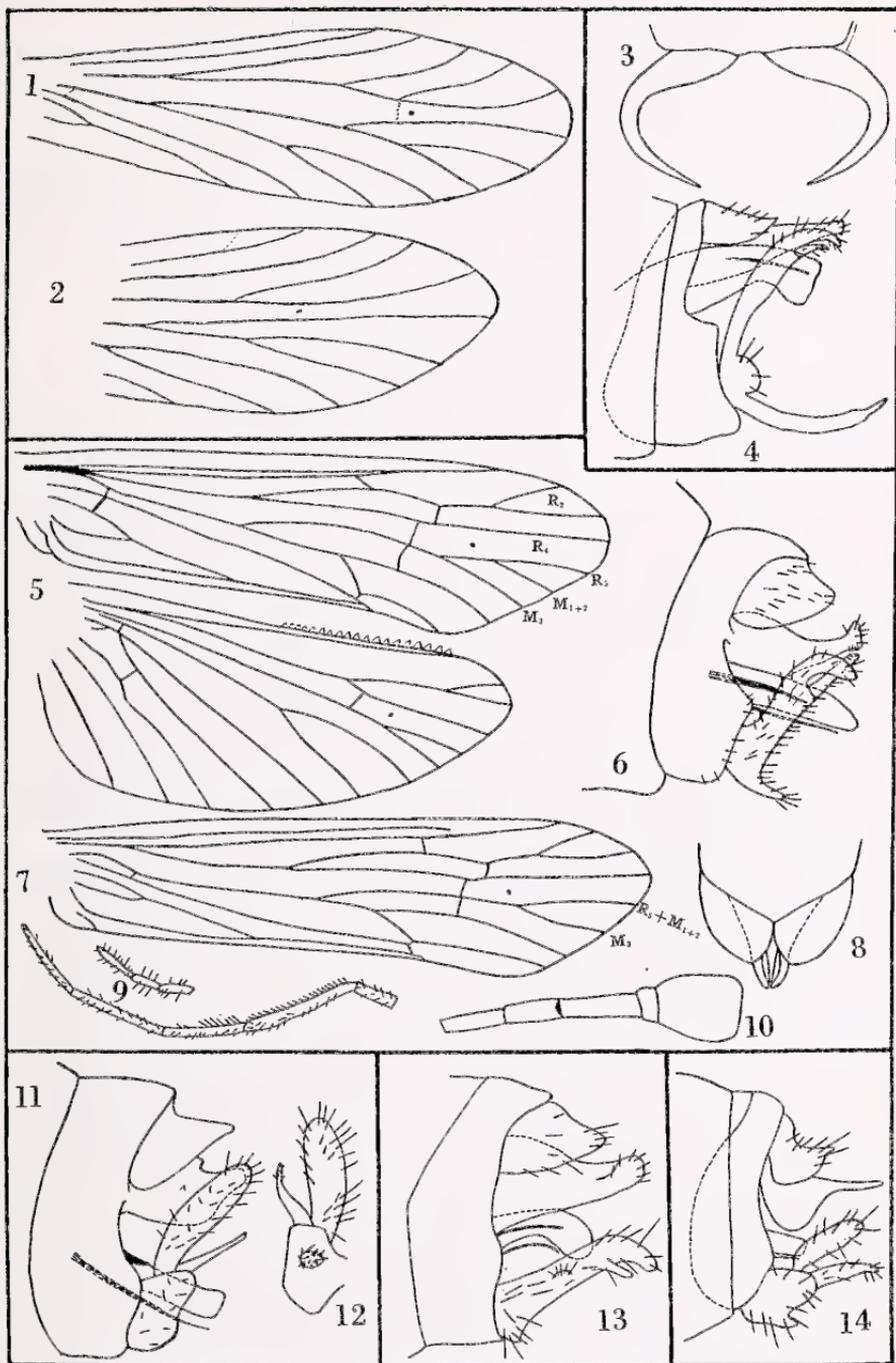
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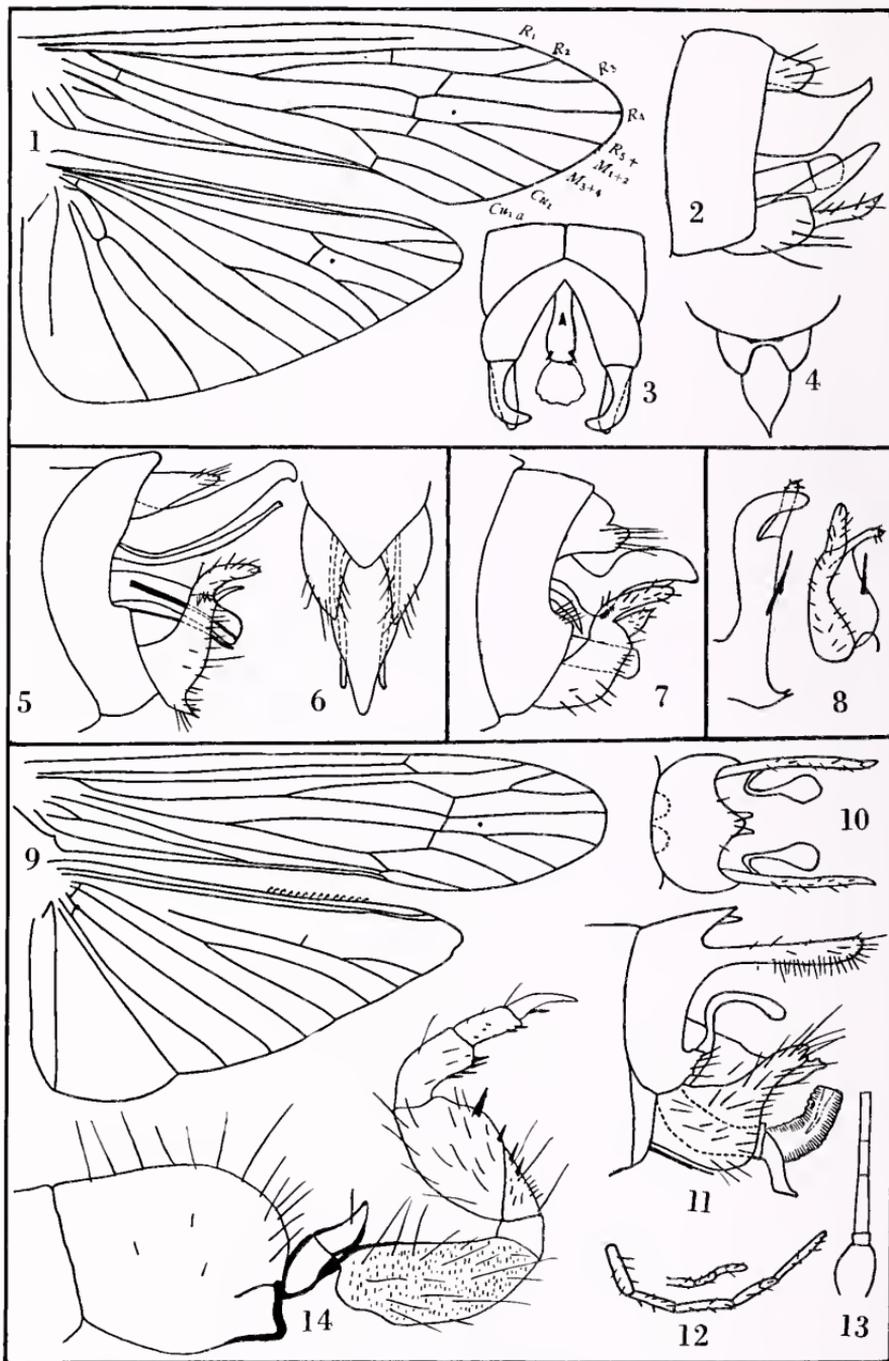
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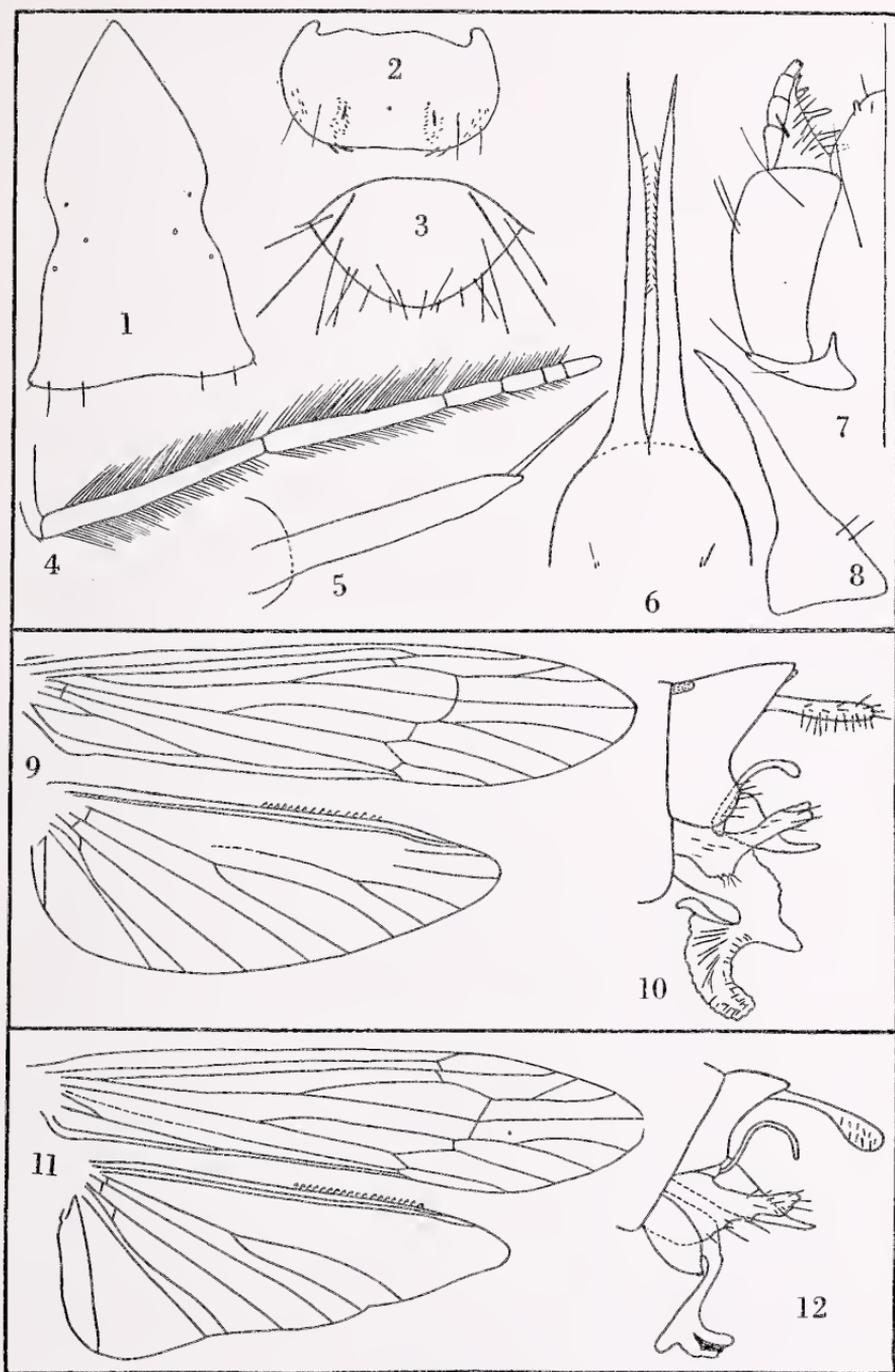
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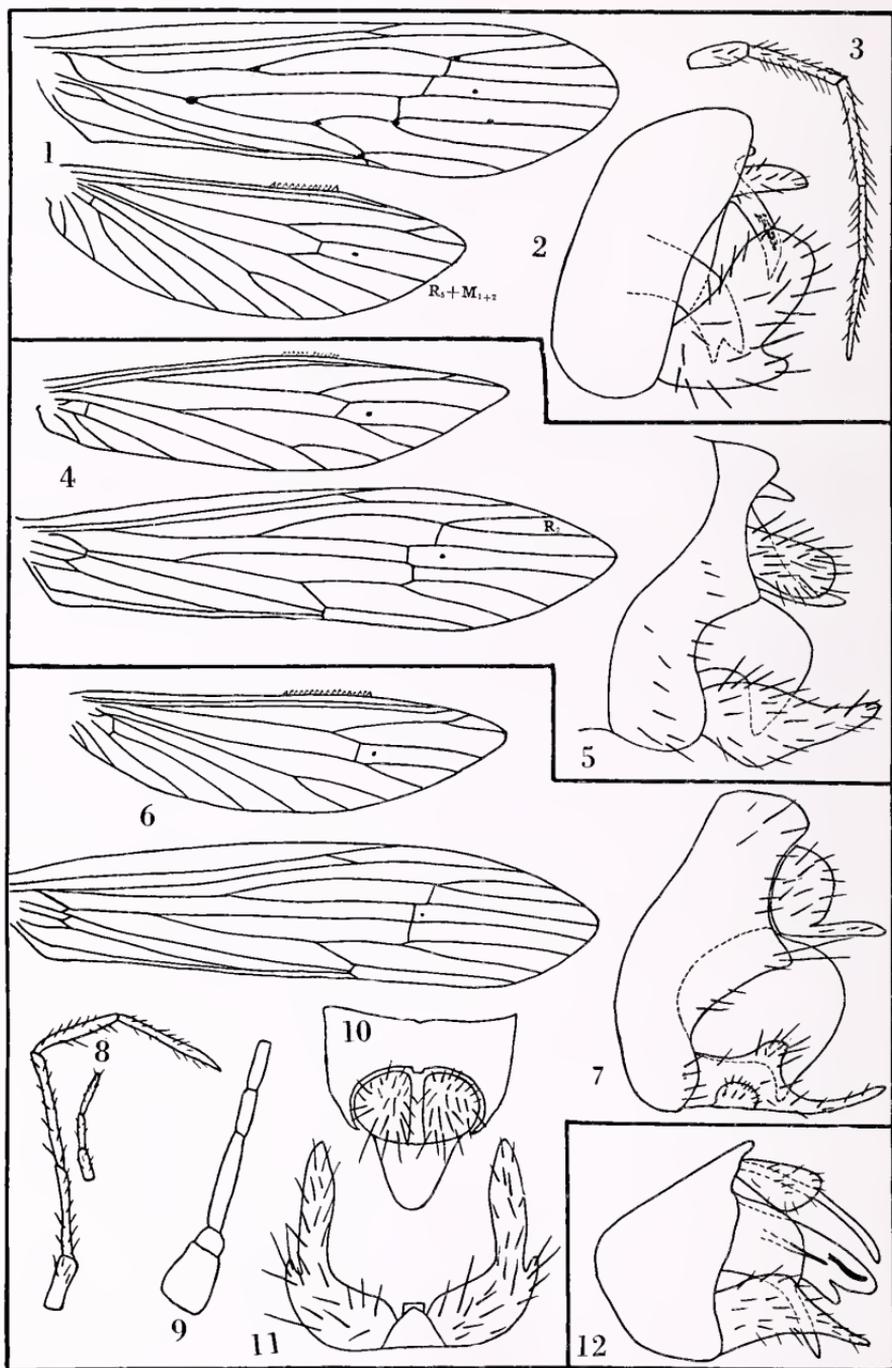
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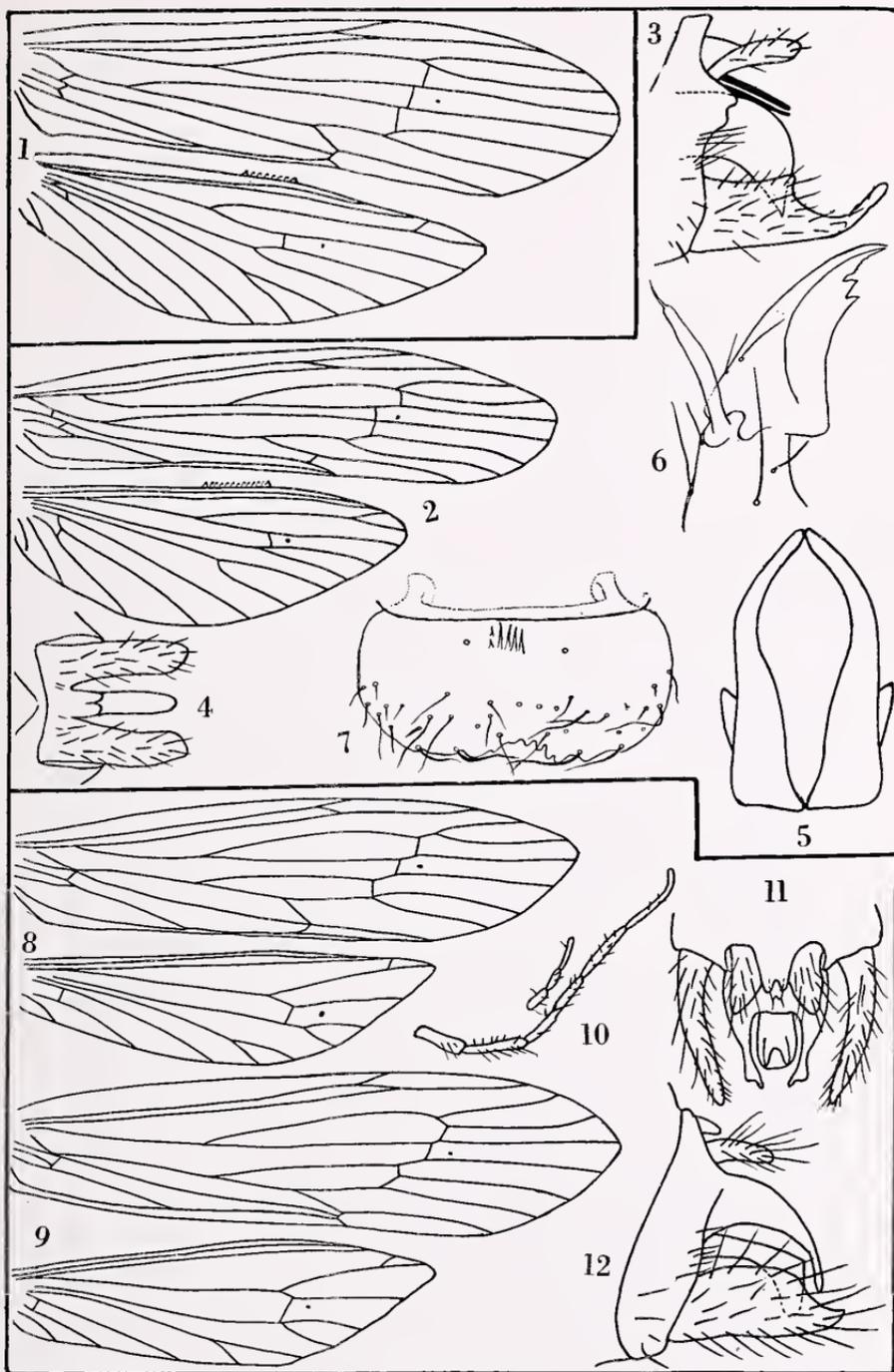


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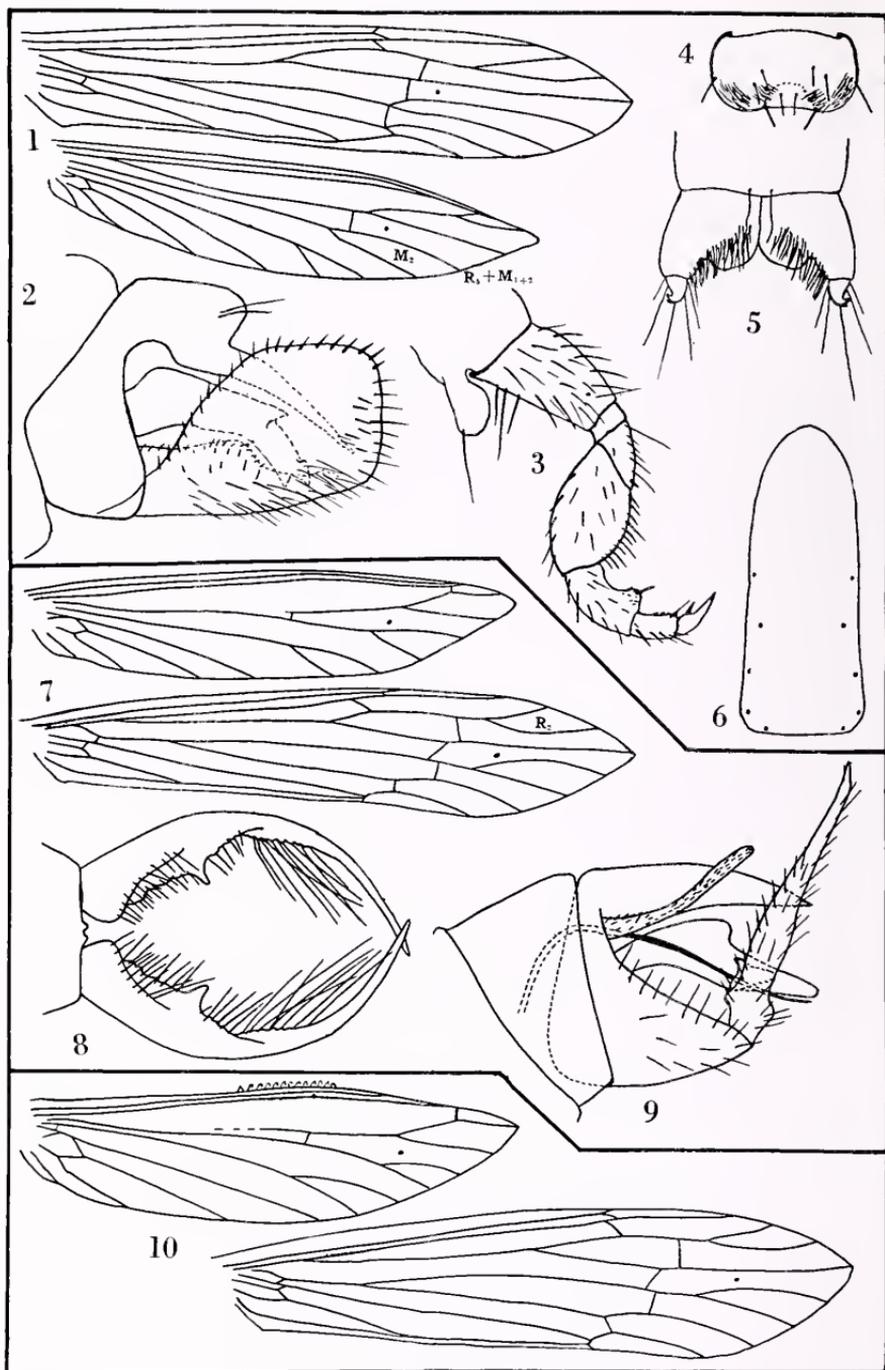


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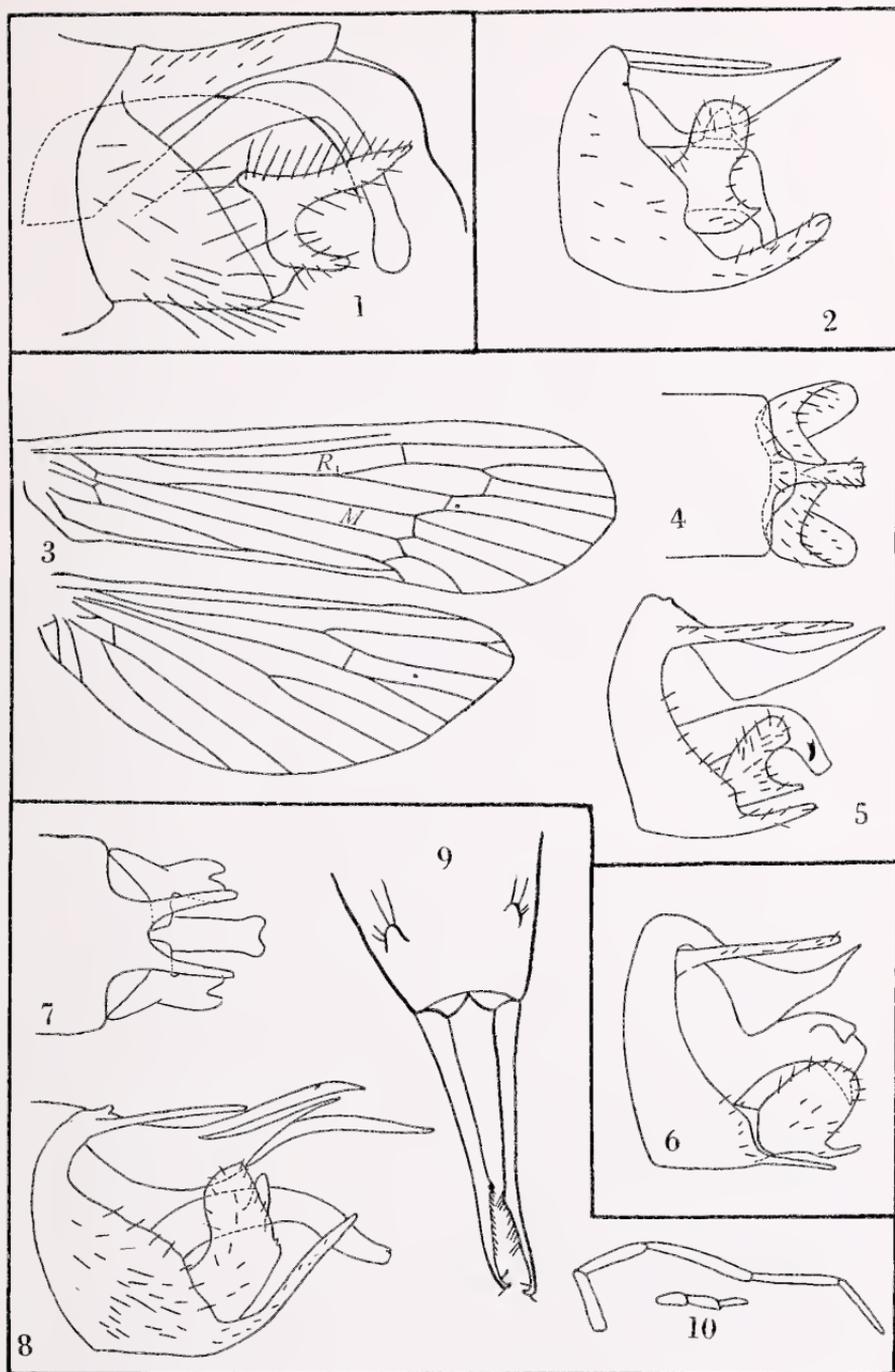
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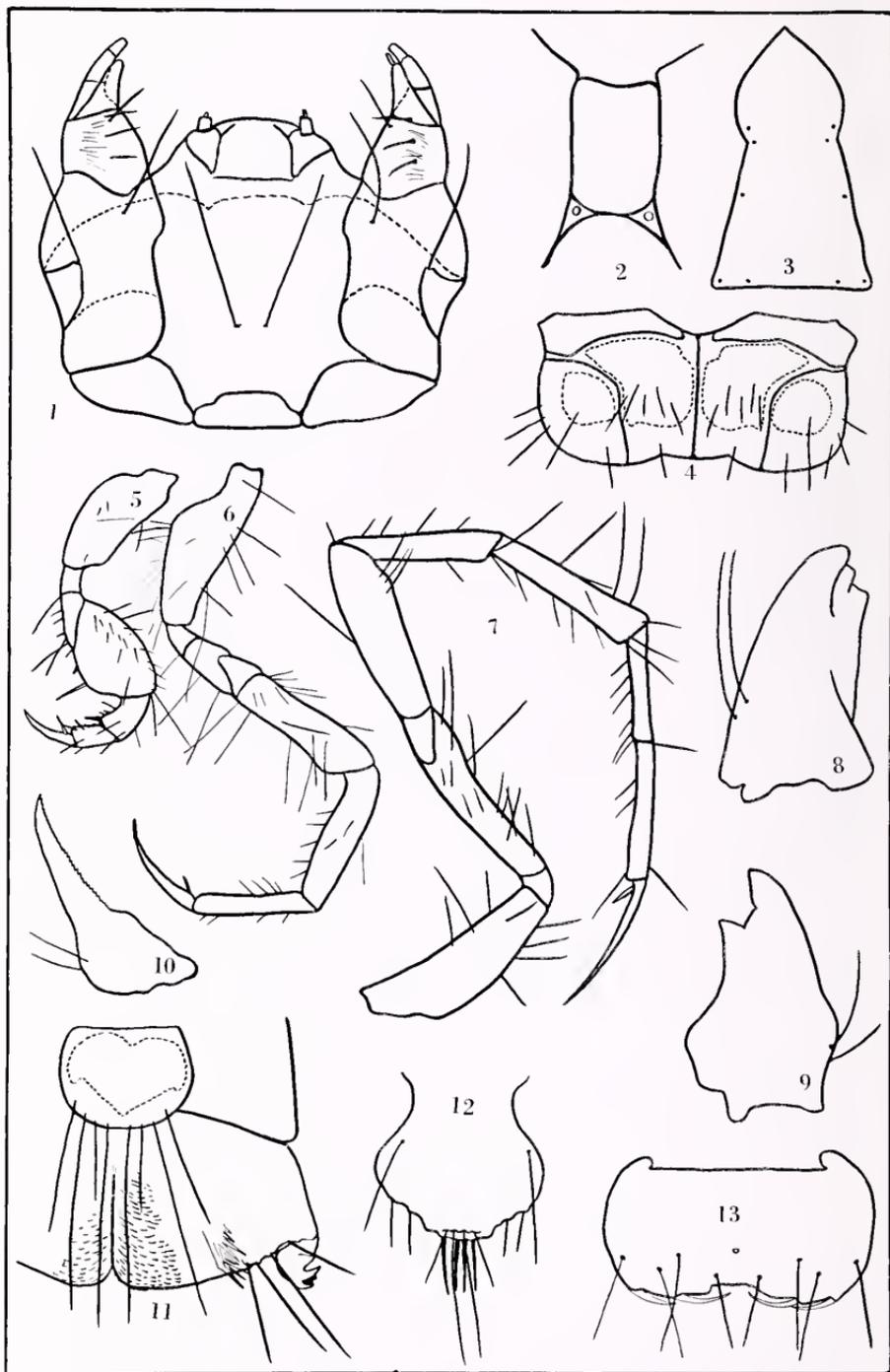
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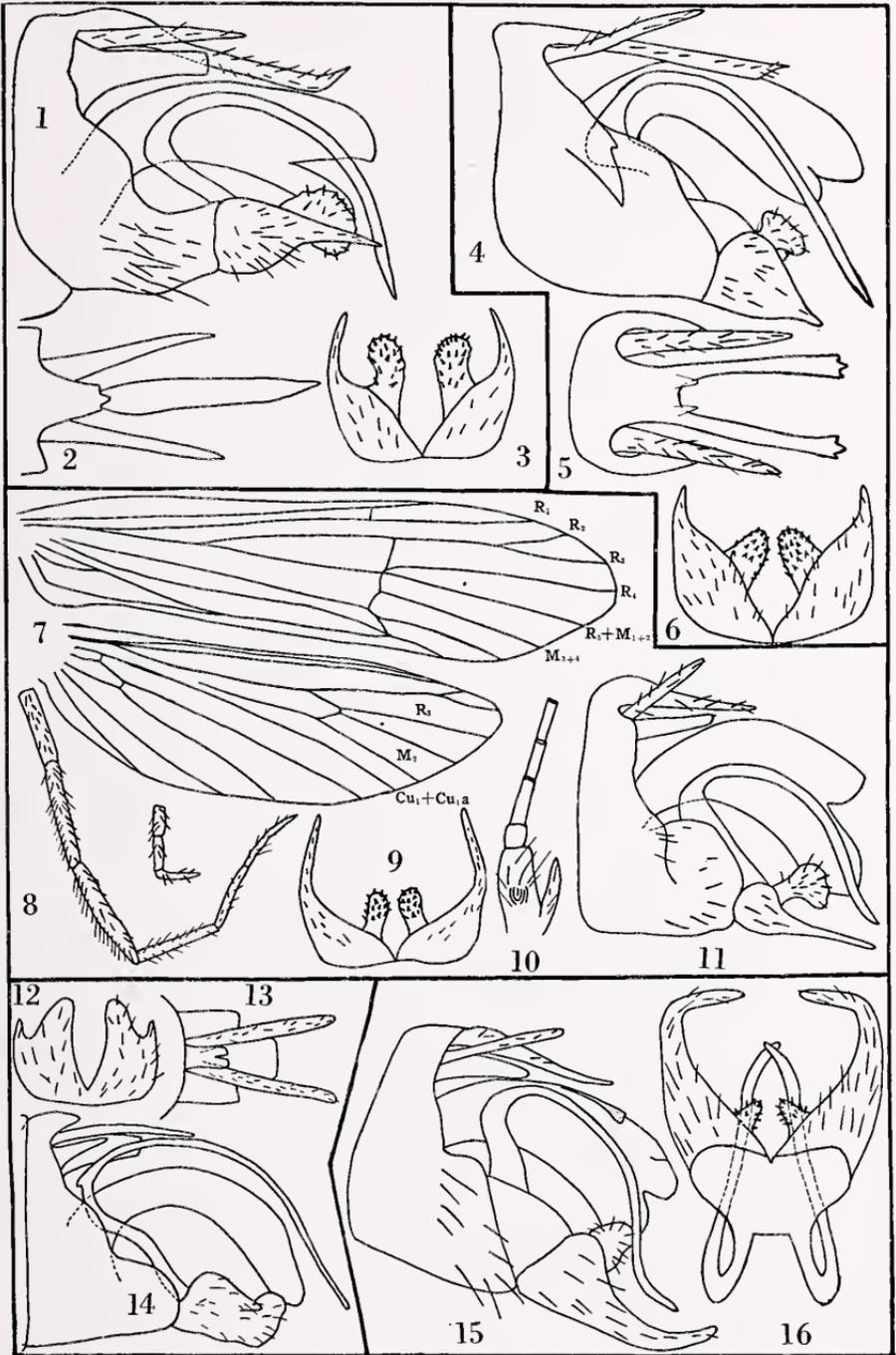
*Setodes*



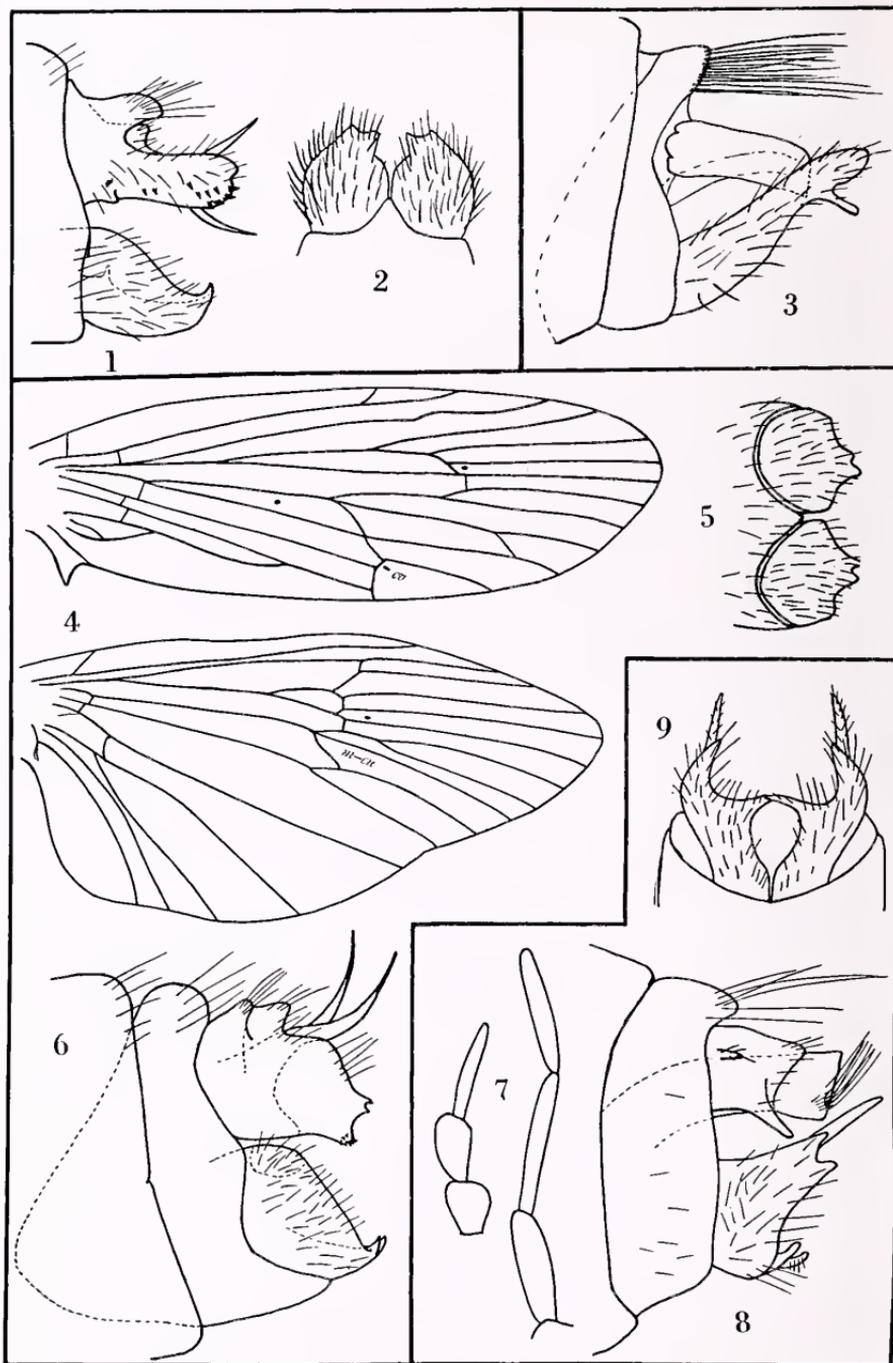
*Setodes; Mystacides*



*Mystacides*

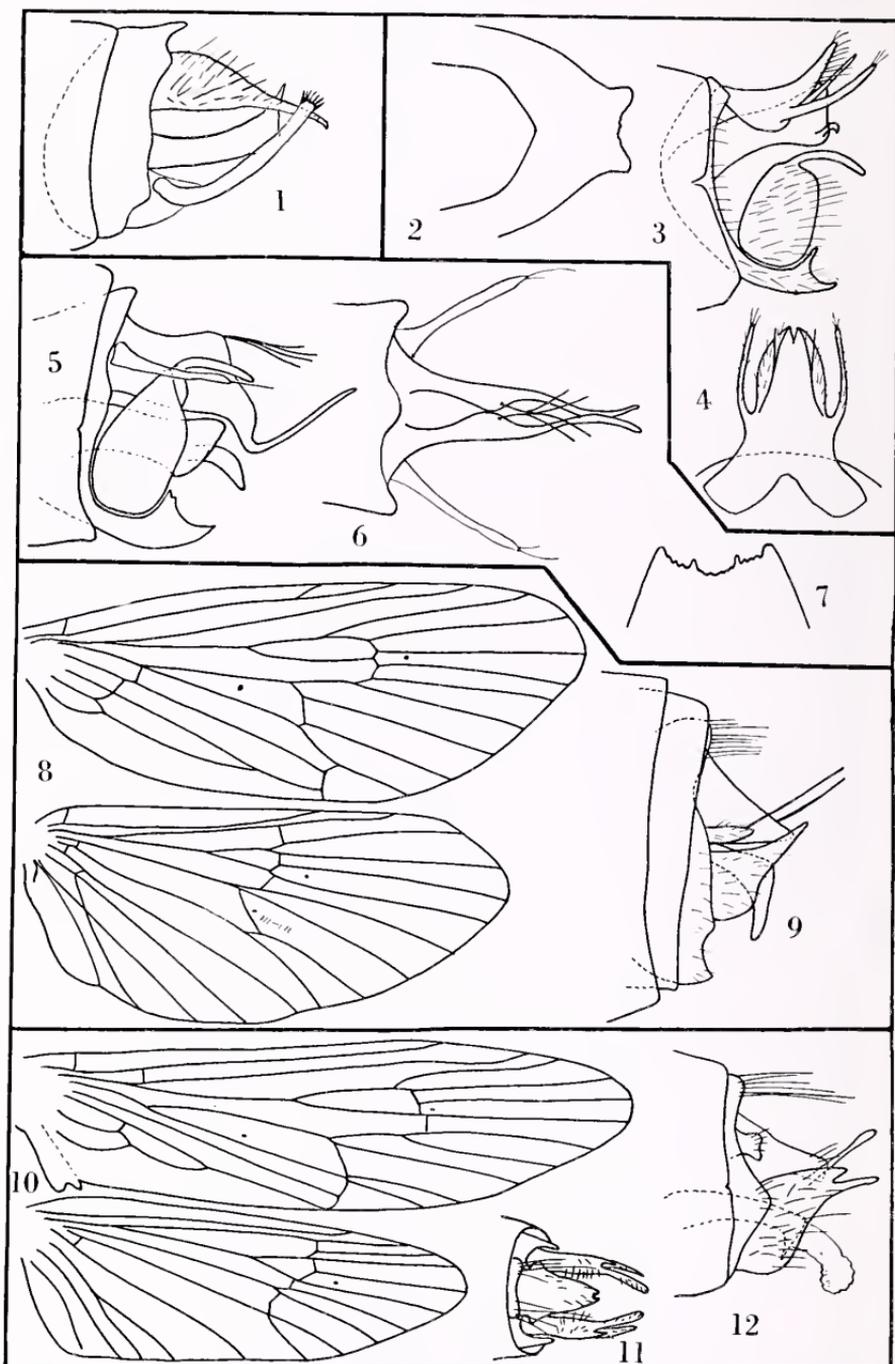


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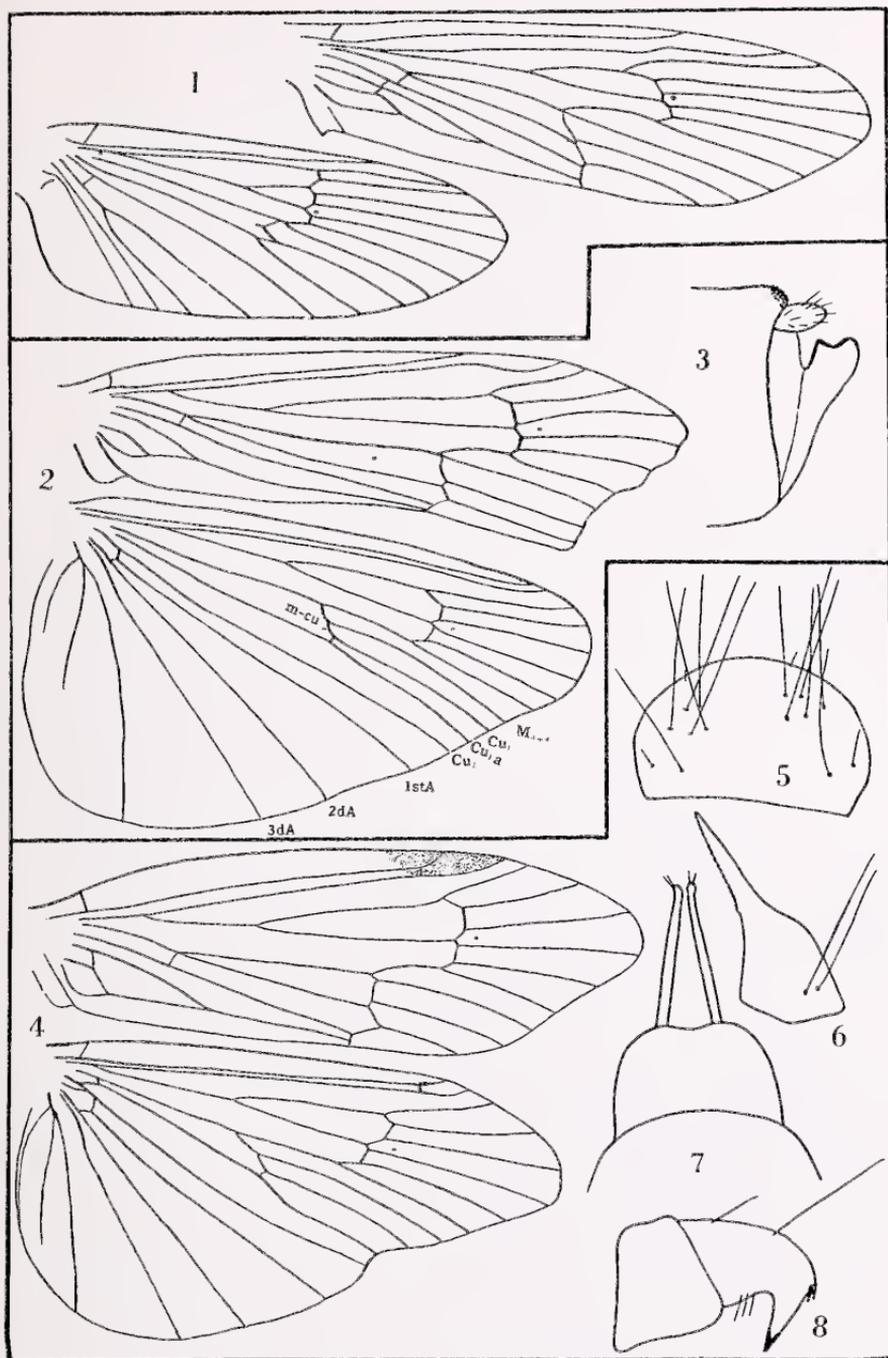


*Phryganca*

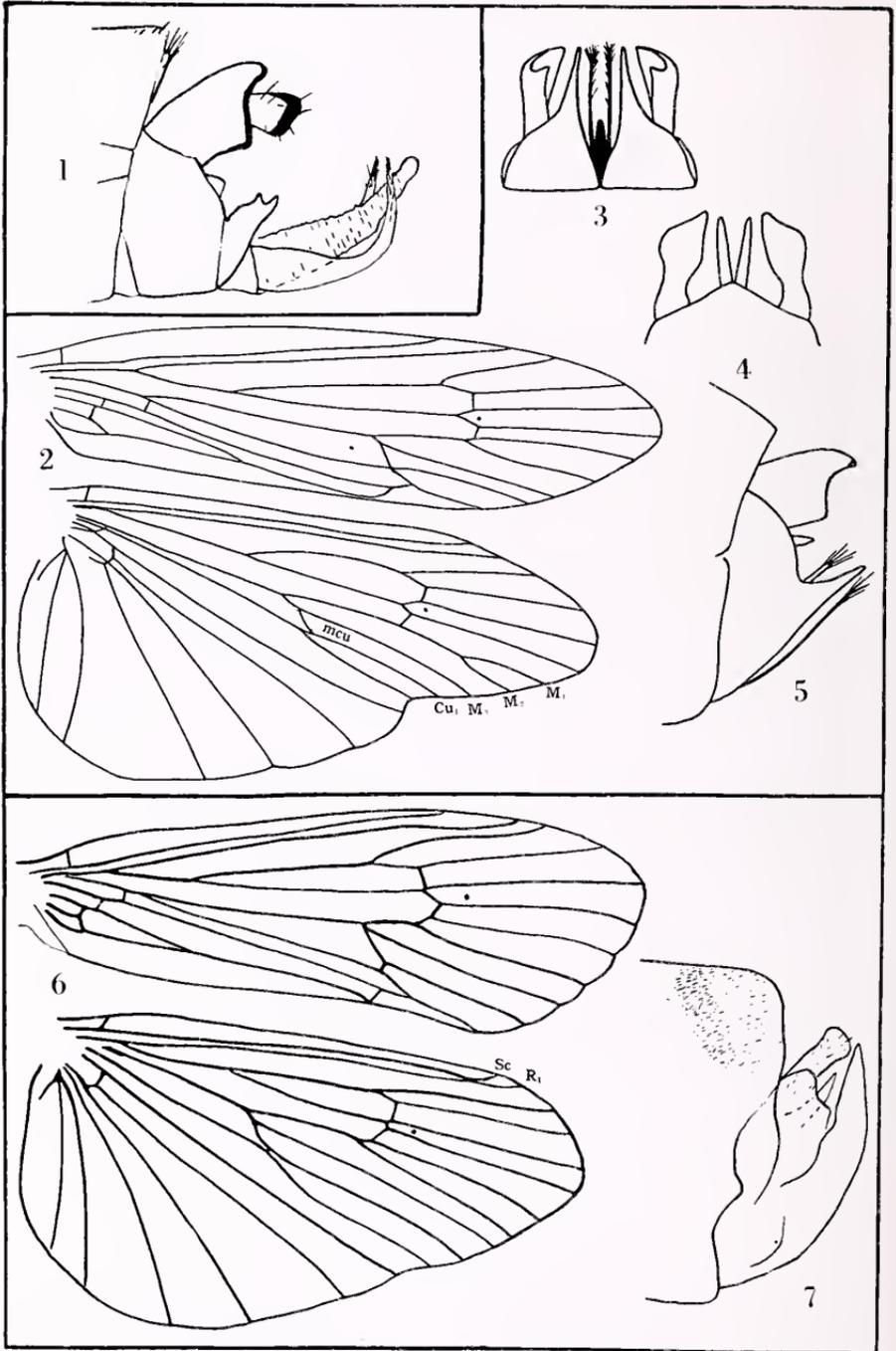




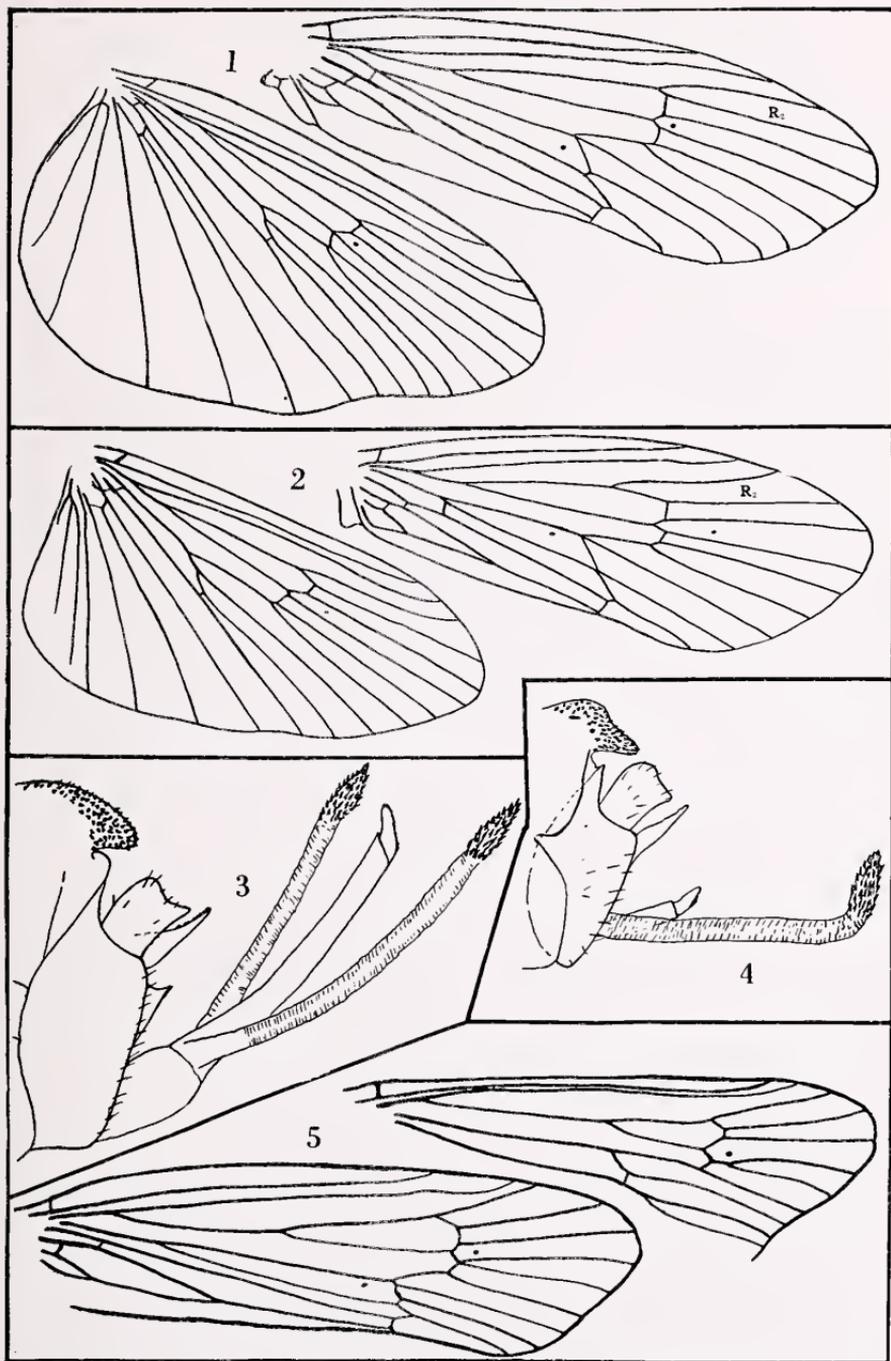
*Neuronina*; *Agrypnia*



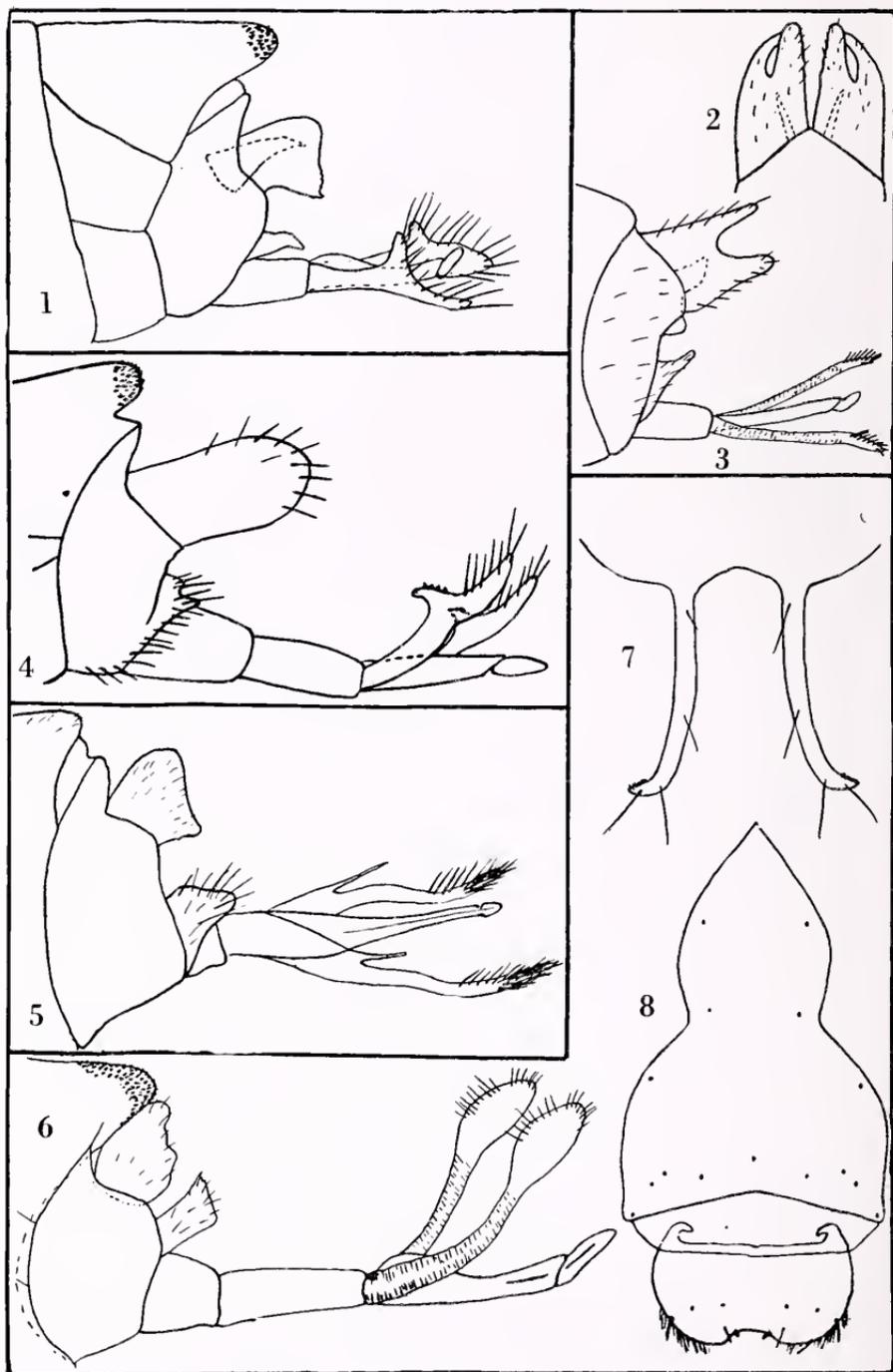
*Agrypnia; Glyphotaelius; Arctoccia*



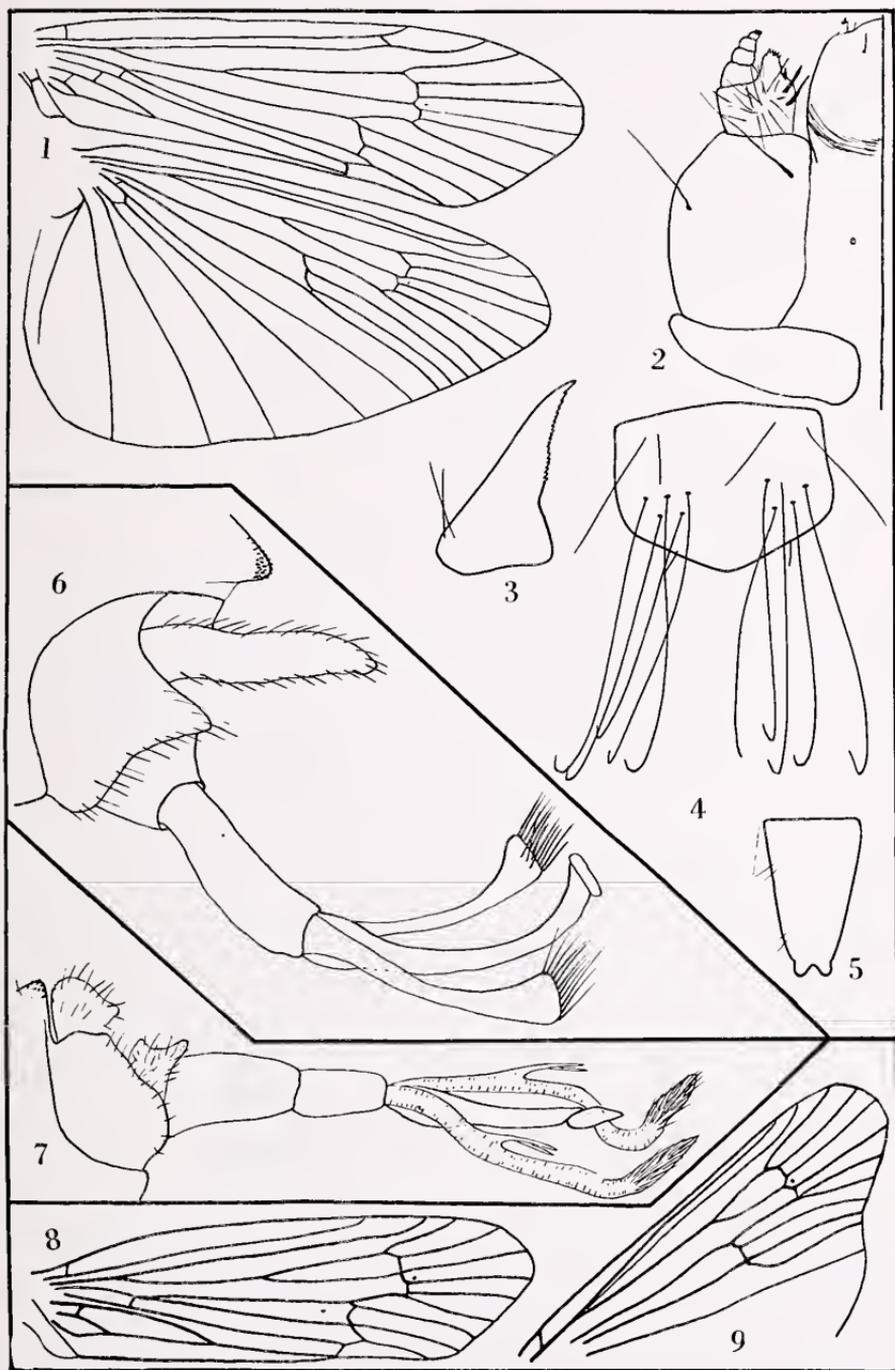
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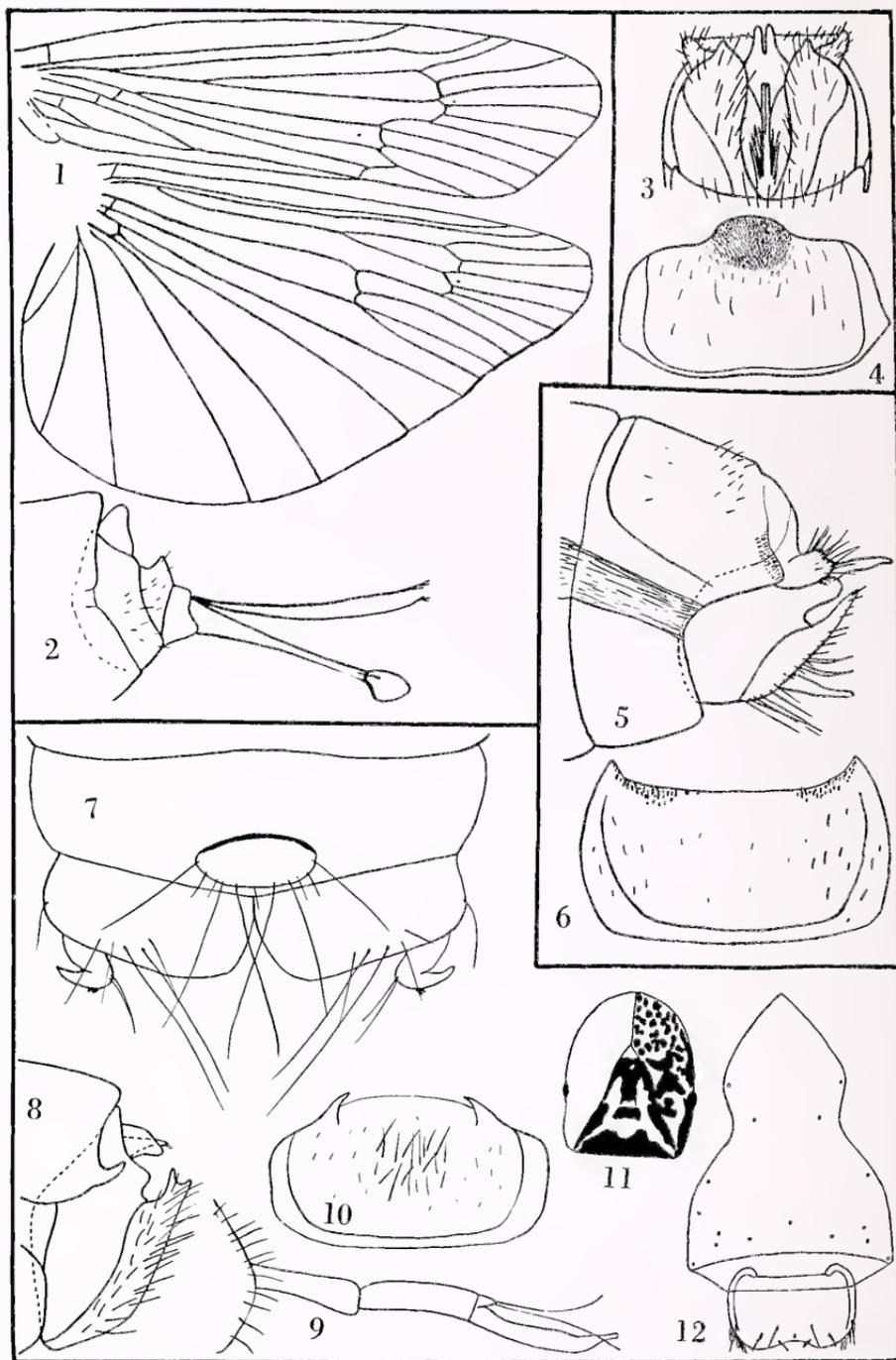
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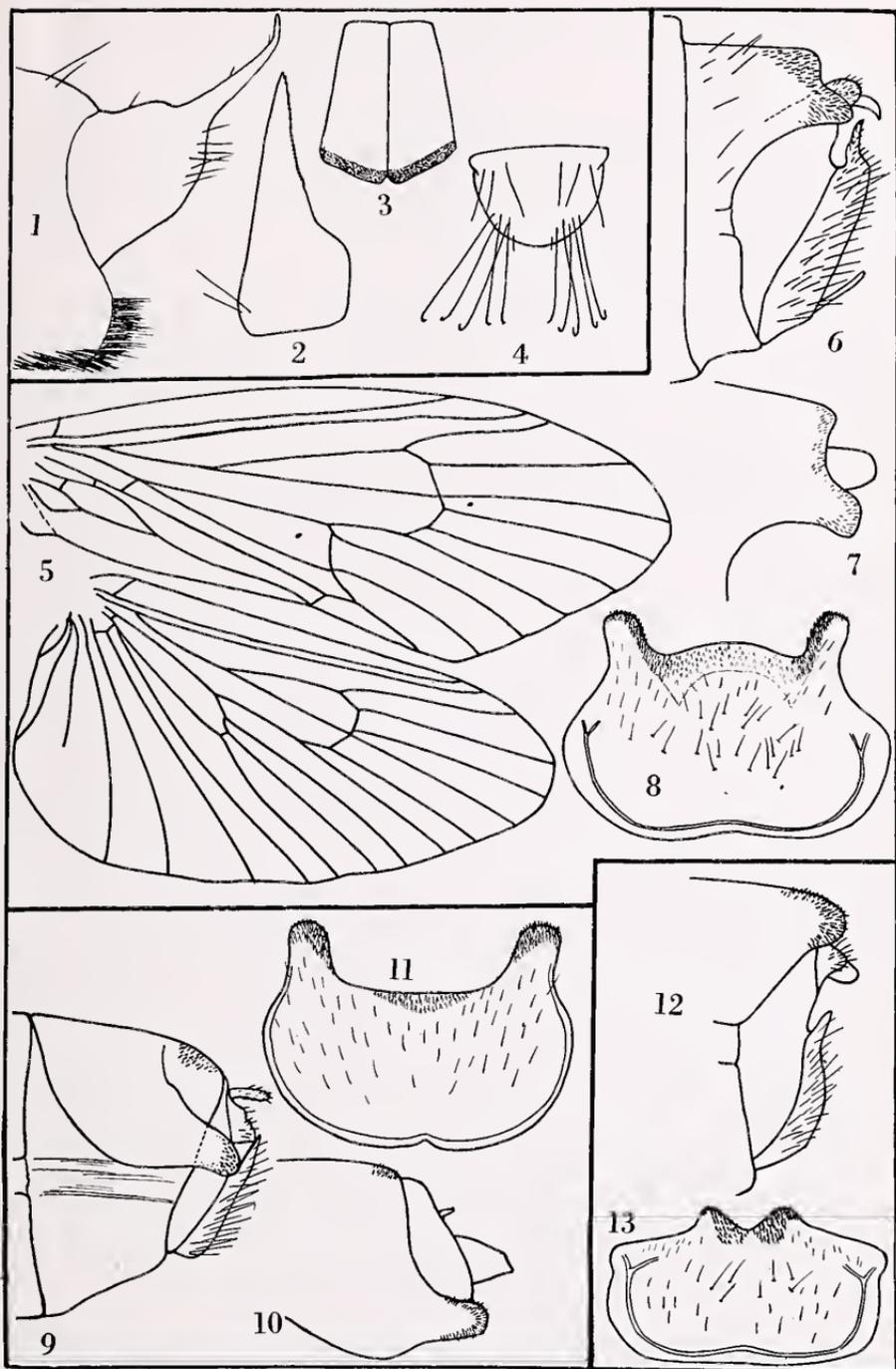
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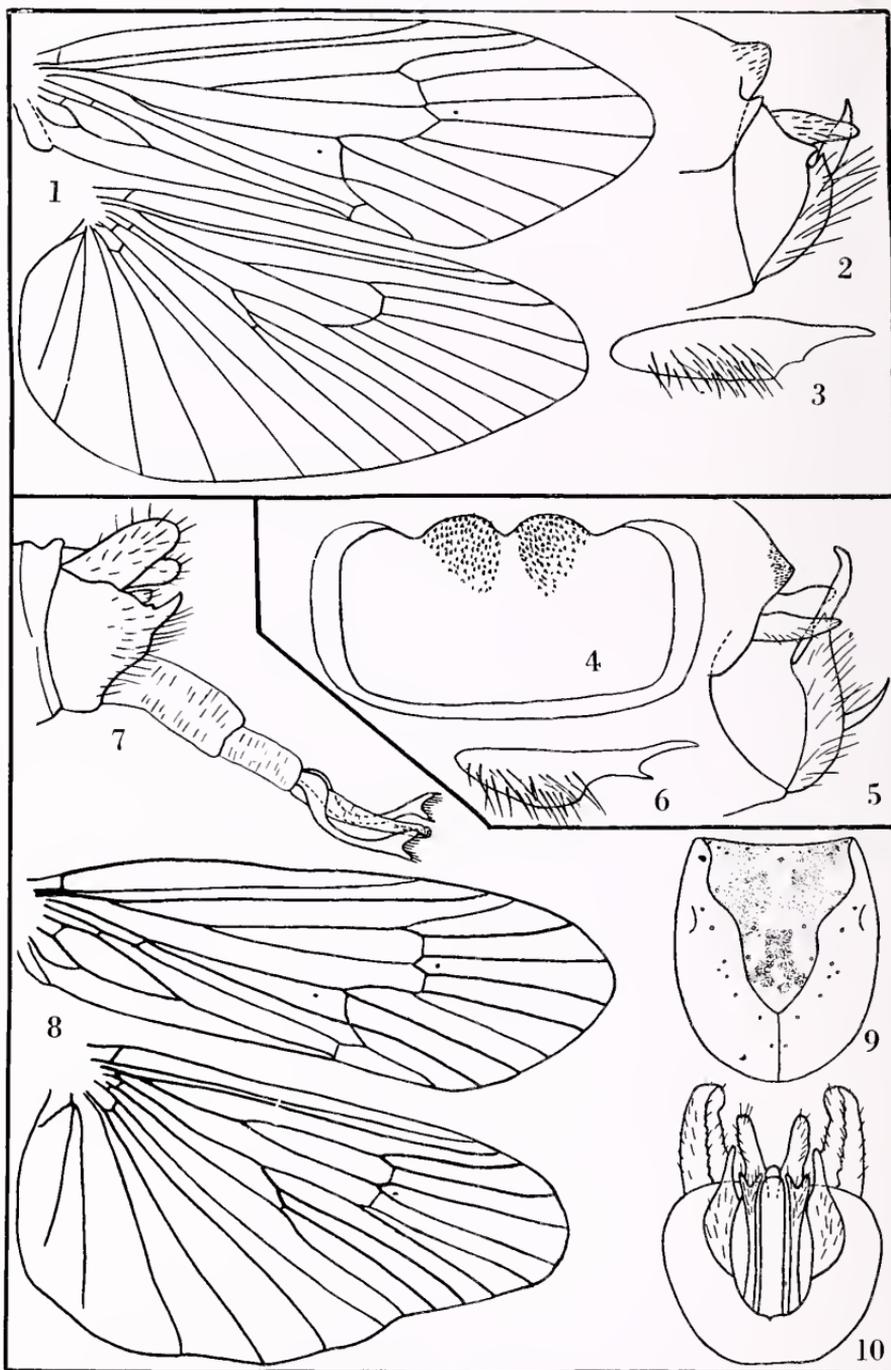
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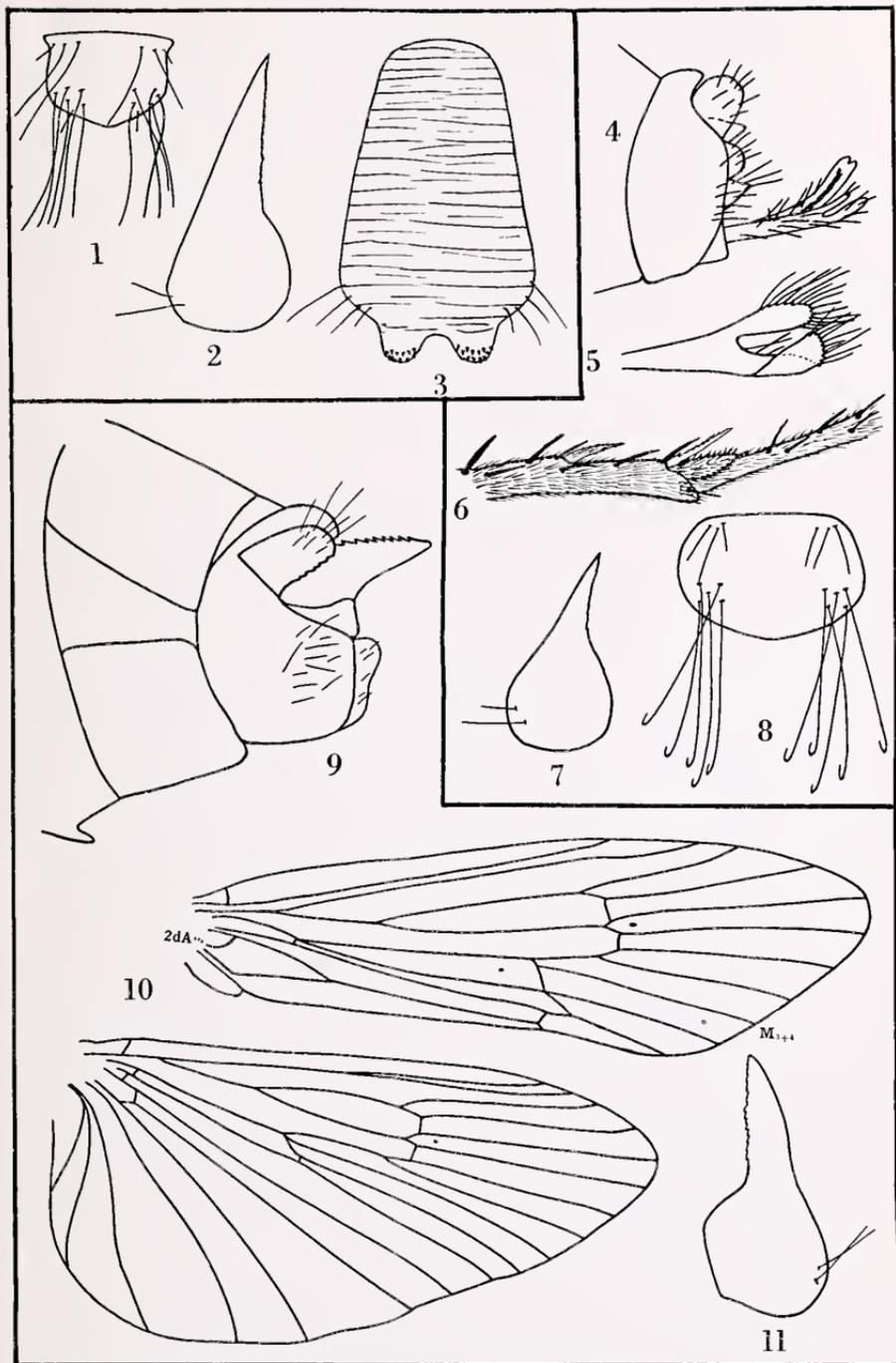
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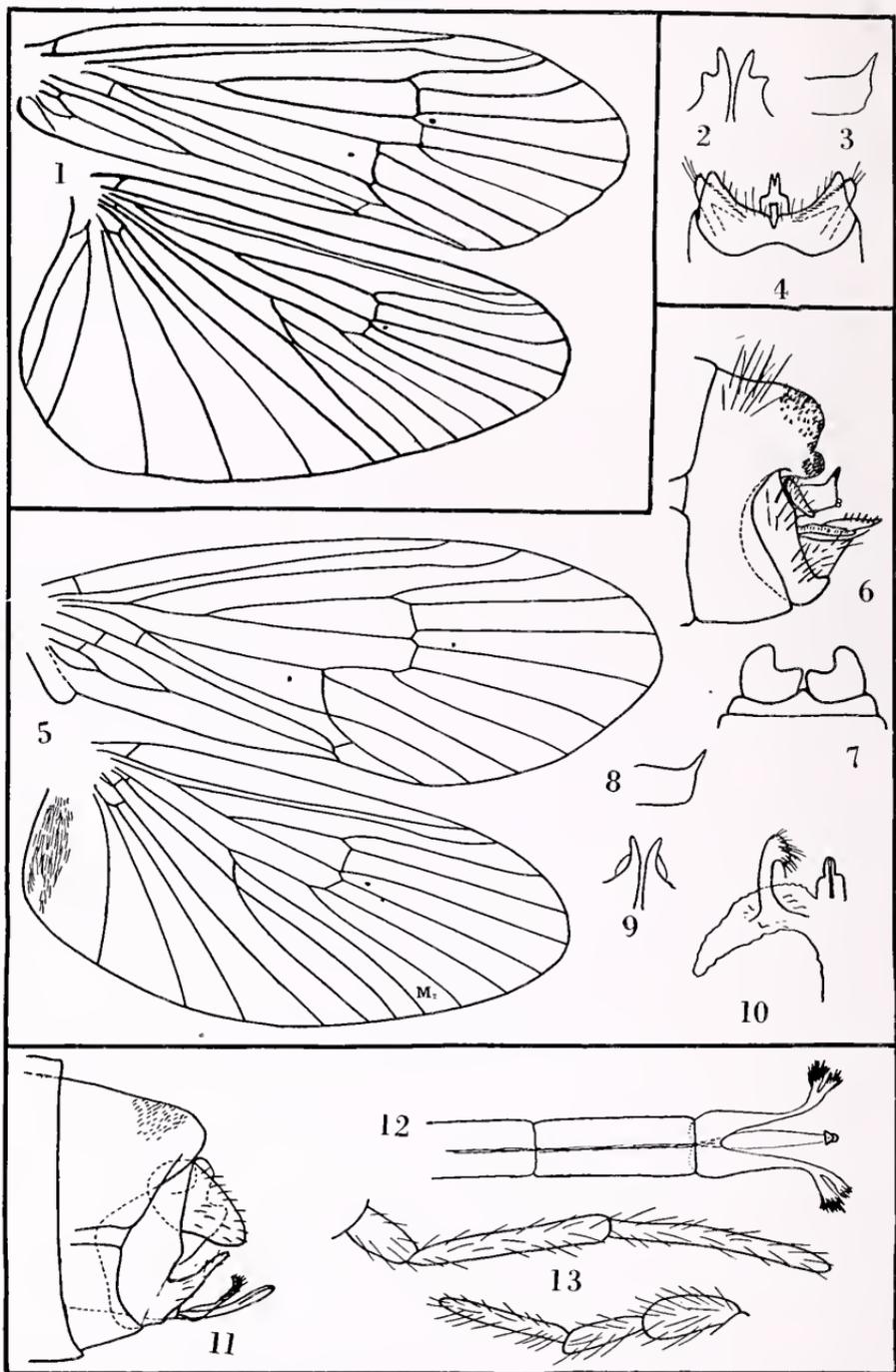
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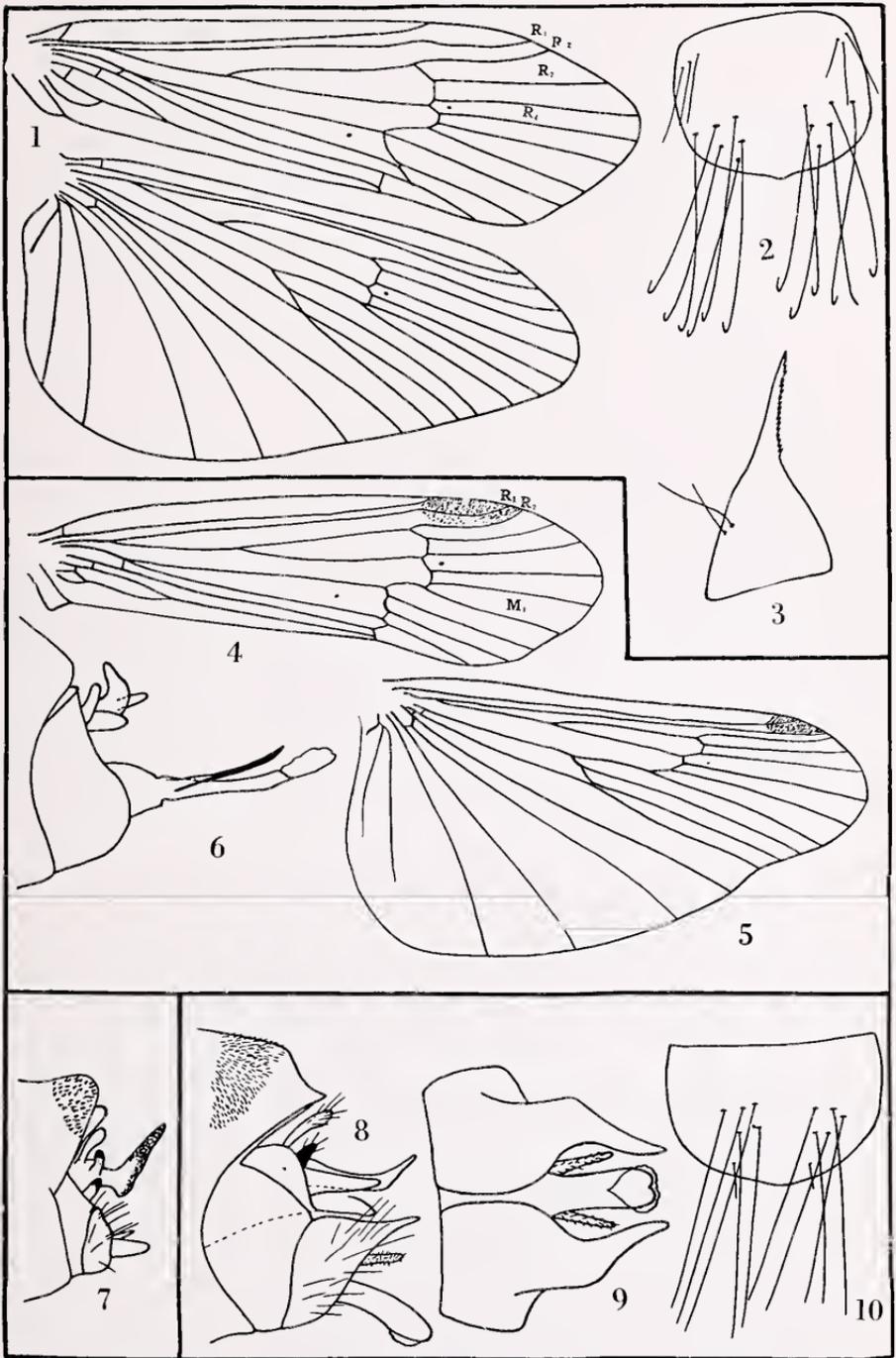
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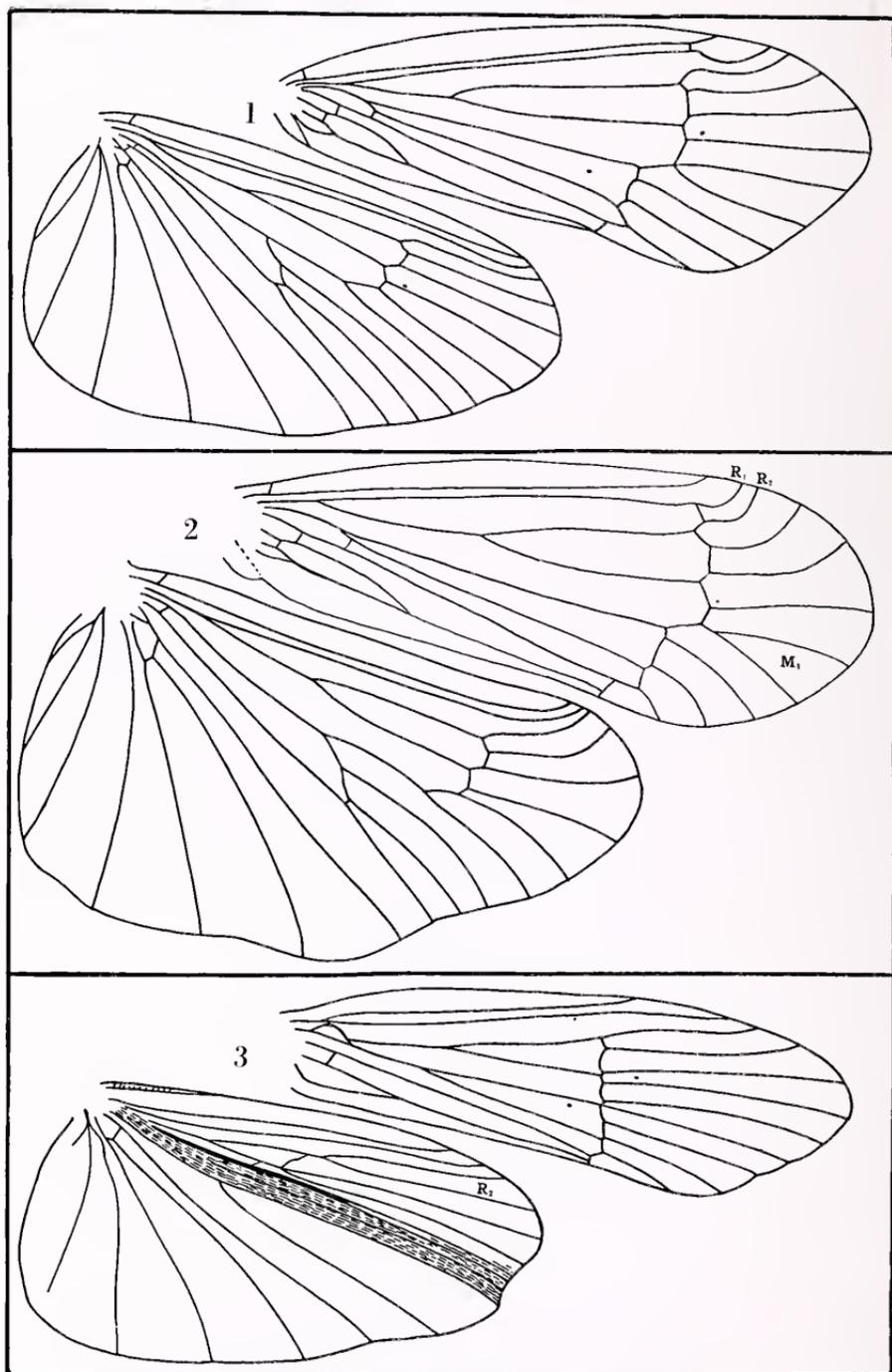
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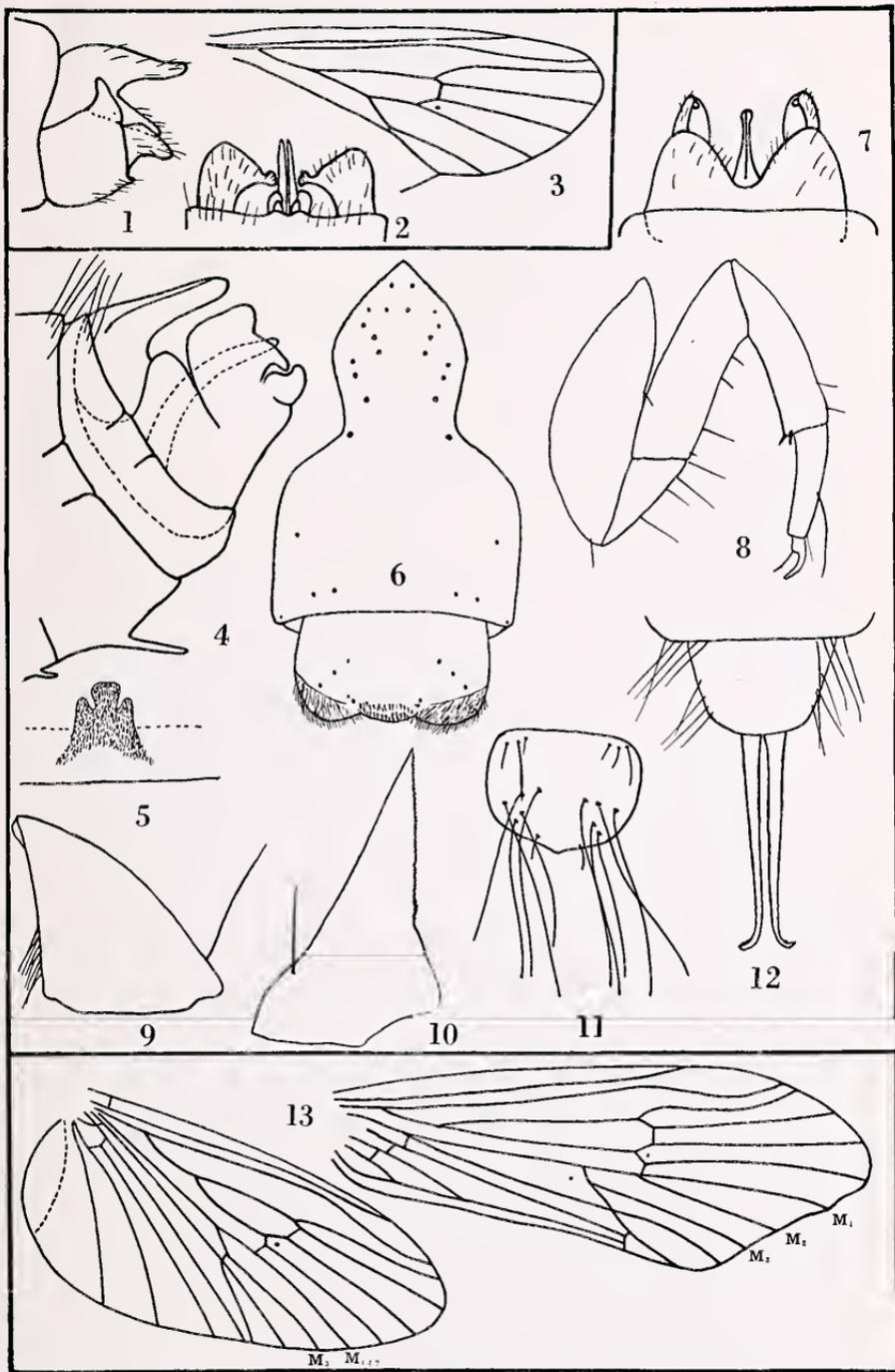


*Halesochila; Drusus; Hesperophylax*

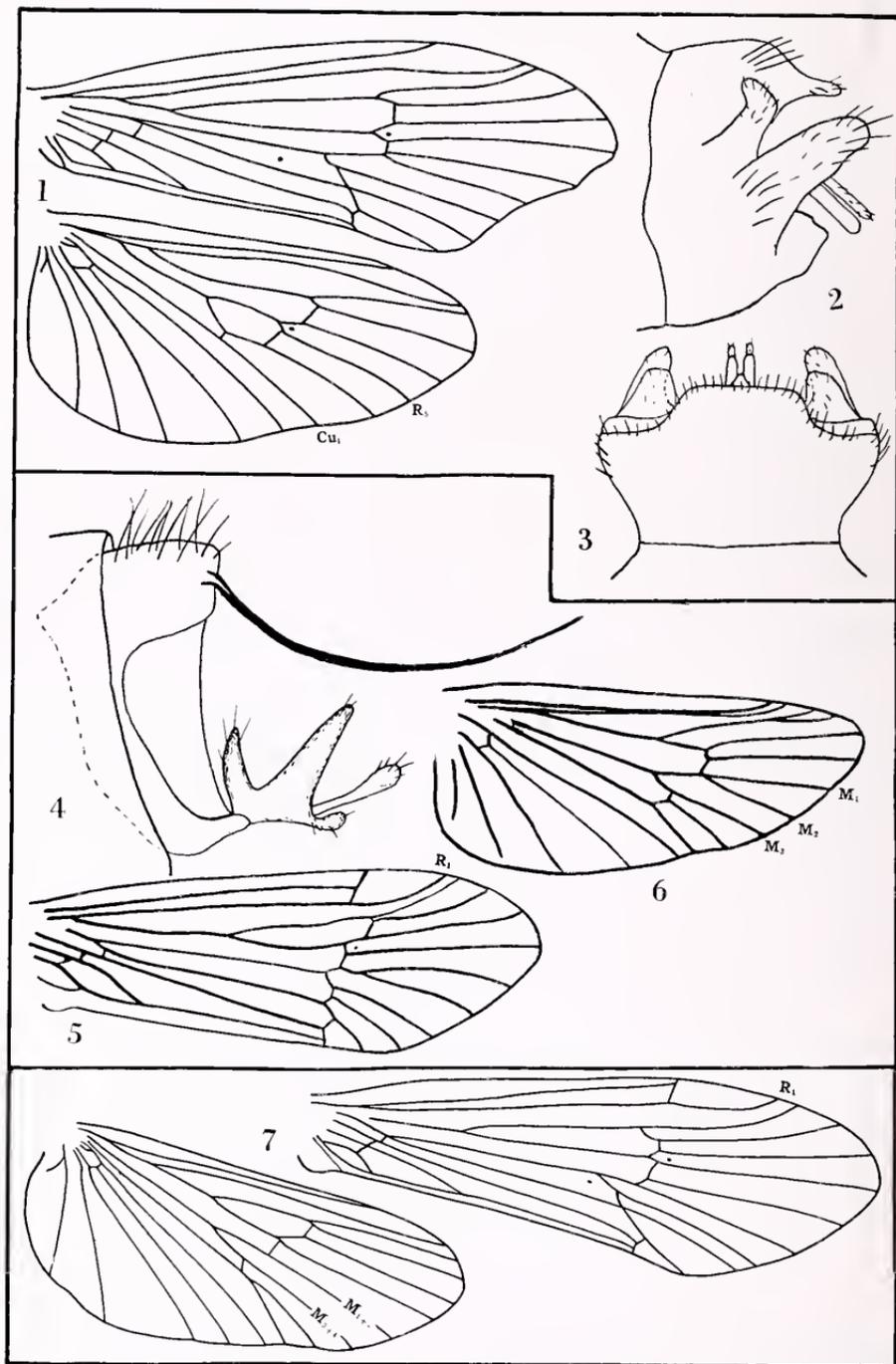


*Hesperophylax; Glyphopsyche; Chilostigma*

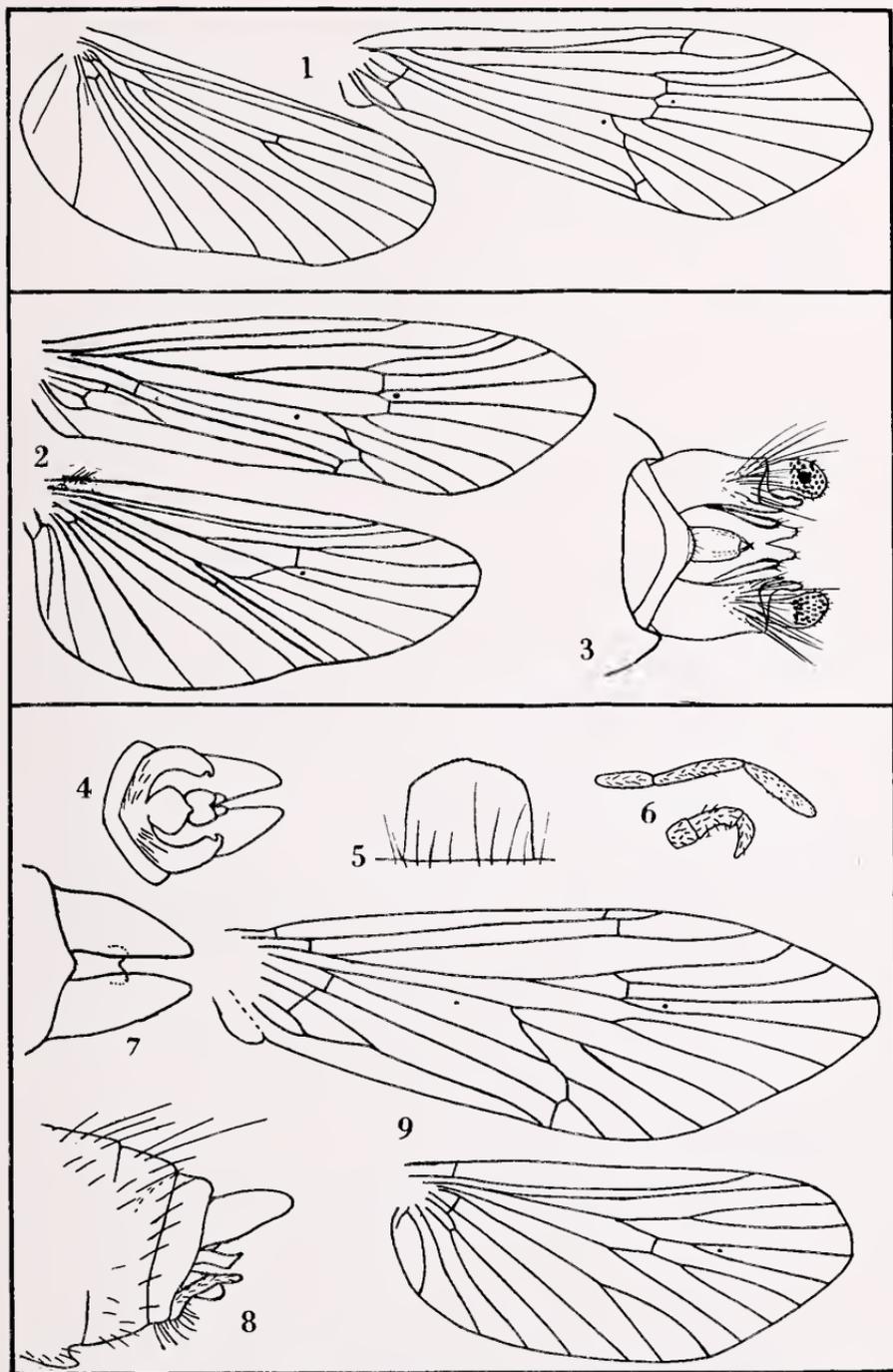
*Chilostigma; Homophylax*



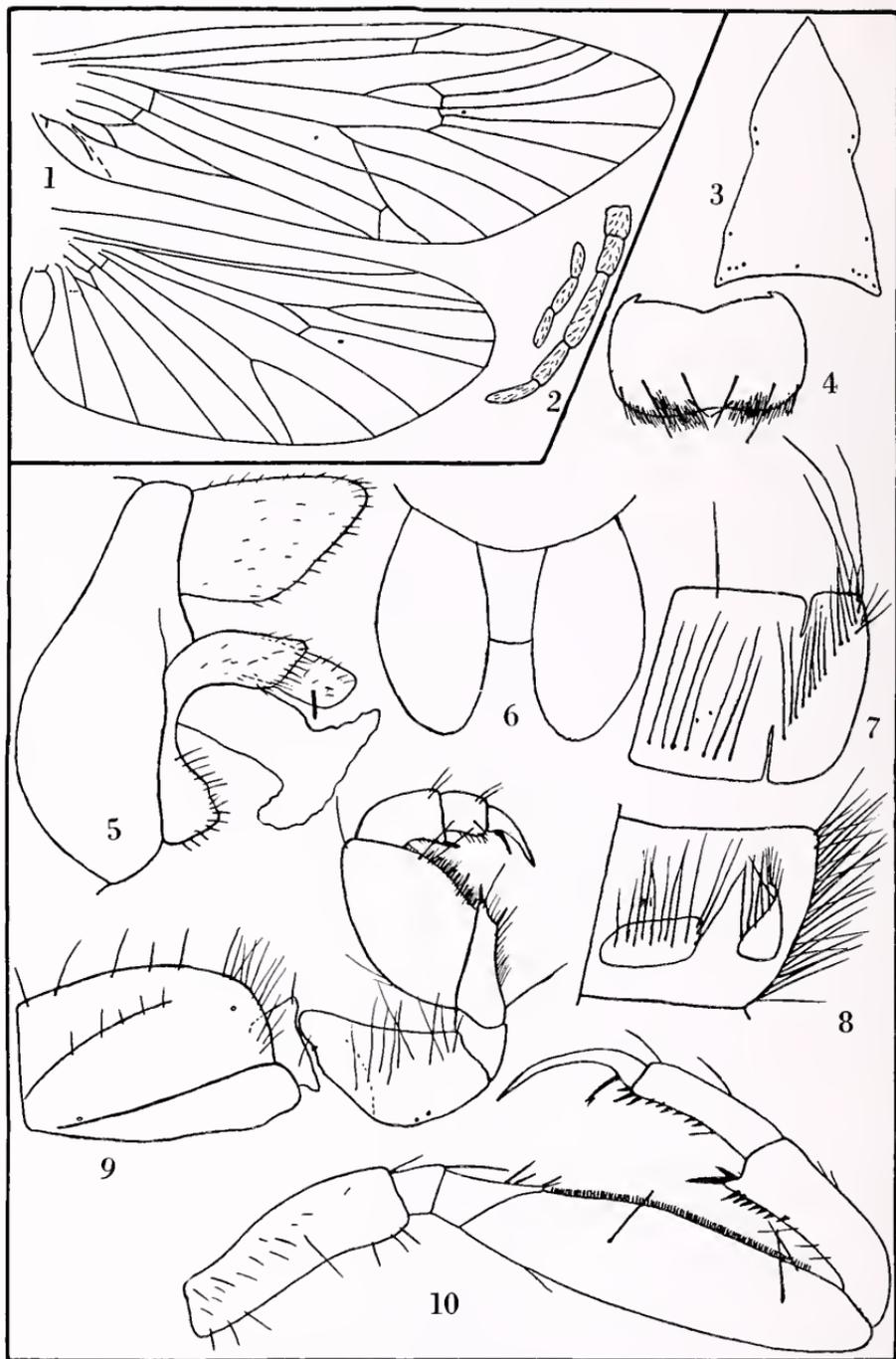
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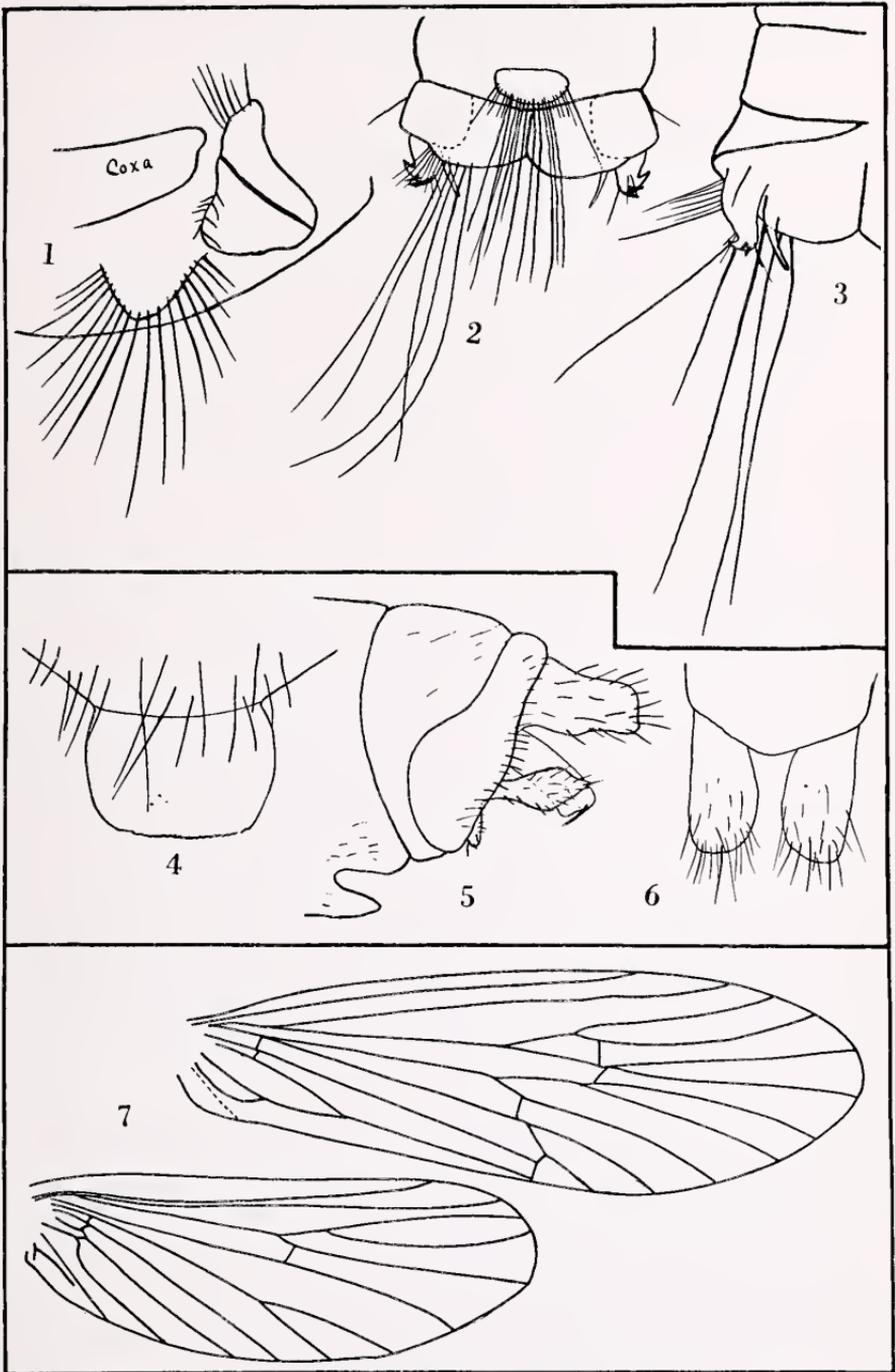
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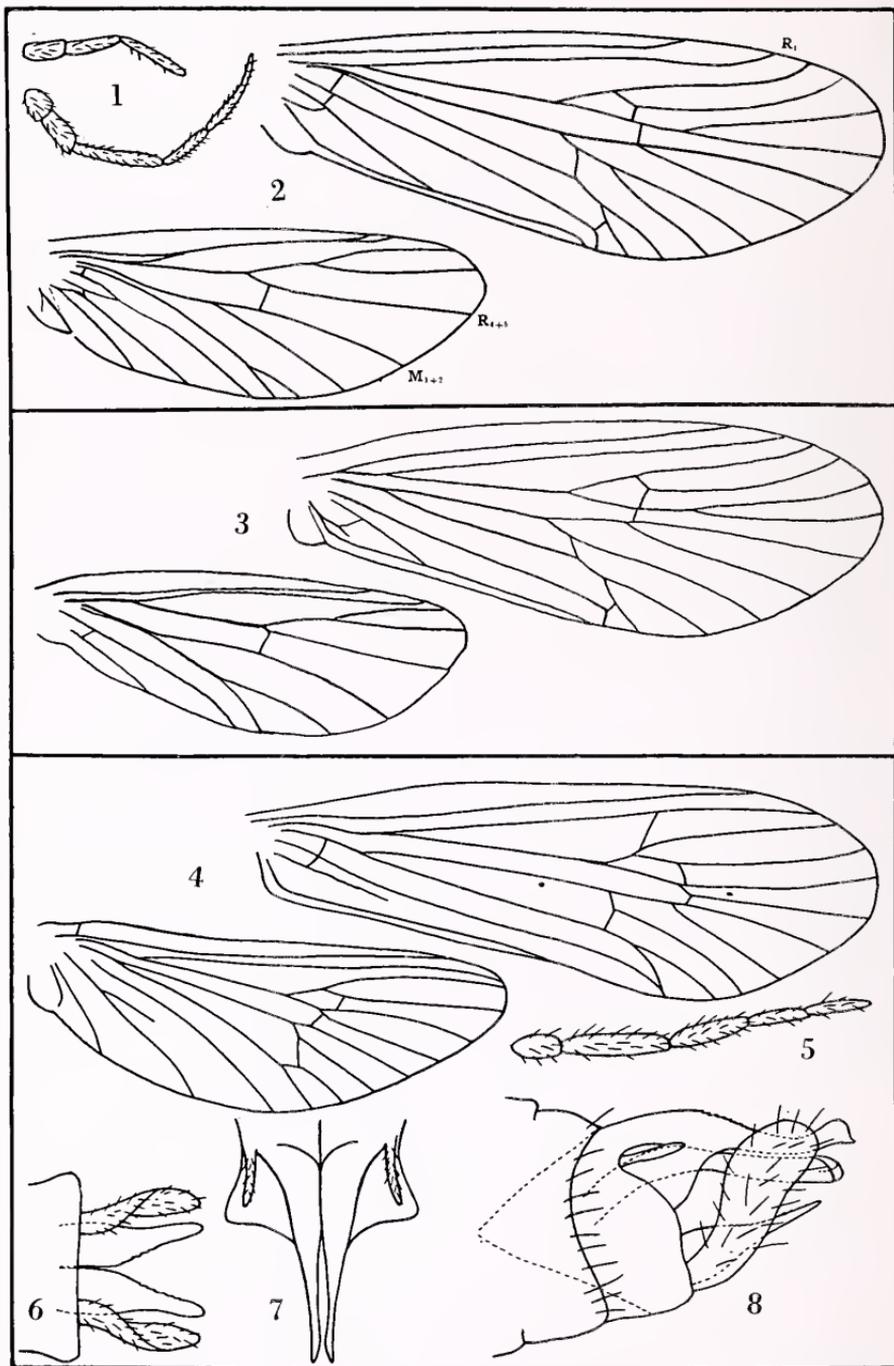
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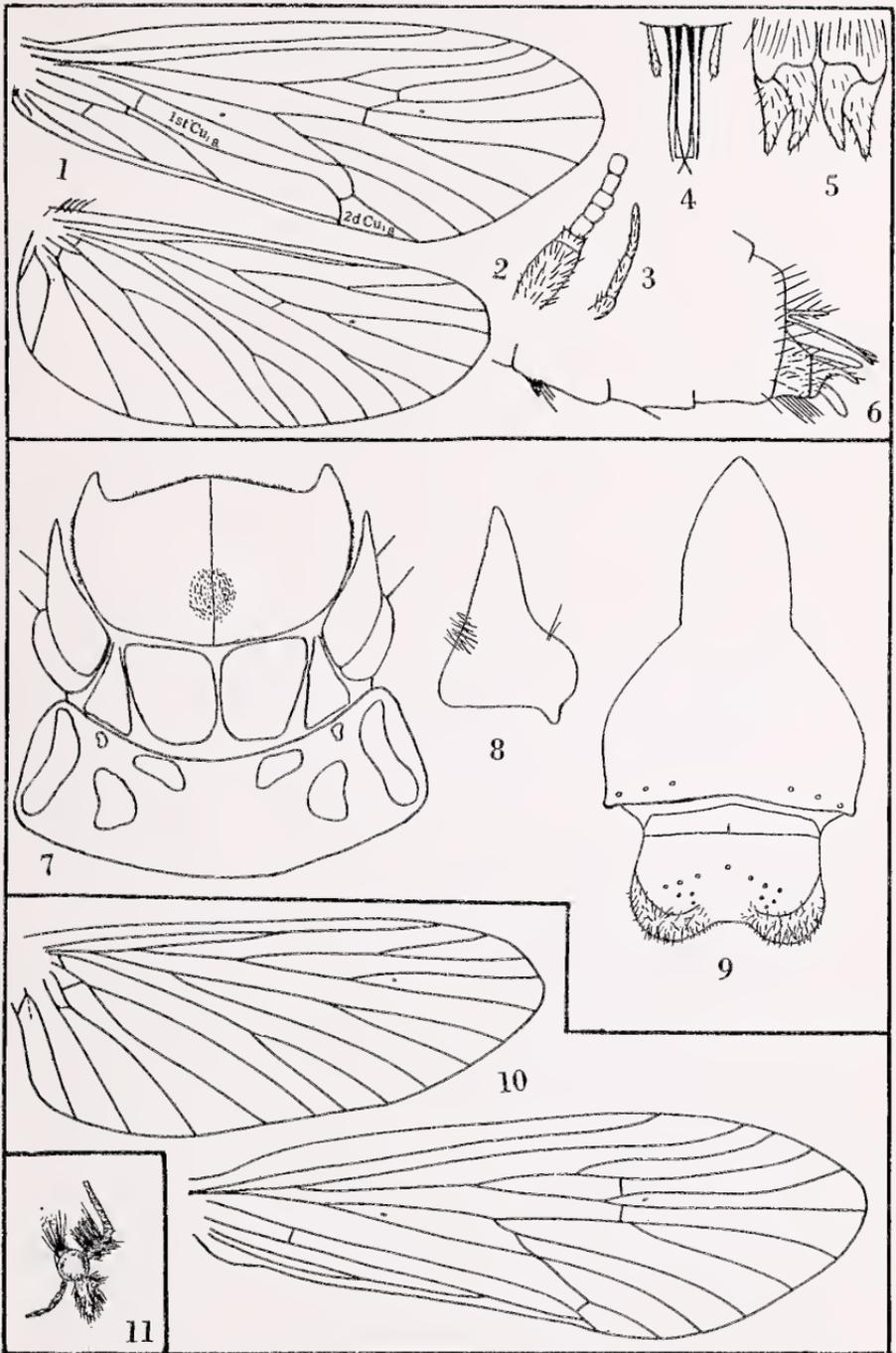
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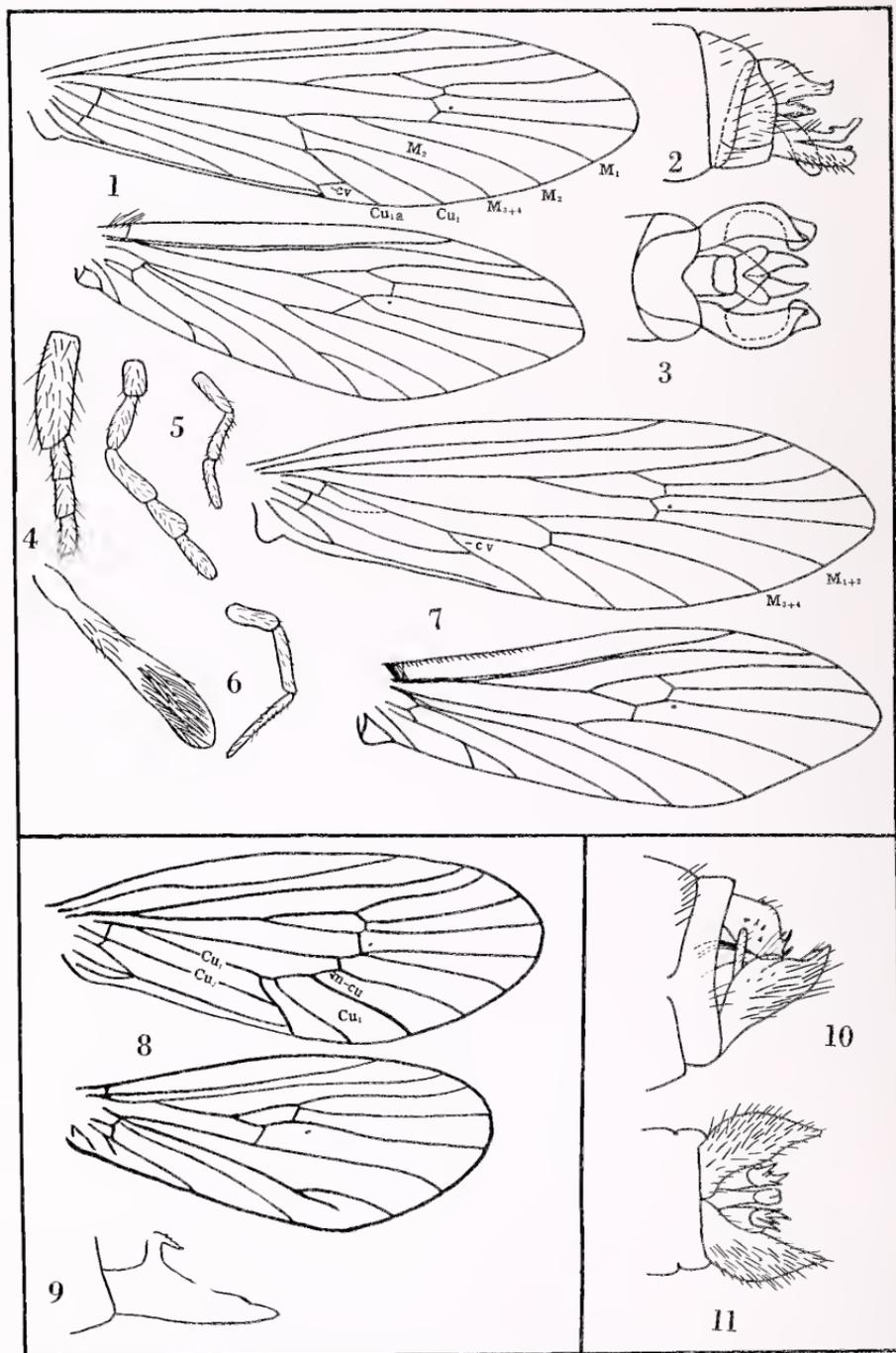
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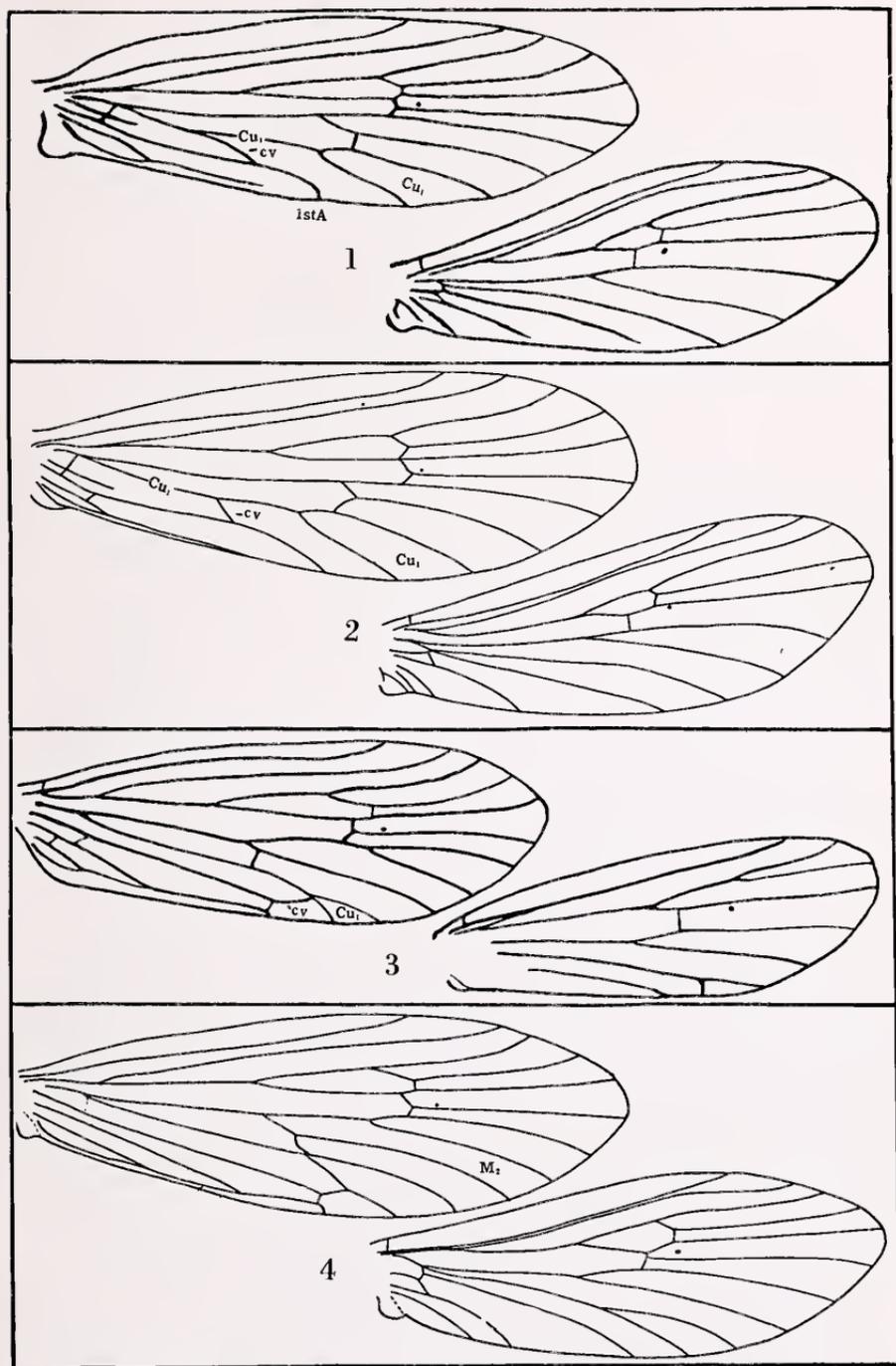
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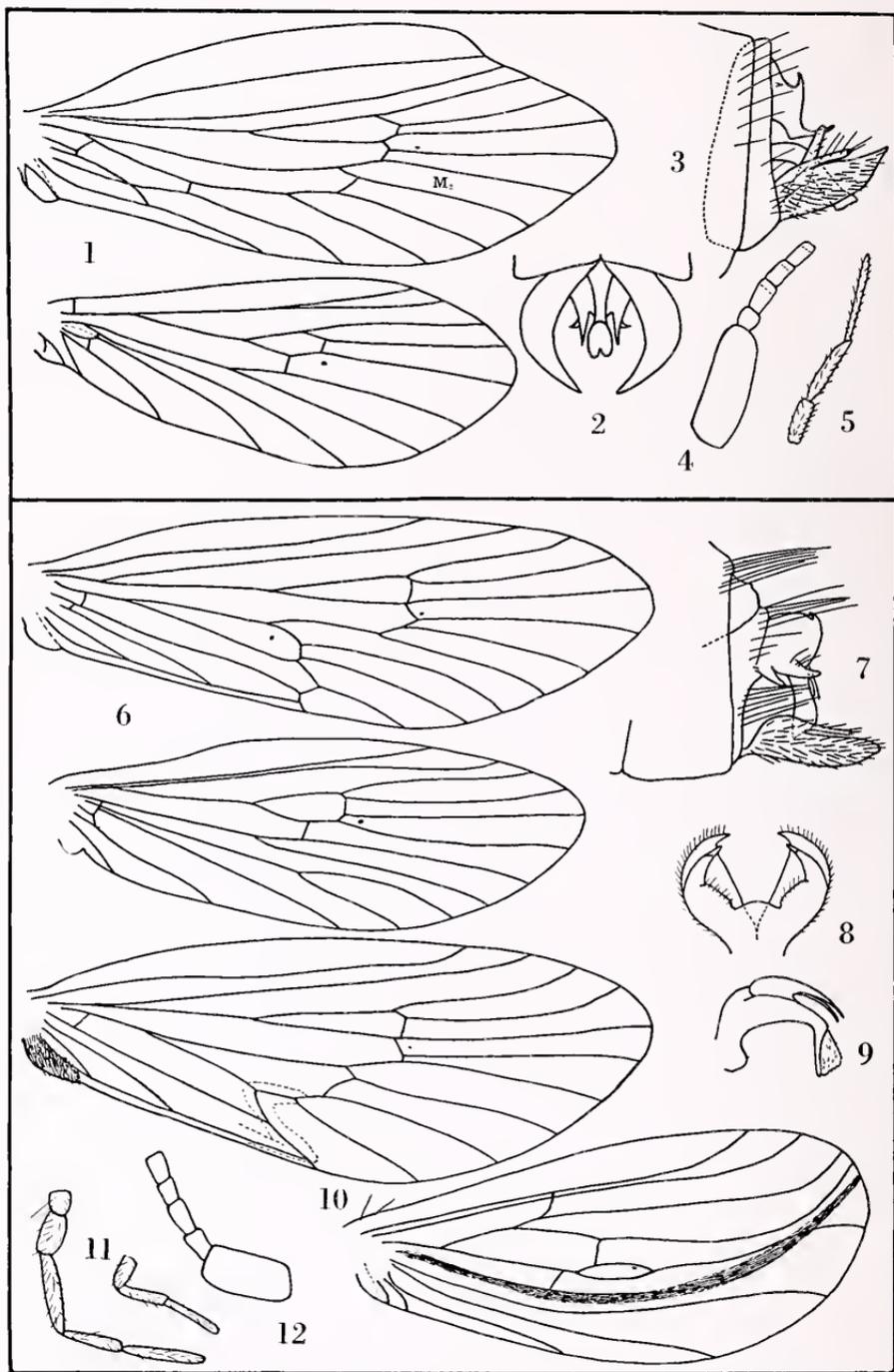
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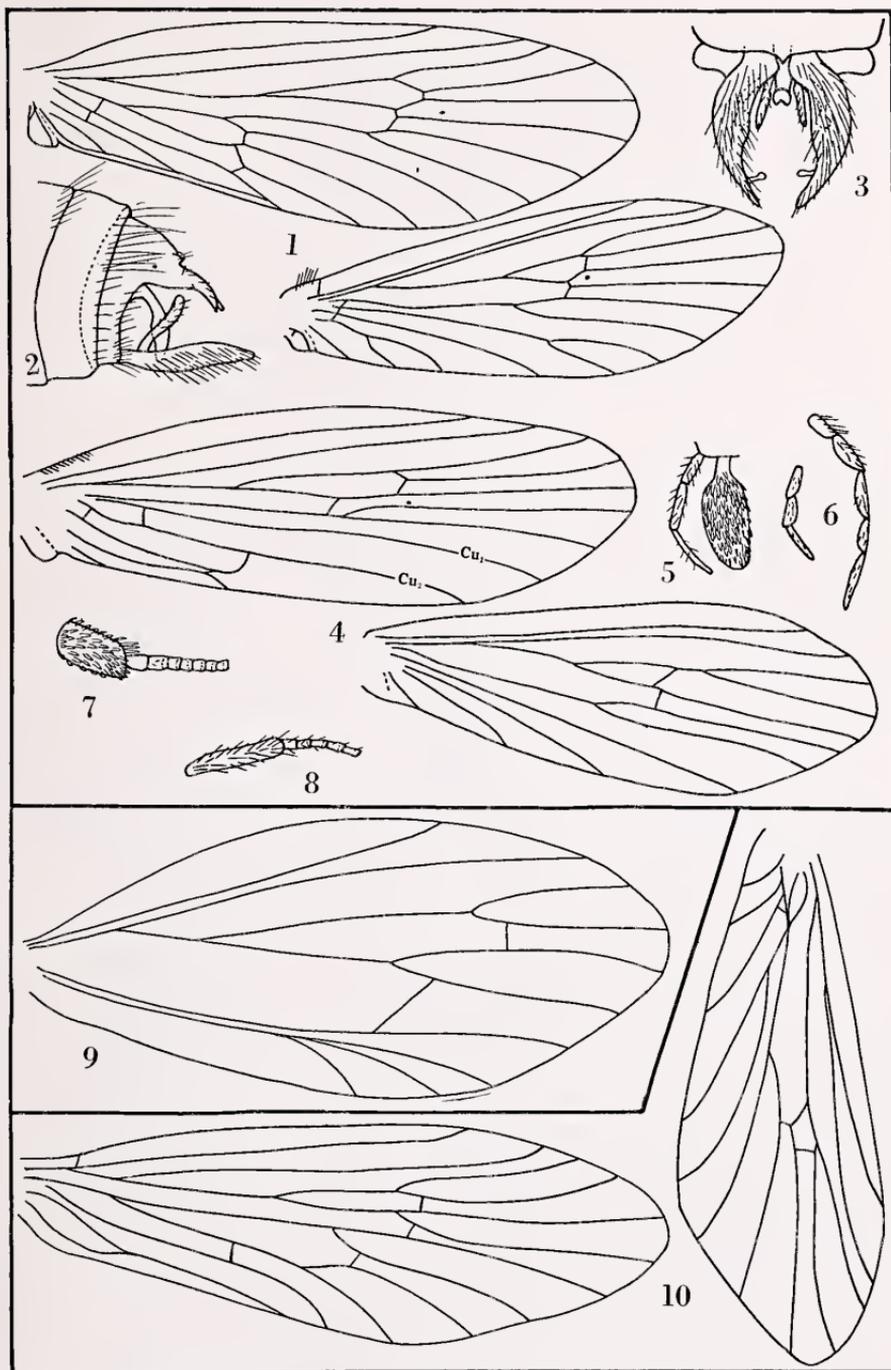
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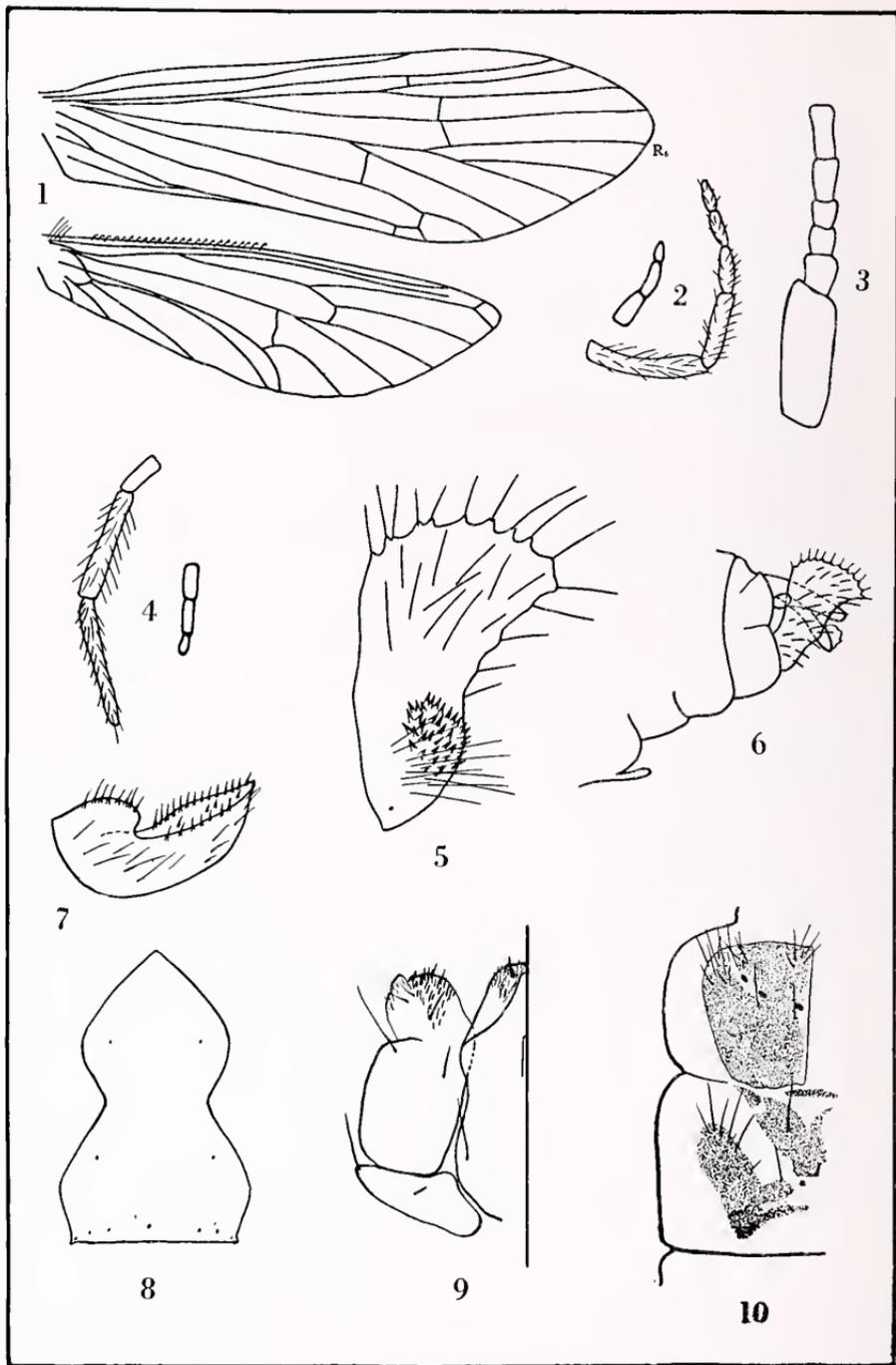
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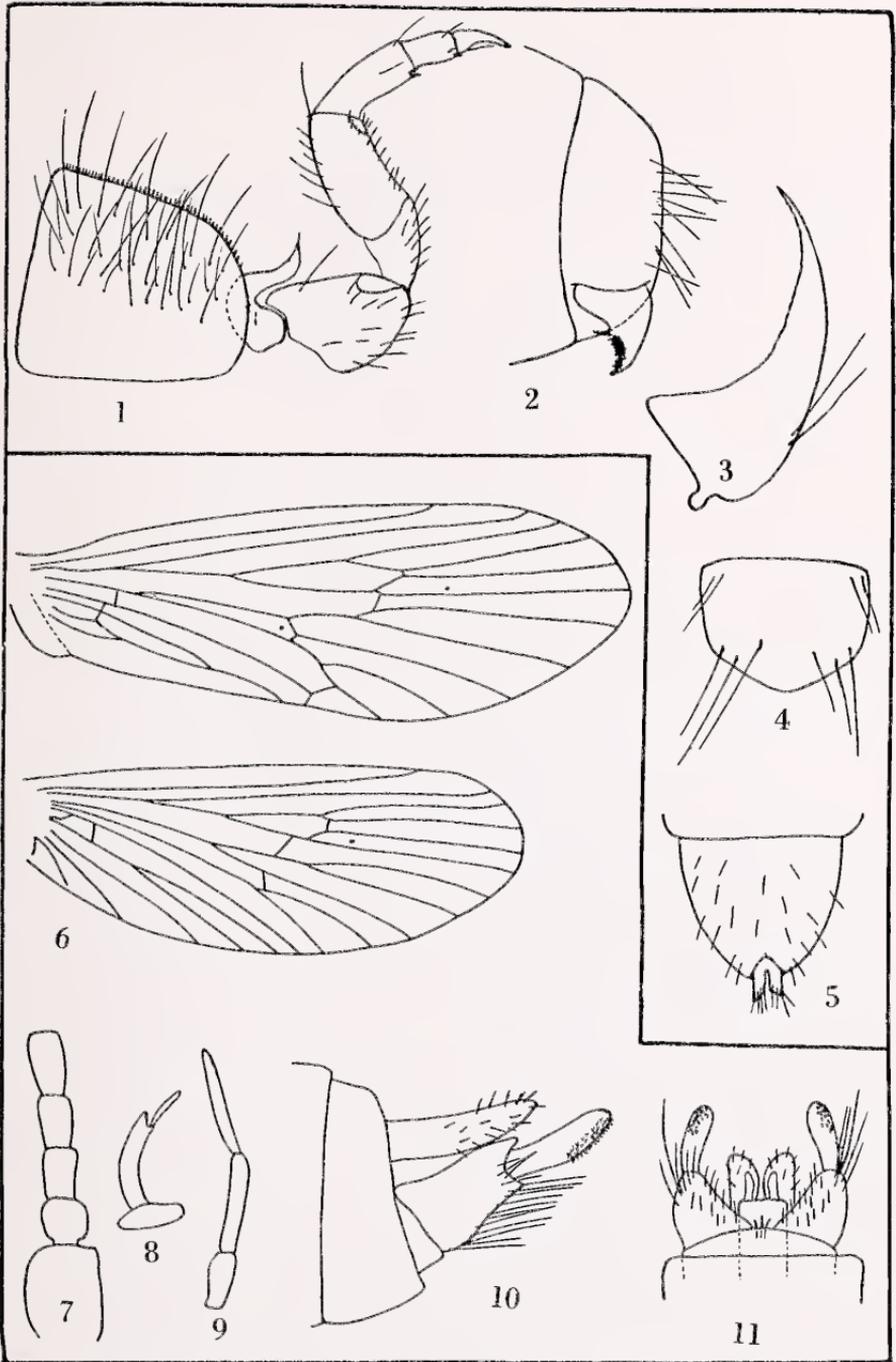
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