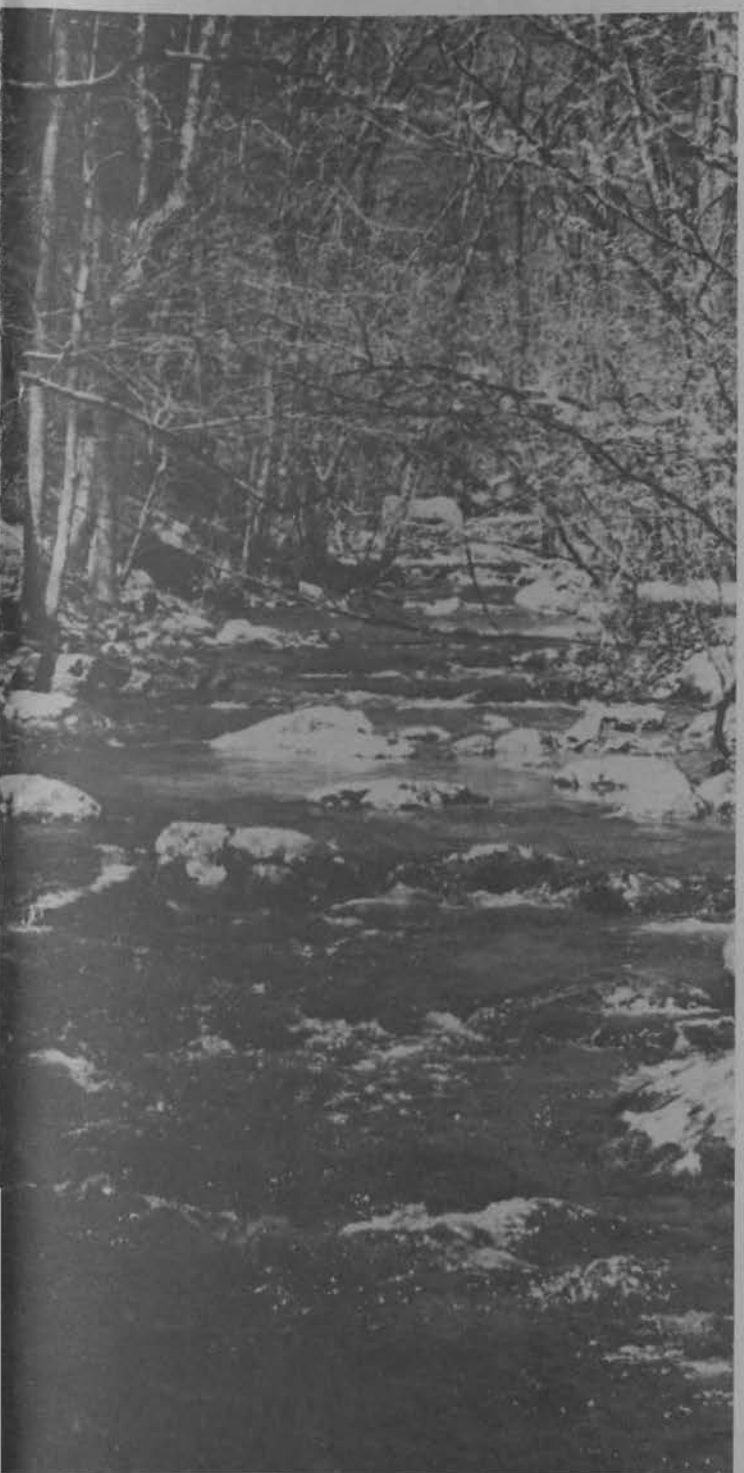

AQUATIC INSECTS OF WISCONSIN

Generic Keys and Notes on Biology, Ecology and Distribution

Technical Bulletin No. 89
Department of Natural Resources
Madison, Wisconsin
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AQUATIC INSECTS OF WISCONSIN

With Generic Keys and Notes on Biology, Ecology, and Distribution

by
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INTRODUCTION

The most recent keys to genera of aquatic insects in North America appear in Pennak (1953), Usinger (1956), and Edmundson (1959), but many taxonomic advances have been made since their publication. Increased interest in the aquatic environment has led to a demand for up-to-date keys to aquatic insects. I have attempted to fill that demand by providing generic keys to aquatic insects that occur in Wisconsin. These keys are restricted to genera that are likely to be found in Wisconsin, and treat only aquatic stages of those genera. The regional scope of the keys eliminates many genera that occur only in distant parts of North America, thus simplifying their use. Although the keys are intended for use in Wisconsin, they should also be applicable for neighboring states.

General information on the biology, ecological requirements, and distribution and abundance of genera in Wisconsin is also included. Appended to each key is a list of species that occur in Wisconsin; species and genera that may occur but have not yet been collected are marked with an asterisk. References to the most recent keys to species that are not monotypic are also included for most of the orders. Because of many uncertainties in identification, no list of species is appended for Diptera, Lepidoptera, or Neuroptera, and no effort has been made to denote by asterisks which species of Ephemeroptera have not been collected in Wisconsin.

KEY TO ORDERS OF AQUATIC INSECTS IN WISCONSIN

1a. Thorax with 3 pairs of segmented legs **3**
1b. Thorax without segmented legs **2**
2a. Mummy-like, in a case, often silk-cemented and containing vegetable or mineral matter ..... pupae (not keyed)
2b. Not in a case; mobile larvae, mostly with prolegs or pseudopods on one or more segments ..... **DIPTERA**
3a. With wings or external wing pads (may be inconspicuous) **4**
3b. Wings or external wing pads absent **10**
4a. With large, functional wings **5**
4b. With wing pads or brachypterous wings **7**
5a. Both pairs of wings completely membranous, with numerous veins ... not aquatic, adults of Plecoptera or Trichoptera that may enter water to oviposit.
5b. Front wings hardened, leather-like in basal half, or shell-like **6**
6a. Front wings hard, opaque, shell-like, and without veination ..... **COLEOPTERA** adults
6b. Front wings hardened only in basal half, mostly membranous and with conspicuous veination near apex **HEMIPTERA**
7a. With 2 or 3 long, filamentous terminal appendages **8**
7b. Terminal appendages absent or not filamentous **9**
8a. Sides of abdomen with plate-like, feather-like, or leaf-like gills; usually with 3 tail filaments, occasionally only 2 .... **EPHEMEROPTERA**
8b. Gills absent from middle abdominal segments; 2 tail filaments ..... **PLECOPTERA**
9a. Labium forming on elbowed, extensile grasping organ .... **ODONATA**
9b. Mouthparts sucking, formed into a broad or narrow tube .. .. **HEMIPTERA**
10a. Mouthparts sucking, formed into a narrow tube **11**
10b. Mouthparts not formed into a narrow tube **12**
11a. Parasitic on sponges; all tarsi with one claw **NEUROPTERA**
11b. Free-living, walking on surface of water or swimming; mesotarsi with two claws ..... **HEMIPTERA**
12a. Ventral abdominal prolegs each with a ring of fine hooks (crochets) ..... **LEPIDOPTERA**
12b. Abdomen without ventral prolegs, except on terminal segment **13**
13a. Antennae extremely small, inconspicuous, one-segmented ..... **TRICHOPTERA**
13b. Antennae elongate, with 3 or more segments **14**
14a. A single claw on each tarsus ..... **COLEOPTERA** larvae
14b. Each tarsus with 2 claws **15**
15a. With conspicuous lateral filaments **16**
15b. Without conspicuous lateral filaments **COLEOPTERA** larvae
16a. Abdomen terminating in 2 slender filaments or a median proleg with 4 hooks ..... **COLEOPTERA** larvae
16b. Abdomen terminating in a single slender filament or in 2 prolegs, each with 2 hooks ..... **MEGALOPTERA**

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PLECOPTERA (Stoneflies)

This small hemimetabolous order is represented in Wisconsin by about 65 species. Nymphs inhabit streams of all sizes, but require high levels of dissolved oxygen and are not found in polluted streams. Low levels of pollution from pasturing cattle probably account for their absence from most streams in agricultural areas of southern Wisconsin. Although numerous in many streams where they are an important source of food for fish, they never become so abundant as to create nuisance problems.

Nymphs of all species are strictly aquatic. Adults of many species can be found close to streams from which they emerged; others fly many miles and are attracted to lights. Adults generally live one to five weeks, and some are known to feed on terrestrial algae. The biology of most species is poorly known, but recent studies indicate 6 to 18 nymphal instars, larger species with longer life cycles having the greatest number.

PTERONARCIDAE (1 genus, 2 species)

Both species are widely distributed throughout the state, the nymphs occurring most commonly among debris in fast water of medium to large streams. In Wisconsin the life cycle is 3 years, with emergence mostly in April and May. Nymphs are detritivores, and appear to be more tolerant of lowered dissolved oxygen levels than most other stoneflies.

NEMOURIDAE (5 genera, 9 species)

Several species are common in Wisconsin, and all have a one-year life cycle. Nymphs inhabit streams of all sizes and often are the only stoneflies to inhabit springs and spring runs. Adults emerge mostly in spring and early summer, depending on the species. One species of *Amphinemura* emerges in early fall. Nymphs may be encountered throughout the year among debris where they feed on diatoms and detritus, but they are very small in late fall.

LEUCTRIDAE (2 genera, 5 species)

Nymphs can be collected uncommonly throughout the year, but are mostly very small in the fall. All species are univoltine, with emergence from May through September, depending on the species. Adults feed on algae and hide in the vicinity of streams from which they emerged. Nymphs are detritivores, and are found among gravel and debris in fast, permanent streams.

CAPNIIDAE (3 genera, 10 species)

Adults of this family are known as "winter stoneflies" because they emerge from January *(Allocapnia)* through April *(Paracapnia),* and can frequently be found crawling on the ice and snow near streams. *Paracapnia* and *Allocapnia* nymphs occur abundantly in streams of all sizes, the latter even in temporary streams; *Capnia* is rare in northwestern Wisconsin. All species are univoltine, with *Allocapnia* spending spring and summer months in the substrate as tiny diapausing nymphs. *Paracapnia* nymphs remain active and can be found through the fall and winter. Nymphs feed on algae and detritus, and are found most abundantly in allochthonous debris.

TAENIOPTERYGIDAE (3 genera, 5 species)

Adults of this family are also "winter stoneflies," emerging in March and early April. The eggs hatch almost immediately, the small nymphs feed briefly, and then burrow into the substrate where they spend the late spring and summer in diapause. Mummy-like diapausing nymphs resume a normal appearance in September and commence feeding on allochthonous detritus and some diatoms. *Taeniopteryx* is common statewide along the banks and among debris in a wide variety of permanent streams.

PERLIDAE (7 genera, 10 species)

Attaneuria, Neoperla, and *Perlinella* occur uncommonly in larger streams, but the other genera are common in a wide variety of streams, especially in strong current where they cling to rocks or debris. *Acroneuria, Paragnetina,* and *Phasganophora* require at least two years to complete their development, adults emerging from May to July. *Perlesta* has a one-year life cycle with emergence in July or August, the nymphs being found mostly from May to August. Nymphs of all species are strictly carnivorous and feed mostly on Chironomidae, Ephemeroptera, and other insects.

PERLODIDAE (3 genera, 16 species)

Arcynopteryx is rare along the shores of Lake Superior, and recently *Isogenoides* nymphs have been found only in cold streams in the northern fourth of the state. *Isoperla* occurs abundantly statewide in all types of unpolluted streams, where nymphs cling to rocks and debris. Nymphs of *Isogenoides* are strictly carnivorous and require one year to complete their development, adults emerging mostly in June. Although most species of *Isoperla* are also carnivores, at least two are herbivore-detritivores and others omnivores. Emergence of *Isoperla* occurs from April to July, depending on the species, but unlike *Isogenoides,* whose eggs hatch almost immediately, hatching of the eggs is delayed until fall in most species.

CHLOROPERLIDAE (3 genera, 6 species)

All species are apparently univoltine. *Alloperla* nymphs are uncommon and have been collected only from rapid streams in northern Wisconsin during the summer, while *Hastaperla* is fairly common throughout the northern half of the state in a wide variety of permanent streams. Nymphs of both genera are carnivores that prey mostly on larvae of Chironomidae. Adults of *Hastaperla* have been collected from May to July, but nymphs have been found only from November through May, suggesting a delayed hatching of eggs. *Rasvena* nymphs remain unknown.

KEY TO GENERA OF PLECOPTERA NYMPHS IN WISCONSIN

1a. Finely branched gills present ventrally or laterally on thorax **2**

1b. Gills absent, confined to prosternum, or not branched.. **3**

2a. Finely branched gills on abdominal sterna 1 and 2 ..... PTERONARCIDAE, **Pteronarcys**

2b. Gills absent from abdominal sterna ..... PERLIDAE **17**

3a. Metathoracic wing pads strongly diverging from axis of body (Figs. 1, 2); robust nymphs with abdomen usually widest in basal third **4**

3b. Metathoracic wing pads nearly parallel along inner margins (Figs. 3-7); elongate nymphs, with abdomen parallel-sided or widest in distal third **6**

4a. Tips of glossae produced nearly as far forward as tips of paraglossae (Fig. 8) **5**

4b. Tips of glossae situated much behind tips of paraglossae (Fig. 9) ..... PERLODIDAE **23**

5a. Second tarsal segment (side view) about as long as, or longer than first (Fig. 10) ..... TAENIOPTERGIDAE **11**

5b. Second tarsal segment much shorter than first (Fig. 11) .. .. NEMOURIDAE **13**

6a. Tips of glossae produced nearly as far forward as tips of paraglossae (Fig. 8) **7**

6b. Tips of glossae situated much behind tips of paraglossae (Fig. 9) ..... CHLOROPERLIDAE **25**

7a. Only first 6 abdominal segments, usually fewer, divided into terga and sterna by a membranous lateral fold (Fig. 12) .. .. LEUCTRIDAE **8**

7b. Terga and sterna of abdominal segments 1 to 9 divided by a membranous fold ventrolaterally (Fig. 13) CAPNIIDAE **9**

8a. LEUCTRIDAE — Only first 4 abdominal segments divided by lateral fold ..... **Leuctra**

8b. First 6 abdominal segments divided by lateral fold .... **Zealeuctra**

9a. CAPNIIDAE — Conspicuous bristles along posterior margin of posterior abdominal terga and on other parts of body (Fig. 14); head with dorsal purplish pattern ... **Paracapnia**

9b. Abdominal bristles inconspicuous and usually more uniformly distributed on each tergum (Fig. 15); head without distinct dorsal pattern **10**

10a. Metathoracic wing pads notched near tip or absent (Fig. 4); tip of galea tapered or pointed (Fig. 16) ..... **Allocapnia**

10b. Metathoracic wing pads notched on inner margin halfway to tip (Fig. 5); tip of galea truncate, with a fringe of long hairs (Fig. 17) ..... **Capnia**

11a. TAENIOPTERYGIDAE — Single gills present on inner side of each coxa; ninth sternum only slightly produced (Fig. 18) ..... **Taeniopteryx**

11b. Gills absent; ninth sternum much produced (Fig. 19) .. **12**

12a. Dorsum yellow with a distinct darker pattern **Strophopteryx**

12b. Dorsum uniformly brown, sometimes with indistinct light areas ..... **Oemopteryx**

13a. NEMOURIDAE — Four branched gills on prosternum .... **Amphinemura**

13b. Prosternum without gills **14**

14a. Pronotum with a lateral fringe (Figs. 20, 21) **15**

14b. Pronotum without a definite lateral fringe (Fig. 22) **16**

15a. Pronotum with shallow notch laterally; a longer, thinner seta in lateral fringe at anterolateral angles and near posterolateral angles (Fig. 20) ..... **Soyedina**

15b. Pronotum rounded laterally; longer, thinner setae absent from lateral fringe (Fig. 21) ..... **Nemoura**

16a. Only ventral bristles of cercal whorls longer than other bristles (Fig. 23); legs indistinctly banded ..... **Shipsa**

16b. Dorsal and ventral bristles of cercal whorls longer than lateral bristles (Fig. 24); legs not banded ..... **Prostoia**

17a. PERLIDAE — Eyes much anterior to hind margin of head (Fig. 25) ..... **Perlinella**

17b. Eyes situated normally, close to hind margin of head (Figs. 26-28) **18**

18a. Anterior ocellus absent; distinct transverse occipital ridge across back of head (Fig. 26); subanal gills present (Fig. 29) ..... **Neoperla**

18b. Three ocelli present (Figs. 27, 28) **19**

19a. A closely set regular row of spinules inserted on a low occipital ridge completely across back of head (Fig. 26) **20**

19b. Occipital ridge absent; spinules on back of head present mainly at sides, or arranged in a transverse row of varying completeness, but always at least a little wavy or irregular (Fig. 27) **21**

20a. Subanal gills present (Fig. 29) ..... **Phasganophora**

20b. Subanal gills absent (Fig. 30) ..... **Paragnetina**

21a. Back of head without spinules, except around eyes (Fig. 28) ..... **Acroneuria**

21b. Back of head with an irregular row of large spinules (Fig. 27) **22**

22a. Subanal gills present (Fig. 29); head patterned .. **Perlesta**

22b. Subanal gills absent (Fig. 30); head unicolorous brown ... . **Attaneuria**

23a. PERLODIDAE — Submental gills present, usually twice as long as their greatest width (Fig. 31) **24**

23b. Submental gills absent (Fig. 32) ..... **Isoperla**

24a. Arms of Y-ridge of mesosternum meet posterior corners of furcal pits (Fig. 33) ..... **Isogenoides**

24b. Arms of Y-ridge approach anterior corners of furcal pits (Fig. 34); 3 large pale spots on each abdominal tergum (Lake Superior) ..... **Arcynopteryx**

25a. CHLOROPERLIDAE — Length of mature nymphs less than 7mm; metathoracic wing pads with inner margins parallel and with several long, pale setae projecting from apex (Fig. 6) ..... **Hastaperla**

25b. Length of mature nymph in excess of 7mm; metathoracic wing pads with inner margins diverging and with only a few inconspicuous setae at apex (Fig. 7) ..... **Alloperla**

Rasvena not keyed

SPECIES LIKELY TO BE FOUND IN WISCONSIN AND MOST RECENT KEY TO SPECIES

PTERONARCIDAE (Adult and nymphal keys Harden and Mickel 1952)

Pteronarcys — dorsata, pictetii

NEMOURIDAE (Adult and nymphal keys Hitchcock 1974)

*Amphinemura — delosa, linda, varshava**
Nemoura — trispinosa
Prostoia — completa, similis
Shipsa — rotunda
Soyedina — vallicularia

LEUCTRIDAE (Adult and nymphal keys Hitchcock 1974)

Leuctra — ferruginea, sibleyi, tenella, tenuis
Zealeuctra — narfi

CAPNIIDAE (Adult and nymphal keys Harper and Hynes 1971)

Allocapnia — granulata, illinoensis, minima, nivicola, pygmaea, rickeri, vivipara
Capnia — vernalis
Paracapnia — angulata, opis

TAENIOPTERYGIDAE (Adult and nymphal keys Hitchcock 1974)

Oemopteryx — glacialis
Strophopteryx — fasciata
Taeniopteryx — burksi, nivalis, parvula

PERLIDAE (Adult and nymphal keys Hitchcock 1974)

Acroneuria — abnormis, internata, lycorias
Attaneuria — ruralis
Neoperla — clymene
Paragnetina — media
Perlesta — placida
Perlinella — drymo, ephyre
Phasganophora — capitata

PERLODIDAE (Adult and nymphal keys Hilsenhoff and Billmyer 1973)

Arcynopteryx — compacta**
Isogenoides — frontalis, krumholzi, olivaceus*
Isoperla — bilineata, clio, cotta, dicala, frisoni, lata, marlynia, nana, richardsoni, signata, slossonae, transmarina

CHLOPERLIDAE (Adult key Hitchcock 1974). No reliable key to nymphs.

Alloperla — caudata, imbecilla*, quadrata**
Hastaperla — brevis, orpha
Rasvena — terna

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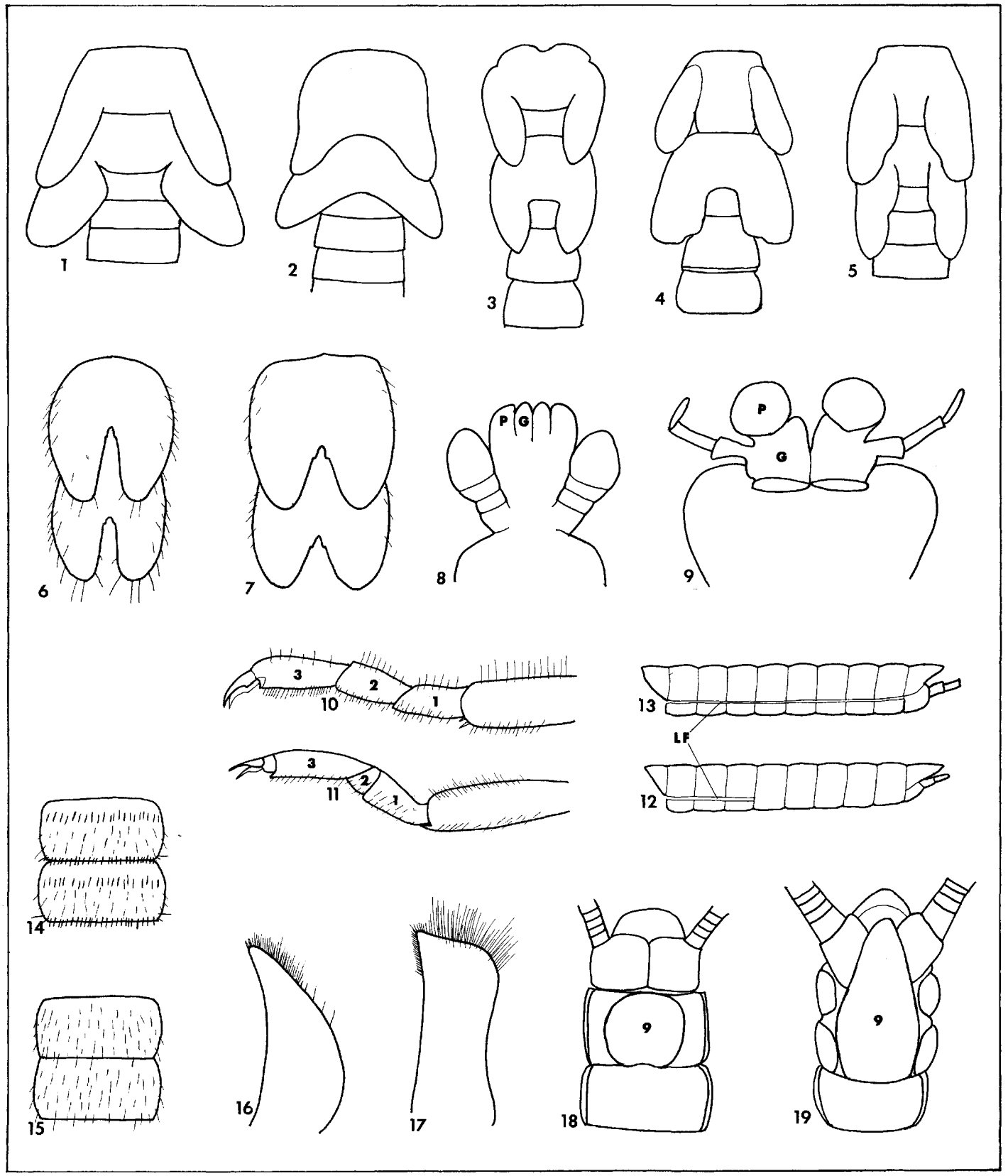
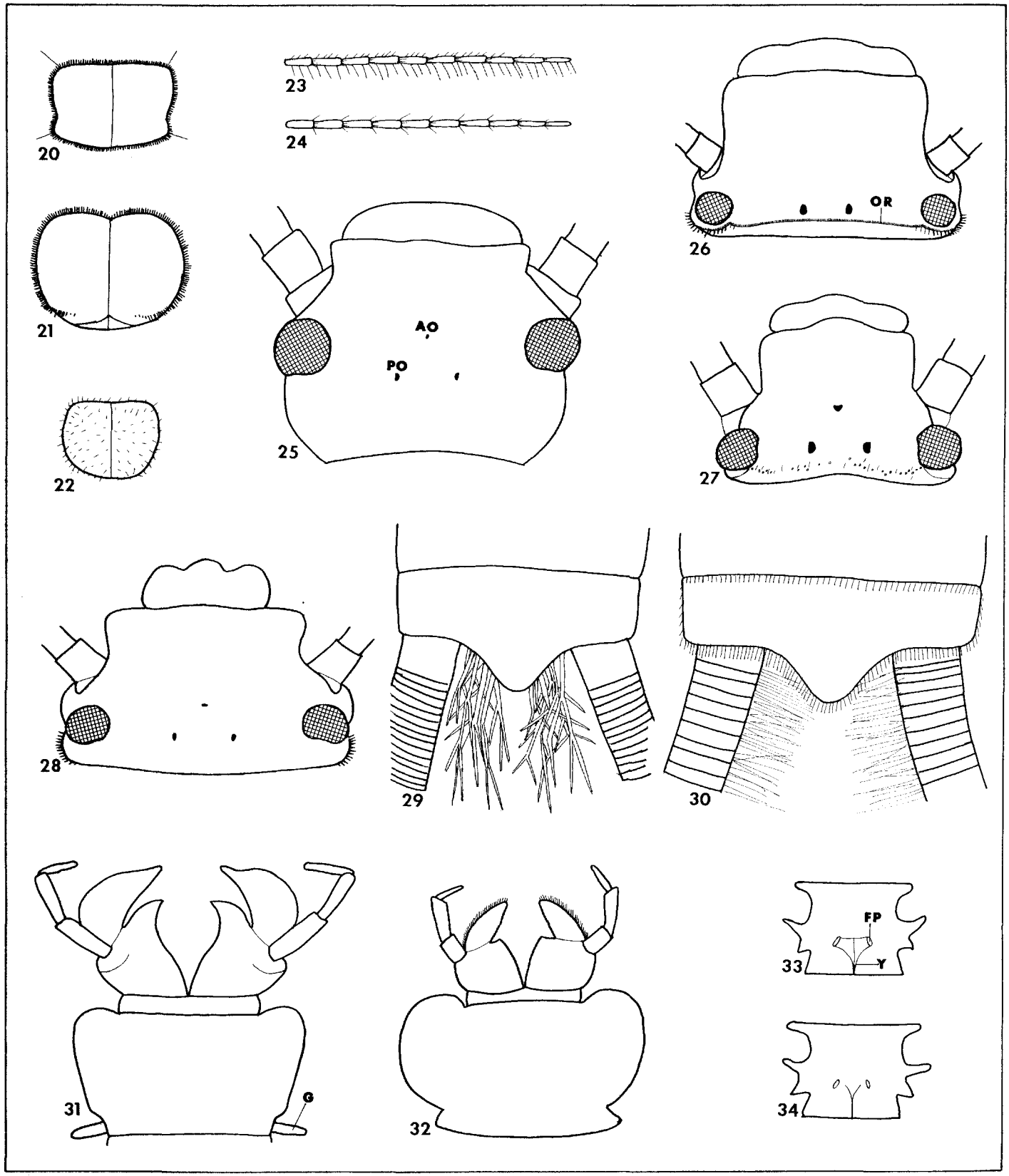


Figures 1-19. — Plecoptera. 1. Wingpads of *Nemoura*. 2. Wingpads of *Isoperla*. 3. Wingpads of *Paracapnia*. 4. Wingpads of *Allocapnia*. 5. Wingpads of *Capnia*. 6. Wingpads of *Hastaperla*. 7. Wingpads of *Alloperla*. 8. Labium of *Nemoura* showing location of glossae (G) and paraglossae (P). 9. Labium of *Acroneuria* showing location of glossae (G) and paraglossae (P). 10. Tarsal segments (1, 2, 3) of *Taeniopteryx*. 11. Tarsal segments (1, 2, 3) of *Nemoura*. 12. Lateral view of abdomen of *Leuctra* showing lateral fold (LF). 13. Lateral view of abdomen of *Allocapnia* showing lateral fold (LF). 14. Abdominal terga 7 and 8 of *Paracapnia*. 15. Abdominal terga 7 and 8 of *Allocapnia*. 16. Galea of *Allocapnia*. 17. Galea of *Capnia*. 18. Ninth sternum (9) of *Taeniopteryx*. 19. Ninth sternum (9) of *Strophopteryx*.



Figures 20-34. — Plecoptera. 20. Pronotum of *Soyedina*. 21. Pronotum of *Nemoura*. 22. Pronotum of *Prostoia*. 23. Lateral view of terminal segments of a cercus of *Shipsa*. 24. Lateral view of terminal segments of a cercus of *Prostoia*. 25. Head of *Perlinella* showing location of anterior ocellus (AO) and posterior ocelli (PO). 26. Head of *Neoperla* showing occipital ridge (OR). 27. Head of *Perlesta*. 28. Head of *Acroneuria*. 29. Dorsal view of terminal segments of *Phasganophora*. 30. Dorsal view of terminal segments of *Paragnetina*. 31. Labium of *Isogenenoides* showing submental gills (G). 32. Labium of *Isoperla*. 33. Mesosternum of *Isogenoides* showing location of furcal pits (FP) and Y-ridge (Y). 34. Mesosternum of *Arcynopteryx*.

EPHEMEROPTERA (Mayflies)

About 150 species occur in Wisconsin, where nymphs inhabit a wide variety of streams throughout the state. Although most species require high levels of dissolved oxygen, many are more tolerant of low dissolved oxygen levels than stoneflies, and are thus more widespread in Wisconsin's streams. Nymphs of some species can also be found in lakes, ponds, marshes, and swamps. Their abundance in clean streams makes them an important source of food for fish, and occasionally they are so abundant that synchronized emergences of adults create nuisance problems because of their attraction to lights.

Adult mayflies do not feed, and generally live only a few days. In this hemimetabolous order there is an extra winged stage between the nymph and adult, the subimago. It usually lasts less than one day and in some species only a few minutes. Most species are univoltine and have 3-20 nymphal instars. With few exceptions, nymphs are herbivores or detritivores.

SIPHLONURIDAE (5 genera, 18 species)

Isonychia is the most common genus, with nymphs being found commonly throughout the year among rocks and debris in rapid currents of a variety of streams. Most species in this genus are apparently bivoltine, while species in other siphlonurid genera are univoltine. Nymphs of *Siphlonurus* are fairly common among shoreline vegetation of larger streams in late fall and before their emergence in late spring. *Ameletus* and *Parameletus* are rare in Wisconsin. The former occurs in very small, rapid streams that may be temporary, and emerges in late spring. *Parameletus* develops rapidly in woodland pools in spring, emerging in May. *Acanthametropus* was collected in 1927 from the mouth of the Pecatonica River just south of Wisconsin, but has not been found since.

OLIGONEURIIDAE (1 genus, 1 species)

Homoeoneuria has been collected from the Rock River in Illinois and may occur in sand bottoms of deep, large rivers in southern Wisconsin.

HEPTAGENIIDAE (9 genera, 24 species)

Nymphs of *Heptagenia, Stenacron,* and *Stenonema* are very common year-around in a wide variety of streams throughout the state. Species of *Heptagenia* and *Stenonema* also inhabit wave-swept shorelines of lakes and have been found at depths of 50 feet or more in Lake Superior. *Epeorus* and *Rhithrogena* occur in rapid, clean streams in the northern half of the state where nymphs are relatively uncommon. *Arthroplea* nymphs are found in vernal pools near large streams in northern Wisconsin, developing rapidly and emerging in late May. *Spinadis, Anepeorus,* and *Pseudiron* are very rare in deep waters of large rivers, the difficulty of collecting in such habitats probably contributing to their apparent rarity. These three genera are unusual because of their carnivorous habits. With the exception of some bivoltine *Heptagenia* and *Stenonema,* heptageniids are univoltine.

METRETOPODIDAE (2 genera, 3 species)

Nymphs of Wisconsin's two genera are relatively uncommon among shoreline vegetation in slower waters of large streams. Adults emerge in late spring, with nymphs being present from late fall to emergence.

BAETIDAE (7 genera, 40 species)

Mayflies in this family occur in almost every stream, pond and weedy lake margin in the state. *Baetis* and *Pseudocloeon* nymphs are common in riffles and along banks of both clean and partially polluted streams during the warmer months, but are uncommon in winter. Most species are univoltine, but some have 2 generations each year. *Centroptilum, Cloeon,* and *Heterocloeon* are uncommon in Wisconsin's streams, and *Paracloeodes* has not been collected. *Callibaetis* is multivoltine, and nymphs can be found among vegetation of almost every pond, lake margin, or stream backwater.

LEPTOPHLEBIIDAE (5 genera, 13 species)

Both *Leptophlebia* and *Paraleptophlebia* are common inhabitants of clean streams throughout the state, the former being found in slow water while the latter occurs in rapid water. Nymphs of *Leptophlebia* leave streams in early spring to enter vernal pools from which they emerge. Species of *Paraleptophlebia* and *Choroterpes* emerge from streams in late spring and summer. *Habrophlebia* and *Habrophlebiodes* have not yet been found in Wisconsin, but should be collected in eddies along stream banks. All Leptophlebiidae are apparently univoltine in Wisconsin.

EPHEMERELLIDAE (1 genus, 19 species)

The only genus is represented by many species in Wisconsin and the nymphs can be found in a variety of habitats from shallow lake margins to very rapid streams. All species are univoltine, with emergence from spring throughout the summer, depending on the species. Most stream inhabiting species appear to be intolerant of lowered levels of dissolved oxygen and occur only in unpolluted streams. Species in one subgenus *(Drunella)* are omnivores, feeding on chironomid larvae as well as plant foods.

TRICORYTHIDAE (1 genus, 2 species)

Nymphs are fairly common among gravel in permanent streams of all sizes. There are at least two generations each year, with much overlapping. Nymphs are most commonly collected in summer and early fall, and are generally absent from spring collections.

CAENIDAE (2 genera, 10 species)

Caenis nymphs occur in a variety of aquatic habitats and appear more tolerant of low dissolved oxygen levels than any other mayfly. Nymphs can be commonly found in the littoral and sublittoral zones of lakes, in ponds and marshes, and in a wide variety of streams where they occur among debris in rapid or slow water. *Brachycercus* nymphs are uncommon among silt-sand stream margins and have been found many miles from shore in Green Bay. Life cycles are poorly known.

POTAMANTHIDAE (1 genus, 2 species)

Nymphs can be found mostly in gravel bottoms of streams where the water is fairly shallow and rapid, but they are rarely abundant. The life cycle is apparently one year, with emergence throughout the summer months.

EPHEMERIDAE (4 genera, 8 species)

Species are univoltine, with synchronized emergences that sometimes create nuisance problems because of their attraction to light. Cities on the Mississippi River and the Great Lakes have experienced difficulties with emergences of *Hexagenia.* Burrowing nymphs of *Hexagenia* are common in silt bottoms of larger streams, while *Ephemera* nymphs burrow commonly in sand and gravel riffles of fast, clean streams, especially in northern Wisconsin. *Pentagenia* and *Litobrancha* are rare in Wisconsin.

POLYMITARCIDAE (2 genera, 3 species)

Nymphs of *Ephoron* are relatively uncommon, being found mostly under rocks in medium-sized, rapid streams. They are univoltine, with emergence during the summer months. *Tortopus* nymphs have not been collected in Wisconsin from their clay-bank habitat.

BAETISCIDAE (1 genus, 4 species)

Although the life cycle is one year, nymphs of different sizes often occur together, suggesting considerable overlap of generations. Nymphs are common in sandy streams with a thin layer of silt along the shores in which the nymphs can partially burrow.

KEY TO GENERA OF EPHEMEROPTERA NYMPHS IN WISCONSIN

1a. Mandibles with large forward-projecting tusks (Fig. 1); gills on abdominal segments 2-7 with fringed margins (Fig. 2) **2**
1b. Mandibles without such tusks **8**
2a. Gills dorsal, curving up over abdomen; protibiae fossorial (Fig. 3) **3**
2b. Gills lateral, projecting from sides of abdomen; protibiae slender, subcylindrical (Fig. 4) ..... POTAMANTHIDAE **Potamanthus**
3a. Conspicuous frontal process between bases of antennae (Figs. 1, 5, 6) **4**
3b. No such process; mandibular tusks with a single, prominent, subapical tooth on inner margin (Fig. 7) ..... POLYMITARCIDAE, **Tortopus**
4a. Mandibular tusks curve inward apically, upper surface with numerous tubercles (Fig. 8) .. POLYMITARCIDAE, **Ephoron**
4b. Mandibular tusks curve upward apically, no tubercles on upper surface (Fig. 9) ..... EPHEMERIDAE **5**
5a. EPHEMERIDAE — Frontal process bifid (Figs. 1, 6) **6**
5b. Frontal process rounded, conical, or truncate (Fig. 5).. **7**
6a. Mandibular tusks with teeth on outer or upper margin (Fig. 1); labial palpi 2-segmented ..... **Pentagenia**
6b. Mandibular tusks smooth on margins (Fig. 9); labial palpi 3-segmented ..... **Ephemera**
7a. Gills on abdominal segment 1 bifid ..... **Hexagenia**
7b. Gills on abdominal segment 1 single ..... **Litobrancha**
8a. Mesonotum modified into a carapace-like structure that covers the gills on abdominal segments 1-6 (Fig. 10) ..... BAETISCIDAE, **Baetisca**
8b. Mesonotum not modified into a carapace; gills exposed **9**
9a. Gills absent from abdominal segment 2, and sometimes from 1 and 3 also; gills on segment 3 or 4 may be operculate (Fig. 11) ..... EPHEMERELLIDAE, **Ephemerella**
9b. Gills present on abdominal segments 1 or 2 to 7 ..... **10**
10a. Gills on abdominal segment 2 operculate or semi-operculate, covering or partially covering the gills on the succeeding segments (Figs. 12, 13) **11**
10b. Gills on abdominal segment 2 similar to other gills ... **13**
11a. Operculate gills somewhat triangular and well separated from each other mesally (Fig. 12); succeeding gills without fringed margins ..... TRICORYTHIDAE, **Tricorythodes**
11b. Operculate gills quadrate and proximate mesally (Fig. 13); succeeding gills with fringed margins ..... CAENIDAE **12**
12a. CAENIDAE — Three prominent tubercles on head (Fig. 14); maxillary and labial palpi 2-segmented ..... **Brachycercus**
12b. No tubercles on head; maxillary and labial palpi 3-segmented ..... **Caenis**
13a. Head flattened dorso-ventrally; eyes and antennae dorsal (Figs. 15, 25); gills a single lamella, often with a fibrilliform tuft (Figs. 17, 18) ..... HEPTAGENIIDAE **14**
13b. Not as above; antennae and eyes lateral (Fig. 16) **22**
14a. HEPTAGENIIDAE — Nymph with only 2 tails **15**
14b. Nymph with 3 tails **16**
15a. Prominent dorsal tubercles on head, thorax, and abdomen ..... **Spinadis**
15b. No tubercles dorsally ..... **Epeorus**
16a. Last pair of gills reduced to a single slender filament with tracheation reduced or absent (Fig. 17) **17**
16b. Last pair of gills similar to preceding pairs (Figs. 18, 19) **18**
17a. Lamellate gills pointed apically (Fig. 20) ..... **Stenacron**
17b. Lamellate gills rounded or truncated apically (Figs. 21, 22) ..... **Stenonema**
18a. Gill lamellae enlarged on segments 1 and 7; all gills projecting ventrally to form a ventral disc (Fig. 19) ..... **Rhithrogena**
18b. Gill lamellae not as above, with those on segments 1 and 7 smaller than intermediate pairs **19**
19a. Gills with a fingerlike projection on lamellae (Fig. 23); tarsal claws very long ..... **Pseudiron**
19b. Gill lamellae without such a projection; claws normal .. **20**
20a. Gills ventral with fibrilliform portion large, lamellar portion small and fingerlike (Fig. 24) ..... **Anepeorus**
20b. Gills dorsal or lateral; fibrilliform portion smaller than lamellar portion **21**
21a. Distal segment of maxillary palpi at least 4 times as long as galea-lacinia (Fig. 25) ..... **Arthroplea**
21b. Distal segment of maxillary palpi much shorter ..... **Heptagenia**
22a. Claws on prothoracic legs bifid (Fig. 26); claws of meso- and metathoracic legs long and slender, about as long as tibiae (Fig. 27) ..... METRETOPODIDAE **23**
22b. Claws on all legs similar in structure **24**
23a. METRETOPODIDAE — Gills on abdominal segments 1-3 double lamellae ..... **Siphloplecton**
23b. Gills on all segments single lamellae ..... **Metretopus**
24a. Gills on abdominal segments 2-7 small, lateral, lanceolate, with a posterior fringe (Fig. 28); gills on segment 1 large, fibrilliform, and projecting between metacoxae ..... OLIGONEURIIDAE, **Homoeoneuria**
24b. Gills not as above **25**
25a. Gills forked (Figs. 29-31), or bilamellate and terminating in a filament or point (Figs. 32, 34), or clusters of filaments (Fig. 35) ..... LEPTOPHLEBIIDAE **26**
25b. Gills single or double lamellae (Figs. 45-47), sometimes with a ventral fibrilliform tuft **30**
26a. LEPTOPHLEBIIDAE — Each gill on abdominal segments 2 to 6 consists of 2 clusters of filaments (Fig. 35) ..... **Habrophlebia**
26b. Gills forked or bilamellate **27**
27a. Gills on abdominal segment 1 different in structure from succeeding pairs (Figs. 31-34) **28**
27b. Gills on segments 1 to 7 narrowly lanceolate and bifid (Figs. 29, 30) **29**
28a. Gills on segment 1 forked (Fig. 31), remaining gills bilamellate (Fig. 32) ..... **Leptophlebia**
28b. Gills on segment 1 single linear lamellae (Fig. 33), remaining gills bilamellate (Fig. 34) ..... **Choroterpes**
29a. Front of labrum rather deeply emarginate (Fig. 36); posterolateral spines on abdominal segment 9 one-half as long as that segment (Fig. 37) ..... **Habrophlebiodes**
29b. Front of labrum only shallowly emarginate (Fig. 38); posterolateral spines on segment 9 not more than one-fourth as long as that segment (Fig. 39) ..... **Paraleptophlebia**
30a. Abdominal segments 8 and 9 produced posterolaterally into distinct, flattened spines (Figs. 40, 41); if spines are weak, antennae are less than twice width of head ..... SIPHLONURIDAE **31**
30b. Abdominal segments 8 and 9 without such spines (Fig. 42); if weak spines are present (Fig. 43), antennae are more than twice width of head ..... BAETIDAE **35**
31a. SIPHLONURIDAE — Prothoracic legs with a dense row of long setae on inner surface (Fig. 44); abdominal gills composed of single lamellae with a fibrilliform tuft.. **Isonychia**
31b. Prothoracic legs without a dense row of long setae; gills without a fibrilliform tuft **32**
32a. Head, pronotum, and mesonotum with conspicuous lateral spines; a row of median spines on abdominal terga ..... **Acanthametropus**
32b. Without such spines **33**
33a. Gill lamellae double on segments 1 and 2, and sometimes other segments (Fig. 45) ..... **Siphlonurus**
33b. Gill lamellae single on all segments (Figs. 46, 47) **34**
34a. Gills with sclerotized band on ventral margin and little or no tracheation (Fig. 46); maxillae with a crown of pectinate spines ..... **Ameletus**
34b. Gills with well-developed tracheation (Fig. 47); maxillae without pectinate spines ..... **Parameletus**

35a. BAETIDAE — With only 2 well-developed tails, median tail absent or no longer than tenth tergum **36**

35b. With 3 well-developed tails, although median tail may be shorter and thinner than laterals, it is much longer than tenth tergum (Fig. 48) **37**

36a. Metathoracic wing-pads present, though they may be minute (Fig. 49) ..... **Heterocloeon**

36b. Metathoracic wing-pads absent ..... **Pseudocloeon**

37a. Median tail shorter and often thinner than lateral ones (Fig. 48); all gills single lamellae; tarsal claws short and denticulate (Fig. 50) ..... **Baetis**

37b. Median tail subequal to lateral ones (Fig. 51) **38**

38a. Metathoracic wing-pads present **39**

38b. Metathoracic wing-pads absent **40**

39a. Gills double lamellae on abdominal segments 1 and 2, with ventral lamella smaller (Fig. 52); lamellae with well-developed palmately or pinately branched trachea .... **Callibaetis**

39b. Gills single lamellae or with a small dorsal flap (Fig. 53); tracheation of gills sparse, with branches usually on inner side only ..... **Centroptilum**

40a. Mature nymph 3mm long; a large round pale spot with a dark border on second abdominal tergum; labial palpi 2-segmented; gill lamellae single ..... **Paracloeodes**

40b. Mature nymph at least 4mm long; dark-bordered pale spot absent from second abdominal tergum; labial palpi 3-segmented; gill lamellae sometimes double or with a dorsal flap ..... **Cloeon**

SPECIES LIKELY TO BE FOUND IN WISCONSIN AND MOST RECENT KEY TO SPECIES

The most recent and complete keys to Ephemeroptera adults and nymphs are in Needham, Traver, and Hsu (1935) and Burks (1953). Nymphal keys are mostly incomplete and should be used with caution. Keys more recent and complete than the above are listed below.

SIPHLONURIDAE

Acanthametropus — pecatonica*
Ameletus — browni, lineatus, ludens, walleyi (Harper 1970)
Isonychia — bicolor, harperi, rufa, sadleri, sayi, sicca
Parameletus — croesus, mldas
Siphlonurus — alternatus, marshalli, quebecensis, rapidus, typicus

OLIGONEURIIDAE

Homoeoneuria — ammophila*

HEPTAGENIIDAE — (Adult and nymphal keys Flowers and Hilsenhoff 1975)

Anepeorus — simplex*
Arthroplea — bipunctata
Epeorus — vitrea
Heptagenia — diabasia, flavescens, hebe, lucidipennis, pulla
Pseudiron — centralis*
Rhithrogena — impersonata, jejuna, pellucida, undulata
Spinadis — undescribed sp.
Stenacron — interpunctatum
Stenonema — bipunctatum, exiguum, fuscum, integrum, mediopunctatum, pulchellum, rubrum, terminatum, tripunctatum

METRETOPODIDAE

Metretopus — borealis
Siphloplecton — basale, interlineatum

BAETIDAE

Baetis — anachris, baeticatus, brunneicolor, cingulatus, frondalis, hiemalis, intercalaris, ochris, pallidulus, pluto, propinquus, pygmaeus, spinosus, vagans
Callibaetis — brevicostatus, ferrugineus, fluctuans, hageni, skokianus
Centroptilum — album, bellum, convexum, rufostrigatum
Cloeon — alamance, insignificans, mendax, minor, rubropictum, simplex
Heterocloeon — curiosus
Paracloeodes — minutum*
Pseudocloeon — anoka, carolina, cingulatum, dubium, ellioti, ida, parvulum, punctiventris (Adult and nymphal keys Daggy 1941)

LEPTOPHLEBIIDAE

Choroterpes — basalis
Habrophlebia — vibrans*
Habrophlebiodes — americana*
Leptophlebia — cupida, johnsoni, nebulosa
Paraleptophlebia — adoptiva, debilis, guttata, moerens, mollis, ontario, praepedita

EPHEMERELLIDAE — (Adult and nymphal keys Allen and Edmunds 1961, 1962a, 1962b, 1963a, 1963b, 1965)

Ephemerella — aestiva, attenuata, aurivillii, bicolor, catawba, cornuta, cornutella, deficiens, dorothea, excrucians, funeralis, invaria, lutulenta, needhami, rotunda, simplex, sordida, subvaria, temporalis

TRICORYTHIDAE

Tricorythodes — atratus, stygiatus

CAENIDAE

Brachycercus — lacustris, nitidus, prudens
Caenis — amica, forcipata, hilaris, jocosa, punctata, ridens, simulans

POTAMANTHIDAE

Potamanthus — myops, verticis

EPHEMERIDAE

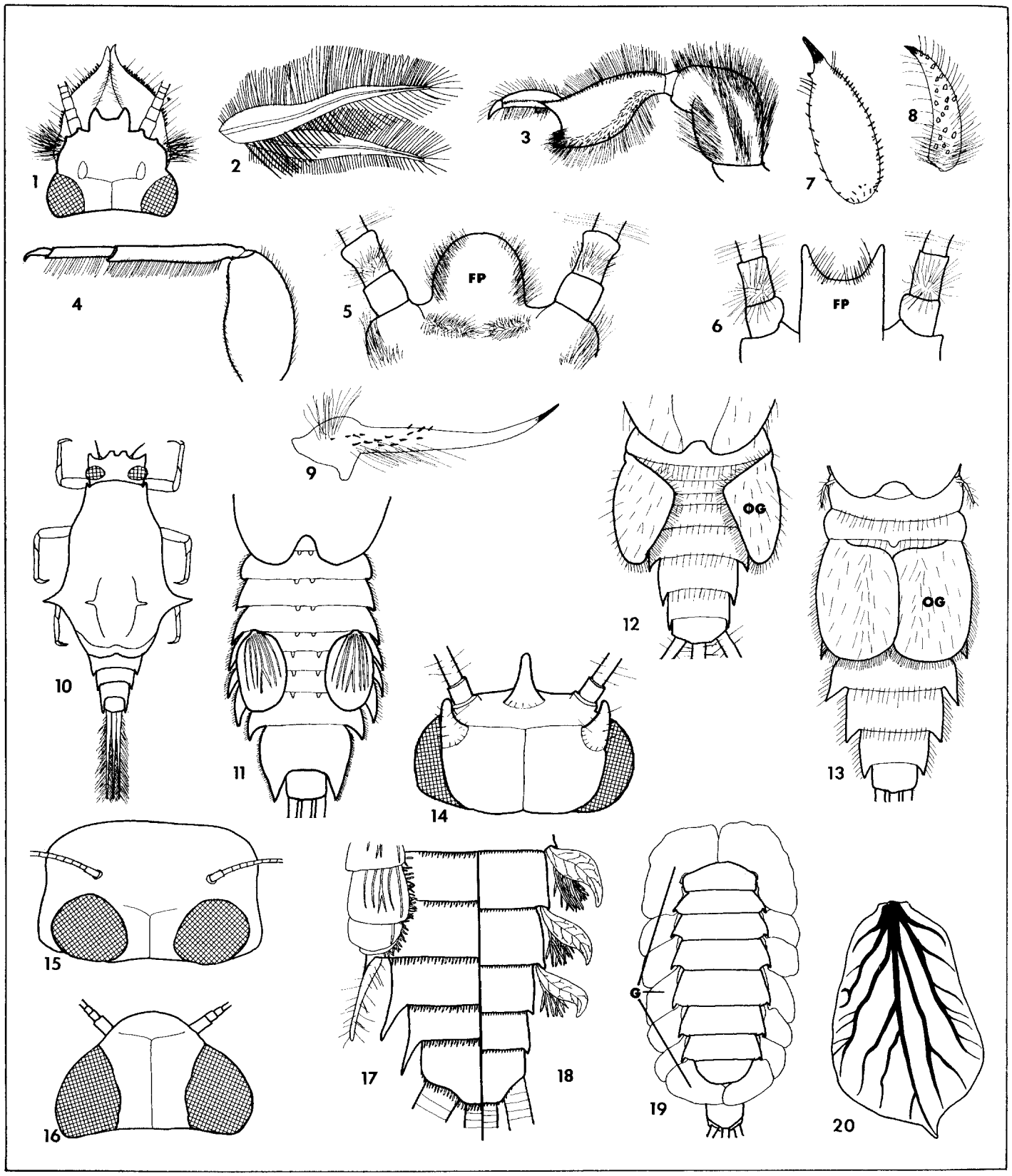
Ephemera — simulans
Hexagenia — atrocaudata, bilineata, limbata, munda, rigida
Litobrancha — recurvata
Pentagenia — vittigera

POLYMITARCIDAE

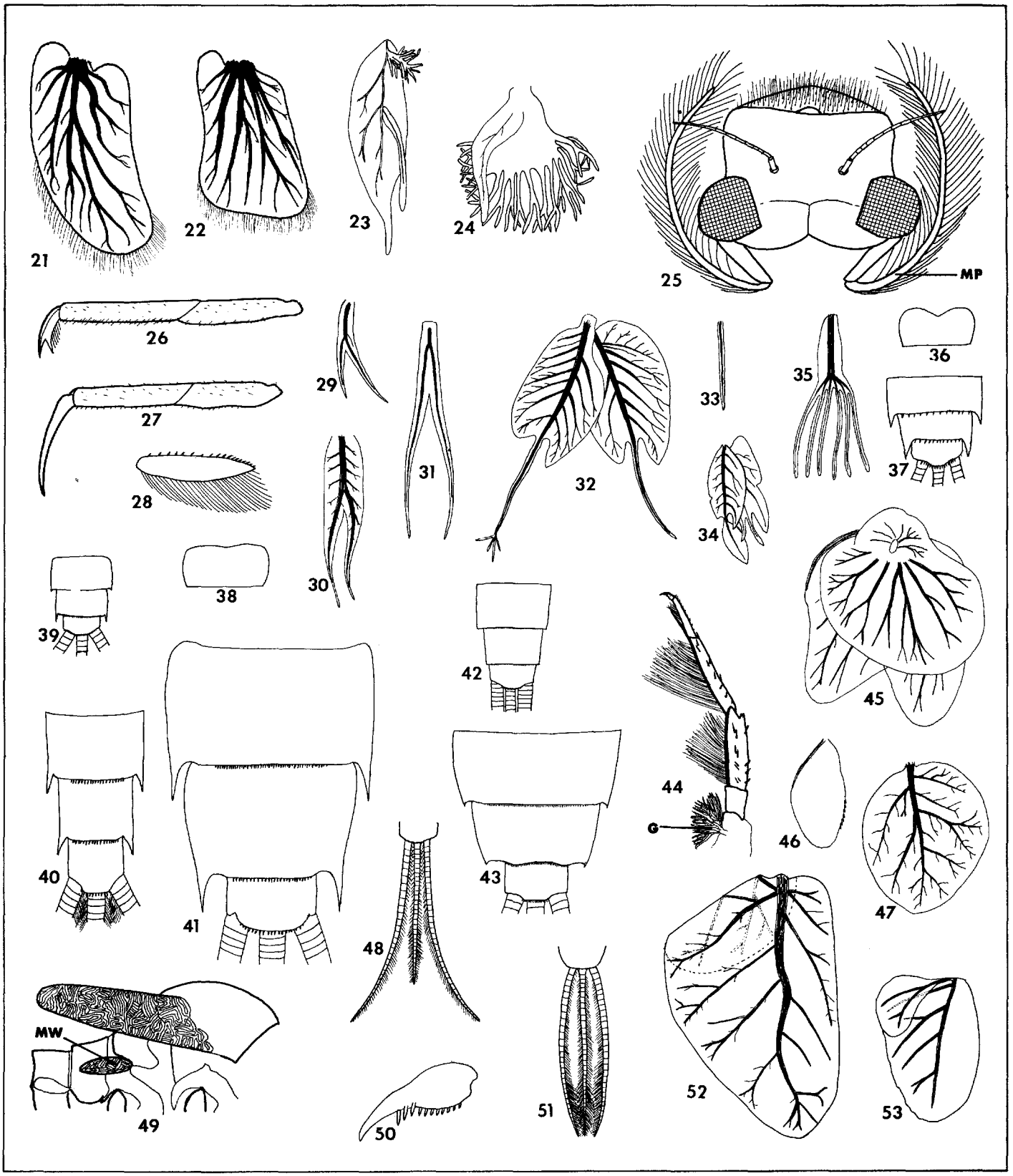
Ephoron — album, leukon
Tortopus — primus*

BAETISCIDAE

Baetisca — bajkovi, lacustris, laurentina, obesa



Figures 1-20. — Ephemeroptera. 1. Dorsal view of head of *Pentagenia*. 2. Gills on right side of abdominal segment 3 of *Hexagenia*. 3. Prothoracic leg of *Hexagenia*. 4. Prothoracic leg of *Potamanthus*. 5. Frontal process (FP) of *Hexagenia*. 6. Frontal process (FP) of *Ephemera*. 7. Dorsal view of right mandibular tusk of *Tortopus*. 8. Dorsal view of right mandibular tusk of *Ephoron*. 9. Lateral view of right mandibular tusk of *Ephemera*. 10. Dorsal view of *Baetisca*. 11. Dorsal view of abdomen of *Ephemerella*. 12. Dorsal view of abdomen of *Tricorythodes* showing operculate gills (OG). 13. Dorsal view of abdomen of *Caenis* showing operculate gills (OG). 14. Dorsal view of head of *Brachycercus*. 15. Dorsal view of head of *Stenonema*. 16. Dorsal view of head of *Siphlonurus*. 17. Left half of abdominal segments 6-10 of *Stenonema*. 18. Right half of abdominal segments 6-10 of *Heptagenia*. 19. Ventral view of abdomen of *Rhithrogena* showing gills (G). 20. Gill lamella of *Stenacron*.



Figures 21-53. — Ephemeroptera. 21. Gill lamella of *Stenonema* (rounded). 22. Gill lamella of *Stenonema* (truncate). 23. Ventral view of gill on abdominal segment 3 of *Pseudiron* (after Burks 1953). 24. Gill on abdominal segment 5 of *Anepeorus* (after Burks 1953). 25. Dorsal view of head of *Arthroplea* showing maxillary palpi (MP). 26. Prothoracic leg of *Siphloplecton*. 27. Metathoracic leg of *Siphloplecton*. 28. Gill on abdominal segment 4 of *Homoeoneuria*. 29. Gill on abdominal segment 1 of *Paraleptophlebia*. 30. Gill on abdominal segment 3 of *Paraleptophlebia*. 31. Gill on abdominal segment 1 of *Leptophlebia*. 32. Gill on abdominal segment 3 of *Leptophlebia*. 33. Gill on abdominal segment 1 of *Choroterpes*. 34. Gill on abdominal segment 3 of *Choroterpes*. 35. Gill on abdominal segment 5 of *Habrophlebia* (after Burks 1953). 36. Labrum of *Habrophlebiodes*. 37. Dorsal view of abdominal segments 8-10 of *Habrophlebiodes*. 38. Labrum of *Paraleptophlebia*. 39. Dorsal view of abdominal segments 8-10 of *Paraleptophlebia*. 40. Dorsal view of abdominal segments 8-10 of *Ameletus*. 41. Dorsal view of abdominal segments 8-10 of *Siphlonurus*. 42. Dorsal view of abdominal seg-

ments 8-10 of *Baetis*. 43. Dorsal view of abdominal segments 8-10 of *Callibaetis*. 44. Prothoracic leg of *Isonychia* with basal gill tuft (G). 45. Dorsal view of gill on left side of abdominal segment 3 of *Siphlonurus*. 46. Dorsal view of gill on right side of abdominal segment 5 of *Ameletus*. 47. Dorsal view of gill on abdominal segment 3 of *Parameletus*. 48. Tail filaments of *Baetis*. 49. Lateral view of meso- and metathorax of *Baetis* showing metathoracic wingpads (MW). 50. Tarsal claw of *Baetis*. 51. Tail filaments of *Centroptilum*. 52. Dorsal view of gill on right side of abdominal segment 3 of *Callibaetis*. 53. Dorsal view of gill on right side of abdominal segment 3 of *Centroptilum*.

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ODONATA (Dragonflies)

In this hemimetabolous order 127 species are known from Wisconsin, and diligent collecting will probably add 30 or more additional species to the state list. Most species inhabit ponds, marshes, and lake margins, but some typically inhabit streams. The order is divided into the suborders Anisoptera (dragonflies) and Zygoptera (damselflies), but disagreement exists on the composition of families, with Corduliidae and Macromiidae frequently considered subfamilies of Libellulidae.

Nymphs and adults are predaceous, and adults are considered highly desirable as predators of mosquitoes. Most species have one-year life cycles, but several require two or more years to complete nymphal development. Adults live several weeks to several months. In most species there are 10-12 nymphal instars.

CALOPTERYGIDAE (2 genera, 4 species)

Nymphs of both genera can be found statewide in permanent streams, especially among bank vegetation and snags of debris where the current is moderate. One or two years are required for nymphal development, depending on the species. Adults emerge in early summer.

LESTIDAE (1 genus, 9 species)

Nymphs inhabit vegetation of still, marshy, or bog-margined waters of ponds or small sheltered lakes. Several species develop in temporary ponds. All species are univoltine, emerging at various times throughout the summer.

COENAGRIONIDAE (8 genera, 33 species)

The most abundant family of damselflies, nymphs of most genera can be found year-around in almost every type of permanent lentic habitat with vegetation. Nymphs of *Argia*, however, occur in streams where they cling to rocks and debris in the current. Most, if not all species are univoltine, and adults can be seen from April through October. *Anomalagrion* may be congeneric with *Ischnura;* nymphs cannot be separated.

CORDULIGASTRIDAE (1 genus, 4 species)

Nymphs of *Cordulegaster* burrow in the substrate of small woodland streams. They have a 3 to 4 year life cycle, with adults emerging during the summer months.

GOMPHIDAE (10 genera, 31 species)

Nymphs inhabit mostly streams or margins of larger lakes, but species of *Arigomphus, Gomphurus,* and *Gomphus* may occur in ponds. *Progomphus* inhabits sandy lakes in central Wisconsin. *Hagenius, Hylogomphus,* and *Stylogomphus* are found only in northern Wisconsin. One-year life cycles are probably the rule for most species, but some may have much longer life cycles; *Hagenius* has a 4-year life cycle. Various species emerge throughout the spring and summer months. Nymphs lie partially buried in sand or silt substrate to ambush their prey.

AESHNIDAE (6 genera, 18 species)

Nymphs of *Basiaeschna, Boyeria, Nasiaeschna,* and some species of *Aeshna* are found in streams, usually where the current is slow. *Anax, Epiaeshna* and other species of *Aeshna* inhabit ponds and margins of lakes where they climb about on vegetation. Most species have life cycles of one to three years, with emergence during the summer. An exception is *Anax,* which migrates into Wisconsin from the south in April and completes two or three generations before remaining nymphs are killed by freezing water.

MACROMIIDAE (2 genera, 4 species)

Nymphs are found uncommonly in muck, marl, and trash in slow areas of streams, or in lakes, where they lie near the surface to ambush prey. Emergence takes place in late spring or early summer, with most species probably being univoltine.

CORDULIIDAE (7 genera, 20 species)

Neurocordulia and *Williamsonia* are rare, and *Cordulia, Somatochlora,* and *Williamsonia* are restricted to northern Wisconsin. *Tetragoneuria* can become abundant, often forming huge swarms in spring and early summer. This family is closely related to the Libellulidae, and the nymphs have similar habits.

LIBELLULIDAE (12 genera, 35 species)

A widespread and abundant family, nymphs occur in permanent lentic habitats of all types. They crawl about on the bottom, among trash, or among weeds waiting to ambush their prey. Most species are probably univoltine with emergence from May to October. Species of *Erythemis, Pachydiplax, Pantala,* and *Tramea* are found only in southern Wisconsin.

KEY TO GENERA OF ODONATA NYMPHS IN WISCONSIN

1a. Abdomen terminating in 3 caudal lamellae, longest more than 1/3 length of abdomen ..... ZYGOPTERA **2**

1b. Abdomen terminating in 3 stiff, pointed valves, longest less than 1/3 length of abdomen ..... ANISOPTERA **4**

2a. First antennal segment as long as, or longer than, remaining segments combined; mentum with deep, median cleft (Figs. 1 and 2) ..... CALOPTERYGIDAE **8**

2b. First antennal segment much shorter than others combined; mentum with at most a very small median cleft (Figs. 3, 4) **3**

3a. Basal half of labium greatly narrowed and elongate (Fig. 3); labium in repose extends back to or past middle coxae ... . LESTIDAE, **Lestes**

3b. Basal half of labium not greatly narrowed (Fig. 4); labium in repose extends only to fore coxae COENAGRIONIDAE **9**

4a. Mentum flat, or nearly so, without stout setae **5**

4b. Mentum spoon-shaped, covering face to base of antennae and armed with stout setae **6**

5a. Antennae 4-segmented; mesotarsi 2-segmented .... GOMPHIDAE **15**

5b. Antennae 6- or 7-segmented; mesotarsi 3-segmented .... AESHNIDAE **24**

6a. Labium with large irregular teeth on distal edge of lateral lobes ..... CORDULEGASTRIDAE, **Cordulegaster**

6b. Labium with distal edge of lateral lobes entire or with small, even crenulations or teeth **7**

7a. Head with a prominent, almost erect, thick frontal horn between bases of antennae, its width at base distinctly less than its length; legs very long, apex of each metafemur reaching to or beyond the apex of abdominal segment 8 .. .. MACROMIIDAE **30**

7b. Head without a prominent, almost erect, thick frontal horn; legs shorter, apex of metafemora usually not reaching apex of abdominal segment 8 .... LIBELLULIDAE and CORDULIIDAE **31**

8a. CALOPTERYGIDAE — Mentum cleft almost halfway to base (Fig. 1) ..... **Calopteryx**

8b. Mentum cleft only to base of lateral lobes (Fig. 2) .... **Hetaerina**

9a. COENAGRIONIDAE — Distal margin of each lateral lobe produced into 3 pointed hooks, middle one shorter than end hook and usually about 1/2 as long as movable hook (Fig. 5); median caudal lamellae usually 1/3 to 1/2 as broad as long and in some species quite thick or triquetral ... **Argia**

9b. Distal margin of each lateral lobe with a comparatively small end hook and a more or less truncate and denticulate middle lobe less than 1/3 as long as movable hook (Fig. 4); caudal lamellae at mid-length less than 1/3 as broad as long (except in **Amphiagrion**) **10**

10a. Posterolateral margin on each side of head angulate, with angle projecting and forming a blunt tubercle (Fig. 6) .. **11**

10b. Posterolateral margin on each side of head broadly rounded, no blunt tubercle (Fig. 7) **12**

11a. Antennae 5- or 6-segmented; caudal lamellae each about 1/3 as broad as long, margins thickly set with setae from base to apex ..... **Amphiagrion**

11b. Antennae 7-segmented; caudal gills each not more than 1/6 as broad as long, margins with only a few widely separated setae ..... **Chromagrion**

12a. Mentum with 1 or 2 dorsal setae on each side of median line, the second, when present, very small .... **Nehalennia**

12b. Mentum with 3 to 7 dorsal setae on each side (Fig. 4).. **13**

13a. Antennae 6-segmented ..... **Enallagma**

13b. Antennae 7-segmented (fewer segments in young nymphs) **14**

14a. Caudal lamellae terminating in a blunt point (Fig. 8) .... **Coenagrion**

14b. Caudal lamellae terminating in a sharp tapered point (Fig. 9) ..... **Ischnura** or **Anamolagrion**

15a. GOMPHIDAE — Naked antennal segment 4 generally about 1/4 as long as hairy segment 3 (Fig. 10); mesothoracic legs closer together at base than prothoracic legs.. **Progomphus**

15b. Segment 4 of antennae vestigial or nearly so (Fig. 11); mesothoracic legs not closer together at base than prothoracic legs **16**

16a. Wing pads strongly divergent ..... **Ophiogomphus**

16b. Wing pads laid parallel along back **17**

17a. Body very flat; abdomen nearly circular; paired tubercles on top of head ..... **Hagenius**

17b. Abdomen more nearly cylindrical; no tubercles on head **18**

18a. Flattened antennal segment 3 nearly as wide as long (Fig. 12) ..... **Stylogomphus**

18b. Long antennal segment 3 more or less cylindrical (Fig. 11) **19**

19a. Dorsal hook on segment 9 is a spinelike termination of mid-dorsal ridge of segment 9 (Fig. 13) ..... **Dromogomphus**

19b. Dorsal hook on segment 9, if present, rises above level of its rounded dorsum **20**

20a. Mid-dorsal length of abdominal segments 9+10 greater than width of 9 at its base **21**

20b. Mid-dorsal length of abdominal segments 9+10 less than width of 9 at its base **22**

21a. Abdominal segment 10 shorter than wide and less than 1/2 as long as abdominal segment 8; end hook on lateral lobe long, strong, incurved (Fig. 14) ..... **Stylurus**

21b. Abdominal segment 10 longer than wide, and more than 1/2 as long as segment 8; end hook small, about size of lateral teeth (Fig. 15) ..... **Arigomphus**

22a. Abdomen moderately pointed to rear; small or vestigial mid-dorsal hooks on middle abdominal segments; no mid-dorsal groove; segment 10 more than 1/2 as long as wide ..... **Gomphus**

22b. Abdomen ending more bluntly, narrowed abruptly on segment 9, where lateral spines are spinulose-serate on outer edge; segment 10 less than 1/2 as long as wide **23**

23a. Lateral spines on segment 9 apart from segment 10 and not much longer than those on 8 (Fig. 16); no distinct mid-dorsal groove on middle abdominal segments; small species, grown nymph less than 27mm ..... **Hylogomphus**

23b. Lateral spines on segment 9 close to segment 10 and much longer than those on 8 (Fig. 17); a mid-dorsal groove normally present on middle abdominal segments; large species, grown nymph 28-40mm ..... **Gomphurus**

24a. AESHNIDAE — Hind angles of head angulate; lateral spines present on abdominal segments 5-9 ..... **25**

24b. Hind angles of head rounded; lateral spines present on abdominal segments 6 or 7-9 (In *Aeshna eremita* the hind angles of the head are slightly angulate and lateral spines are present on abdominal segments 5-9) **28**

25a. Blade of lateral lobe of labium wide and squarely truncated on outer end (Fig. 18); tips of paraprocts incurved; a moundlike protuberance on each side of mesothorax at about mid-height ..... **Boyeria**

25b. Blade of lateral lobe narrowed toward tip (Fig. 19); tips of paraprocts straight **26**

26a. Dorsum of abdomen broadly rounded; epiproct about 2/3 the length of paraprocts ..... **Basiaeschna**

26b. Dorsum of abdomen with a low median ridge; epiproct about same length as paraprocts **27**

27a. Blunt dorsal hooks on median ridge of abdominal segments 7-9; cerci each less than 1/2 as long as epiproct ..... **Nasiaeschna**

27b. No dorsal hooks on median ridge; cerci 3/4 length of epiproct ..... **Epiaeschna**

28a. Lateral spines present on abdominal segments 7-9 only (rarely an extremely small one on segment 6) **29**

28b. Lateral spines present on abdominal segments 6-9. . **Aeshna**

29a. Truncated blade of lateral lobe with prominent end hook (Fig. 20); mentum 2 or more times as long as width at base ..... **Anax**

29b. End hook not prominent (Fig. 21); mentum less than 1 1/2 times as long as width at base ..... **Aeshna**

30a. MACROMIIDAE — Lateral setae 6; dorsal setae 5-6 + 3-4 ..... **Macromia**

30b. Lateral setae 5, dorsal setae 5 + 1-2 ..... **Didymops**

31a. LIBELLULIDAE and CORDULIIDAE — Abdomen with a mid-dorsal hook, spine, or knob on segments 6 or 7 ..... **32**

31b. Abdomen without mid-dorsal hooks, spines, or knobs on segments 6 and 7 ..... **44**

32a. A mid-dorsal hook, spine or knob on abdominal segment 9 ..... **33**

32b. No mid-dorsal hook, spine, or knob on abdominal segment 9 ..... **38**

33a. Lateral spines of abdominal segment 9 reaching almost to tip of epiproct or beyond ..... CORDULIIDAE **34**

33b. Lateral spines of abdominal segment 9 not reaching beyond mid-length of epiproct, usually only to its base **37**

34a. No lateral spines on Segment 8 ..... **Williamsonia**

34b. Distinct lateral spines on segment 8 ..... **35**

35a. Mid-dorsal hooks knoblike, with apices blunt and rounded (Fig. 22); crenulations on distal margin of lateral lobe very deep, each crenula 2 or more times as long as wide (Fig. 23) ..... **Neurocordulia**

35b. Mid-dorsal hooks spinelike, with apices acuminate (Fig. 24); crenulations on distal margin of lateral lobe shallow, each crenula as long as or shorter than width **36**

36a. Distal half of dorsal surface of mentum heavily setose; lateral setae 4 or 5 ..... **Epicordulia**

36b. Distal half of dorsal surface of mentum with few, or usually, no setae; lateral setae 6-8 ..... **Tetragoneuria**

37a. Each cercus about as long as epiproct; lateral setae 6-8 .. .. CORDULIIDAE, **Somatochlora**

37b. Each cercus about 2/3 as long as epiproct; lateral setae 5 ..... LIBELLULIDAE, **Perithemis**

38a. Each cercus 2/3 to equal length of paraprocts; lateral setae 7 ..... CORDULIIDAE, **Dorocordulia**

38b. Each cercus less than 2/3 length of paraprocts .... LIBELLULIDAE **39**

39a. Dorsal setae on mentum 0-3; all inconspicuous ... **Ladona**

39b. Dorsal setae on mentum 7-21, all prominent **40**

40a. Lateral spines of abdominal segment 9 long and straight, reaching to or beyond tips of paraprocts and about twice mid-dorsal length of segment 9; no mid-dorsal hook on segment 8 ..... **Celithemis**

40b. Lateral spines of abdominal segment 9 not twice mid-dorsal length of that segment; dorsal hook present or absent on segment 8 ..... **41**

41a. Eyes small, projecting forward from anterolateral margins of head, and less than 1/2 length of head (Fig. 25); (excluding labrum and clypeus); body with numerous long hairs **42**

41b. Eyes larger and more lateral, occupying 1/2 or more than 1/2 length of head (Fig. 26); body with only scattered long hairs **43**

42a. Abdominal segments 7-9 with brown or black, shining mid-dorsal ridges; width of head across eyes less than 1 1/4 width of prothorax across dorsolateral ridges; distal margin of mentum crenulate ..... **Plathemis**

42b. Abdominal segments 7-9 without dark mid-dorsal ridges; width of head across eyes more than 1 1/4 width of prothorax across dorsolateral ridges; distal margin of mentum evenly contoured, not obviously crenulate ..... **Libellula**

43a. Dorsal hook present on segment 3; epiproct and paraprocts about equal in length; dark markings usually present on abdominal sterna ..... **Leucorrhinia**

43b. No dorsal hook on segment 3; epiproct usually noticeably shorter than paraprocts; abdominal sterna without dark markings ..... **Sympetrum**

44a. Apical third of cerci and paraprocts strongly decurved; no lateral spines on abdomen; lateral setae 7-8 .... LIBELLULIDAE, **Erythemis**

44b. Apical third of cerci and paraprocts straight or only slightly decurved; lateral spines may or may not be present ... **45**

45a. Lateral spines prominent on abdominal segment 8, at least 1/4 mid-dorsal length of that segment **46**

45b. Lateral spines on abdominal segment 8 absent or so small they are difficult to see **52**

46a. Lateral spines on abdominal segment 8 longer than mid-dorsal length of that segment ..... LIBELLULIDAE **47**

46b. Lateral spines on abdominal segment 8 less than 2/3 mid-dorsal length of that segment **48**

47a. Epiproct as long as or longer than paraprocts .... **Pantala**

47b. Epiproct shorter than paraprocts ..... **Tramea**

48a. Tips of lateral spines of abdominal segment 9 extending farther caudad than tip of epiproct .... LIBELLULIDAE, **Pachydiplax**

48b. Tips of lateral spines of abdominal segment 9 not extending beyond tip of epiproct **49**

49a. Each cercus not more than 1/2 length of paraprocts .... LIBELLULIDAE **50**

49b. Each cercus more than 2/3 length of paraprocts **51**

50a. Lateral spines of abdominal segments 8 and 9 subequal in length; body hairy; abdominal sterna without dark markings ..... **Libellula**

50b. Lateral spines of abdominal segment 9 about twice length of those of segment 8; body smooth; dark markings on abdominal sterna ..... **Leucorrhinia**

51a. Crenulations of distal margin of lateral lobes obsolete or shallow, each crenula less than 1/4 as deep as broad; lateral setae 6; dorsal setae 9-11 .... LIBELLULIDAE, **Nannothemis**

51b. Crenulations of distal margin of lateral lobes of medium depth, each crenula 1/3 to 1/2 as deep as broad; lateral setae 7; dorsal setae 12-13 ..... CORDULIIDAE, **Cordulia**

52a. Cerci each about equal in length to epiproct; crenulations on distal margin of lateral lobe deep .... CORDULIIDAE, **Somatochlora**

52b. Cerci each 2/3 length of epiproct or slightly less; crenulations on distal margin of lateral lobes obsolete .... LIBELLULIDAE, **Sympetrum**

Synonyms

epiproct = superior appendage
paraproct = inferior appendage
cercus = lateral appendage
lateral lobe = palpal lobe
lateral setae = palpal setae
dorsal setae = premental setae or mental setae
caudal lamellae = caudal gills
mentum = prementum

SPECIES LIKELY TO BE FOUND IN WISCONSIN AND MOST RECENT KEY TO SPECIES

CALOPTERYGIDAE

Calopteryx — aequabilis, maculata (Adult and nymphal keys Walker 1953)

*Hetaerina — americana, titia** (Adult keys Johnson 1972)

LESTIDAE (Adult and nymphal keys Walker 1953)

Lestes — congener, disjunctus, dryas, eurinus, forcipatus, inaequalis, rectangularis, unguiculatus, vigilax

COENAGRIONIDAE (Adult and nymphal keys Walker 1953)

Amphiagrion — saucium
Anomalagrion — hastatum
Argia — apicalis, bipunctulata, moesta, sedula*, tibialis, translata*, violacea*
Chromagrion — conditum
Coenagrion — angulatum, interrogatum, resolutum*
Enallagma — antennatum, aspersum, boreale, carunculatum, civile, clausum, cyathigerum, divagans*, ebrium, exsulans, geminatum, hageni, signatum, traviatum*, vesperum*
Ischnura — kellicotti, posita*, verticalis*
Nehalennia — gracilis, irene

CORDULEGASTRIDAE (Adult and nymphal keys Needham and Westfall 1955 and Walker 1958)

Cordulegaster — diastatops, erronea*, maculata, obliqua*

GOMPHIDAE (Adult and nymphal keys Needham and Westfall 1955 and Walker 1958)

Arigomphus — cornutus, furcifer, submedianus, villosipes**
Dromogomphus — spinosus
Gomphurus — externus, fraternus, lineatifrons, vastus, ventricosus*
Gomphus — exilis, graslinellus, lividus, quadricolor, spicatus
Hagenius — brevistylus
*Hylogomphus — brevis, viridifrons**
Ophiogomphus — anomalus, aspersus, carolus, columbrinus, rupinsulensis
Progomphus — obscurus
Stylogomphus — albistylus
Stylurus — amnicola, laurae, notatus, plagiatus*, scudderi, spiniceps*

AESHNIDAE (Adult and nymphal keys Needham and Westfall 1955 and Walker 1958)

Aeshna — canadensis, clepsydra, constricta, eremita, interrupta, mutata, sitchensis*, subarctica*, tuberculifera, umbrosa, verticalis*
Anax — junius, longipes
Basiaeschna — janata
Boyeria — grafiana, vinosa*
Epiaeschna — heros
Nasiaeschna — pentacantha

MACROMIIDAE (Adult and nymphal keys Needham and Westfall 1955)

Didymops — transversa
*Macromia — illinoiensis, pacifica, taeniolata**

CORDULIIDAE (Adult and nymphal keys Needham and Westfall 1955)

Cordulia — shurtleffi
Dorocordulia — libera
Epicordulia — princeps
Neurocordulia — molesta, yamaskanensis
Somatochlora — cingulata, elongata, ensigera*, forcipata, franklini*, incurvata*, kennedyi, minor, tenebrosa*, walshii, williamsoni*
Tetragoneuria — canis, cynosura, spinigera
Williamsonia — fletcheri

LIBELLULIDAE (Adult and nymphal keys Needham and Westfall 1955)

Celithemis — elisa, eponina, monomelaena
Erythemis — simplicicollis
Ladona — julia
Leucorrhinia — frigida, glacialis, hudsonica, intacta, proxima
Libellula — cyanea, incesta, luctuosa, pulchella, quadrimaculata, semifasciata, vibrans*
Nannothemis — bella
Pachydiplax — longipennis
Pantala — flavescens, hymenaea
Perithemis — tenera
Plathemis — lydia
Sympetrum — ambiguum, corruptum, costiferum, danae, internum, obtrusum, rubicundulum, semicinctum, vicinum* (Adult and nymphal keys Tai 1967)
*Tramea — carolina, lacerata, onusta**

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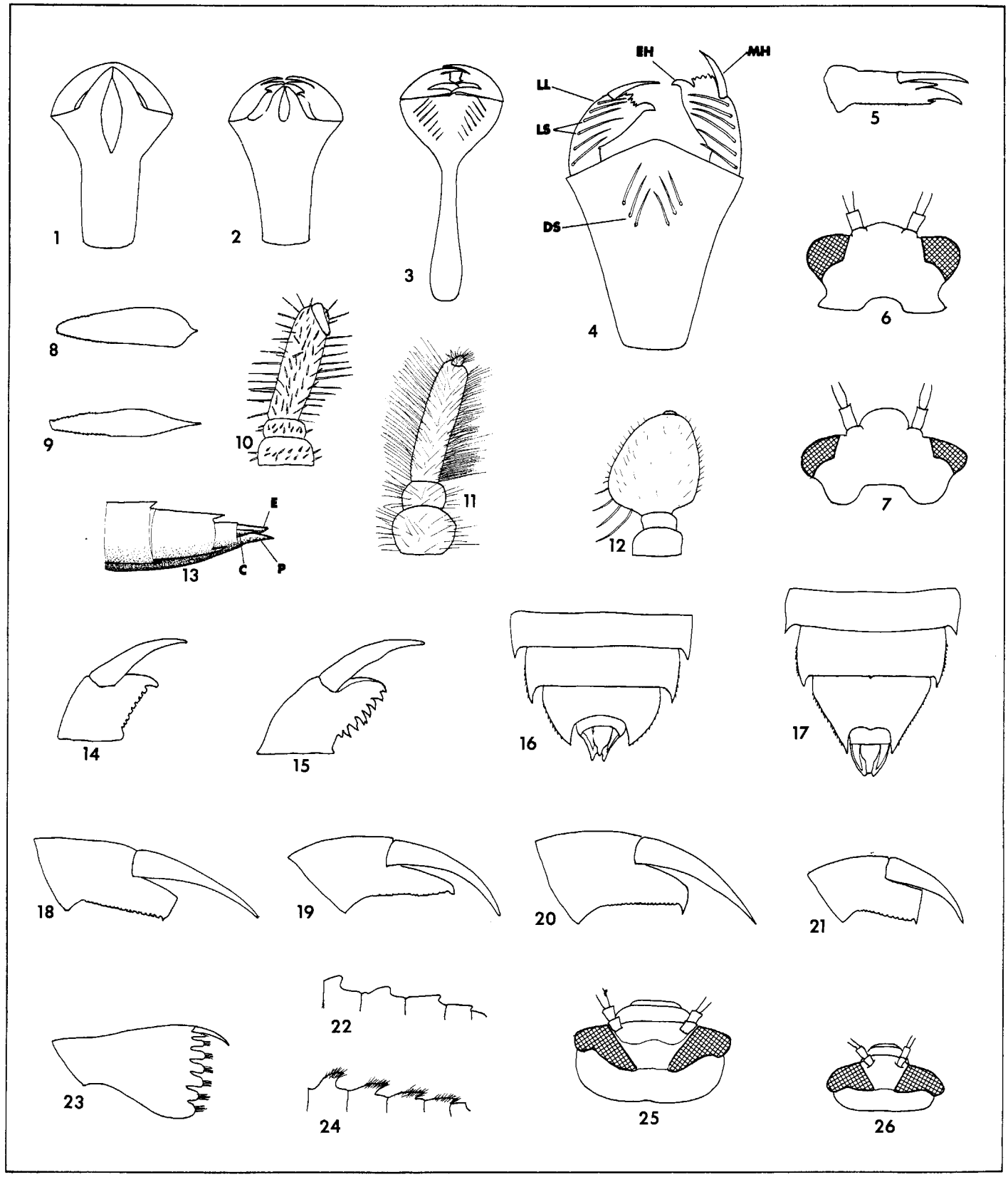

Figures 1-26. — Odonata. 1. Ventral view of mentum of *Calopteryx*. 2. Ventral view of mentum of *Hetaerina*. 3. Dorsal view of mentum of *Lestes*. 4. Dorsal view of mentum of *Enallagma* showing dorsal setae (DS), lateral lobes (LL), lateral setae (LS), movable hook (MH), and end hook (EH). 5. Dorsal (inner) view of left lateral lobe of *Argia*. 6. Dorsal view of head of *Amphiagrion*. 7. Dorsal view of head of *Enallagma*. 8. Lateral caudal lamella of *Coenagrion*. 9. Lateral caudal lamella of *Ischnura*. 10. Antenna of *Progomphus*. 11. Antenna of *Gomphus*. 12. Antenna of *Stylogomphus*. 13. Lateral view of abdominal segments 8-10 of *Dromogomphus* showing epiproct (E), paraprocts (P), and cerci (C). 14. Dorsal view of left lateral lobe of *Stylurus*. 15. Dorsal view of left lateral lobe of *Arigomphus*. 16. Dorsal view of terminal abdominal segments of *Hylogomphus*. 17. Dorsal view of terminal abdominal segments of *Gomphurus*. 18. Lateral lobe of *Boyeria*. 19. Lateral lobe of *Basiaeschna*. 20. Lateral lobe of *Anax*. 21. Lateral lobe of *Aeshna*. 22. Lateral view of mid-dorsal hooks of *Neurocordulia*. 23. Lateral lobe of *Neurocordulia*. 24. Lateral view of mid-dorsal hooks of *Tetragoneuria*. 25. Dorsal view of head of *Libellula*. 26. Dorsal view of head of *Leucorrhinia*.

In this largely terrestrial order, about one-third of the families either live in the water or are closely associated with it. In the six aquatic families, eggs and nymphs remain in the water, and adults are away from the water only while making dispersal flights. Nymphs and adults of the five semiaquatic Hemipteran families run about on the surface of the water, leaving only for dispersal flights or to find suitable wintering sites. The Octeridae, Saldidae, and Gelastocoridae are also closely associated with water, but only individuals of the latter are likely to enter it.

This is a paurometabolous order. Nymphs of most species have 5 instars and closely resemble adults, except for their lack of wings and genitalia. In many genera of semiaquatic Hemiptera, apterous and brachypterous adults are frequent. The taxonomy of most groups has been thoroughly studied, and adults of almost all species can be accurately identified.

HEBRIDAE (2 genera, 4 species)

Often called "velvet bugs", these tiny creatures inhabit the surface of very shallow, still water that is covered with vegetation. They may frequently leave the water, with *Hebrus* probably being more terrestrial than aquatic. Although tiny, they are predators and feed on other tiny insects and crustacea. Life cycles are poorly known, but they are probably multivoltine and overwinter as adults.

HYDROMETRIDAE (1 genus, 1 species)

The one Wisconsin species of "marsh treader" has been thoroughly studied. It is generally uncommon throughout the state where it may be found walking on algal mats among vegetation in very shallow, quiet water. It is multivoltine, and adults may live as long as one year. Hydrometrids are predators, usually feeding on insects in the surface film. Brachypterous adults are frequently encountered.

MESOVELIIDAE (1 genus, 3 species)

"Water treaders" are very common in late summer, but are absent in early spring because they overwinter as eggs. They have several summer generations, and by fall large numbers of these tiny yellow-green bugs can be found on duckweed or algal mats in sheltered areas of ponds and lake margins. Apterous and brachypterous adults are much more common than macropterous ones. They feed on small insects and other animals in the surface film.

GERRIDAE (5 genera, 15 species)

Most gerrids, often called "water striders", "pond skaters", or "wherrymen", are common throughout the state, especially in late summer. *Limnogonus* is rare and found only in southern Wisconsin, but the other genera are widely distributed in ponds, lakes, and streams. An exception is *Metrobates,* which occurs commonly only on larger streams. Most species are bivoltine or multivoltine, overwintering as adults. All are strict predators, and apterous and brachypterous forms are common.

VELIIDAE (2 genera, 8 species)

Microvelia inhabits weedy lake margins, ponds, marshes, and stream margins, while *Rhagovelia* is found only in streams. They are common statewide, especially in late summer. Like the other semiaquatic Hemiptera, they are predators, have several generations each summer, and have apterous, brachypterous, and macropterous forms.

NOTONECTIDAE (2 genera, 9 species)

Known as "backswimmers", notonectids are commonly found throughout the state in ponds, ditches, and lake margins with emergent vegetation. They overwinter as adults, have at least two generations each summer, and become most abundant in late summer and fall. They are fierce predators, and winged adults disperse widely.

PLEIDAE (1 genus, 1 species)

A single species of "pigmy backswimmer" becomes abundant in weedy ponds and lake margins throughout the state in late summer and early fall, but disappears into wintering sites by November. They feed on tiny insects and crustacea, and probably complete at least two generations each summer.

NAUCORIDAE (1 genus, 1 species)

A single species of this predatory bug occurs uncommonly in certain ponds, sloughs, and stream margins in the southern third of the state. There are no more than two generations each summer, and perhaps only one.

NEPIDAE (2 genera, 4 species)

Nepa is rare among trash and debris in slow streams, ponds, and lake margins. *Ranatra* is a common summer inhabitant of weedy ponds and lake margins, but in the fall it flies into streams where it winters under the banks. Wisconsin species are probably bivoltine. They are called "water scorpions", and feed on other insects, small fish, and any other aquatic animals they are able to catch.

BELOSTOMATIDAE (2 genera, 3 species)

The "giant water bugs", especially *Belostoma,* are common statewide, and are sometimes called "electric light bugs" because of their attraction to light. These large predators breed in weedy ponds and lake margins where they normally complete two generations and then fly to streams in the fall to spend the winter months.

CORIXIDAE (10 genera, 56 species)

"Water boatmen", especially *Hesperocorixa, Sigara,* and *Trichocorixa,* are abundant throughout the state in a variety of aquatic habitats. *Corisella* and *Palmacorixa* are less frequently encountered, *Callicorixa* is restricted to northern Wisconsin, and the remaining genera are rare. They fly frequently and can be readily captured by light traps. In the fall, after completing about two generations, pond species fly to larger lakes and rivers which they use as overwintering sites. As herbivores, they are unique among aquatic Hemiptera.

KEY TO GENERA OF AQUATIC AND SEMIAQUATIC HEMIPTERA IN WISCONSIN (ADULTS)

1a. Antenna shorter than head, concealed in groove beneath eye; aquatic **2**

1b. Antenna as long as head or longer, usually plainly visible; semiaquatic **8**

2a. Rostrum broad, blunt, and triangular, not distinctly segmented; front tarsus a one-segmented scoop ..... CORIXIDAE **13**

2b. Rostrum cylindrical or cone-shaped, distinctly 3- or 4-segmented; front tarsus not scooplike **3**

3a. Abdomen with long, slender, rounded respiratory appendages (Fig. 1) ..... NEPIDAE **23**

3b. Apical respiratory appendages, if present, short and flat **4**

4a. Eyes protuberant; ocelli present; metathoracic legs without swimming hairs; 7-9mm (mostly riparian) ..... GELASTOCORIDAE, **Gelastocoris**

4b. Eyes not protuberant; ocelli absent; metathoracic legs with swimming hairs **5**

5a. Length 18mm or more; short, flat, retractile apical appendages present (Fig. 2) ..... BELOSTOMATIDAE **22**

5b. Length less than 16mm; apical appendages absent **6**

6a. Profemora almost as wide as long; body flattened; length 10-12mm ..... NAUCORIDAE, **Pelocoris**

6b. Profemora elongate; body elongate or hemispherical; backswimmers **7**

7a. Hemispherical; length 2.0-2.5mm ..... PLEIDAE, **Plea**

7b. Elongate; more than 5mm long ..... NOTONECTIDAE **24**

8a. Claws of at least protarsi inserted before apex (Fig. 3).. **9**

8b. Claws of all tarsi at apex (Fig. 4) **10**

9a. Metafemur very long, greatly surpassing apex of abdomen ..... GERRIDAE **25**

9b. Metafemur short, not, or only slightly, surpassing apex of abdomen ..... VELIIDAE **29**

10a. Head as long as entire thorax, very slender with eyes set about halfway to base; length 7.5-10.0mm ..... HYDROMETRIDAE, **Hydrometra**

10b. Head short and stout, eyes near posterior margin **11**

11a. Wingless, or if winged, without veins in the membrane.. **12**

11b. Winged, with veins in the membrane of hemelytra (riparian) ..... SALDIDAE

12a. Lower part of head grooved to receive rostrum; legs without bristles; less than 2.5mm long ..... HEBRIDAE **30**

12b. Lower part of head not grooved; legs with scattered, stiff, black bristles (Fig. 5); length 2.5-4.0mm ..... MESOVELIIDAE, **Mesovelia**

13a. CORIXIDAE — Rostrum without transverse grooves; pronotum without transverse dark bands; length 5.9-8.3mm ..... **Cymatia**

13b. Rostrum with transverse grooves; pronotum with transverse bands although they may be indistinct **14**

14a. Entire hemelytral pattern usually effaced; upper surface of male pala deeply incised; vertex of male acuminate; both sexes with palar claw serrate at base; length 5.0-5.5mm .. **Ramphocorixa**

14b. Hemelytral pattern distinct, although limited areas may be effaced in some species **15**

15a. Small shining corixids, the males with sinistral asymmetry; apex of clavus not, or scarcely, exceeding a line drawn through costal margins at nodal furrows (Fig. 6); length 2.8-4.6mm ..... **Trichocorixa**

15b. Male asymmetry dextral; apex of clavus plainly exceeding a line drawn through costal margins at nodal furrows **16**

16a. Pruninose area at base of claval suture short and broadly rounded at apex (Fig. 7), usually about 2/3 as long as postnodal pruinose areas; prothoracic lobe truncate (Fig. 8); length 6.3-11.4mm ..... **Hesperocorixa**

16b. Pruinose area at base of claval suture narrowly rounded or pointed at apex (Fig. 9), and almost as long as postnodal pruinose area; prothoracic lobe rounded (Fig. 10) **17**

17a. Markings on clavis transverse, those on corium transverse, longitudinal, or reticulate **18**

17b. Markings on clavus and corium narrow and broken, usually open reticulate with many interconnections **19**

18a. Corial pattern transverse and with little contrast; male strigil absent; male pala with two rows of pegs; length 6.9-8.1mm ..... **Callicorixa**

18b. Corium usually with contrasting pattern, either transverse, longitudinal, or reticulate; male strigil present; male pala with one row of pegs (2 exceptions): length 3.6-9.2mm ... **Sigara**

19a. Rear margin of head sharply curved, embracing a very short pronotum (Fig. 11); interocular space much narrower than the width of an eye; length 4.0-6.0mm ..... **Palmacorixa**

19b. Rear margin of head gently curved; interocular space about equal to the width of an eye (Fig. 12) **20**

20a. Smooth, shining insects; male pala triangular; prothoracic lobe tapering to a narrowly rounded apex (Fig. 13); length 5.3-8.0mm ..... **Corisella**

20b. Rastrate, hairy species **21**

21a. Eyes protuberant with inner anterior angles broadly rounded; postocular space broad; length 7.6-9.2mm.. **Dasycorixa**

21b. Eyes normal; postocular space narrow; length 6.8-7.8mm .. **Cenocorixa**

22a. BELOSTOMATIDAE — Length 18-25mm ..... **Belostoma**

22b. Length greater than 40mm ..... **Lethocerus**

23a. NEPIDAE — Body oval, more than 1/3 as wide as long; length 18-20mm ..... **Nepa**

23b. Body slender subcylindrical, stick-like; length 23-42mm ... **Ranatra**

24a. NOTONECTIDAE — Slender; antennae 3-segmented; length 4.1-8.3mm ..... **Buenoa**

24b. Robust; antennae 4-segmented; length 8.5-15.5mm ..... **Notonecta**

25a. GERRIDAE — Inner margin of eyes concave behind middle (Fig. 14) **26**

25b. Inner margin of eyes convexly rounded **27**

26a. Tarsal segments of prothoracic leg subequal in length; length 7.0-20.0mm ..... **Gerris**

26b. First tarsal segment of prothoracic leg much shorter than second; length 4.5-7.9mm ..... **Limnogonus**

27a. First antennal segment subequal in length to remaining three together; length 3.0-5.0mm ..... **Metrobates**

27b. First antennal segment much shorter than remaining three together **28**

28a. Third antennal segment with several stiff bristles (Fig. 15); length 2.3-3.5mm ..... **Rheumatobates**

28b. Third antennal segment with fine pubescence only; length 3.0-4.3mm ..... **Trepobates**

29a. VELIIDAE — Mesotarsi with plumose hairs and leaflike claws (Fig. 16); length 3.4-4.6mm ..... **Rhagovelia**

29b. Mesotarsi without plumose hairs; length 1.5-3.0mm ..... **Microvelia**

30a. HEBRIDAE — Antennae 4-segmented; length 1.7-2.2mm ... **Merragata**

30b. Antennae 5-segmented; length 1.8-2.2mm (riparian) **Hebrus**

SPECIES LIKELY TO BE FOUND IN WISCONSIN AND MOST RECENT KEY TO SPECIES

HEBRIDAE (Adult key Wilson 1958)

Hebrus — buenoi, burmeisteri

Merragata — brunnea, hebroides

HYDROMETRIDAE (monotypic)

Hydrometra — martini

MESOVELIIDAE (Adult key Hungerford 1924)

Mesovelia — cryptophila, douglasensis*, mulsanti*

GERRIDAE

Gerris — alacris, argenticollis*, buenoi, comatus, conformis*, dissortis, insperatus, marginatus, remigis* (Adult key Calabrese 1974)

Limnogonus — hesione

Metrobates — hesperius

Rheumatobates — rileyi

Trepobates — inermis, knighti, pictus (Adult key Drake and Harris 1932)

VELIIDAE

Microvelia — albonotata, americana, buenoi, fontinalis, hinei, pulchella* (Adult key Blatchley 1926)

Rhagovelia — obesa, oriander (Adult key Bacon 1956)

NOTONECTIDAE

Buenoa — confusa, limnocastoris, macrotibialis, margaritacea (Adult key Truxal 1953)

Notonecta — borealis, insulata, irrorata, lunata, undulata (Adult key Hungerford 1933)

PLEIDAE — (monotypic)

Plea — striola

NAUCORIDAE — (monotypic)

Pelocoris — femoratus

NEPIDAE (Adult keys Hungerford 1922)

Nepa — *apiculata*

Ranatra — *fusca, kirkaldyi*, nigra*

BELOSTOMATIDAE

Belostoma — *flumineum*

Lethocerus — *americanus, griseus* (Adult key Menke 1963)

CORIXIDAE (Adult key Hilsenhoff 1970)

Callicorixa — *alaskensis*, audeni*

Cenocorixa — *bifida*, dakotensis, utahensis*

Corisella — *edulis, tarsalis*

Cymatia — *americana**

Dasycorixa — *hybrida**

Hesperocorixa — *atopodonta, interrupta, kennicottii, laevigata, lobata, lucida, michiganensis, minorella, nitida*, obliqua, scabricula, semilucida, vulgaris*

Palmacorixa — *buenoi, gillettei, nana*

Ramphocorixa — *acuminata*

Sigara — *alternata, bicoloripennis, compressoidea, conocephala, decorata, decoratella, defecta, dolabra, douglasensis, grossolineata, hubbelli*, johnstoni, knighti, lineata, mackinacensis, macropala, mathesoni, modesta*, mullettensis, penniensis, signata, solensis, transfigurata, trilineata, variabilis*

Trichocorixa — *borealis, calva, kanza, macroceps*, naias*

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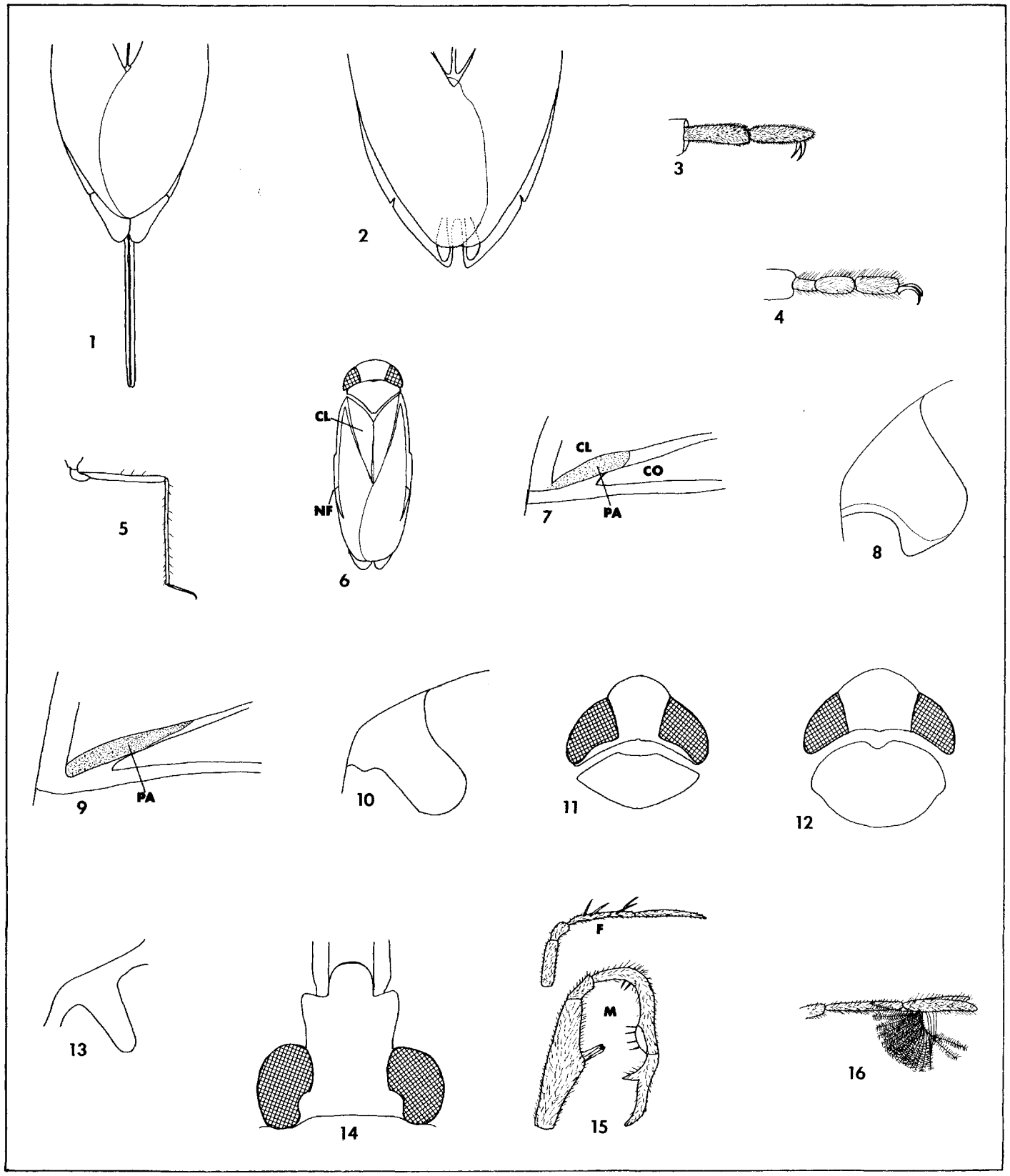

Figures 1-16. — Hemiptera. 1. Dorsal view of posterior abdominal segments of *Nepa*. 2. Dorsal view of posterior abdominal segments of *Belostoma*. 3. Protarsus of *Gerris*. 4. Protarsus of *Mesovelia*. 5. Metathoracic leg of *Mesovelia*. 6. Dorsal view of female *Trichocorixa* showing clavis (CL), and nodal furrow (NF). 7. Lateral view of *Hesperocorixa* showing pruinose area (PA) of claval suture, clavis (CL), and corium (CO). 8. Ventrolateral view of prothoracic lobe of *Hesperocorixa*. 9. Lateral view of claval suture of *Sigara* showing pruinose area (PA). 10. Ventrolateral view of prothoracic lobe of *Sigara*. 11. Dorsal view of head and pronotum of *Palmacorixa*. 12. Dorsal view of head and pronotum of *Corisella*. 13. Ventrolateral view of prothoracic lobe of *Corisella*. 14. Dorsal view of head of *Gerris*. 15. Antennae of female (F) and male (M) *Rheumatobates*. 16. Mesotarsus of *Rhagovelia*.

TRICHOPTERA (Caddisflies)

About 275 species of caddisflies probably occur in Wisconsin; 208 species were recently listed on the basis of adult identifications (Longridge and Hilsenhoff 1973). *Lenarchulus pulchellus* is a synonym, and *Nyctiophylax affinis, N. celta,* and *N. moesta* were identified and replace *N. vestitus,* a nomen dubium (Morse 1972). Additionally, larval collections of *Nemotaulius hostilis* and *Psychoglypha subborealis* would increase the number of Wisconsin species to 211. Although all species on the appended list may not occur in Wisconsin, additional undescribed species will undoubtedly be found. Larvae and pupae of most species cannot be accurately identified, and larval keys that do not contain all known species must be used with caution. Even some genera remain unknown as larvae.

Larvae and pupae of this holometabolous order are mostly stream inhabitants, but some occur in ponds, lakes, marshes, and specialized habitats such as springs. Their tolerance to organic pollution varies widely, with some species being quite tolerant. Their abundance in most streams makes them a valuable fisheries resource. Adults live a few days to several weeks, and many are strong fliers that travel many miles. Most are also attracted to lights, which aids in their collection, but may create nuisance problems near rivers where they are especially abundant. There are normally five larval instars, and carnivores, omnivores, herbivores, and detritivores are all represented by the various species. Most species are univoltine, with much overlapping of generations.

PHILOPOTAMIDAE (3 genera, 6 species)

Chimarra larvae are widespread inhabitants of a variety of streams where they feed on diatoms and algae on rocks and among debris. They construct their silken retreats usually in areas of rapid current. Emergence occurs in late spring and early summer. *Dolophilodes* and *Wormaldia* are restricted to small, cold, rapid streams, and the latter is rare. *Dolophilodes* adults may be found almost every month.

PSYCHOMYIIDAE (2 genera, 2 species)

The larvae occur in a variety of streams, but are relatively uncommon. They can be found mostly among cracks in decaying wood where they feed on algae and detritus. The two Wisconsin species are univoltine with emergence from May to August.

POLYCENTROPODIDAE (6 genera, 25 species)

The carnivorous larvae occur in a wide variety of streams where they construct silken retreats on rocks, decaying wood, or among debris. *Polycentropus* and *Neureclipsis* are the most common and widespread genera; a species of the latter is probably the most tolerant of any caddisfly to organic pollution. *Polycentropus* larvae also occur along margins of lakes. All species are probably univoltine.

HYDROPSYCHIDAE (7 genera, 40 species)

Hydropsyche and *Cheumatopsyche* are perhaps the most abundant and widespread caddisfly genera. Their omnivorous larvae can be found in almost every stream that is not severely polluted. Here they build retreats on rocks, logs, and other submerged objects in various currents. Although most species are univoltine, some may be bivoltine because adults are present from May to November. *Diplectrona* and *Parapsyche* are found among rocks only in cold, rapid streams, while *Macronema* may be locally common on rocks in certain streams of the northern half of the state. *Potamyia* larvae burrow into waterlogged wood in the deeper and slower waters of large streams in southern Wisconsin, and are especially abundant in the Wisconsin River. Larvae of *Diplectrona* and *Parapsyche* are omnivorous, while *Macronema* is mostly a herbivore and *Potamyia* an herbivore-detritivore. All of these genera are apparently univoltine, with adults emerging during late spring or summer.

RHYACOPHILIDAE (1 genus, 5 species)

Larvae are found only in rapid, cold streams where they cling to moss-covered rocks or debris lodged among the rocks. They have a one-year life cycle, with much overlapping. Larvae of Wisconsin species are mostly carnivorous, and adults are on the wing from May through August.

GLOSSOSOMATIDAE (3 genera, 8 species)

The larvae are herbivorous, living mostly on rocks from which they scrape algae, diatoms, and detritus. They inhabit clean, clear streams that are relatively free from organic enrichment. *Glossosoma* is common and widely distributed, with pupation during the late fall and winter and emergence from April into the summer. *Agapetus* is rare in the north, and *Protoptila* larvae are hard to find because of their very small size. Adults of these univoltine genera emerge in the summer.

HYDROPTILIDAE (10 genera, 46 species)

Because of their extremely small size, these "microcaddisflies" are easily overlooked, but judging from numbers of adults collected at light traps, they are certainly not as uncommon as larval collections would indicate. The herbivorous-detritivorous larvae can be found on stones, vegetation, sand, and a variety of other substrates in streams, lakes, and ponds. Most species are probably univoltine, but bivoltine species may exist. Adults are found from May through August.

BRACHYCENTRIDAE (2 genera, 10 species)

Brachycentrids are found in a variety of rapidly flowing streams, and are often abundant in those that are spring fed. Here *Brachycentrus* larvae attach to logs and rocks, and *Micrasema* larvae mostly inhabit moss that covers rocks. All species are univoltine, with emergence from spring to late summer, depending on the species. Young larvae are herbivores, but they consume more and more animal material as they grow.

PHRYGANEIDAE (7 genera, 17 species)

Larvae of *Fabria* and *Hagenella* are unknown, but adults have been collected in northern Wisconsin. *Banksiola* larvae inhabit ponds and lakeshore vegetation, while *Phryganea, Ptilostomis,* and *Agrypnia* are fairly common among vegetation of stream and lake margins, the former even occurring in deeper waters of lakes. *Oligostomis* larvae inhabit margins of fast, cold streams. All phryganeids are apparently univoltine and emerge in late spring or early summer. Feeding habits range from carnivorous to herbivorous, with the former probably predominating.

GOERIDAE (1 genus, 1 species)

Often considered a subfamily of Limnephilidae, the distinctive larvae can be readily distinguished. They are herbivores that inhabit small, clean, rapid streams, but are never abundant. Pupation and emergence occur in late spring.

LIMNEPHILIDAE (18 genera, 54 species)

The herbivorous larvae are widespread and abundant in a variety of aquatic habitats. Some inhabit ponds and marshes *(Anabolia, Asynarchus, Ironoquia, Arctopora, Limnephilus, Nemotaulius),* some a variety of streams *(Anabolia, Limnephilus, Neophylax, Pycnopsyche, Platycentropus),* and others very specialized habitats such as springs and spring runs *(Frenesia, Hesperophylax),* small cold streams *(Psychoglypha),* small woodland streams *(Hydatophylax),* and pools in rocky northern streams *(Onocosmoecus).* Known species have a one-year life cycle, with emergence from early spring to late fall, depending on the species.

LEPIDOSTOMATIDAE (1 genus, 8 species)

Larvae inhabit a wide variety of cleaner streams throughout the state, where they can be found on rocks, in debris, and among moss covering rocks. The life cycle is one year, with

emergence during the summer. Although larvae may occasionally consume algae or animal material, they are mostly detritivores.

SERICOSTOMATIDAE (1 genus, 1 species)

Agarodes larvae are uncommon in medium to large streams with a sand and gravel bottom, and feed on diatoms and detritus among the gravel. They are probably univoltine, with emergence in July and August.

ODONTOCERIDAE (1 genus, 1 species)

The genus *Psilotreta* is uncommon in small, sand- and gravel-bottomed creeks, where larvae feed on algae in the sand under rocks. Pupation occurs in spring, with emergence mostly in June.

MOLANNIDAE (1 genus, 4 species)

Larvae are uncommon, occurring most frequently under logs or rocks in sand- and gravel-bottomed clean streams or lake margins where they feed on algae and diatoms. Molannids are univoltine, with emergence from late spring to midsummer.

HELICOPSYCHIDAE (1 genus, 1 species)

Larvae are found attached to rocks in a variety of clean streams where the current is not too rapid. They also occur on rocks on the windswept shores of clean lakes. The only species is univoltine, with emergence during the summer. Larvae are scrapers, feeding on algae and diatoms.

LEPTOCERIDAE (7 genera, 47 species)

Larvae inhabit a variety of lakes and streams, where they may be found on rocks, in sand, or on vegetation. Although common, they never seem to become abundant. Larvae of *Triaenodes* may also occur in ponds. Larvae of *Oecetus* are carnivores, while larvae of the other genera are omnivores. All species are probably univoltine, with emergence in late spring or summer.

KEY TO GENERA OF THE TRICHOPTERA LARVAE IN WISCONSIN

1a. Each thoracic segment covered with a single dorsal plate, which may have a mesal or transverse fracture line ... **2**

1b. Metanotum mostly membranous, having only scattered hairs or small plates, or divided into 2 or more sclerites **19**

2a. Abdomen with rows of branched gills; no portable case ..... HYDROPSYCHIDAE **3**

2b. Abdomen without gills, and usually much enlarged; larvae less than 5mm long and usually in barrel- or purselike cases which may be attached to the substrate ..... HYDROPTILIDAE **9**

3a. HYDROPSYCHIDAE — Head with a broad, depressed, flat, dorsal area surrounded by an extensive arcuate carina (Fig. 1); anterior margin of protibiae and tarsi with a dense brush of pale setae ..... **Macronoma**

3b. Head not as above; protibiae and tarsi without setal brush **4**

4a. Protrochantin forked (Fig. 2) **5**

4b. Protrochantin simple (Fig. 3), sometimes with a dorsal spur **6**

5a. Prosternal plate with a pair of detached, moderate-sized, posterior sclerites (Fig. 4) ..... **Hydropsyche**

5b. Prosternal plate with at most a pair of detached, very minute, sclerotized dots (Fig. 5). (**Potamyia** with a large dorsal spur on protrochantin will key here, but ventral surface of head is pale. In **Cheumatopsyche,** only area around eye is pale) ..... **Cheumatopsyche**

6a. Genae completely separated by an elongate gula (Figs. 6, 7) **7**

6b. Gula triangular and short, or virtually absent; genae fused for most of their length (Figs. 8, 9) **8**

7a. Gula with sides nearly parallel (Fig. 6); abdomen with short, black scalelike setae on dorsum and arranged in tufts along posterior margin ..... **Parapsyche**

7b. Gula narrowed posteriorly (Fig. 7); abdomen with only coarse hairs of varying lengths, never in tufts. . **Arctopsyche**

8a. Meso- and metanotum entire; mentum cleft (Fig. 8) **Potamyia**

8b. Meso- and metanotum divided by transverse fracture line in posterior third; mentum subconical, not cleft (Fig. 9) ..... **Diplectrona**

9a. HYDROPTILIDAE — Abdomen enlarged, at least some part of it much thicker than thorax (Fig. 10) **10**

9b. Abdomen slender, not appreciably thicker than thorax; no case (early instars) ..... Not Keyed

10a. Each abdominal segment with a small, dark, dorsal sclerite (Fig. 10); case translucent, ovoid, and flattened (Fig. 11a). . ..... **Leucotrichia**

10b. Abdominal segments 2 to 7 without dark, dorsal sclerites, at most with a small delicate ring or very pale sclerites **11**

11a. Abdominal segments with conspicuous dorsal and ventral projections (Fig. 12) ..... **Ithytrichia**

11b. Abdominal segments without dorsal and ventral projections **12**

12a. Meso- and metathoracic legs almost 3 times as long as prothoracic legs (Fig. 13) ..... **Oxyethira**

12b. Meso- and metathoracic legs not more than 1 1/2 times as long as prothoracic legs (Figs. 14, 15) **13**

13a. Tarsal claws about same length as tarsi (Figs. 14, 15, 16); case purselike (Figs. 11c, d, e) **14**

13b. Tarsal claws much shorter than tarsi (Fig. 17); case not purselike, more barrel-shaped (Figs. 11f, g, h) **17**

14a. Tarsal claws with long, stout, inner tooth (Fig. 16); larvae robust; case purselike (Fig. 11c) ..... **Stactobiella**

14b. Tarsal claws without stout inner tooth; case either purselike or cylindrical **15**

15a. Metatibia twice as long as deep (Fig. 14) ..... **Agraylea**

15b. Metatibia about as long as deep (Fig. 15) **16**

16a. Metanotum with setae at antero-ventral angle (Fig. 18); abdominal terga often with inconspicuous, pale, rectangular sclerites ..... **Hydroptila**

16b. Metanotum with setae dorsad of antero-ventral angle (Fig. 19); abdominal terga with inconspicuous sclerotized mesal rings (Figs. 20) ..... **Ochrotrichia**

17a. Anal legs apparently combined with body mass (Fig. 21); eighth abdominal tergum with only one or two pairs of weak setae (Fig. 22) ..... **Orthotrichia**

17b. Anal legs distinctly projecting from body mass (Fig. 23); eighth abdominal tergum with many setae (Fig. 24) **18**

18a. Thoracic terga clothed with long, slender, erect, inconspicuous setae (Fig. 25); case of sand grains and evenly tapered (Fig. 11g) ..... **Neotrichia**

18b. Thoracic terga clothed with shorter, stout, black setae, which are conspicuous (Fig. 26); case evenly tapered, semi-translucent, and with dorsal side fluted with raised ridges (Fig. 11h) ..... **Mayatrichia**

19a. Meso- and metanotum entirely membranous, or (in **Oligostomis**) with only weak sclerites on mesonotum at SA1 (for location of SA1 and other setal areas see Fig. 53) **20**

19b. Meso- and often metanotum with some conspicuous sclerotized plates **38**

20a. Abdominal segment 9 with dorsum entirely membranous; no portable cases **21**

20b. Abdominal segment 9 bearing a sclerotized dorsal plate; with or without cases **30**

21a. Protrochantin broad, hatchet-shaped (Fig. 27) ..... PSYCHOMYIIDAE **22**

21b. Protrochantin pointed (Fig. 28) or undeveloped **23**

22a. PSYCHOMYIIDAE — Anal claw with several long teeth ventrally (Fig. 29); mentum with a pair of high, quadrangular sclerites (Fig. 30) ..... **Psychomyia**

22b. Anal claw lacking ventral teeth (Fig. 31); mentum with a

pair of wide, short sclerites (Fig. 32) ..... **Lype**

23a. Protrochantin undeveloped; head without muscle scars; labrum membranous and T-shaped (Fig. 33) ..... PHILOPOTAMIDAE **24**

23b. Protrochantin pointed (Fig. 28); head usually with muscle scars (Figs. 34, 42); labrum sclerotized and widest near base (Fig. 34) **26**

24a. PHILOPOTAMIDAE — Apex of fronto-clypeus deeply emarginate, often with a large or pointed left lobe and a smaller right one (Fig. 33) ..... **Chimarra**

24b. Apex of fronto-clypeus at most slightly asymmetrical (Figs. 35, 36) **25**

25a. Fronto-clypeus almost perfectly symmetrical, widened abruptly near anterior margin (Fig. 35) ..... **Wormaldia**

25b. Fronto-clypeus slightly asymmetrical, anterior portion uniformly widened (Fig. 36) ..... **Dolophilodes**

26a. POLYCENTROPODIDAE — Tarsi broad and densely pilose (Fig. 37); mandibles short and triangular, each with a large, thick mesal brush (Fig. 38) ..... **Phylocentropus**

26b. Tarsi with little or no pile (Fig. 39); mandibles elongate (Fig. 40) **27**

27a. Muscle scars of head darker than surroundings (Fig. 34); if muscle scars are indistinct, anal claw is obtusely bent (Fig. 41) **28**

27b. Muscle scars of head paler than surroundings (Fig. 42); if muscle scars are indistinct, anal claw is acutely bent (Fig. 43) **29**

28a. Basal segment of anal proleg with several setae (Fig. 44) ..... **Polycentropus**

28b. Basal segment of anal proleg without setae, except sometimes a few distally (Fig. 45) ..... **Neureclipsis**

29a. Anal claw without ventral teeth (Fig. 46) ..... **Cyrnellus**

29b. Anal claw with well-developed ventral teeth (Fig. 43) ..... **Nyctiophylax**

30a. SA3 on meso- and metanotum consisting of a cluster of setae (Figs. 55, 57, 58, 59); head with conspicuous, longitudinal, dark stripes dorsally (Figs. 55, 57, 58, 59); case of vegetable matter is readily vacated .. PHRYGANEIDAE **34**

30b. SA3 on meso- and metanotum consisting of a single seta (Figs. 51, 53, 54); no dark stripes on head **31**

31a. Anal claw long, about as long as elongate sclerite on anal leg (Fig. 47); protrochantin conspicuous; no portable case ..... RHYACOPHILIDAE, **Rhyacophila**

31b. Anal claw small, much shorter than elongate sclerite on anal leg (Fig. 48); protrochantin difficult to distinguish; saddle-shaped or turtlelike case (Fig. 49) ..... GLOSSOSOMATIDAE **32**

32a. GLOSSOSOMATIDAE — Anal claw divided into many teeth (Fig. 50); meso- and metanotum with only one dorsal pair of hairs in addition to those at SA3 (Fig. 51); less than 4mm long ..... **Protoptila**

32b. Anal claw with 1 large tooth, and 1 or 2 small ones (Fig. 52); mesonotum and usually metanotum with setae at both SA1 and SA2 (Figs. 53, 54) **33**

33a. Pronotum notched only at extreme anterolateral angle, at which point the legs are attached (Fig. 53); setae only at SA2 and SA3 on abdominal terga ..... **Glossosoma**

33b. Pronotum narrowed from middle to anterior margin; legs attached at middle (Fig. 54); several abdominal terga with setae at SA1, SA2, and SA3 ..... **Agapetus**

34a. SA1 of mesonotum with brownish-yellow sclerites (Fig. 55); case a series of rings (Fig. 56a) ..... **Oligostomis**

34b. SA1 of mesonotum membranous **35**

35a. Pronotum with a semicircular dark stripe behind anterior pale margin (Fig. 57); case a series of rings (Fig. 56a) ..... **Ptilostomis**

35b. Pronotum either with diagonal dark stripes or a dark anterior margin (Figs. 58-60); case built as a single spiral (Fig. 56b) **36**

36a. Meso- and metanotum with two irregular, longitudinal dark bands, separated by a pale area (Fig. 58); pronotum with dark stripes converging posteriorly (Fig. 58) .... **Banksiola**

36b. Meso- and metanotum with fairly uniform pigmentation.. **37**

37a. Anterior margin of pronotum bordered with black, followed by a dark brown band of variable width (Fig. 59); a dark stripe on fronto-clypeus (Fig. 59); posteroventral surface of pro- and mesocoxae with numerous, distinct, projecting scales ..... **Phryganea**

37b. Pronotum either with diagonal dark stripes or a uniformly dark anterior margin (Fig. 60); fronto-clypeus with or without a dark stripe; scales on procoxae small but distinct, those on mesocoxae indistinct ..... **Agrypnia**

38a. Claws of metathoracic legs very small, those of meso- and prothoracic legs long (Fig. 61); case of sand with lateral flanges (Fig. 62) ..... MOLANNIDAE, **Molanna**

38b. Claws of metathoracic legs as long as those of mesothoracic legs **39**

39a. Mesonotum membranous, except for a pair of sclerotized, narrow, curved or angled bars (Fig. 63); cases ovate or convex (Fig. 65a) ..... LEPTOCERIDAE, **Ceraclea**

39b. Mesonotum without such a pair of sclerotized bars **40**

40a. Antennae long, at least 8 times as long as wide, and arising near base of mandibles (Fig. 68) ..... LEPTOCERIDAE **41**

40b. Antennae very short, not more than 4 times as long as wide, often very inconspicuous and arising at various points (Figs. 84, 95, 96) **46**

41a. LEPTOCERIDAE (in part) — Mesothoracic legs with claw stout and hook-shaped, tarsus bent (Fig. 64); case slender and transparent (Fig. 65b) ..... **Leptocerus**

41b. Mesothoracic legs with claw slender, slightly curved, tarsus straight (Fig. 66); case seldom transparent **42**

42a. Mandibles long, sharp at apex, teeth considerably below apex (Fig. 67); maxillary palpi nearly as long as stipes (Fig. 68) ..... **Oecetis**

42b. Mandibles shorter, blunt at apex, teeth near or at apex (Fig. 63); maxillary palpi usually short **43**

43a. Anal segment developed into a pair of sclerotized, concave plates, with spinose dorsolateral and mesal carinae, and an overhanging ventral flap (Fig. 69); case slender .. **Setodes**

43b. Anal segments convex and without carinae between anal hooks **44**

44a. Metatibiae with a fracture near middle which appears to divide tibiae into 2 segments (Figs. 70, 71) **45**

44b. Metatibiae entirely sclerotized, without a fracture in middle (Fig. 66); case elongate, of various materials (Fig. 65c) ..... **Nectopsyche**

45a. Metatibiae with a regular fringe of long hair (Fig. 70); case elongate, made of spirally arranged bits of vegetation (Fig. 65d) ..... **Triaenodes**

45b. Metatibiae with only irregularly placed hairs (Fig. 71); case elongate, of sand, stones, or vegetation, often with pieces projecting beyond opening (Fig. 65e) ..... **Mystacides**

46a. Anterolateral margins of pronotum produced into long, sharp, forward-projecting points (Figs. 72, 74, 75) **47**

46b. Anterolateral margins of pronotum not produced into long points **49**

47a. Mesonotum divided into 2 pairs of plates (Fig. 72); lateral plates of mesothorax with anterior margins formed into long projecting sclerites (Fig. 72); case tubular, of sand with pebbles along side (Fig. 73) ..... GOERIDAE, **Goera**

47b. Mesonotal plate divided only by a mesal fracture line (Figs. 74, 75); case tubular, slightly curved, and of sand grains (Fig. 76) **48**

48a. Protrochantin produced as a short, curved point; four weakly sclerotized plates on metanotum at SA1 and SA2 (Fig. 74); basal gill tufts with 5 or fewer gills; tibiae and tarsi tan; case readily crushed SERICOSTOMATIDAE, **Agarodes**

48b. Protrochantin not produced beyond edge of coxa; 3 sclerotized plates on metanotum, SA1 combined to form a thin plate, with separate plates at SA3 (Fig. 75); basal gill tufts of 10 or more fine gills; tibiae and tarsi black; case extremely hard ..... ODONTOCERIDAE, **Psilotreta**

49a. Pronotum divided by a sharp furrow across middle, the area in front of furrow depressed (Fig. 77); meso- and metathoracic legs about 3 times as long as prothoracic legs ..... BRACHYCENTRIDAE **50**

49b. Pronotum with at most a shallow furrow (Fig. 84); meso- and metathoracic legs not more than twice as long as prothoracic legs **51**

50a. BRACHYCENTRIDAE — Metacoxae with a ventral, semicircular lobe bearing a row of long setae (Fig. 78); mesonotum with 4 elongate sclerites; plates of metanotum heavily sclerotized (Fig. 79) ..... **Brachycentrus**

50b. Metacoxae without a ventral lobe bearing setae (Fig. 80); mesonotum with 2 very wide sclerites that may be longitudinally divided near lateral margins; plates of metanotum only lightly sclerotized (Fig. 81) ..... **Micrasema**

51a. Antennae very close to eyes (Fig. 82); no dorsal spacing tubercle on abdominal segment 1; case usually of bits of vegetable matter (Fig. 83) ..... LEPIDOSTOMATIDAE, **Lepidostoma**

51b. Antennae about mid-way between eye and base of mandible (Fig. 84); dorsal spacing tubercle usually prominent ... **52**

52a. Spiral case of sand grains or tiny stones and resembling a snail shell (Fig. 85); larvae almost always remaining in case; metanotum with large sclerites that tend to coalesce (Fig. 86); lateral spacing tubercles with about 200 tiny, sclerotized, flat scales; anal claw with many teeth (Fig. 87) ..... HELICOPSYCHIDAE, **Helicopsyche**

52b. Case not spiral-shaped; SA1, SA2, and SA3 of metanotum with small plates or setae (Figs. 89, 91) ..... LIMNEPHILIDAE **53**

53a. LIMNEPHILIDAE — All gills single **54**

53b. Most gills in clusters of 2 or more **59**

54a. Femora, tibiae, and tarsi annulate with black (Fig. 88) ..... **Psychoglypha**

54b. Legs lacking contrasting annuli **55**

55a. Anterior margin of mesonotum with a mesal rectangular emargination (Fig. 89); head elongated; case of sand grains and tiny stones (Fig. 90a) ..... **Neophylax**

55b. Mesonotum without a mesal emargination; head nearly ovoid **56**

56a. Anterior metathoracic plates replaced by a transverse row of setae (Fig. 91); case cornucopia-shaped of sand grains, with larger grains laterally ..... **Apatania**

56b. Anterior metathoracic plates present **57**

57a. Head brown with inconspicuous muscle scars posteriorly (Fig. 84); case of small sand grains, slightly tapered and curved (Fig. 90b) ..... **Pseudostenophylax**

57b. Head pale with dark scars and blotches; cases usually of vegetable matter **58**

58a. Abdominal segments 2-7 with ventral rings (Fig. 92) ..... **Hydatophylax**

58b. Abdominal segments 3-7 with ventral rings (Fig. 93) ..... **Pycnopsyche**

59a. Some gills in clusters of 4 or more **60**

59b. No gills in clusters of more than 3 ..... **62**

60a. Gills on basal segments arising in clusters of 10-15; case slightly curved and usually of wood fragments (Fig. 90d) ..... **Ironoquia**

60b. Fewer gills in clusters on basal segments **61**

61a. Gills on basal segments in clusters of 6-8; case of sand grains (Fig. 90c) ..... **Hesperophylax**

61b. Some gills on basal segments in clusters of 4, never 6, case of vegetable matter (Fig. 90f) ..... **Onocosmoecus**

62a. Legs with contrasting black annuli, case of sticks ..... **Glyphopsyche**

62b. Legs not annulate **63**

63a. Pronotum with numerous pale setae along anterior margin; setae on bulbous ventral portion of prolegs (Fig. 94); head almost uniformly brown with light muscle scars posteriorly; case of stones or sand (Fig. 90e) ..... **Frenesia**

63b. Pronotum lacking pale setae along anterior margin; no setae on prolegs **64**

64a. Head yellow with a dark stripe centrally on the frontoclypeus and a dark U-shaped band on genae (Fig. 95); case of leaves or other vegetation ..... **Nemotaulius**

64b. Head marked either with spots and infuscations, or mostly darkened, or with a V-shaped dark band on genae; cases extremely variable **65**

65a. Prosternal horn extending beyond apices of procoxae (Fig. 96); head pale with dark spots; case usually of vegetation placed transversely (Fig. 90g) ..... **Platycentropus**

65b. Prosternal horn at most reaching apices of procoxae; head marked variously, pale with dark spots in some species; cases variable in material and construction, some similar to **Platycentropus** ..... **Limnephilus, Asynarchus, Arctopora, Anabolia**

Cernotina, **Fabria** and **Hagenella** not keyed.

SPECIES MOST LIKELY TO BE FOUND IN WISCONSIN AND MOST RECENT KEY

PHILOPOTAMIDAE (Adult and larval key Ross 1944)

Chimarra — aterrima, feria, obscura, socia
Dolophilodes — distinctus
Wormaldia — moestus

PSYCHOMYIIDAE (both genera monotypic)

Lype — diversa
Psychomyia — flavida

POLYCENTROPODIDAE (Adult keys Ross 1944)

Cernotina — spicata**
Cyrnellus — marginalis
Neureclipsis — bimaculatus, crepuscularis, validus
Nyctiophylax — affinis, banksi, celta, moestus* (Adult key Morse 1972)
Phylocentropus — placidus
Polycentropus — aureolus, centralis, cinereus, clinei, confusus, crassicornis, flavus, glacialis, interruptus, melanae*, nascotius, pentus, remotus, sabulosus*, weedi* (Descr. Blickle and Morse 1955)

HYDROPSYCHIDAE (Adult keys Ross 1944, Denning 1943)

Arctopsyche — ladogensis**
Cheumatopsyche — analis, aphanta, campyla, gracilis, minuscula, oxa, pasella, sordida, speciosa, wabasha (Adult key Miller 1965)
Diplectrona — modesta
Hydropsyche — aerata, arinale, betteni, bidens, bitida, bronta, cheilonis, cuanis, dicantha, frisoni*, hageni, morosa, orris, phalerata, placoda, recurvata, riola, scalaris, separata*, simulans, slossonae, sparna, valanis*, vexa, walkeri* (Larval key Ross 1944)
Macronema — zebratum
Parapsyche — apicalis
Potamyia — flava

RHYACOPHILIDAE (Adult key Schmid 1970, larval key Flint 1962)

Rhyacophila — acropedes, fuscula, manistee, melita*, vibox*

GLOSSOSOMATIDAE

*Agapetus — hessi, rossi**
Glossosoma — intermedium, nigrior
Protoptila — erotica, lega, maculata, tenebrosa (Adult key Ross 1944)

HYDROPTILIADE (Adult and larval keys Ross 1944)

Agraylea — costello, multipunctata*
Hydroptila — ajax, albicornis, amoena, armata, berneri, callia, consimilis, grandiosa, hamata, jackmanni, perdita, salmo*, scolops, spatulata, strepha*, valhalla*, virgata*, waubesiana, wyomia*
Ithytrichia — clavata
Leucotrichia — pictipes
Mayatrichia — ayama
Neotrichia — falca, halia*, okopa*, vibrans**
Ochrotrichia — spinosa, tarsalis
Orthotrichia — americana, balduti, cristata*
Oxyethira — araya, berneri*, coercens*, forcipata, michiganensis*, obtatus*, pallida, rivicola*, serrata, sida*, zeronia**
Stactobiella — delira, palmata

BRACHYCENTRIDAE (Adult and larval keys Ross 1944)

Brachycentrus — americanus, fuliginosus, incanus*, lateralis, numerosus, occidentalis*
Micrasema — rusticum, wataga, + 2 others (Adult keys Ross 1947, Ross and Unzicker 1965)

PHRYGANEIDAE (Adult keys Ross 1944, larval keys Wiggins 1960)

Agrypnia — colorata, improba*, macdunnoughi*, straminea, vestita*
Banksiola — crotchi, smithi (Adult key Wiggins 1956)
*Fabria — complicata, inornata**
Hagenella — canadensis
Oliogostomis — ocelligera
Phryganea — cinerea, sayi
Ptilostomis — augustipennis, ocellifera, postica*, semifasciata*

GOERIDAE

Goera — stylata

LIMNEPHILIDAE (Adult keys Ross 1944, larval keys Flint 1960)

Anabolia — bimaculata, consocia, ozburni, sordida
Apatania — incerta, zonella
Arctopora — pulchella
Asynarchus — montanus
Frenesia — missa
Glyphopsyche — irrorata
Hesperophylax — designatus
Hydatophylax — argus
Ironoquia — lyrata, punctatissima
Leptophylax — gracilis
Limnephilus — arcocurvus, argenteus, canadensis, curtus*, externus, hyalinus, indivisus, infernalis, janus, moestus, ornatus, partitus*, parvulus, perpusillus, quaeris*, rhombicus, rossi*, secludens*, sericeus, submonilifer*
Nemotaulius — hostilis
Neophylax — autumnus, concinnus, consimilis, fuscus, oligius*
Onocosmoecus — quadrinotatus
Platycentropus — amicus, indistinctus, plectrus*, radiatus*
Pseudostenophylax — uniformis
Psychoglypha — subborealis
Pycnopsyche — aglona, guttifer, lepida, limbata, scabripennis, subfasciata (Adult key Betten 1950)

LEPIDOSTOMATIDAE (Adult keys Ross 1946, Flint and Wiggins 1961)

Lepidostoma — americanum, bryanti, costalis, griseum, sackeni, strophis*, togatum, unicolor**

SERICOSTOMATIDAE (monotypic)

Agarodes — distinctum

ODONTOCERIDAE (monotypic)

Psilotreta — indecisa

MOLANNIDAE (Adult keys Ross 1944, larval keys Sherberger and Wallace 1971)

Molanna — blenda, flavicornis, tryphena, uniophila

HELICOPSYCHIDAE (monotypic)

Helicopsyche — borealis

LEPTOCERIDAE (Adult and larval keys Ross 1944)

Ceraclea — alagmus, ancylus, angustus, annulicornis, arielles, cancellatus, dilutus, erraticus, flavus, mentieus, miscus, nephus, pfadti*, punctatus, resurgens, saccus*, tarsipunctatus, transversus*
Leptocerus — americanus
Mystacides — longicornis, sepulchralis
Nectopsyche — albida, candida, diarina, exquisita, pavida*
Oecetis — avara, cinerascens, immobilis, inconspicua, ochracea, osteni, persimilis
Setodes — guttatus, incerta, oligia*
Triaenodes — aba, baris, borealis, dipsia*, flavescens*, frontalis, ignita, injusta, marginata, nox*, tarda*

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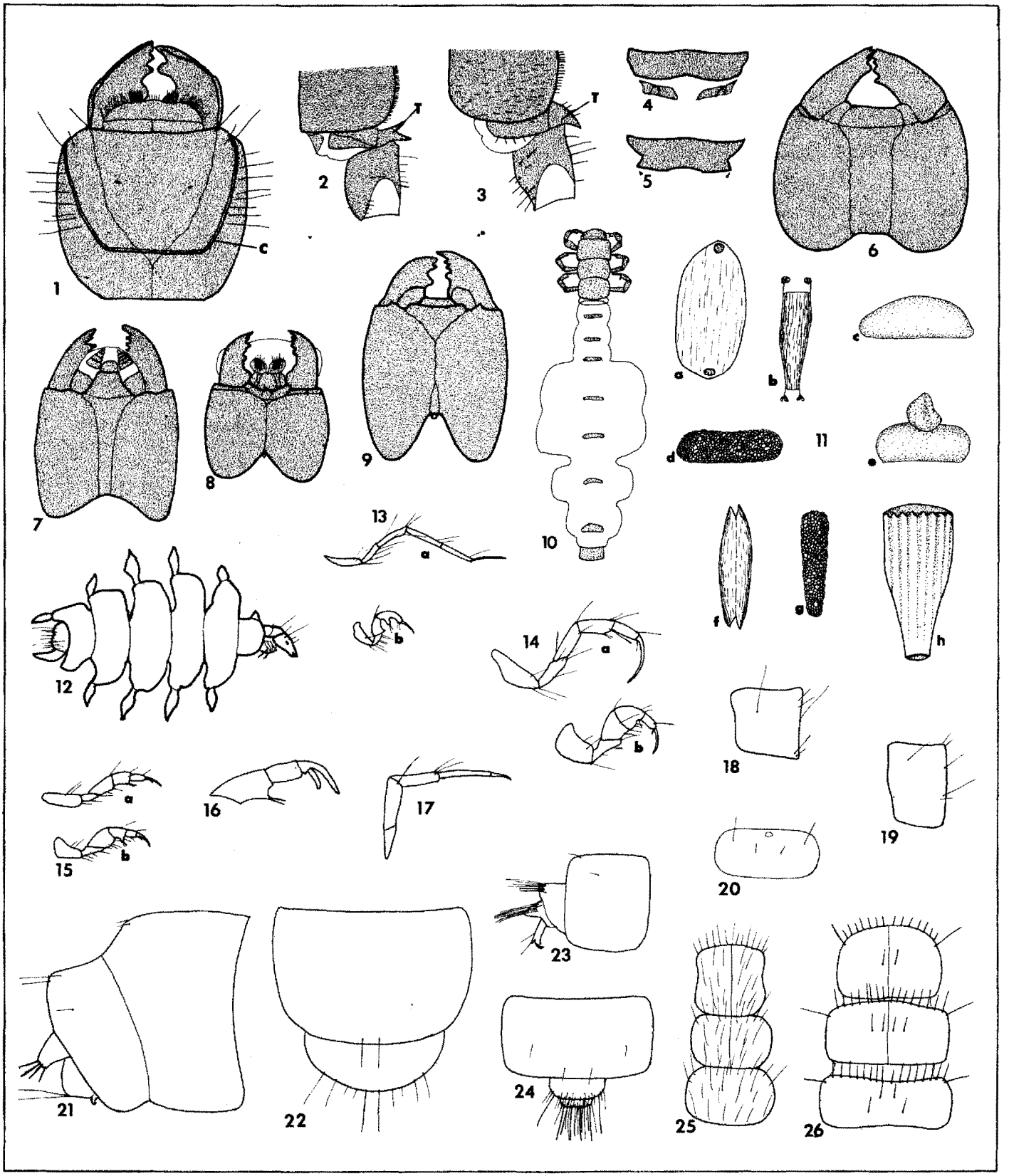
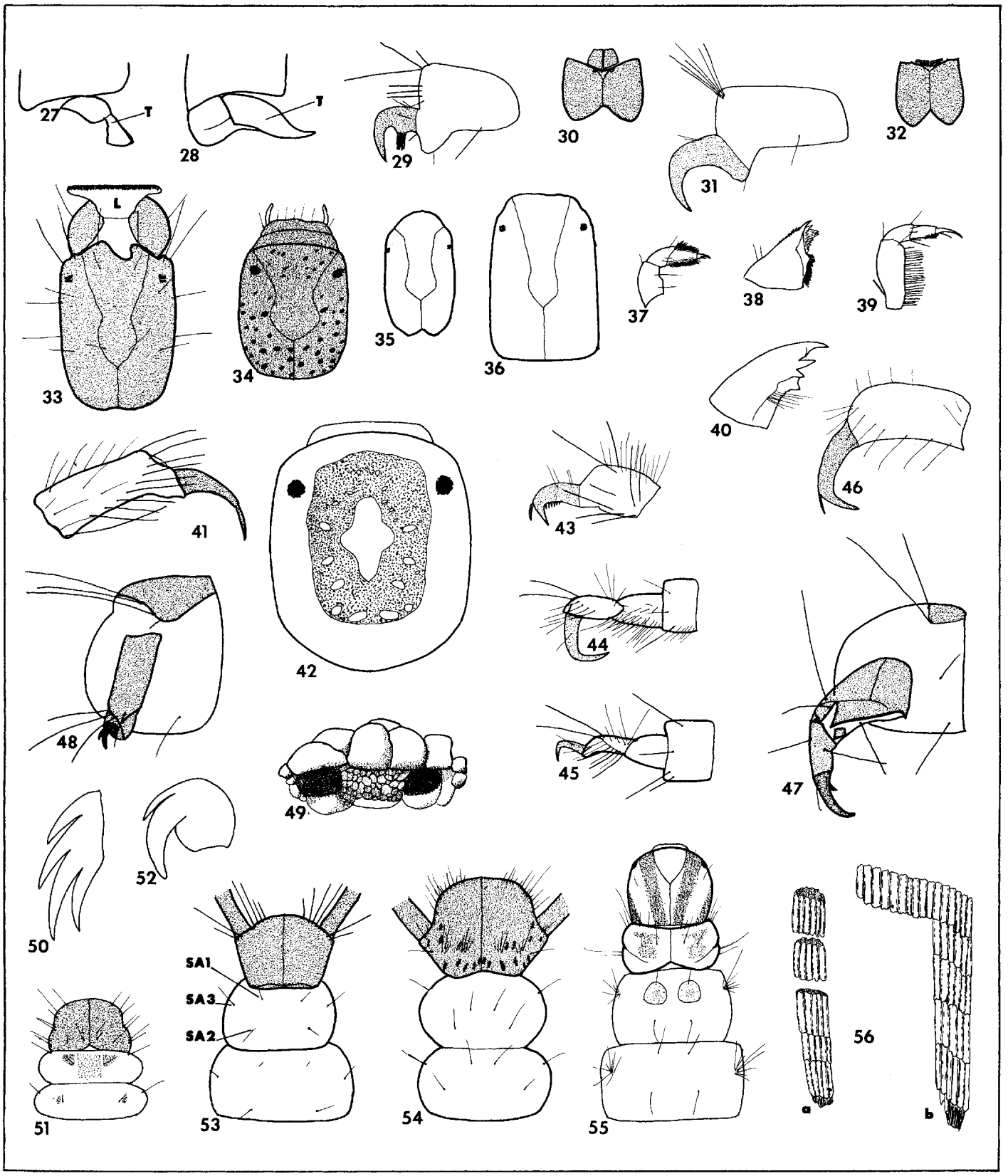
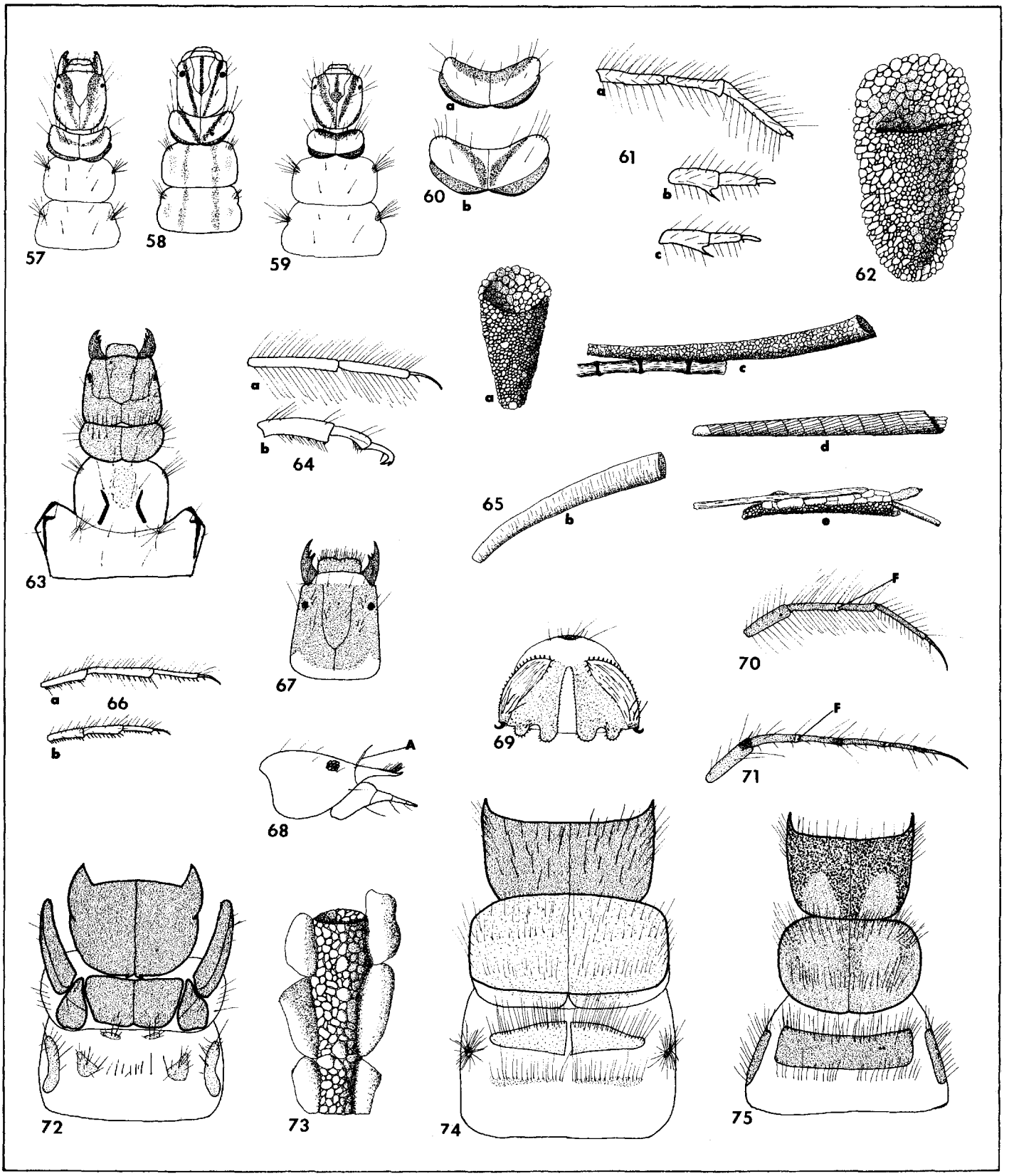


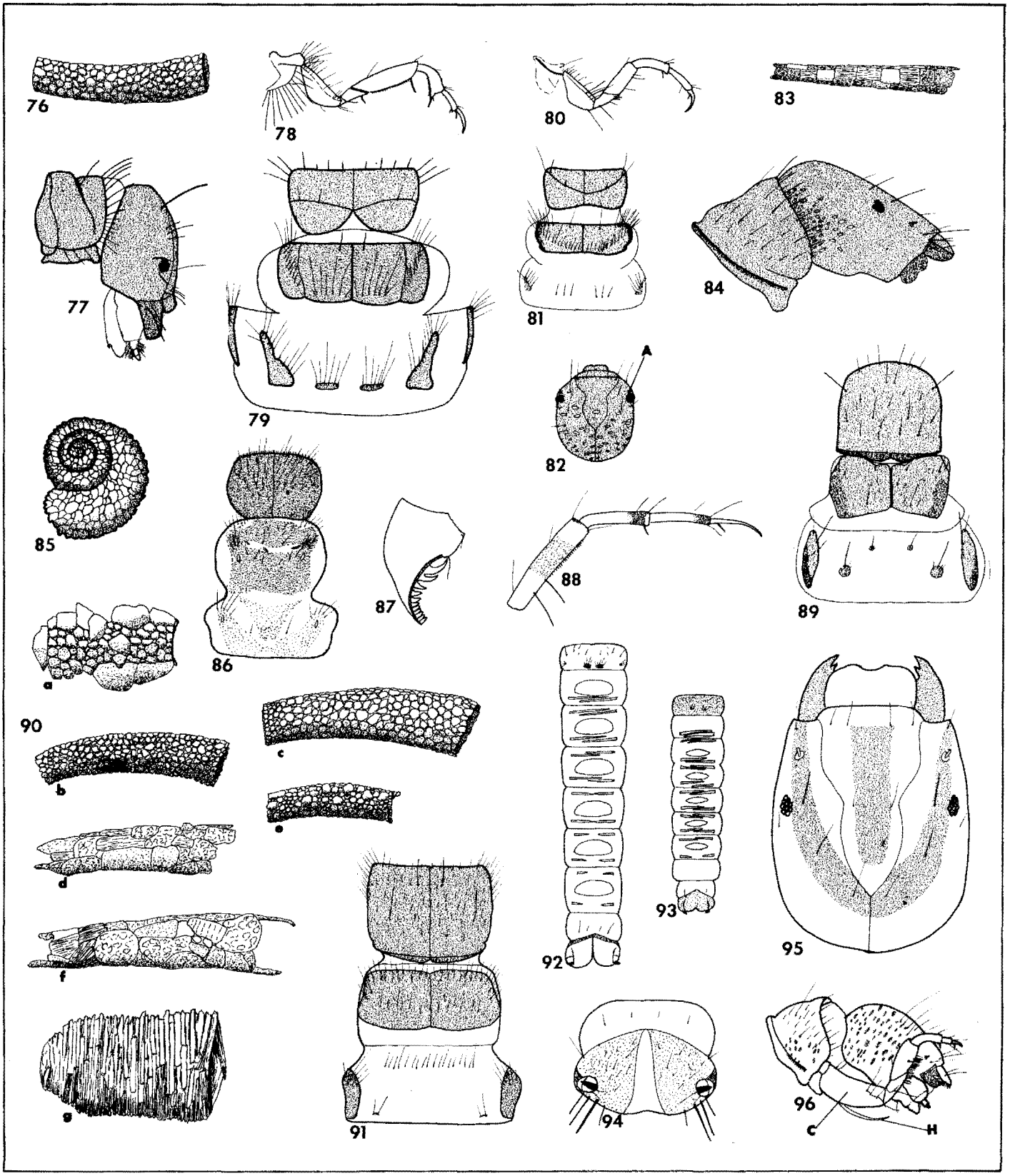
Figures 1-26. — Trichoptera. 1. Dorsal view of head of *Macronema* showing arcuate carina (C). 2. Lateral view of prothorax of *Cheumatopsyche* showing protrochantin (T). 3. Lateral view of prothorax of *Parapsyche* showing protrochantin (T). 4. Prosternum of *Hydropsyche*. 5. Prosternum of *Cheumatopsyche*. 6. Ventral view of head of *Parapsyche*. 7. Ventral view of head of *Arctopsyche*. 8. Ventral view of head of *Potamyia*. 9. Ventral view of head of *Diplectrona*. 10. Dorsal view of *Leucotrichia*. 11. Cases of Hydroptilidae: a. *Leucotrichia*, b. *Oxyethira*, c. *Stactobiella*, d. *Hydroptila*, e. *Ochrotrichia*, f. *Orthotrichia*, g. *Neotrichia*, h. *Mayatrichia*. 12. Lateral view of *Ithytrichia*. 13. *Oxyethira:* a. mesothoracic leg, b. prothoracic leg. 14. *Agraylea:* a. metathoracic leg, b. prothoracic leg. 15. *Hydroptila:* a. metathoracic leg, b. prothoracic leg. 16. Metatibia and tarsus of *Stactobiella*. 17. Metathoracic leg of *Orthotrichia*. 18. Lateral view of metanotum of *Hydroptila*. 19. Lateral view of metanotum of *Ochrotrichia*. 20. Dorsal view of abdominal segment 3 of *Ochrotrichia*. 21. Lateral view of abdominal segments 8-10 of *Orthotrichia*. 22. Dorsal view of abdominal segments 8-9 of *Orthotrichia*. 23. Lateral view of abdominal segments 7-10 of *Neotrichia*. 24. Dorsal view of abdominal segments 7-9 of *Neotrichia*. 25. Dorsal view of thorax of *Neotrichia*. 26. Dorsal view of thorax of *Mayatrichia*.



Figures 27-56. — Trichoptera. 27. Lateral view of prothorax of *Psychomyia* showing protrochantin (T). 28. Lateral view of prothorax of *Polycentropus* showing protrochantin (T). 29. Anal claw of *Psychomyia*. 30. Genae and mentum of *Psychomyia*. 31. Anal claw of *Lype*. 32. Genae and mentum of *Lype*. 33. Dorsal view of head of *Chimarra* showing labrum (L). 34. Dorsal view of head of *Polycentropus*. 35. Dorsal view of head of *Wormaldia* (mouthparts omitted). 36. Dorsal view of head of *Dolophilodes* (mouthparts omitted). 37. Tarsus of *Phylocentropus*. 38. Dorsal view of left mandible of *Phylocentropus*. 39. Tarsus of *Polycentropus*. 40. Dorsal view of left mandible of *Polycentropus*. 41. Anal claw of *Polycentropus*. 42. Dorsal view of head of *Nyctiophylax*. 43. Anal claw of *Nyctiophylax*. 44. Anal proleg of *Polycentropus*. 45. Anal proleg of *Neureclipsis*. 46. Anal claw of *Cyrnellus*. 47. Anal proleg of *Rhyacophila*. 48. Anal proleg of *Glossosoma*. 49. Ventrolateral view of case of *Glossosoma*. 50. Anal claw of *Protoptila*. 51. Dorsal view of thorax of *Protoptila*. 52. Anal claw of *Glossosoma*. 53. Dorsal view of thorax of *Glossosoma* showing setal areas (SA1, SA2, SA3). 54. Dorsal view of thorax of *Agapetus*. 55. Dorsal view of head and thorax of *Oligostomis*. 56. Cases of Phryganeidae (separated to show construction): a. *Ptilostomis*, b. *Phryganea*.



Figures 57-75. — Trichoptera. 57. Dorsal view of head and thorax of *Ptilostomis*. 58. Dorsal view of head and thorax of *Banksiola*. 59. Dorsal view of head and thorax of *Phryganea*. 60. Pronota of 2 species of *Agrypnia*. 61. *Molanna:* a. metathoracic leg, b. mesothoracic leg, c. prothoracic leg. 62. Case of *Molanna*. 63. Dorsal view of head and thorax of *Ceraclea*. 64. Tibia and tarsus of *Leptocerus:* a. metathoracic leg, b. prothoracic leg. 65. Cases of Leptoceridae: a. *Ceraclea*, b. *Leptocerus*, c. *Nectopsyche*, d. *Triaenodes*, e. *Mystacides*. 66. Femur, tibia, and tarsus of *Nectopsyche:* a. metathoracic leg, b. mesothoracic leg. 67. Dorsal view of head of *Oecetis*. 68. Lateral view of head of *Oecetis* showing antenna (A). 69. Posterior view of anal segment and prolegs of *Setodes*. 70. Metathoracic leg of *Triaenodes* showing fracture (F). 71. Metathoracic leg of *Mystacides* showing fracture (F). 72. Dorsal view of thorax of *Goera*. 73. Case of *Goera*. 74. Dorsal view of thorax of *Agarodes*. 75. Dorsal view of thorax of *Psilotreta*.



Figures 76-96. — Trichoptera. 76. Case of *Psilotreta*. 77. Lateral view of pronotum and head of *Brachycentrus*. 78. Metathoracic leg of *Brachycentrus*. 79. Dorsal view of thorax of *Brachycentrus*. 80. Metathoracic leg of *Micrasema*. 81. Dorsal view of thorax of *Micrasema*. 82. Dorsal view of head of *Lepidostoma* showing location of antennae (A). 83. Case of *Lepidostoma*. 84. Lateral view of head and pronotum of *Pseudostenophylax*. 85. Case of *Helicopsyche*. 86. Dorsal view of thorax of *Helicopsyche*. 87. Anal claw of *Helicopsyche*. 88. Mesofemur, tibia, and tarsus of *Psychoglypha*. 89. Dorsal view of thorax of *Neophylax*. 90. Cases of Limnephilidae: a. *Neophylax*, b. *Pseudostenophylax*, c. *Hesperophylax*, d. *Ironoquia*, e. *Frenesia*, f. *Onocosmoecus*, g. *Platycentropus*. 91. Dorsal view of thorax of *Apatania* (after Flint 1960). 92. Ventral view of abdomen of *Hydatophylax*. 93 .Ventral view of abdomen of *Pycnopsyche*. 94. Ventral view of abdominal segments 9-10 of *Frenesia*. 95. Dorsal view of head of *Nemotaulius*. 96. Lateral view of prothorax and head of *Platycentropus* showing prosternal horn (H) in relation to coxae (C).

MEGALOPTERA
(Fishflies and Alderflies)

This small holometabolous order has just two families. Only the larvae are aquatic, and they occur commonly in a variety of lotic and lentic habitats. There are normally 10 larval instars, and life cycles of most species are 2 or 3 years in Wisconsin, with emergence in late spring or early summer. Larvae of all species are carnivores; nothing is known about feeding habits of the short-lived adults.

CORYDALIDAE — Fishflies and Dobsonflies (3 genera, 5 species)

Species in this order are among our largest insects. *Nigronia* and *Corydalus* larvae are found statewide under rocks in well aerated streams of all sizes, with *Nigronia* often being abundant. *Chauliodes* larvae are most frequently encountered in weedy ponds, but also occur in marshes, lake margins, and even in streams.

SIALIDAE — Alderflies (1 genus, 11 species)

Larvae of *Sialis* occur in both lotic and lentic habitats, usually burrowing in deposits of silt. They are common in littoral zones of some lakes, and may be encountered occasionally a mile or more from shore.

KEY TO GENERA OF MEGALOPTERA LARVAE IN WISCONSIN

1a. Last abdominal segment with a long median filament ..... SIALIDAE, **Sialis**

1b. Last abdominal segment without a median filament, but with a pair of lateral hooks ..... CORYDALIDAE **2**

2a. A large tuft of filamentous gills at the base of each lateral process ..... **Corydalus**

2b. No filamentous gills at the base of each lateral process .. **3**

3a. Dorsal respiratory tubes on abdominal segment 8 short, not reaching past middle of abdominal segment 9 .... **Nigronia**

3b. Dorsal respiratory tubes on abdominal segment 8 long, reaching past end of abdomen ..... **Chauliodes**

SPECIES LIKELY TO BE FOUND IN WISCONSIN AND MOST RECENT KEY TO SPECIES

CORYDALIDAE (Adult key Davis 1903)

Chauliodes — pectinicornis, rastricornis (Larval key Cuyler 1958)

Corydalus — cornutus

Nigronia — fasciatus, serricornis* (Larval key Neunzig 1966)

SIALIDAE (Adult key Ross 1937, descr. Flint 1964)

Sialis — americana, contigua, dreisbachi*, glabella*, hasta*, infumata, itasca, joppa, mohri, vagans, velata*

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AQUATIC NEUROPTERA
(Spongilla Flies)

In this relatively large holometabolous order there is one family, Sisyridae, that has become adapted to an aquatic environment. Larvae of this family are parasitic on certain freshwater sponges, mostly in the genus *Spongilla* or *Ephydatia.* Larvae hatch from eggs laid above the water, drop into the water, and then drift or swim until they find a suitable host where they can complete their development. The third instar larva crawls from the water to pupate. Larvae of *Sisyra* and *Climacia* may be found in both lentic and lotic situations, anyplace where the host species of sponge is found.

KEY TO GENERA OF AQUATIC NEUROPTERA LARVAE IN WISCONSIN

1a. Dorsal tubercles pronounced, with 2 or 3 minute spines at bases of setae ..... **Climacia**

1b. Dorsal tubercles short, without minute spines at bases of setae ..... **Sisyra**

AQUATIC LEPIDOPTERA (Moths)

In this very large terrestrial order, larvae and pupae of a few species in the family Pyralidae have become adapted to the aquatic environment. Larvae of *Neocataclysta, Nymphula,* and *Paraponyx* construct cases of plant materials and live in lentic environments where they feed on plants. *Parargyractis* larvae are lotic and feed on diatoms and algae growing on rocks. Although fairly common in some areas, aquatic Lepidoptera have not been studied in Wisconsin and very little is known about them. Larvae of additional species of Lepidoptera that live on emergent vegetation or bore into stems of aquatic plants may be collected while sampling aquatic habitats.

KEY TO GENERA OF AQUATIC LEPIDOPTERA LARVAE IN WISCONSIN

1a. Filamentous gills present **2**
1b. Filamentous gills absent **3**
2a. Gills branched, with up to 400 gill filaments; larvae in a case of material cut from the food plant *(Nuphar, Potamogeton, Vallisneria,* etc.) ..... **Paraponyx**
2b. Gills unbranched, with about 120 gill filaments; larvae free-living on rocks in lotic situations ..... **Parargyractis**
3a. Larva in a case constructed from its food plant **4**
3b. Larva free-living, without a case ..... terrestrial
4a. Body cylindrical, moniliform; head paler than body; case of *Lemna* on which it feeds ..... **Neocataclysta**
4b. Body somewhat flattened, not moniliform; head darker than body; on *Lemna, Potamogeton, Nuphar,* or other plants from which case is built ..... **Nymphula**

AQUATIC COLEOPTERA (Beetles)

In this, the largest insect order, only about 10% of the families have a majority of species with an aquatic stage. A few additional families have a limited number of aquatic species. About 1% of the known species of Coleoptera have an aquatic stage; and more than 300 aquatic species occur statewide. In Wisconsin there are six families in which most adults and larvae are aquatic (Dytiscidae, Elmidae, Gyrinidae, Haliplidae, Hydrophilidae, and Noteridae), two families in which adults are aquatic (Dryopidae, Hydraenidae), two families with aquatic larvae (Helodidae and Psephenidae), and one more family with a few species of aquatic larvae (Chrysomelidae). Pupae are terrestrial or live in air-filled cacoons. Life cycles, habitat, feeding habits, and distribution vary widely from family to family. Species keys can be used to accurately identify adults in most genera, but larvae cannot be identified to species and sometimes not even to genus.

HALIPLIDAE — Crawling Water Beetles (3 genera, 24 species)

Adults and larvae of *Haliplus* and *Peltodytes* are found among matted vegetation and debris along the shores of lakes, ponds, and slow streams, and are often abundant. Eggs are laid in the spring, larvae complete three instars on vegetation where they feed mostly on algae, and then pupate on shore under a stone or log. The aquatic adults, which emerge in summer or fall, are also mostly herbivorous.

DYTISCIDAE — Predaceous Water Beetles (27 genera, 140 species)

Both larvae and adults are predators, mainly on other arthropods. Larvae of most species complete their development in the spring, pupate on dry land in the summer, emerge in late summer or fall, and overwinter as adults. A few species overwinter as larvae, and in dry years, many may overwinter as pupae. Larvae and adults of most species can be collected in a variety of shallow, debris-laden, or vegetation-choked habitats. Ponds, small puddles, marshes, swamps, lake margins, and streams all harbor species, some of which may become abundant. Except for some lotic *Agabus,* most species are lentic and not very habitat specific. Adults often fly, especially just after emergence, and can be frequently collected at lights.

NOTERIDAE — Burrowing Water Beetles (3 genera, 3 species)

Although adults resemble small dytiscids in structure and habits, larvae are very different. The herbivorous larvae feed on plant roots and pupate within an air-filled cacoon on these roots in late summer. Adults emerge in fall and overwinter. *Suphisellus* is rare in southern Wisconsin; the other two genera have not been found, but occur in Michigan.

GYRINIDAE — Whirligig Beetles (2 genera, 26 species)

Both genera are common inhabitants of Wisconsin's ponds,

lakes, and streams. Larvae complete 3 instars during the summer months and pupate on shore. Adults emerge in late summer and fall, often congregating in large schools of mixed species. Species that inhabit ponds fly to wintering sites along large streams and lakes in the fall. Larvae are predaceous; adults are scavengers.

HYDROPHILIDAE — Water Scavenger Beetles (17 genera, 67 species)

Some genera (subfamily Sphaeridiinae) are not aquatic, and others represent a transition between aquatic and terrestrial environments, living largely at the water-land interface. *Chaetarthria* is mostly riparian, and the larvae of *Anacaena, Paracymus, Laccobius,* and *Crenitis* are also riparian, with the adults of these genera having some affinity for the terrestrial environment. The rest of the genera are widespread and often abundant in a variety of aquatic habitats. *Sperchopsis, Crenitis,* and *Hydrobius* inhabit lotic situations, although the latter may also occur in ponds. The remaining genera are primarily lentic, preferring weedy ponds, marshes, swamps, and lake margins, but also occurring along the margins of streams. The larvae have 3 instars and are predators, while the adults are scavengers and feed on a variety of food. All species are probably univoltine, with larvae most numerous in spring and early summer, and adults most abundant in late summer and fall. Most species probably overwinter as adults, but in some years pupae of some species may also overwinter.

HYDRAENIDAE — Minute Moss Beetles (2 genera, 5 species)

Only the adults are aquatic, and in Wisconsin they are rarely collected, perhaps because of their small size. A third genus, *Limnebius,* may also occur; adults are only 1mm long and could be easily overlooked. The beetles are scavengers, and feed on dead animals and plant material in swamps and margins of streams.

PSEPHENIDAE — Water Penny Beetles (2 genera, 2 species)

Only the larvae are aquatic, attaching to rocks in streams or windswept lake shores where they scrape algae and diatoms from rocks. There are apparently 6 larval instars and a 2-year life cycle. Pupation occurs in summer on moist rocks near the stream and adults emerge in less than 2 weeks. Adults are riparian, but enter the water to oviposit. Both species are fairly common throughout the state, but habitat requirements are specific and in a given stream *Psephenus* larvae can be abundant or absent.

ELMIDAE — Riffle Beetles (6 genera, 26 species)

Larvae and adults of all Wisconsin genera are aquatic. They are common in waterlogged wood (*Macronychus, Ancyronyx, Stenelmis, Dubiraphia*), in gravel substrate of streams (*Stenelmis, Optioservus*), among stream vegetation (*Dubiraphia*) and occasionally occur along margins of clean lakes (*Macronychus, Stenelmis, Dubiraphia*). *Microcylloepus* is rare. The herbivorous larvae have 5 or 6 instars, and most species probably require 2 years to complete their development. Adults are also herbivores. Upon emergence from the terrestrial pupal chamber, they fly and disperse widely, but after entering the water they rarely if ever leave the aquatic environment.

DRYOPIDAE — Riffle Beetles (1 genus, 2 species)

The environment and habits of *Helichus* adults are very similar to those of elmids, but the larvae are not aquatic. Although both species are distributed statewide, they are most common in the southwestern part of the state.

HELODIDAE — Marsh Beetles (4 genera, 22 species)

The herbivorous larvae can be frequently found in a variety of shallow lentic habitats, including tree holes. Almost nothing is known about their life cycle or biology.

CHRYSOMELIDAE (1 genus)

Larvae and pupae of *Donacia* inhabit and feed upon the roots and submerged stems of aquatic plants, especially water lillies. Oxygen is obtained from the plant. Although Chrysomelidae is a very large terrestrial family, larvae of this aquatic genus are apparently uncommon.

KEY TO GENERA OF AQUATIC COLEOPTERA IN WISCONSIN (ADULTS)

1a. Two pairs of eyes, a dorsal and a ventral pair divided by sides of head; meso- and metathoracic legs short, flattened; tarsi folding fanwise ..... GYRINIDAE **9**

1b. One pair of eyes; meso- and metathoracic legs not extremely flat; tarsi not folded fanwise **2**

2a. Metacoxae expanded into large plates that cover 2 or 3 abdominal sterna and bases of metafemora (Fig. 1) ..... HALIPLIDAE **10**

2b. Metacoxae not expanded into large plates **3**

3a. Prosternum with a postcoxal process that extends posteriorly to mesocoxae (Fig. 2); first visible abdominal sternum completely divided by metacoxal cavities (Fig. 2) **4**

3b. Prosternum with postcoxal process absent or short; first visible abdominal sternum extending for its entire breadth behind coxal cavities (Fig. 3) **6**

4a. Anterior of prosternum, its postcoxal process, and meso- and metasternum in same plane (Fig. 4); pro- and mesotarsi distinctly 5-segmented, segment 4 as long as 3 ..... **5**

4b. Anterior of prosternum greatly depressed and not in same plane as its postcoxal process and meso- and metasternum (Fig. 5); pro- and mesotarsi appear to be 4-segmented (except **Bidessonotus**) with segment 4 very small and concealed between lobes of segment 3 ..... DYTISCIDAE (in part) **14**

5a. Prosternal process pointed; no curved spur or hooked apex on protibiae ..... DYTISCIDAE (in part) **24**

5b. Prosternal process truncate or rounded; protibiae with curved spur or hooked apex (Fig. 6) ..... NOTERIDAE **12**

6a. Antennae short, club-shaped with segment 4, 5, or 6 modified to form a cupule (Fig. 7); maxillary palpi usually longer than antennae **7**

6b. Antennae filiform or pectinate, usually longer than maxillary palpi **8**

7a. Antennae with 5 segments past cupule; less than 2.5mm long ..... HYDRAENIDAE **39**

7b. Antennae with 3 segments past cupule; 1.5-40mm long ..... HYDROPHILIDAE **40**

8a. Antennae slender, filiform; less than 4.5mm long ..... ELMIDAE **57**

8b. Antennae short with pectinate club (Fig. 8); 5.0-6.3mm long ..... DRYOPIDAE, **Helichus**

9a. GYRINIDAE — Scutellum visible; elytra with distinct rows of sharp punctures; 3-8mm ..... **Gyrinus**

9b. Scutellum not visible; elytral punctures scattered and indistinct; 9-16mm ..... **Dineutus**

10a. HALIPLIDAE — Pronotum with sides widest at base, convergent anteriorly (Fig. 9) **11**

10b. Pronotum with sides of basal 2/3 nearly parallel (Fig. 10); 4.0-4.5mm ..... **Brychius**

11a. Last segment of maxillary palpi conical, as wide and as long or longer than next to last (Fig. 11); 3.5-5.0mm ..... **Peltodytes**

11b. Last palpal segment narrower and much shorter than next to last (Fig. 12) ..... **Haliplus**

12a. NOTERIDAE — Prosternal process rounded posteriorly; 2.5-3.0mm ..... **Pronoterus**

12b. Prosternal process truncate posteriorly **13**

13a. Length 2.7-3.0mm ..... **Suphisellus**

13b. Length 3.7-4.5mm ..... **Hydrocanthus**

14a. DYTISCIDAE (in part) — Scutellum fully visible; apices of elytra and last abdominal sternum produced, acuminate; 4mm ..... **Celina**

14b. Scutellum covered by elytra; apex of abdomen not acuminate **15**

15a. Less than 2.2mm long; metacoxal process not produced laterally, bases of trochanters entirely free (Fig. 13) ... **16**

15b. More than 2.3mm long; metacoxal process produced laterally to cover bases of trochanters (Figs. 14, 22-25) **19**

16a. Metatibiae straight, almost uniform in width (Fig. 15); metatarsal claws unequal; 1.8mm ..... **Desmopachria**

16b. Metatibiae arcuate, narrow at base (Fig. 16); metatarsal claws equal in length **17**

17a. Pro- and mesotarsi distinctly 5-segmented; metacoxal lines strongly impressed and converging anteriorly across mid-metasternum to meet at mesocoxae (Fig. 17); 1.7-2.2mm .. .. **Bidessonotus**

17b. Pro- and mesotarsi apparently 4-segmented; metacoxal lines not continuing onto mid-metasternum **18**

18a. Head with transverse suture behind eyes (Fig. 18); 1.8-2.2mm ..... **Liodessus**

18b. Head without a transverse suture behind eyes; 1.6-2.0mm.. ..... **Uvarus**

19a. A diagonal carina crossing epipleura near base (Fig. 19) **20**

19b. No carina crossing epipleura **21**

20a. Prosternal process broadly rounded at tip, and as wide as procoxae (Fig. 20); 2.4-2.6mm ..... **Hydrovatus**

20b. Prosternal process pointed at tip, and only half as wide as procoxae (Fig. 21); 2.3-5.4mm ..... **Hygrotus**

21a. Bases of metafemora touching metacoxal lobes (Fig. 22); 4.5-5.0mm ..... **Laccornis**

21b. Metafemora separated from metacoxal lobes by basal part of trochanters **22**

22a. Posterior margin of metacoxal process truncate or angularly prominent at middle (Figs. 23, 24); 2.5-6.0mm **Hydroporus**

22b. Posterior margin of metacoxal process incised at middle (Fig. 25) **23**

23a. Metacoxal plates micropunctate with scattered larger punctures; pronotum with distinct sulcations laterally; 3.4-4.4mm ..... **Oreodytes**

23b. Metacoxal plates densely micropunctate, without larger punctures; pronotum without lateral sulci; 4.3-5.0mm .... **Deronectes**

24a. DYTISCIDAE (in part) — Very large, 25-40mm **25**

24b. Smaller, 4-17mm **26**

25a. One large spur at apex of metatibiae twice as broad as other; beetle widest at posterior third; 28-33mm .. **Cybister**

25b. Large spurs at apex of metatibiae subequal in width; beetle widest near middle; 25-40mm ..... **Dytiscus**

26a. Scutellum not visible; metatarsi with a single stout claw; 4.0-6.0mm ..... **Laccophilus**

26b. Scutellum fully visible; metatarsi with two claws **27**

27a. Anterior margin of eyes emarginate above bases of antennae (Fig. 26) **28**

27b. Eyes not emarginate above bases of antennae **36**

28a. Metafemora with a linear group of stout setae ventrally near posterior, apical angle (Fig. 27) **29**

28b. Metafemora without such setae **30**

29a. Metatarsal claws of equal length or nearly so; 6.0-11.0mm.. ..... **Agabus**

29b. Outer metatarsal claw 2/3 or less length of inner claw; 8.0-11.5mm ..... **Ilybius**

30a. Prosternum with a median longitudinal furrow from near front margin to apex of prosternal process; 8.5-9.0mm .... **Matus**

30b. Prosternum without a longitudinal furrow **31**

31a. Metacoxal lines coming so close together posteriorly as almost to touch median line (Fig. 28); 4.5-5.5mm **Copelatus**

31b. Metacoxal lines not converging so close to median line (Fig. 2) **32**

32a. Metatarsal claws of same length, or nearly so; less than 9mm long **33**

32b. Metatarsal claws obviously unequal in length; more than 9mm long **34**

33a. Terminal palpal segments notched or emarginate at apex; 7.5-8.5mm ..... **Coptotomus**

33b. Terminal palpal segments not emarginate; 6.0-7.0mm .... **Agabetes**

34a. Elytra sculptured with numerous parallel transverse grooves; 15-17mm ..... **Colymbetes**

34b. Elytra without transverse grooves **35**

35a. Large black beetles with coarsely reticulate elytra; 14-16mm ..... **Neoscutopterus**

35b. Smaller beetles, with elytra not reticulate and usually irrorate; 9-11mm ..... **Rhantus**

36a. Outer margin of metasternal wings straight (Fig. 29); outer spur at apex of metatibiae acute; 12-14mm ..... **Hydaticus**

36b. Outer margin of metasternal wings arcuate (Fig. 30); outer spur at apex of metatibiae blunt, more or less emarginate.. ..... **37**

37a. Elytra densely punctate, and usually fluted and hairy in females; 12-16mm ..... **Acilius**

37b. Elytral punctation extremely fine or absent; females without fluted elytra **38**

38a. Hind margin of mesofemora with stiff setae that are as long as or longer than femora are wide (Fig. 31); 9-13mm .... **Thermonectus**

38b. Setae on hind margin of mesofemora only about half as long as femora are wide (Fig. 32); 11-16mm.. **Graphoderus**

39a. HYDRAENIDAE — Maxillary palpi much longer than antennae; pronotum coarsely, closely punctate, sides without a transparent border; 1.8-2.2mm ..... **Hydraena**

39b. Maxillary palpi shorter than antennae; pronotum variously sculptured, almost always with a transparent border in at least basal half; 1.2-2.5mm ..... **Ochthebius**

40a. HYDROPHILIDAE — Pronotum with 5 longitudinal grooves; 2.8-4.5mm ..... **Helophorus**

40b. Pronotum without longitudinal grooves **41**

41a. Pronotum granular and conspicuously narrower than elytral bases; scutellum very small; eyes protuberant; 3.5-4.0mm.. ..... **Hydrochus**

41b. Pronotum not appreciably narrower than base of elytra, or if so, scutellum elongate **42**

42a. Basal segment of metatarsi longer than second; antennae usually longer than maxillary palpi; segment 2 of maxillary palpi much thicker than 3 or 4 .. *Sphaeridiinae (terrestrial)*

42b. Basal segment of metatarsi shorter than second; antennae subequal to or shorter than maxillary palpi; segment 2 of maxillary palpi not, or very little thicker than 3 or 4 .... **43**

43a. Meso- and metasternum with a continuous median longitudinal keel, which is prolonged posteriorly into a spine between hind coxae (Fig. 3) **44**

43b. Meso- and metasternum without a continuous median longitudinal keel **47**

44a. Length 8-16mm **45**

44b. Length 31-37mm **46**

45a. Prosternum sulcate to receive anterior part of keel; 8-11mm ..... **Tropisternus**

45b. Prosternum carinate; 13-16mm ..... **Hydrochara**

46a. Prosternum sulcate, closed anteriorly; 32-37mm **Hydrophilus**

46b. Prosternum bifurcate, open anteriorly; 31-33mm **Dibolocelus**

47a. First 2 abdominal sternites with a common excavation covered by a fringe of long golden hairs arising from anterior margin of first abdominal sternite; 2mm (semiaquatic) .... **Chaetarthria**

47b. Basal abdominal sternites normal **48**

48a. Meso- and metatibiae with fringes of long swimming hairs; head strongly deflexed; scutellum elongate; 2.5-6.0mm .... **Berosus**

48b. Meso- and metatibiae not fringed with swimming hairs; head not deflexed; scutellum almost as wide as long .. **49**

49a. Maxillary palpi stout and short, about same length as antennae; last segment of palpi as long or longer than next to last **50**

49b. Maxillary palpi slender, much longer than antennae; last palpal segment usually shorter than next to last **55**

50a. Length 6-10mm **51**

50b. Length 2-4mm **52**

51a. Lateral margins of elytra weakly serrate basally (Fig. 33); meso- and metatarsi with scattered fine hairs dorsally; 8-9mm ..... **Sperchopsis**

51b. Lateral margins of elytra without serrations; meso- and metatarsi with a dorsal fringe of fine swimming hairs; 6-10mm ..... **Hydrobius**

52a. Metatibiae arcuate (Fig. 34); elytra without sutural striae; 2.5-4.0mm ..... **Laccobius**

52b. Metatibiae not arcuate (Fig. 35); elytra with sutural striae (Fig. 36) **53**

53a. Prosternum longitudinally carinate; mesosternum with a strong transverse ridge; black or nearly black with a metalic sheen; 2.0-2.5mm ..... **Paracymus**

53b. Prosternum not carinate; mesosternum with toothlike protuberance, low transverse ridge, or smooth; dark brown to nearly black **54**

54a. Mesosternum with a toothlike protuberance .... **Anacaena**

54b. Mesosternum with a low transverse ridge, or smooth ..... **Crenitis**

55a. All tarsi 5-segmented, basal segment small; 2.5-9.5mm ..... **Enochrus**

55b. Meso- and metatarsi 4-segmented **56**

56a. Mesosternum with a transverse carina; only sutural striae of elytra impressed; 3.0-6.0mm ..... **Cymbiodyta**

56b. Mesosternum with a prominent conical process; elytra with many impressed striae; 6.0-8.0mm ..... **Helocombus**

57a. ELMIDAE — Legs very long (Fig. 37), mesofemora as long or longer than basal width of elytra; elytra never with longitudinal testaceous vittae **58**

57b. Legs of normal size (Figs. 38-40), mesofemora less than 3/4 basal width of elytra; elytra often with longitudinal testaceous vittae **59**

58a. Unicolorous dark brown; 2.7-3.7mm ..... **Macronychus**

58b. Elytra with conspicuous orange markings (Fig. 37); 2.7-3.5mm ..... **Ancyronyx**

59a. Dorsal surface of pronotum smooth, except for punctures; lateral margin of pronotum smooth (Fig. 38); elongate beetles (Fig. 38); 2.0-3.5mm ..... **Dubiraphia**

59b. Dorsal surface of pronotum with basal carinae (Fig. 39) or scattered bumps, sulci, and carinae (Fig. 40); lateral margin of pronotum at least weakly serrated (Figs. 39, 40) **60**

60a. Surface of pronotum smooth, except for punctures and basal carinae (Fig. 39); 1.7-3.5mm ..... **Optioservus**

60b. Surface of pronotum rough, with bumps, sulci, and carinae (Fig. 40) **61**

61a. Large, more than 2.5mm; tomentum absent; 2.7-4.2mm ..... **Stenelmis**

61b. Small, less than 2.5mm; tomentum present (Fig. 41); 1.7-2.2mm ..... **Microcylloepus**

KEY TO GENERA OF AQUATIC COLEOPTERA IN WISCONSIN (LARVAE)

1a. Each tarsus with 2 claws; legs 5-segmented **2**

1b. Each tarsus with 1 claw; legs apparently 4-segmented (except Haliplidae) **4**

2a. Abdomen with 4 conspicuous hooks on last segment; abdominal segments with at least 8 pairs of lateral filaments (Fig. 1) ..... GYRINIDAE **9**

2b. No hooks on last abdominal segment; if lateral abdominal filaments are present, there are only 6 pairs **3**

3a. Posterior half of abdomen conspicuously narrowed (Fig. 2); legs and cerci often elongate ..... DYTISCIDAE **13**

3b. Posterior half of abdomen little narrowed (Fig. 3); legs and cerci short ..... NOTERIDAE **12**

4a. Legs distinctly 5-segmented; abdomen terminating in 1 or 2 long filaments (Fig. 4) ..... HALIPLIDAE **10**

4b. Legs apparently 4-segmented; abdomen not terminating in long filaments **5**

5a. Mandibles large, readily visible from above (Fig. 5) ..... HYDROPHILIDAE **34**

5b. Mandibles not readily visible from above **6**

6a. Antennae long, filiform, as long as head and thorax combined (Fig. 6) ..... HELODIDAE **43**

6b. Antennae much shorter than head and thorax combined **7**

7a. Body oval and extremely flat (Fig. 7); head completely concealed from dorsal view ..... PSEPHENIDAE **46**

7b. Body elongate, round, or triangular in cross section; head exposed **8**

8a. Body elongate and sclerotized, with a ventral movable operculum closing a caudal chamber containing gills (Fig. 8) ..... ELMIDAE **47**

8b. All terga rounded and pale; grub-like larvae with 2 spines on last abdominal segment (Fig. 9) ..... CHRYSOMELIDAE, **Donacia**

9a. GYRINIDAE — Head narrowed posteriorly to form a distinct collar (Fig. 10) ..... **Dineutus**

9b. Elongate head not narrowed posteriorly to form a collar (Fig. 11) ..... **Gyrinus**

10a. HALIPLIDAE — Each body segment with 2 or more long, spinelike filaments, each half as long as body .. **Peltodytes**

10b. Spines on body segments less than length of a segment **11**

11a. Third antennal segment 2-3 times as long as second ..... **Haliplus**

11b. Third antennal segment shorter than second .... **Brychius**

12a. NOTERIDAE — Mandibles stout, bifid at tip; third antennal segment no longer than fourth ..... **Suphisellus**

12b. Mandibles slender, not bifid at tip; third antennal segment at least twice as long as fourth ..... **Hydrocanthus**

13a. DYTISCIDAE — Lateral gills on abdominal segments 1 to 6 ..... **Coptotomus**

13b. No lateral gills on abdominal segments **14**

14a. Head with a frontal projection (Fig. 12) **15**

14b. Head without a frontal projection **20**

15a. Cerci with secondary hairs (Fig. 13) **Deronectes, Oreodytes**

15b. Cerci with only primary hairs (Fig. 14) **16**

16a. Cerci short, less than length of last abdominal segment **17**

16b. Cerci distinctly longer than last abdominal segment ... **18**

17a. Cerci very short, about 1/4 length of last abdominal segment ..... **Laccornis**

17b. Cerci nearly as long as last abdominal segment; recurved trachael trunks projecting past last segment (Fig. 15) **Celina**

18a. Frontal projection notched laterally (Figs. 16, 17) ..... **Hygrotus, Hydroporus**

18b. Frontal projection without lateral notches (Fig. 12) **19**

19a. Larva greatly widened in middle (Fig. 12) ..... **Hydrovatus**

19b. Larva not greatly widened in middle; not more than 2.5mm long ..... **Bidessonotus, Liodessus, Uvarus**

20a. Abdominal segments 7 and 8 with a lateral fringe of long swimming hairs **29**

20b. Abdominal segments 7 and 8 without a lateral fringe of long swimming hairs **21**

21a. Cerci extremely short, ventral, difficult to see (Fig. 18) .... **Agabetes**

21b. Cerci at least 1/4 length of last abdominal segment ... **22**

22a. Pro- and mesothoracic legs chelate, with inner apex of tibiae formed into a long serrated process parallel to and as long as tarsi (Fig. 19) ..... **Matus**

22b. Legs not chelate **23**

23a. Cerci with only primary hairs, usually 7 in 2 whorls (Fig. 14) **24**

23b. Cerci with numerous secondary hairs (Figs. 13, 25) **26**

24a. Fourth antennal segment double, one half very short (Fig. 20); mandibles with an area of serrations on inner edge (Fig. 21) ..... **Copelatus**

24b. Fourth antennal segment single; mandibles without serrations **25**

25a. Lateral margin of head more or less compressed or keeled; spines on posterolateral margins of head usually on a line that would intersect or pass just below ocelli (Fig. 22) ..... **Ilybius**

25b. Lateral margin of head not keeled; spines on posterolateral margins of head usually on a line that would pass well below ocelli (Fig. 23) ..... **Agabus**

26a. Fourth antennal segment more than 2/3 length of third.. **27**

26b. Fourth antennal segment less than 1/2 length of third.. **28**

27a. Cerci with several short, spinelike, setae on outer edge (Fig. 24); head not more than 2.5mm wide ..... **Rhantus**

27b. Cerci with at most 2 or 3 short setae (Fig. 25); head often about 3mm wide ..... **Colymbetes**

28a. A row of spines on posterolateral margin of head; fourth antennal segment less than 1/4 as long as third; head less than 1.3mm wide ..... **Laccophilus**

28b. No spines on posterolateral margin of head; fourth antennal segment about 1/3 as long as third ..... **Agabus**

29a. Maxillary stipes at least 4 times as long as wide (Fig. 26) **30**

29b. Maxillary stipes broad, not more than 3 times as long as wide (Fig. 27) **32**

30a. Head with long teeth anteriorly; cerci absent ..... **Cybister**

30b. Head without long teeth anteriorly; cerci present **31**

31a. Cerci with lateral fringes; labium without projecting lobes.. ..... **Dytiscus**

31b. Cerci without lateral fringes; labium with 2 projecting lobes (Fig. 28) ..... **Hydaticus**

32a. Ligula apically bifid (Fig. 29) ..... **Acilius**

32b. Ligula simple (Fig. 30) **33**

33a. Ligula nearly equal to or longer than first segment of labial palps (Fig. 30) ..... **Graphoderus**

33b. Ligula not as long as first segment of labial palps ..... **Thermonectus**

34a. HYDROPHILIDAE — First 7 abdominal segments with long lateral gills, some 2-3 times width of a segment .. **Berosus**

34b. Lateral gills absent or shorter than width of a segment.. **35**

35a. Nine complete abdominal segments, tenth reduced but distinct ..... **Helophorus**

35b. Eight complete abdominal segments, 9 and 10 reduced and united **36**

36a. Gula well-developed and attaining occipital opening; antennae arising farther forward than mandibles; sclerotized plates on abdominal segments ..... **Hydrochus**

36b. Gula reduced and not attaining occipital opening; antennae not arising anterior to point of insertion of mandibles .. **37**

37a. First antennal segment at least twice as long as next 2 together (Fig. 31); femora with fringes of long swimming hairs **41**

37b. First antennal segment no more than slightly longer than following 2 segments (Fig. 32); femora without fringes of long swimming hairs **38**

38a. Mandibles asymmetrical, the right with 2 teeth, the left with only 1; abdomen with prolegs on segments 3 to 7 **Enochrus**

38b. Mandibles symmetrical, each with 2 or 3 inner teeth; abdomen without prolegs **39**

39a. Labroclypeus with more than 6 teeth, those on right not clearly defined ..... **Cymbiodyta**

39b. Labroclypeus with 4 or 5 prominent teeth **40**

40a. Middle tooth on labroclypeus smaller than others (Fig. 33); prosternum entire ..... **Sperchopsis**

40b. All teeth of labroclypeus subequal (Fig. 34); prosternum with a mesal fracture ..... **Hydrobius**

41a. Head subspherical; antennae 4-segmented; each mandible with a single inner tooth, which is larger and bifid on right mandible (Fig. 35) ..... **Hydrophilus**

41b. Head subquadrangular, narrowed behind; antennae 3-segmented; each mandible with more than 1, usually 2, inner teeth **42**

42a. Mentum with sides nearly straight (Fig. 36); lateral gills rudimentary tubular projections with several terminal setae ..... **Tropisternus**

42b. Mentum with sides convergent basally (Fig. 37); lateral gills fairly well developed and pubescent ..... **Hydrochara**

43a. HELODIDAE — Anterior margin of hypopharynx with a central cone bearing 1 pair of flat spines (Fig. 38); head with 3 ocelli on each side ..... **Elodes**

43b. Cone bearing 2 pairs of flat spines; head with 1 or 2 ocelli on each side **44**

44a. Sides of abdominal segments with setae similar to those on dorsum, although usually more numerous ..... **Cyphon**

44b. Sides of abdominal segments 3-6 with a regular row of very short, flattened setae that differ markedly from setae on dorsum (Fig. 39) **45**

45a. Anterior of labrum straight, with corners bent under to expose inner portion in dorsal view (Fig. 40) .. **Prionocyphon**

45b. Anterior of labrum simply emarginate (Fig. 41) .... **Scirtes**

46a. PSEPHENIDAE — Abdominal pleura separated from each other (Fig. 7); no gills on abdominal segments 2-6 **Ectopria**

46b. Abdominal pleura contiguous; gills on abdominal segments 2-6 ..... **Psephenus**

47a. ELMIDAE — Prothorax with a posterior sternum (Fig. 42) **48**

47b. Prothorax without a posterior sternum (Fig. 43) **50**

48a. Posterolateral angles of anterior abdominal segments produced (Fig. 44) ..... **Ancyronyx**

48b. Posterolateral angles of abdominal segments not produced **49**

49a. Anterior margin of head with a distinct tooth on each side (Fig. 45) ..... **Stenelmis**

49b. Anterior margin of head without a distinct tooth on each side ..... **Microcylloepus**

50a. Last abdominal segment 5 times longer than wide ..... **Dubiraphia**

50b. Last abdominal segment less than 3 times as long as wide **51**

51a. Mesopleuron divided (Fig. 46) ..... **Macronychus**

51b. Mesopleuron undivided (Fig. 47) ..... **Optioservus**

Desmopachria, Neoscutopterus, Dibolocelus, Helocombus, and **Pronoterus** not keyed.

SPECIES LIKELY TO BE FOUND IN WISCONSIN AND MOST RECENT KEY TO SPECIES

HALIPLIDAE

Brychius — hungerfordi**

Haliplus — apostolicus, blanchardi, borealis, canadensis, connexus, cribrarius, fasciatus, immaculicollis, leopardus, longulus, ohioensis, nitens*, pantherinus, subguttatus, triopsis* (Adult keys Wallis 1933a)

Peltodytes — duodecimpunctatus, dunavani, edentulus, lengi*, litoralis*, pedunculatus*, sexmaculatus, tortulosus* (Adult keys Roberts 1913, Descr. Young 1961)

DYTISCIDAE

Acilius — fraternus, mediatus, semisulcatus, sylvanus (Adult keys Hilsenhoff 1975)

Agabetes — acuductus

Agabus — aeruginosus, ambiguus, antennatus, anthracinus, bifarius, canadensis, confinis, confusus, discolor*, disintegratus, erichsoni, erythropterus*, gagates, leptapsis*, obtusatus*, phaeopterus, punctatus, semipunctatus*, semivittatus, seriatus, subfuscatus*, tristis*, velox** (Adult keys Fall 1922a, Leech 1938)

Bidessonotus — inconspicuus**

Celina — angustata

Colymbetes — longulus, seminger*, sculptilis* (Adult keys Hatch 1928)

Copelatus — chevrolati, glyphicus* (Adult keys Young 1954)

Coptotomus — interrogatus

Cybister — fimbriolatus

Deronectes — griseostriatus, depressus (Adult keys Fall 1923, Zimmerman and Smith manuscript)

Desmopachria — convexa

Dytiscus — cordieri, dauricus, fasciventris, harrisii*, hybridus, marginalis, sublimatus*, verticalis* (Adult keys Hatch 1928, Wallis 1950)

Graphoderus — fasciatocollis, liberus, occidentalis, perplexus (Adult key Wallis 1939a)

Hydaticus — modestus, piceus (Adult keys Blatchley 1910)

Hydroporus — baldiellus, clypealis, columbianus*, consimilis, dentellus, despectus, dichrous, fuscipennis, glabriusculus, hybridus*, melanocephalus*, mellitus, niger, notabilis, obscurus*, paugus, planiusculus, pulcher, rectus, semiflavus, signatus, solitarius, somnus, spurius*, stagnalis, striatopunctatus*, striola, superioris, tartaricus*, tenebrosus, triangularis, tristis, vitiosus*, vittatipennis, vittatus, wickhami* (Adult keys Fall 1923, Young 1953b)

Hydrovatus — pustulatus

Hygrotus — acaroides, canadensis, compar, dissimilis, farctus, impressopunctatus, infuscatus*, laccophilinus, nubilus, patruelis**, sayi, suturalis*, turbidus* (Adult keys Fall 1919, Anderson 1971, manuscript)

Illybius — ater, augustior*, biguttulus, confusus*, denikei, fraterculus*, ignarus*, laramaeus, pleuriticus, subaeneus* (Adult keys Wallis 1939b)

Laccophilus — biguttatus, fasciatus, maculosus, proximus, undatus** (Adult key Zimmerman 1970)

Laccornis — conoideus, deltoides, difformis** (Adult key Fall 1923)

Liodessus — affinis, flavicollis, fuscatus (Adult Key 1954)

Matus — bicarinatus, ovatus* (Adult key Young 1953a)

Neoscutopterous — angustus**

Oreodytes — laevis, scitulus* (Adult key Hatch 1933)

Rhantus — binotatus, consimilis, frontalis, sinuatus**, suturellus*, wallisi* (Adult keys Hatch 1928, Wallis 1933b, Zimmerman and Smith 1975)

Thermonectus — basillaris, ornaticollis (Adult key Blatchley 1910)

Uvarus — granarius, lacustris (Adult key Young 1954)

NOTERIDAE

Hydrocanthus — iricolor**

Pronoterus — semipunctatus**

Suphisellus — puncticollis

GYRINIDAE

Dineutus — assimilis, discolor, hornii, nigrior (Adult key Hatch 1929)

Gyrinus — aeneolus, affinis, analis, aquiris, bifarius, confinis, dichrous, frosti, hatchi, impressicollis, latilimbus, lecontei, lugens, maculiventris, marginellus, minutus, parcus, pectoralis, piceolus*, pugionis, ventralis, wallisi* (Adult key Fall 1922b, Descr. Wallis 1926a, 1926b)

HYDROPHILIDAE

Anacaena — limbata

Berosus — aculeatus, fraternus*, infuscatus*, ordinatus*, peregrinus*, pugnax, striatus** (Adult keys Wooldridge 1967, Matta 1974)

Chaetarthria — pallida**

*Crenitis — digestus, longulus** (Adult key Willson 1967)

Cymbiodyta — acuminata, blanchardi, chamberlaini, minima, semistriata, toddi, vindicata* (Adult key Smetana 1974)

Dibolocelus — ovatus**

Enochrus — blatchleyi, cinctus, collinus, consors, consortus, diffusus, hamiltoni, ochraceus, perplexus, pygmaeus, sayi* (Adult key Gunderson manuscript)

Helocombus — bifidus

Helophorus — lacustris, linearis*, lineatus*, nitidulus*, oblongus*, tuberculatus**

*Hydrobius — fuscipes, melaenus, tumidus** (Adult key Wooldridge 1967)

Hydrochara — obtusata

Hydrochus — brevitarsus, currani, granulatus, neosimplex* (manuscript name — Hellman), *pseudosquamifer, rufipes, scabratus, setosus*, squamifer, subcupreus* (Adult key Hellman manuscript)

Hydrophilus — triangularis

Laccobius — agilis, arenarius, minutoides*, spangleri** (Adult key Willson 1967, Cheary manuscript)

Paracymus — confluens, despectus*, subcupreus* (Adult key Wooldridge 1966)

Sperchopsis — tesselatus

Tropisternus — blatchleyi, columbianus, ellipticus, glaber, lateralis, mixtus, natator (Adult key Spangler 1960)

HYDRAENIDAE (Adult key Blatchley 1910)

*Hydraena — pennsylvanica**

Ochthebius — cribricollis, foveicollis*, nitidus*, putnamensis**

PSEPHENIDAE

Ectopria — nervosa

Psephenus — herricki

ELMIDAE

Ancyronyx — variegata

Dubiraphia — bivittata, minima, quadrinotata, robusta, vittata (Adult key Hilsenhoff 1973)

Macronychus — glabratus

Microcylloepus — pusillus

Optioservus — fastiditus, trivittatus (Adult key Brown 1972)

Stenelmis — bicarinata, concinna, crenata, decorata, douglasensis, markelii, musgravei, quadrimaculata, sandersoni, vittipennis, + several undescribed (Adult key Brown 1972)

DRYOPIDAE (Adult key Brown 1972)

Helichus — lithophilus, striatus

HELODIDAE (No larval key)

Cyphon — aliceae, alvahi, americanus*, collaris, craigi, diffusus*, elutus, modestus, nebulosus, obscurus, punctatus, perplexus*, pusillus, shenefelti, variabills*

Elodes — fuscipennis, pulchella, thoracica

Prionocyphon — discoideus, limbatus**

Scirtes — orbiculatus, tibialis

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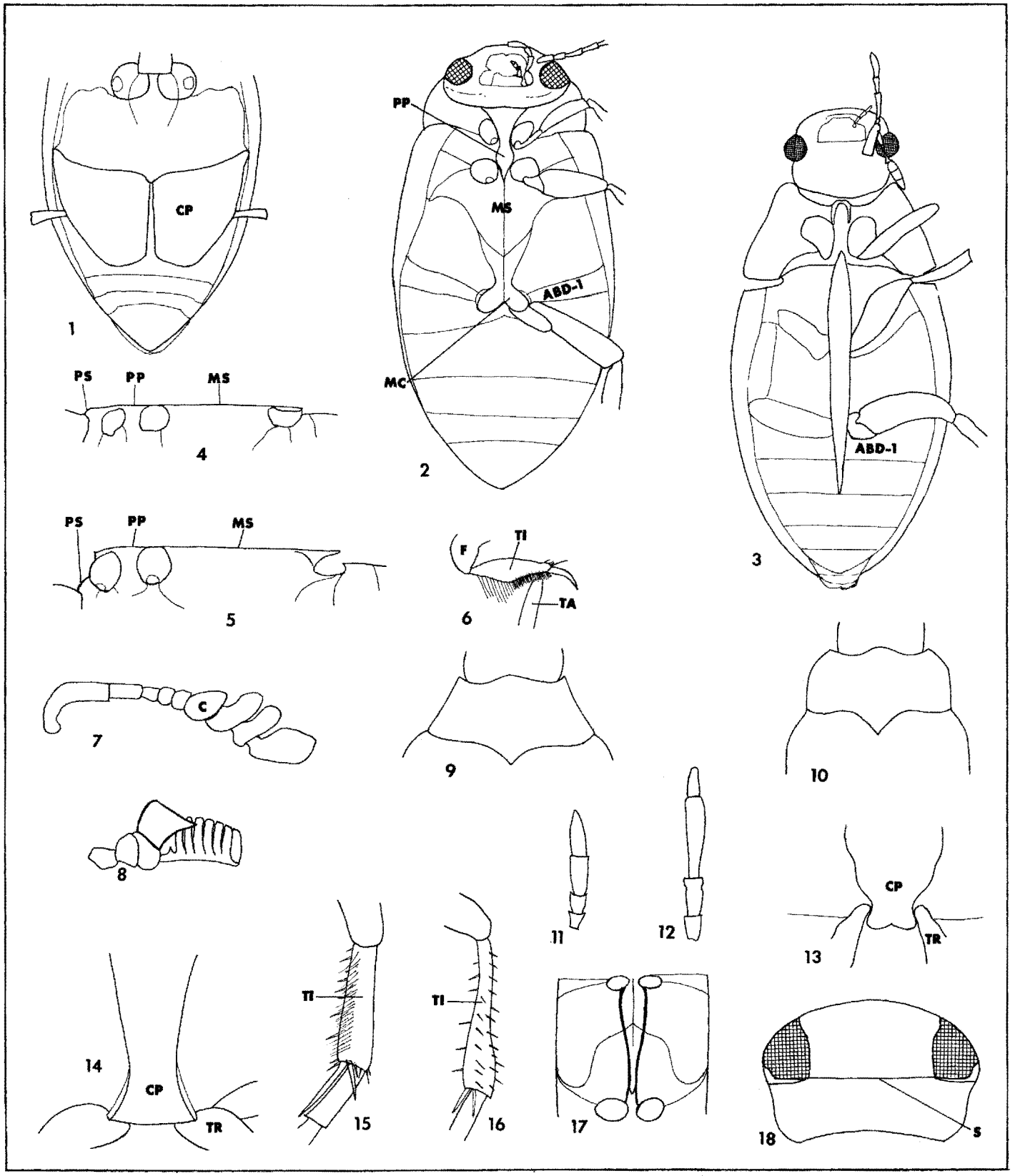
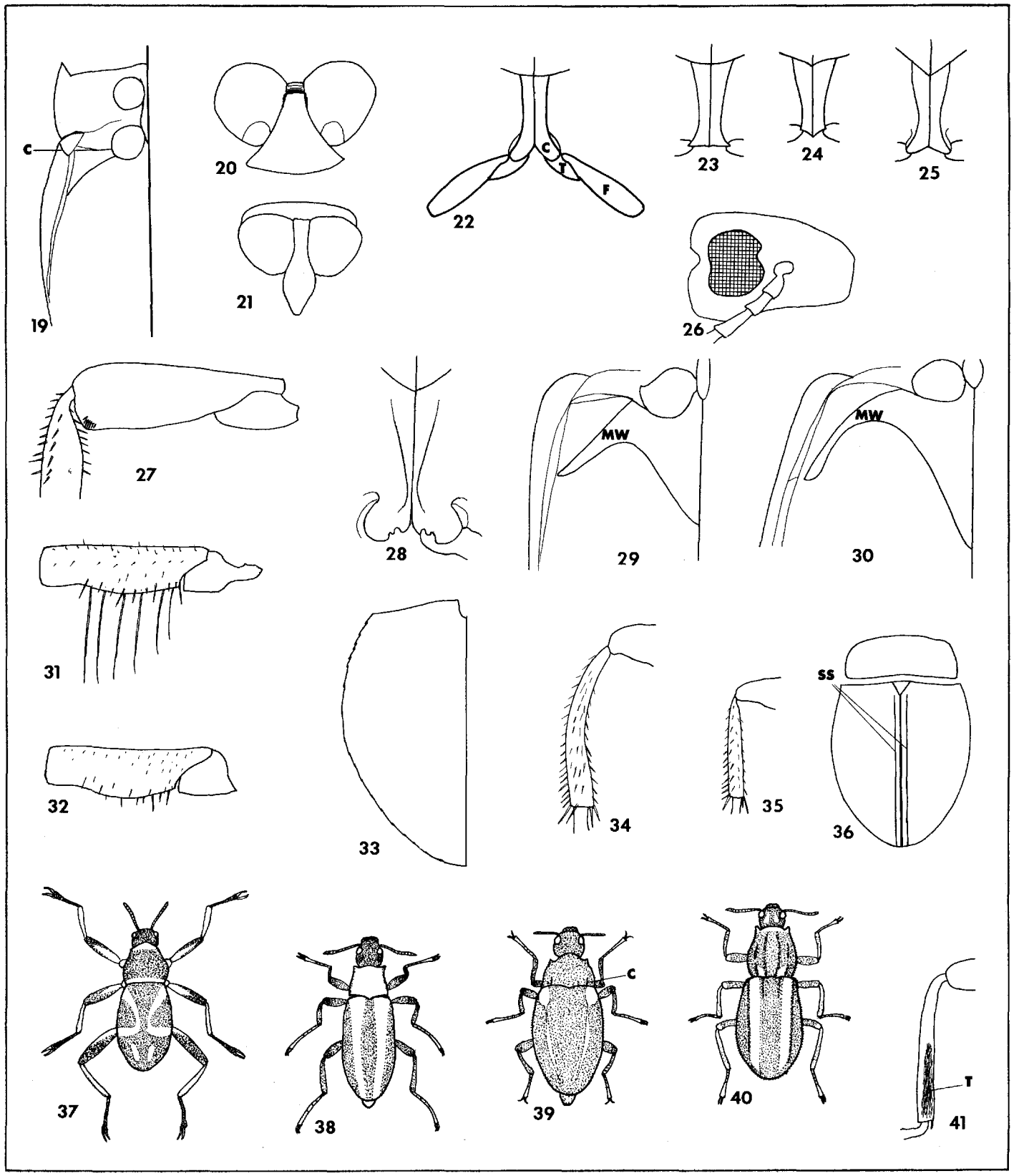
Gunderson, R., Department of Biological Sciences, St. Cloud State College, St. Cloud, Minnesota 56301 — *Enochrus*

Hellman, J. L., Department of Entomology, University of Maryland, College Park, Maryland 20742 — *Hydrochus*

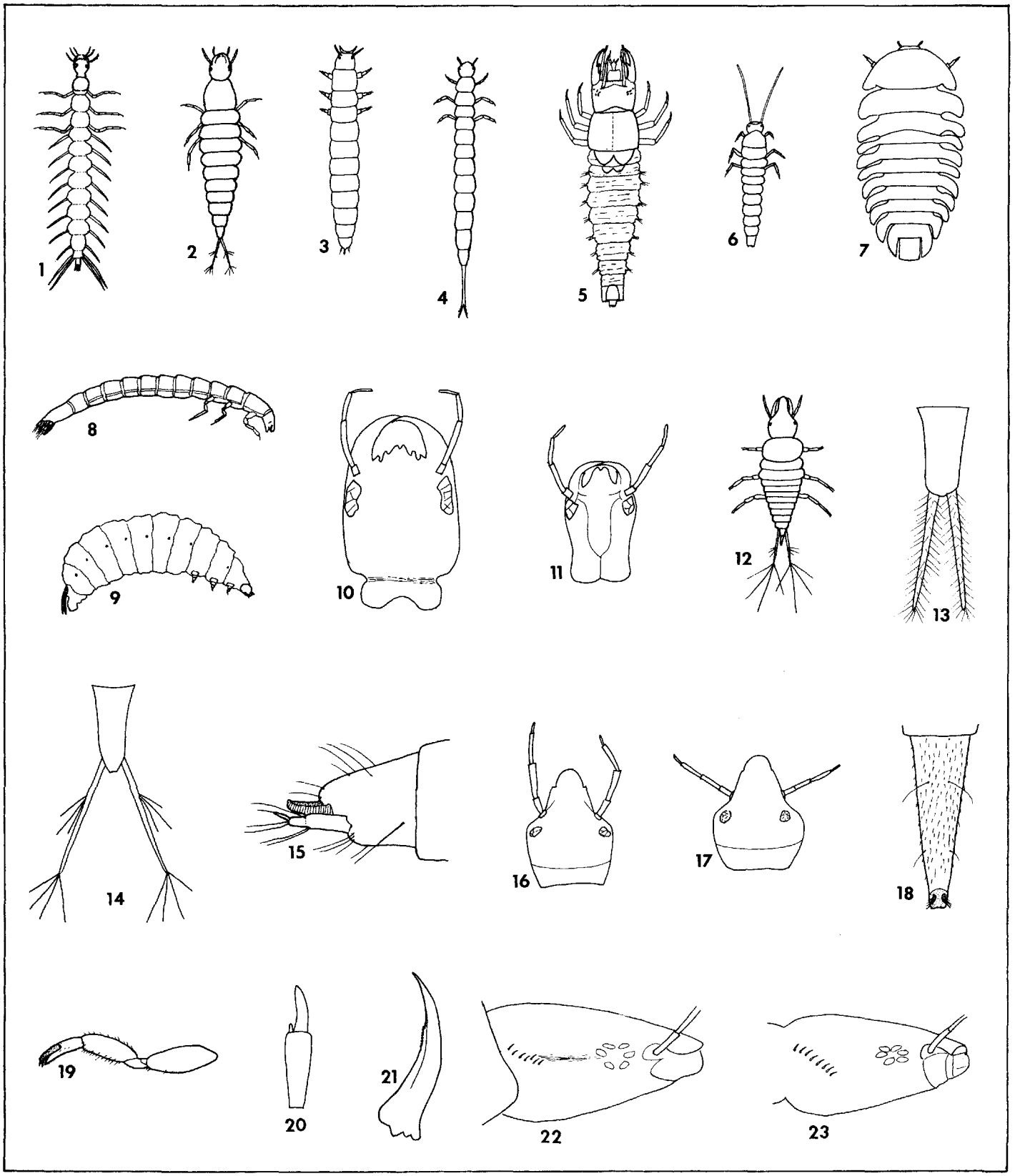
Zimmerman, J. R. and A. H. Smith, Department of Biology, Box 3 AF, Las Cruces, New Mexico 88003 — *Deronectes*



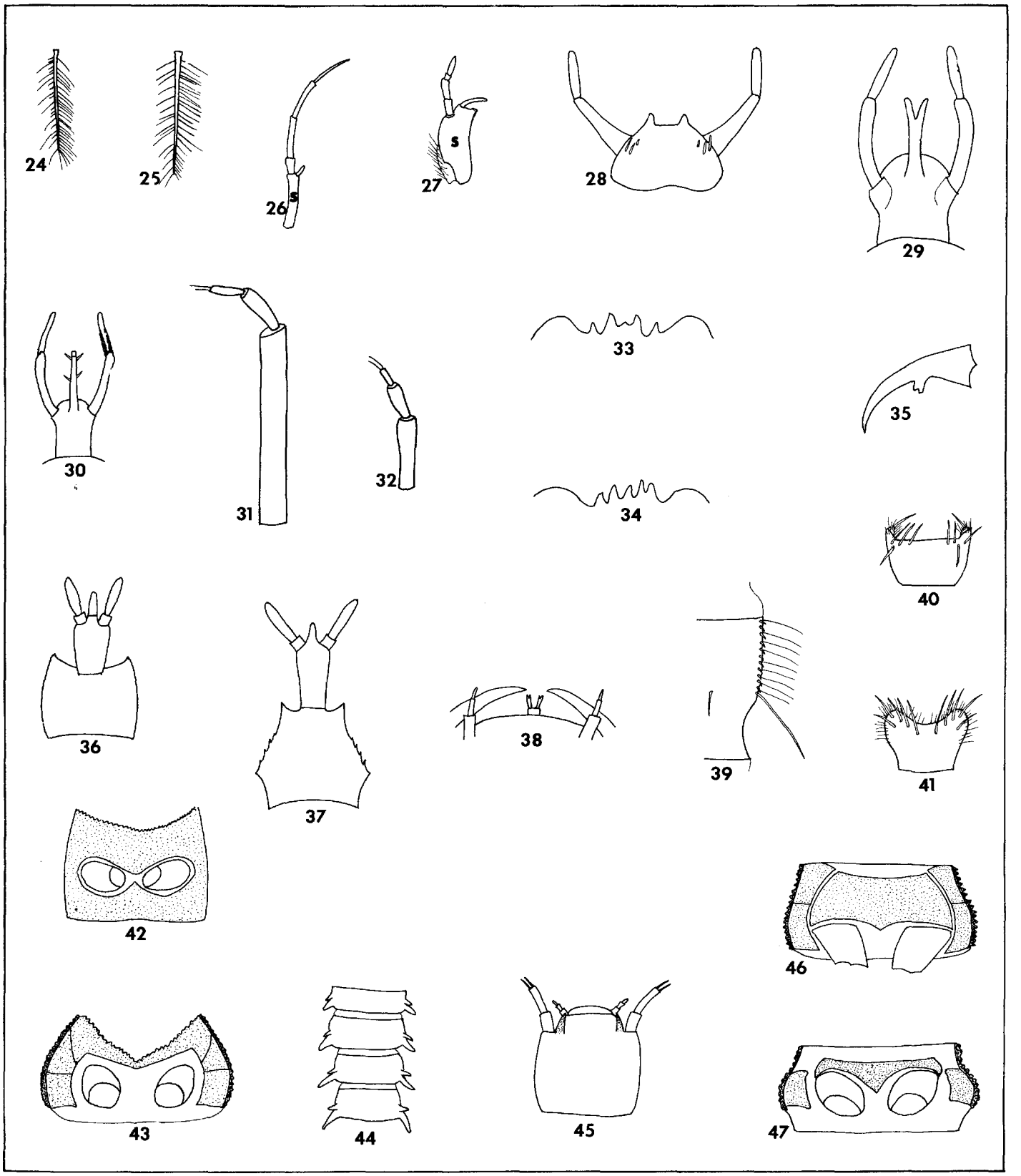
Figures 1-18. — Coleoptera adults. 1. Ventral view of posterior of *Haliplus* showing coxal plates (CP). 2. Ventral view of *Agabus* showing prosternal process (PP), first abdominal segment (ABD-1), metacoxal process (MC), and metasternum (MS). 3. Ventral view of *Tropisternus* showing first abdominal segment (ABD-1). 4. Lateral view of thoracic sterna of *Agabus* (ventral side up) showing prosternum (PS), its postcoxal process (PP), and mesosternum (MS). 5. Lateral view of thoracic sterna of *Hydroporus* showing prosternum (PS), its postcoxal process (PP), and mesosternum (MS). 6. Profemur (F), tibia (TI), and tarsus (TA) of *Hydrocanthus*. 7. Antenna of *Tropisternus* showing cupule (C). 8. Antenna of *Helichus*. 9. Pronotum of *Haliplus*. 10. Pronotum of *Brychius*. 11. Maxillary palp of *Peltodytes*. 12. Maxillary palp of *Haliplus*. 13. Metacoxal process (PC) and trochanters (TR) of *Desmopachria*. 14. Metacoxal process (CP) and trochanters (TR) of *Hydroporus*. 15. Metatibia (TI) of *Desmopachria*. 16. Metatibia (TI) of *Liodessus*. 17. Meso- and metasternum of *Bidessonotus*. 18. Dorsal view of head of *Liodessus* showing transverse suture (S).



Figures 19-41. — Coleoptera adults. 19. Ventral view of meso- and metathorax of *Hygrotus* showing carina (C). 20. Procoxae and prosternal process of *Hydrovatus*. 21. Procoxae and prosternal process of *Hygrotus*. 22. Metacoxal lobes (C), trochanters (T), and femora (F) of *Laccornis*. 23 and 24. Metacoxal processes of *Hydroporus*. 25. Metacoxal process of *Deronectes*. 26. Lateral view of head of *Agabus*. 27. Ventral view of metafemur of *Agabus*. 28. Metacoxal plates of *Copelatus*. 29. Metasternum of *Hydaticus* showing metasternal wing (MW). 30. Metasternum of *Acilius* showing metasternal wing (MW). 31. Mesofemur of *Thermonectus*. 32. Mesofemur of *Graphoderus*. 33. Elytron of *Sperchopsis*. 34. Metatibia of *Laccobius*. 35. Metatibia of *Anacaena*. 36. Elytra of *Anacaena* showing sutural striae (SS). 37. Dorsal view of *Ancyronyx*. 38. Dorsal view of *Dubiraphia*. 39. Dorsal view of *Optioservus* showing basal carina (C). 40. Dorsal view of *Stenelmis*. 41. Protibia of *Optioservus* showing tomentum (T).



Figures 1-23. — Coleoptera larvae. 1. Dorsal view of *Gyrinus*. 2. Dorsal view of *Agabus*. 3. Dorsal view of *Pronoterus*. 4. Dorsal view of *Haliplus*. 5. Dorsal view of *Tropisternus*. 6. Dorsal view of *Scirtes*. 7. Dorsal view of *Ectopria*. 8. Lateral view of *Stenelmis*. 9. Lateral view of *Donacia*. 10. Dorsal view of head of *Dineutus*. 11. Dorsal view of head of *Gyrinus*. 12. Dorsal view of *Hydrovatus*. 13. Last abdominal segment and cerci of *Laccophilus*. 14. Last abdominal segment and cerci of *Agabus*. 15. Lateral view of last abdominal segment and cerci of *Celina* (after Spangler 1973). 16 and 17. Dorsal view of heads of *Hygrotus*. 18. Ventral view of last abdominal segment of *Agabetes* (after Spangler and Gordon 1973). 19. Prothoracic leg of *Matus* (after Spangler and Gordon 1973). 20. Last two antennal segments of *Copelatus* (after Spangler 1962). 21. Mandible of *Copelatus* (after Spangler 1962). 22. Lateral view of head of *Ilybius*. 23. Lateral view of head of *Agabus*.



Figures 24-47. — Coleoptera larvae. 24. Cercus of *Rhantus*. 25. Cercus of *Colymbetes*. 26. Ventral view of right maxilla of *Dytiscus* showing stipes (S). 27. Ventral view of right maxilla of *Acilius* showing stipes (S). 28. Labium of *Hydaticus*. 29. Labium of *Acilius*. 30. Labium of *Graphoderus*. 31. Antenna of *Tropisternus*. 32. Antenna of *Hydrobius*. 33. Anterior margin of fronto-clypeus of *Sperchopsis*. 34. Anterior margin of fronto-clypeus of *Hydrobius*. 35. Dorsal view of right mandible of *Hydrophilus*. 36. Labium of *Tropisternus*. 37. Labium of *Hydrochara*. 38. Ventral view of anterior margin of head of *Elodes*. 39. Lateral margin of sixth abdominal tergum of *Scirtes*. 40. Dorsal view of labrum of *Prionocyphon*. 41. Dorsal view of labrum of *Scirtes*. 42. Prosternum of *Stenelmis*. 43. Prosternum of *Optioservus*. 44. Dorsal view of abdominal segments 2-5 of *Ancyronyx*. 45. Dorsal view of head of *Stenelmis*. 46. Mesosternum and mesopleura of *Macronychus*. 47. Mesosternum and mesopleura of *Optioservus*.

This very large holometabolous order is mostly terrestrial, but there are many species and several families with aquatic larvae. Most aquatic Diptera are in the suborder Nematocera, which contains several families in which most or all of the species have aquatic larvae and pupae. In the suborders Brachycera and Cyclorrhapha, families in which aquatic species occur are largely terrestrial, and even within a genus there may be aquatic and terrestrial species. There are normally 4 larval instars in Nematocera, 3 in most Cyclorrhapha, and as many as 8 or 9 in Brachycera.

Family and generic names used in the key follow Stone *et al.* (1965) and take into consideration a ruling by the International Commission on Zoological Nomenclature (1963) to suppress Meigen 1800 genera. A more recent classification by Hamilton *et al.* (1969) was used for Chironomidae. Unfortunately the taxonomy of larvae in most families is very poorly known, and species identification is possible in only a few (Culicidae, Chaoboridae, Simuliidae, and Sciomyzidae). The problem is especially acute in Brachycera and Cyclorrhapha where generic identifications of larvae are not possible in some families. A list of species of aquatic Diptera in Wisconsin is not appended because of larval identification problems. In most families adults can be identified, but in many families one cannot tell which species have aquatic larvae. The catalog of North American Diptera (Stone *et al.* 1965) lists species distribution and references to recent species keys. Within about 2 years a comprehensive manual of North American Diptera will be published, and it will contain keys to species as well as the most recent information on their distribution.

NEMATOCERA

TIPULIDAE — Crane Flies (13 aquatic genera)

One of the largest and most common nematocerous families, the long-legged and often large adults are frequently encountered. Many species and genera are terrestrial or semiaquatic. Most aquatic species develop in streams where *Antocha, Dicranota, Hexatoma,* and *Tipula* are most common and *Limnophila, Limonia, Pedicia, Pilaria, Erioptera,* and *Pseudolimmophila* also can be found in the bottom substrate, moss or algal scum on rocks, debris, or rotting wood. *Helius, Prionocera,* and *Phalacrocera* occur in weedy ponds, marshes, or margins of lakes and streams. Most species probably have a one year life cycle. The larvae have a wide range of food habits, with both herbivorous and carnivorous species being found, but there has been little study of their biology.

PSYCHODIDAE — Moth Flies (2 genera, 14 species)

Species in two of the genera are aquatic; others are semiaquatic or terrestrial. Most are probably multivoline, breeding in water with large amounts of organic matter, water that is often very polluted. Larvae and adults feed on decaying organic matter, but little is known about their biology.

PTYCHOPTERIDAE — Phantom Crane Flies (2 genera, 4 species)

The larvae live on decaying debris along edges of ponds and slow streams, or in shallow marsh areas. All species are aquatic as larvae and pupae, but they are generally uncommon and difficult to find. Little is known about their biology.

BLEPHARICERIDAE — Net-winged Midges (1 genus, 2 species)

Larvae of this small family are rare in Wisconsin, occurring only in the fastest water of clean northern streams. Here they are found on rocks or vegetation hanging into the stream where they feed on algae and diatoms.

DIXIDAE (2 genera, 3 species)

Larvae in this aquatic family are fairly common in cattail marshes and among vegetation along streams, ponds, and lakes. They usually remain in the surface film and feed on microorganisms and detritus. Adults are short-lived midges that do not feed. Little is known about their life cycle.

CHAOBORIDAE — Phantom Midges (3 genera, 8 species)

The transparent larvae occur in selected lentic habitats. The uncommon larvae and pupae of *Eucorethra* and *Mochlonyx* are found in snow-melt pools in the spring where they feed mostly on *Aedes* mosquito larvae and emerge shortly after *Aedes* mosquitoes in the spring. *Chaoborus* larvae occur commonly in pools, ponds, and marshes, and are one of the few insect genera to commonly inhabit sublittoral and profundal zones of lakes. It is the only genus to commonly occur in limnetic areas. Larvae of *Chaoborus* are predaceous on small insects and crustacea. Most species are univoltine in Wisconsin, with emergence in late spring or early summer. The short-lived adults are frequently attracted to lights and may create nuisance problems.

CULICIDAE — Mosquitoes (9 genera, 50 species)

Because adults of some species feed on people and occasionally transmit disease, both the biology and taxonomy have been thoroughly studied. Larvae of one or more species breed in almost every conceivable lentic situation. *Aedes* are abundant in snow-melt pools, and along with much rarer *Psorophora* larvae, also occur abundantly in temporary ponds and marshes. *Anopheles* are common among emergent vegetation of marshes, and stream and lake margins. *Culex, Culiseta,* and *Uranotaenia* commonly inhabit permanent ponds and marshes. *Mansonia* larvae attach to cattails and similar plants from which they get air for respiration. *Wyomyia* larvae are found only in pitcher plants, and tree holes contain *Aedes* larvae or very rarely *Orthopodomyia* in the extreme south. Most species are univoltine, but several are multivoltine. Larvae of most species feed on microorganisms, algae, and detritus, but *Psorophora* larvae are predaceous. Adults may be abundant from spring to fall, and species of *Culex, Culiseta,* and *Anopheles* overwinter as adults. Most species winter as eggs, but *Wyomyia* and *Mansonia* winter as larvae, the former freezing in the ice.

CERATOPOGONIDAE — Biting Midges, Punkies, No-see-ums (8 genera)

Most species are very small, and probably because of their size they have been infrequently collected and are poorly known. Some species have terrestrial or only semiaquatic larvae, while aquatic species inhabit a variety of lentic habitats from tree holes to lakes. *Palpomyia* may be found in the sublittoral or profundal mud of lakes, but most *Palpomyia, Bezzia, Probezzia,* and other genera are found among emergent vegetation of lakes, ponds, and marshes. Larvae cannot be identified at the species level, and some genera cannot be separated. Most species have one or more generations per year. *Palpomyia, Bezzia,* and *Probezzia* larvae are predators, but feeding habits of other genera are poorly known. Adult *Culicoides* bite man, and can occasionally create a severe nuisance problem.

CHIRONOMIDAE — Lake Flies, Midges (69 aquatic genera)

Members of this very large nematocerous family are abundant in almost every type of aquatic habitat. Adults are often so numerous that they create nuisance problems, but fortunately they do not feed and are short-lived. Larvae are herbivores, omnivores, or detritivores, depending on the species. Most species are multivoltine, with adults on the wing in all but the coldest part of the winter. Biologies of a few species have been studied in detail, but in general the taxonomy is poorly known. Most larvae cannot be identified to species and some cannot be identified at the generic level. Adults of many species remain undescribed, and even adult taxonomy is somewhat confused.

SIMULIIDAE — Black Flies (4 genera, 27 species)

Larvae and pupae inhabit streams of all types where they attach to rocks and other objects in the current and feed by filtering plankton and organic debris from the water. Adults are bloodsucking insects that feed on animals, including humans, and sometimes become a serious problem along certain streams. *Cnephia, Prosimulium,* and most *Eusimulium* inhabit only cleaner streams, and are univoltine with emergence in the spring. Some species of *Simulium* are very tolerant of organic pollution and become abundant in partially polluted streams. Many are also multivoltine, with emergences throughout the spring and summer.

BRACHYCERA

STRATIOMYIDAE — Soldier Flies (4 aquatic genera)

Most larvae are terrestrial, but larvae in at least 4 genera are known to be aquatic. Larval taxonomy is undeveloped; most species and many genera cannot be identified. Larvae of aquatic species are found among vegetation and debris in marshes, ponds, and lake margins where they feed on algae, detritus, and microorganisms. Pupae are aquatic, and remain in a puparium. Aquatic species are probably univoltine, with adults being found on flowers.

TABANIDAE — Horse Flies and Deer Flies (2 aquatic genera)

The predaceous larvae of some species are aquatic, but most inhabit semiaquatic situations. Pupation takes place in moist soil above the water line. Adults bite and are very annoying pests of humans and other animals. Larvae of *Chrysops* are found in streams, while those of *Tabanus* inhabit ponds and other lentic situations. Most species are univoltine, with adults being most abundant during the summer months.

RHAGIONIDAE — Snipe Flies (1 aquatic genus, 1 species)

A single species, *Atherix variegata,* is aquatic in Wisconsin and its predaceous larvae can be commonly found in gravel riffles of a variety of streams. The life cycle is one year, with pupation on land and emergence of the predaceous adults in early summer.

EMPIDIDAE — Dance Flies

Although most empidids are terrestrial, larvae of some species are aquatic, and in Wisconsin have frequently been collected from streams. Unfortunately larval taxonomy is in such a poor state that identification even at the generic level is not reliable. Little is known about their biology and life cycle.

DOLICHOPODIDAE

The predaceous larvae may be aquatic, semiaquatic, or terrestrial, but are so poorly known that generic identification is not reliable.

CYCLORRHAPHA

SYRPHIDAE — Flower Flies (3 aquatic genera)

Most species of this widespread and common family have terrestrial larvae, but those in at least 3 genera have been found in grossly polluted water and other shallow situations with an abundance of organic matter. Larvae feed on organic debris and pupate in a puparium, but identification at the species level is not possible.

SCIOMYZIDAE — Marsh Flies (12 aquatic genera, 63 species)

The larvae are predators or parasites of snails, slugs, or fingernail clams (*Renocera*) and except for those that feed on slugs and terrestrial snails, they are aquatic. Recently most species have been reared, so both larvae and adults can be identified to species, although mouthparts have to be examined even for some generic determinations. Pupation is at the water's surface, either in a snail shell or a floating puparium.

EPHYDRIDAE — Shore Flies, Brine Flies

Larvae are either aquatic, semiaquatic, or leaf miners, but their taxonomy is so poorly known that identification at the generic level is not realistic. Larvae are probably herbivores, but little is known about their biology.

MUSCIDAE (4 aquatic genera)

Although most larvae are terrestrial, those of some species of *Limnophora, Lispe, Lispoides, Spilogona,* and perhaps other genera are aquatic and live in streams, ponds, and lake margins. So little is known about the larvae that identifications at even the generic level are questionable. Larvae of most species are probably predaceous and have a one-year life cycle.

KEY TO GENERA OF AQUATIC DIPTERA LARVAE IN WISCONSIN

1a. Larvae apparently 7-segmented; first 6 segments each with a prominent ventral sucker (Fig. 1) ..... BLEPHARICERIDAE, **Blepharicera**

1b. Without 6 ventral suckers **2**

2a. Head capsule completely sclerotized and fully visible; mandibles opposed and moving in a horizontal plane.. **12**

2b. Head capsule absent, incomplete behind, or retracted at least partially into thorax **3**

3a. Head capsule incomplete posteriorly and more or less retracted into thorax (Figs. 32-35); mandibles opposed and moving in a horizontal plane ..... TIPULIDAE **36**

3b. Head capsule lacking, or incompletely sclerotized and elongate or truncate in shape (Figs. 2, 20, 21); mandibles replaced by vertically moving mouthhooks **4**

4a. Head mostly visible, truncate in shape (Figs. 2, 20, 21); body somewhat flattened; posterior spiracular chamber margined with long, soft hairs (Fig. 2) ..... STRATIOMYIDAE **21**

4b. Body nearly circular in cross section; head mostly retracted into thorax and elongate or indistinguishable.. **5**

5a. Larva with a partially retractile caudal respiratory tube at least one-half as long as body (Fig. 3) ... SYRPHIDAE **34**

5b. Larvae without a long respiratory tube **6**

6a. Caudal spiracular disc with palmate hairs and surrounded by 8-10 lobes, some of which may be very short (Fig. 24); body wrinkled (Fig. 4) ..... SCIOMYZIDAE **25**

6b. Caudal spiracular disc without palmate hairs; if surrounded by lobes, body is not wrinkled **7**

7a. Abdomen with distinct prolegs and paired terminal processes (Figs. 7-9) **9**

7b. Prolegs indistinct or absent; terminal processes lacking **8**

8a. Body tapering at both ends; a girdle of pseudopods on each segment (Fig. 5) ..... TABANIDAE **24**

8b. Body terminating in a spiracular pit surrounded by pointed lobes; pseudopods only on ventral surface of segments (Fig. 6) ..... DOLICHOPODIDAE (no generic key)

9a. Terminal processes ciliated, laterally divergent, and longer than prolegs (Fig. 7) ..... RHAGIONIDAE, **Atherix**

9b. Terminal processes not ciliated and shorter than prolegs **10**

10a. Head structure visible with palpi and antennae; less than 4mm long (Fig. 8) ..... EMPIDIDAE (no generic key)

10b. Head structure lacking; may be more than 4mm **11**

11a. Posterior pair of prolegs as long as or longer than respiratory tubes (Fig. 9) ..... MUSCIDAE (no generic key)

11b. Posterior prolegs absent or shorter than respiratory tubes ..... EPHYDRIDAE (no generic key)

12a. Prolegs absent **13**

12b. Prolegs present at one or both ends of body or on abdominal segments (Figs. 15, 17, 18, 19) **16**

13a. Thoracic segments fused and distinctly thicker than abdomen (Fig. 10) **14**

13b. Thorax and abdomen about equal in diameter (Figs. 13, 14) **15**

14a. Antennae prehensile, with long, strong apical spines (Fig. 11) ..... CHAOBORIDAE **48**

14b. Antennae not prehensile and lacking long apical spines (Fig. 12) ..... CULICIDAE **50**

15a. Thoracic and abdominal segments each distinctly divided into 2 or 3 annuli (Fig. 13) ..... PSYCHODIDAE **58**

15b. No secondary annulations (Fig. 14) ..... CERATOPOGONIDAE **59**

16a. Prolegs on intermediate body segments (Figs. 15, 17).. **17**

16b. Prolegs on anterior and/or posterior ends of body only (Figs. 18, 19) **18**

17a. Paired ventral prolegs on abdominal segments 1 and 2 (Fig. 15); posterior end of body with 2 pairs of fringed processes (Fig. 16) ..... DIXIDAE **63**

17b. Paired ventral prolegs on abdominal segments 1, 2, and 3; posterior end of body with a long respiratory tube (Fig. 17) ..... PTYCHOPTERIDAE **64**

18a. Prolegs present only on prothorax; posterior of abdomen swollen (Fig. 18) ..... SIMULIIDAE **65**

18b. Posterior prolegs present **19**

19a. Only posterior prolegs present ..... CERATOPOGONIDAE, **Dasyhelia**

19b. Both anterior and posterior prolegs present (Fig. 19) .. **20**

20a. Body covered with long, strong spines or bristles ..... CERATOPOGONIDAE, **Atrichopogon**

20b. Body at most covered with setae ... CHIRONOMIDAE **68**

21a. STRATIOMYIDAE — Antennae dorsal, remote from margin of head (Fig. 20) **22**

21b. Antennae at anterolateral angles of head (Fig. 21) **23**

22a. Ventral curved spines on posterior margin of next to last segment (may be concealed in intersegmental membranous fold) ..... **Euparyphus**

22b. No spines on posterior margin of next to last segment ... . **Nemotelus**

23a. Ventral curved spines on posterior margin of next to last segment (may be concealed) ..... **Odontomyia**

23b. No spines on posterior margin of next to last segment ... . **Stratiomys**

24a. TABANIDAE — Last antennal segment as long as or longer than next to last (Fig. 22); larvae less than 20mm long ... . **Chrysops**

24b. Last antennal segment shorter than next to last (Fig. 23); grown larva more than 20mm ..... **Tabanus**

25a. SCIOMYZIDAE* — Patches of spinules present ventrally **26**

25b. Patches of spinules absent **29**

26a. Integument with a thick coat of transparent spinules; palmate hairs surrounding posterior spiracles; ventral or ventrolateral lobes of spiracular disc elongate (Fig. 24) .... **Antichaeta**

26b. Integument without a thick coat of transparent spinules; posterior spiracles without palmate hairs; ventral and ventrolateral lobes of spiracular disc short **27**

27a. Anterior spiracles bifid ..... **Colobaea**

27b. Anterior spiracles circular, not divided **28**

28a. Lobes of spiracular disc reduced, only ventral lobes distinct ..... **Sciomyza**

28b. At least ventral and ventrolateral lobes distinct .... **Pherbellia, Pteromicra, Atrichomelina**

29a. Hypostomal and pharyngeal sclerites fused (Fig. 25) .... **Renocera**

29b. Hypostomal and pharyngeal sclerites separate (Fig. 26) **30**

30a. Ventral arch triangular (Fig. 27); integument black; 8 lobes on spiracular disc ..... **Dictya**

30b. Ventral arch bilobed (Figs. 28, 29); 8 or 10 lobes on spiracular disc **31**

31a. Spiracular disc with 10 lobes (Fig. 24); ventral arch with posterolateral projections (Fig. 28) ..... **Sepedon**

31b. Spiracular disc with 8 lobes; ventral arch without posterolateral projections (Fig. 29) **32**

32a. Postanal portion of segment 12 much longer than wide .. .. **Elgiva**

32b. Postanal portion of segment 12 about as long as wide **33**

33a. Lateral, ventrolateral, and ventral lobes of spiracular disc elongate, subequal ..... **Hedria**

33b. Lateral lobes much shorter than elongate or short ventrolateral and ventral lobes ..... **Tetanocera**

34a. SYRPHIDAE — Respiratory tube, when extended, about 1/2 length of body ..... **Chrysogaster**

34b. Respiratory tube, when extended, much longer than body (Fig. 3) **35**

35a. Longitudinal tracheal trunks straight ..... **Eristalis**

35b. Longitudinal tracheal trunks undulating ..... **Helophilus**

36a. TIPULIDAE — Body covered with very long spines .... **Phalacrocera**

36b. Body without long spines **37**

37a. Spiracular disc surrounded by 6 or 8 lobes **38**

37b. Spiracular disc surrounded by 5 or fewer lobes **39**

38a. Spiracular lobes elongate, digitiform, and fringed with long hairs (Fig. 30) ..... **Prionocera**

38b. Spiracular lobes usually bifid, not elongate or fringed with long hairs ..... **Tipula**

39a. Spiracular disc with 2 long ventral lobes (Fig. 31) **40**

39b. Spiracular disc not as above **42**

40a. Spiracles lacking or vestigial; dark creeping welts dorsally and ventrally on abdominal segments 2-7 (Fig. 32) **Antocha**

40b. Spiracles large and exposed **41**

41a. Conspicuous cylindrical prolegs on abdominal segments 3-7 ..... **Dicranota**

41b. Ventral raised welts on abdominal segments 4-7.. **Pedicia**

42a. Blades of maxillae visible, projecting from retracted head; head capsule 4-6 slender rods, posterior incisions deep (Fig. 33) **43**

42b. Blades of maxillae do not project from retracted head; head capsule massive and complete with narrow posterior incisions (Fig. 34) **45**

43a. Mentum a narrow, sclerotized, transverse bar (Fig. 35) ... . **Limnophila**

43b. Mental region not sclerotized **44**

44a. Dorsal plate of head capsule united into a spatula; spiracular lobes elongate and covered with very long fringe of hair (Fig. 36) ..... **Pilaria**

44b. Dorsal plate of head capsule divided; spiracular lobes short; hair fringe on lobes not exceptionally long (Fig. 37); entire body clothed with yellow pubescence ... **Hexatoma**

45a. Abdominal segments with basal creeping welts **46**

45b. Abdominal segments without creeping welts **47**

46a. Dorsal and ventral creeping welts ..... **Limonia**

46b. Only 6 ventral welts; body covered with long, dark pubescence ..... **Helius**

47a. Spiracular disc with 4 lobes (Fig. 38) .. **Pseudolimnophila**

47b. Spiracular disc with 5 lobes (Fig. 39) ..... **Erioptera**

48a. CHAOBORIDAE — Abdominal segment 8 with dorsal respiratory siphon ..... **Mochlonyx**

48b. No respiratory siphon on abdominal segment 8 ..... **49**

49a. Dark air sacks in thorax and abdominal segment 7 .... **Chaoborus**

49b. Air sacks lacking ..... **Eucorethra**

50a. CULICIDAE — Abdominal segment 8 without a respiratory siphon (Fig. 10) ..... **Anopheles**

50b. A respiratory siphon on abdominal segment 8 (Fig. 40) **51**

51a. Siphon with a pecten (Fig. 40) **52**

51b. Siphon without a pecten **56**

52a. Upper and lower head hairs single, spinelike (Fig. 41) .... **Uranotaenia**

52b. Upper and lower head hairs not spinelike **53**

* Adapted for Wisconsin from a manuscript by Lloyd V. Knutson

53a. Siphon with a pair of large basoventral hair tufts (Fig. 40) ..... **Culiseta**

53b. Siphon without such hair tufts (Figs. 42-45) **54**

54a. Siphon with several pairs of ventral tufts, some of which may be single long hairs (Fig. 42) ..... **Culex**

54b. Siphon with only a single pair of ventral tufts, or none **55**

55a. Ventral brush of anal segment with several tufts arising out of sclerotized ring (Fig. 43) ..... **Psorophora**

55b. Ventral brush of anal segment with all tufts posterior to sclerotized ring (Fig. 44), or sclerotized ring incomplete ventrally ..... **Aedes**

56a. Siphon triangular and very short (Fig. 45); head wider than long ..... **Mansonia**

56b. Siphon conical and elongate; head as long as wide .. **57**

57a. Siphon with many single hairs (Fig. 46) ..... **Wyeomyia**

57b. Siphon with a single pair of highly branched tufts ..... **Orthopodomyia**

58a. PSYCHODIDAE — Twenty-six dorsal plates; paired adanal plates and a single preanal plate (Fig. 47) ..... **Pericoma**

58b. Dorsal plates absent or numbering less than 26; adanal plate single, transverse, preanal plates absent.. **Psychoda**

59a. CERATOPOGONIDAE — Head more than twice as long as wide; body segments long and slender (Fig. 14) **60**

59b. Head about 1-1/2 times as long as wide; body segments only slightly longer than head **61**

60a. Anal hairs as long as or longer than last segment; entire dorsal surface mottled with red pigment; length not exceeding 6mm ..... ***Alluaudomyia***

60b. Anal hairs usually shorter than last segment (Fig. 14); mottling, if present, does not cover entire dorsum ..... **Bezzia, Probezzia,** or **Palpomyia**

61a. Body curved; less than 5mm long; body segments wider than head ..... **Stilobezzia**

61b. Body straight **62**

62a. Head pear-shaped; body segments wider than head; up to 10mm long ..... **Palpomyia**

62b. Head oval; body segments about same width as head; less than 5mm long (Fig. 48) ..... **Culicoides**

63a. DIXIDAE — Dorsum of abdomen bare or nearly so **Dixella**

63b. Dorsum of abdomen with rosettes of hair on segments 2-7 ..... **Dixa**

64a. PTYCHOPTERIDAE — Body pale; prolegs weakly developed; mandibles with 3 outer teeth ..... **Ptychoptera**

64b. Body rusty-red; prolegs well-developed; mandibles with a single outer tooth ..... **Bittacomorpha**

65a. SIMULIIDAE — Antennal segments 1-2 colorless, 3-4 dark brown or black; mental plate with laterally notched middle tooth (Fig. 49) ..... **Prosimulium**

65b. Apical antennal segments not darker than basal ones; middle tooth of mental plate not notched (Figs. 51, 52) **66**

66a. Ventral tubercles large and conspicuous (Fig. 50); head spots dark; throat cleft rounded apically; anal lobes compound ..... **Eusimulium**

66b. Ventral tubercles absent or inconspicuous; head spots dark or light; throat cleft pointed apically, inverted V-shaped, or rounded; anal lobes simple or compound .. **67**

67a. Mental plate with a large median tooth and a large tooth on each side flanked by 3 smaller teeth (Fig. 51); anal gill with compound lobes (one common species has 3 simple lobes) ..... **Simulium**

67b. Mental plate not as above (Fig. 52); anal gill with simple lobes ..... **Cnephia**

68a. CHIRONOMIDAE — Antennae retractile into head, basal segment usually elongate (Fig. 53) ... TANYPODINAE **72**

68b. Antennae non-retractile **69**

69a. Striated ventromental plates present (Fig. 54) ..... CHIRONOMINAE **107**

69b. Ventromental plates, if present, never striated but sometimes bearded (Fig. 55) **70**

70a. Third antennal segment annulated (Fig. 56) ..... DIAMESINAE **85**

70b. Third antennal segment not annulated **71**

71a. Ventromental plates large and heavily bearded (Fig. 55) or mesally pointed (Fig. 57) ..... DIAMESINAE **87**

71b. Ventromental plates, if present, small, rounded or laterally pointed, and not heavily bearded (Fig. 58) ..... ORTHOCLADINAE **89**

72a. TANYPODINAE — Dorsomental combs present (Fig. 53) **73**

72b. Dorsomental combs absent **75**

73a. Ligula with 5 black teeth ..... **Procladius**

73b. Ligula with 4 or 5 yellow or reddish teeth **74**

74a. Toothed margin of ligula convex (Fig. 59); mandibles with a bulbous base and very minute lateral teeth (Fig. 60); ligula with 5 teeth ..... **Tanypus**

74b. Toothed margin of ligula straight or concave (Fig. 61); lateral teeth on mandible usually distinct; ligula with 4 or 5 teeth ..... **Psectrotanypus**

75a. Body with a dense fringe of hairs laterally; ligula with 6 or 7 teeth **76**

75b. Body without lateral hair fringe, only scattered setae; ligula with 5 teeth **77**

76a. Ligula with 6 teeth; mandibles hook-like (Fig. 62); antennae 3/4 as long as head ..... **Clinotanypus**

76b. Ligula with 7 teeth; mandibles gently curved (Fig. 63); antennae 1/2 as long as head ..... **Coelotanypus**

77a. Head about 3 times as long as antennae; preanal papillae about 9 times as long as wide; body red; mandibles with a strong blunt lateral tooth and a small accessory tooth ... . **Natarsia**

77b. Head seldom more than twice as long as antennae; preanal papillae not more than 7 times as long as wide; body never red; mandibles variable **78**

78a. Maxillary palpi with 2 or more basal segments .... **Ablabesmyia**

78b. Maxillary palpi with only 1 basal segment **79**

79a. Preanal papillae dark and about 6 times as long as wide; supra-anal bristle dark, stiff, and longer than posterior prolegs; anal papillae longer than prolegs (Fig. 64) .... **Pentaneura**

79b. Preanal papillae less than 5 times as long as wide; supra-anal bristle shorter than posterior prolegs and not stiff; anal papillae not longer than prolegs **80**

80a. Middle tooth of ligula longer than first lateral teeth; anal papillae about same length as prolegs **81**

80b. Middle tooth of ligula smaller or subequal to first lateral teeth; anal papillae shorter than prolegs **82**

81a. First and/or second antennal segments brown .... **Labrundinia**

81b. All antennal segments yellow; lotic ..... **Nilotanypus**

82a. Basal antennal segment 6.0-7.5 times as long as remaining segments; some claws on posterior prolegs dark and some toothed on inner edge ..... **Guttipelopia**

82b. Basal antennal segment less than 5.5 times as long as remaining segments; claws on posterior prolegs variable, usually all yellow **83**

83a. Toothed margin of ligula straight, teeth subequal (Fig. 65); basal antennal segment less than 3.6 times as long as remaining segments ..... **Zavrelimyia**

83b. Toothed margin of ligula concave; basal antennal segment more than 3.6 times as long as remaining segments .. **84**

84a. First lateral teeth of ligula pointed outward (Fig. 66); lateral teeth of mandibles minute and indistinct .... **Conchapelopia, Arctopelopia, Rheopelopia**

84b. First lateral teeth of ligula not pointed outward; lateral teeth of mandibles distinct ..... **Larsia**

85a. DIAMESINAE — Mandible with a hook-shaped lateral tooth (Fig. 67); mental plate without distinct teeth .. **Potthastia**

85b. Mandible with 4 lateral teeth; mental plate with numerous strong teeth **86**

86a. Middle of mental plate with a very broad pale tooth (Fig. 68) ..... **Sympotthastia**

86b. Middle of mental plate dark with several teeth (Fig. 69) .. .. **Diamesa**

87a. DIAMESINAE — Ventromental plates with only a few hairs (Fig. 57); middle of mental plate concave with indistinct teeth (Fig. 57) ..... **Monodiamesa**

87b. Ventromental plates heavily bearded (Fig. 55); middle of mental plate, if concave, with 2 distinct median teeth (Fig. 55) **88**

88a. Mental plate inconspicuous with unpaired middle tooth; mandibles circular and heavily haired ..... **Odontomesa**

88b. Mental plate with a pair of teeth in center (Fig. 55); mandibles not heavily haired ..... **Prodiamesa**

89a. ORTHOCLADINAE — Antennae at least half as long as head; mental plate with 13 teeth, middle tooth slightly recessed between first laterals **90**

89b. Antennae less than half as long as head **91**

90a. Antennae longer than head, 4-segmented ... **Corynoneura**

90b. Antennae slightly more than half as long as head, 5-segmented ..... **Thienemanniella**

91a. Preanal papillae absent; anal prolegs reduced or absent; mental plate with a reduced number of teeth (Figs. 70, 71) **92**

91b. Preanal papillae present; anal prolegs normal; mental plate with several pairs of teeth that are usually distinct ... **93**

92a. Mental plate with spine-like lateral teeth (Fig. 70); phoretic ..... **Symbiocladius**

92b. Mental plate with a truncated middle tooth and 2 or 3 pairs of lateral teeth (Fig. 71) ..... **Pseudosmittia**

93a. Body with numerous long, dark setae, many longer than a body segment; center of mental plate truncated with several subequal teeth (Fig. 72); phoretic .... **Epoicocladius**

93b. Body usually without long dark setae; if long dark setae are present, middle of mental plate is convex with only 1 or 2 middle teeth **94**

94a. Ventromental plates conspicuous and bearing setae (Figs. 58, 73, 74) **95**

94b. Ventromental plates, if present, without distinct setae (Figs. 78, 79) **97**

95a. Mental plate with 14 teeth of nearly equal size (Fig. 73) .. .. **Diplocladius**

95b. If mental plate has 14 teeth, they are unequal in size.. **96**

96a. Mental plate with 14 distinct teeth, first laterals small and closely applied to middle teeth (Fig. 74); last tooth of mandible shorter than distance between tips of first and third laterals ..... **Rheocricotopus**

96b. If teeth on mental plate are distinct, there are less than 14 (Fig. 58); last tooth of mandible usually longer than distance between tips of first and third laterals **Psectrocladius**

97a. Mental plate very dark with a broadly truncated middle tooth and 5 pairs of lateral teeth (Fig. 75) .. **Cardiocladius**

97b. Mental plate without a broadly truncated, dark middle tooth **98**

98a. Mental plate very dark with a small middle tooth recessed between large first laterals (Fig. 76), or with 2 very long middle teeth and 4 or 5 lateral teeth (Fig. 77) ..... **Brillia**

98b. Mental plate without a small recessed middle tooth or extremely long middle teeth **99**

99a. Mental plate with 14 teeth; ventromental plates distinct (Fig. 78) ..... **Trissocladius**

99b. Mental plate with less than 14 teeth; ventromental plates sometimes distinct **100**

100a. Last tooth of mandibles at least twice as long as distance between tips of first and third laterals; mental plate with flat lateral teeth and a middle tooth with twin mesal peaks (Fig. 79); ventromental plates distinct; phoretic .... **Plecopteracoluthus**

100b. Last tooth of mandibles much less than twice as long as distance between tips of first and third laterals; teeth on mental plate rounded or pointed; ventromental plate usually indistinct **101**

101a. Mental plate with an even number of teeth **102**

101b. Mental plate with an odd number of teeth **104**

102a. Last tooth of mandible usually no longer than first lateral tooth (Fig. 80); if longer, body with long setae .... **Eukiefferiella**

102b. Last tooth of mandible distinctly longer than first lateral tooth (Fig. 81); body without long setae **103**

103a. Antennae 7-segmented, with segment 3 very short and segments 1, 2, and 4 elongate (Fig. 82); lateral teeth of mental plate becoming uniformly shorter laterally (Fig. 83) .... **Heterotrissocladius**

103b. Antennae 5-segmented, with only segments 1 and 2 elongate (Fig. 84); third lateral teeth of mental plate shorter than fourth laterals (Fig. 85) ..... **Parametriocnemus**

104a. Mental plate with 11 teeth, the middle tooth broad and peaked mesally (Fig. 84); body with several conspicuous long hairs ..... **Eukiefferiella**

104b. If mental plate has 11 teeth, the middle tooth is not broad and mesally peaked; body without long, conspicuous hairs **105**

105a. Mental plate with 11 teeth, all rounded and uniformly dark (Fig. 87) ..... **Smittia**

105b. If mental plate has 11 teeth, they are not all rounded or uniformly dark **106**

106a. Mental plate evenly colored and contoured, with a rounded middle tooth and 6 pairs of lateral teeth (Fig. 88) .... **Orthocladius**

106b. Mental plate with the middle tooth and first two lateral teeth usually paler; several species, each with one or more of the following characteristics: mental plate with only 7 or 9 teeth; outer edge of mandibles crenulate (Fig. 89); inner margin of mandibles with serrations (Fig. 90); second lateral teeth very closely applied to first laterals (Fig. 91); body with hair pencils on posterolateral margins of posterior abdominal segments (Fig. 92) ..... **Cricotopus**

107a. CHIRONOMINAE — Antennae on dorsal protuberances of head, which are always longer than broad (Fig. 96); first antennal segment curved and at least 6 times as long as wide ..... TANYTARSINI **108**

107b. Antennae not on large protuberances; first antennal segment not distinctly curved and less than 4 times as long as wide ..... CHIRONOMINI **113**

108a. TANYTARSINI — Ventromental plates well separated, pointed at inner apices ..... **Stempellina**

108b. Ventromental plates almost meeting, bluntly rounded at inner apices (Fig. 93) **109**

109a. Lauterborn organs large, longer than their petioles (Fig. 94) **110**

109b. Lauterborn organs small, less than 1/2 as long as their petioles (Fig. 95) **111**

110a. Petiole of lauterborn organ not more than 1/2 as long as lauterborn organ; dorsal eye-spot not wider than width of basal antennal segment ..... **Paratanytarsus**

110b. Petiole of lauterborn organ about 2/3 as long as lauterborn organ; dorsal eye-spot wider than width of basal antennal segment ..... **Cladotanytarsus**

111a. Lauterborn organs about 1/3 as long as their petioles; lotic ..... **Rheotanytarsus**

111b. Lauterborn organs less than 1/5 as long as their petioles; lotic or lentic **112**

112a. Antennal tubercle with an inner apical spur (Fig. 96) .... **Micropsectra**

112b. Antennal tubercle without a spur at apex .... **Tanytarsus**

113a. CHIRONOMINI — Antennae 6-segmented, with large lauterborn organs alternating on segments 2 and 3 .... **114**

113b. Antennae usually 5-segmented, without large lauterborn organs **118**

114a. All teeth on mental plate unicolorous **115**
114b. Middle of mental plate pale in relation to lateral teeth **116**
115a. Middle pair of teeth small, first laterals large; median and first lateral teeth clearly anterior to remaining laterals (Fig. 97); mental plate with 16 teeth ... **Stictochironomus**
115b. Middle pair of teeth and second laterals long, first laterals small (Fig. 98) ..... **Lauterborniella**
116a. Mental plate with a single pale broad median tooth and 6 dark laterals that are progressively shorter (Fig. 99) ..... **Paralauterborniella**
116b. Mental plate with at least 2 pale median teeth **117**
117a. Mental plate with 2 pale median teeth and often a minute tooth between them; lateral teeth dark, second laterals the longest (Fig. 100) ..... **Microtendipes**
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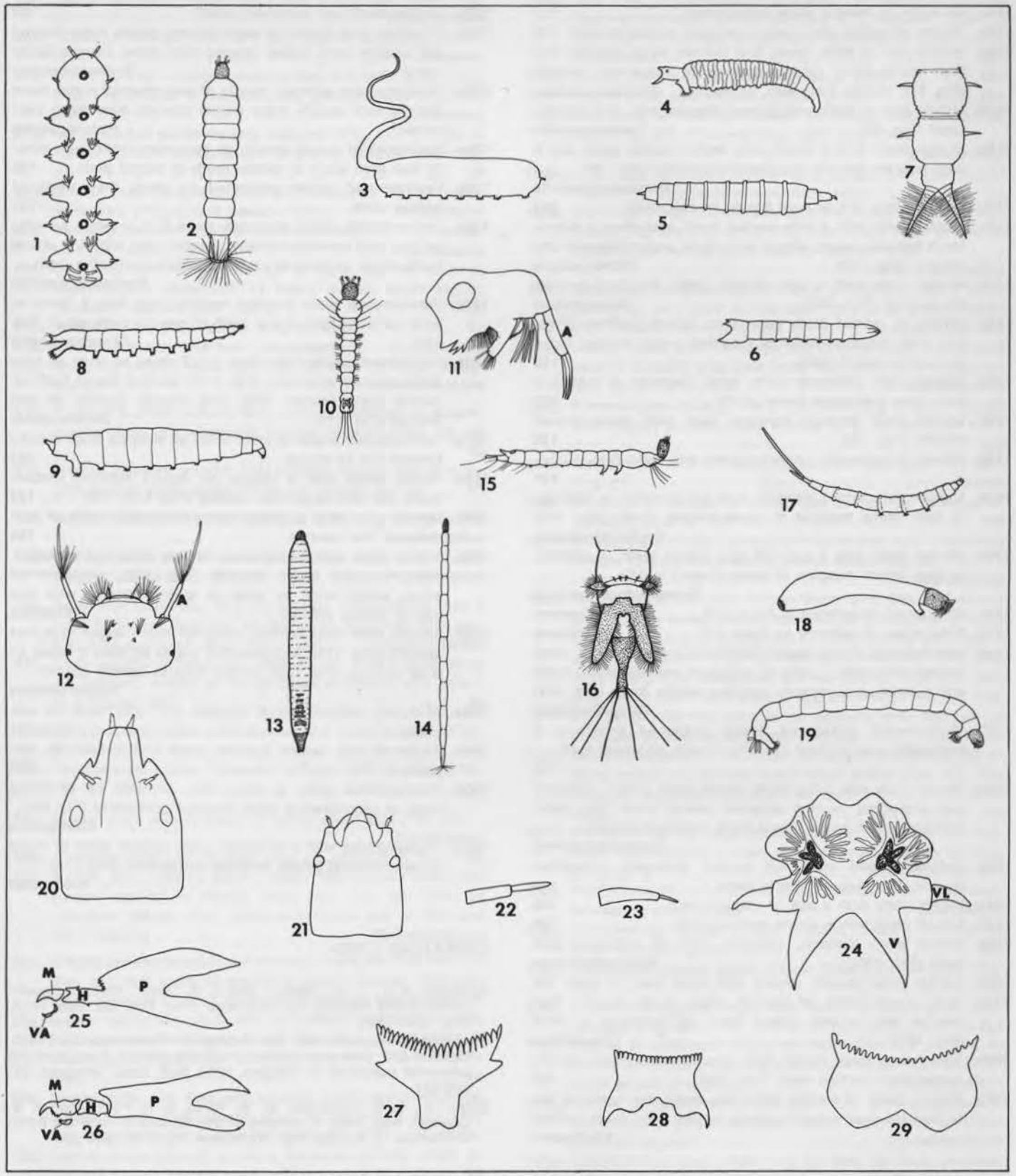

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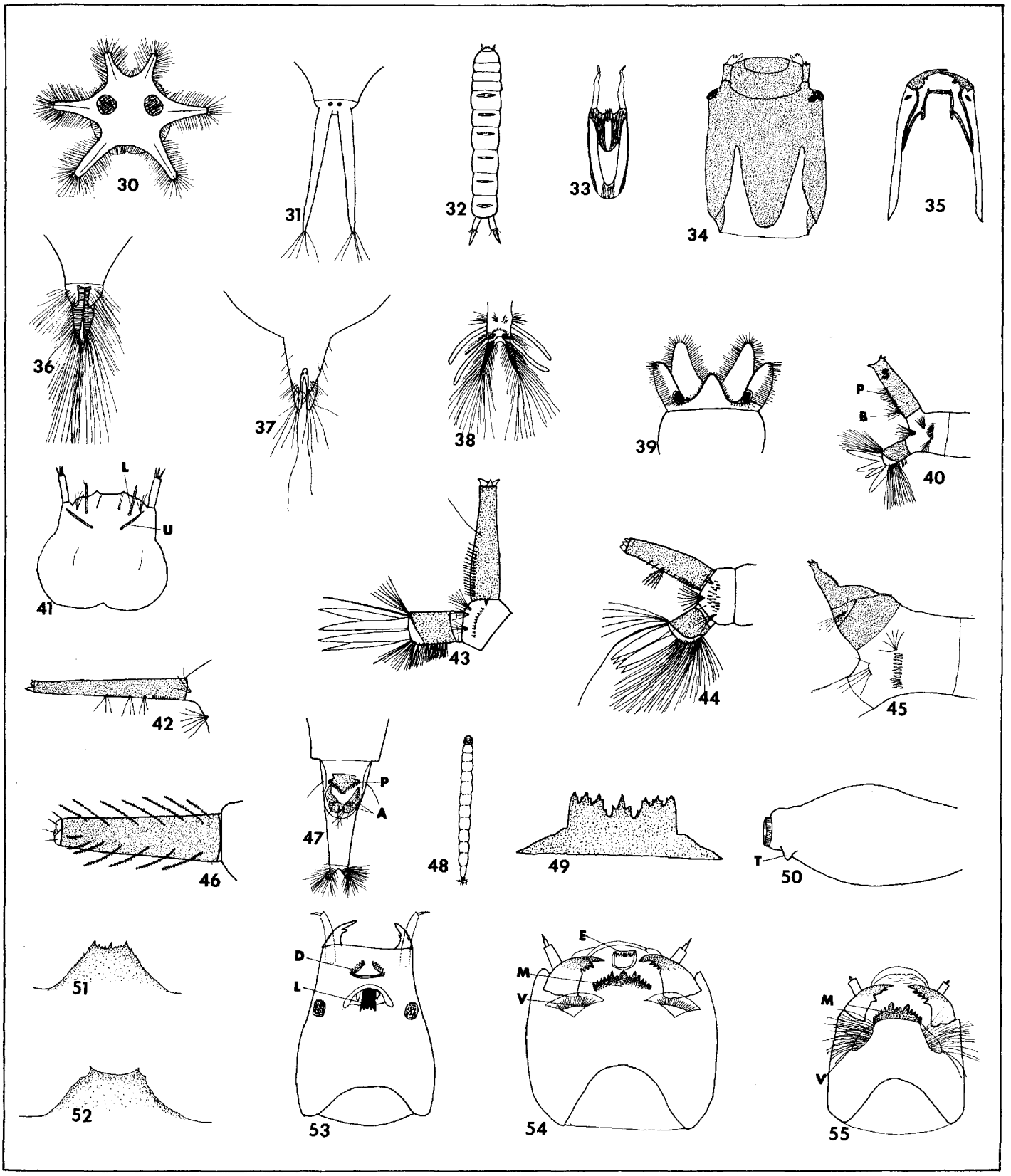

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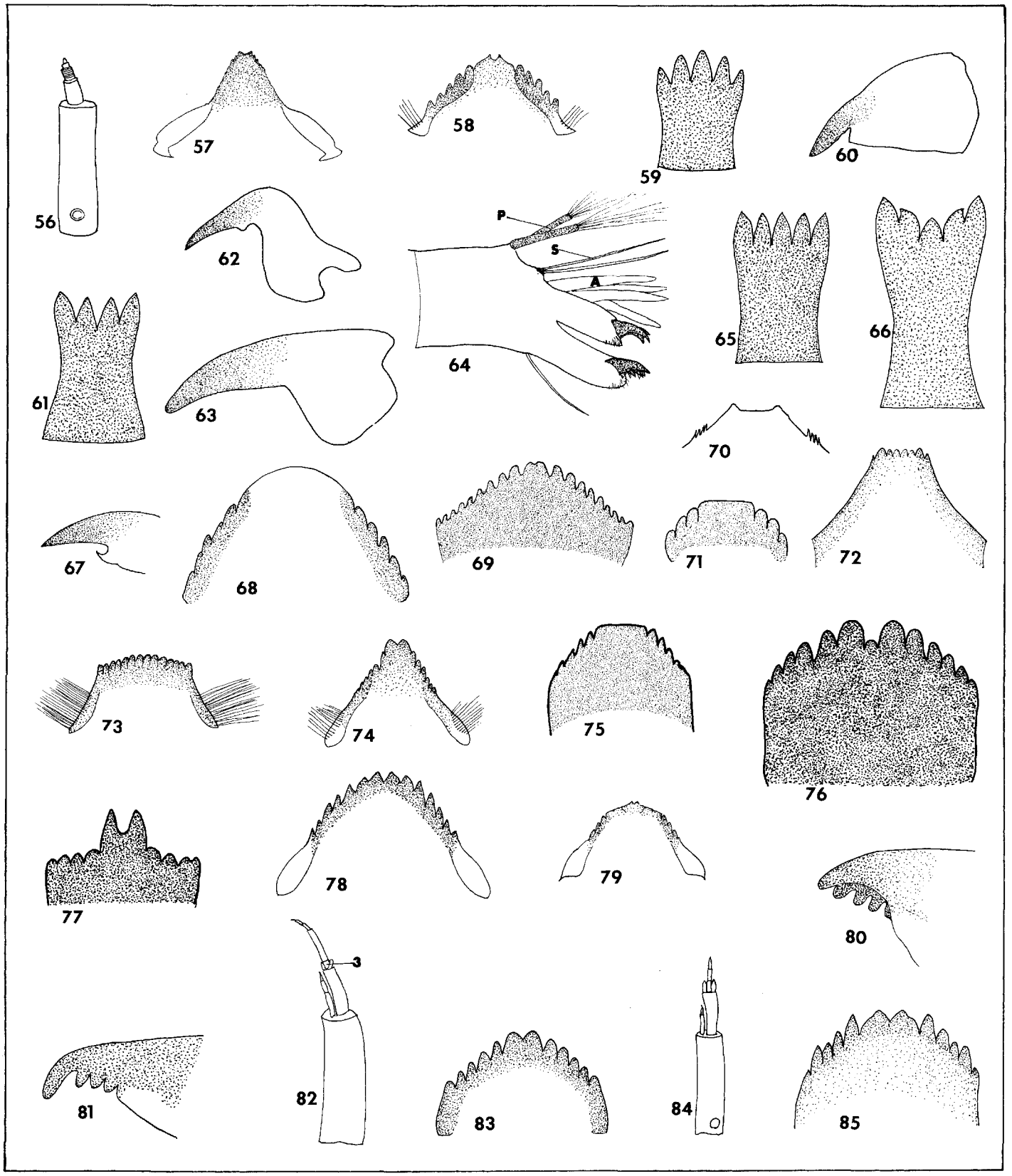

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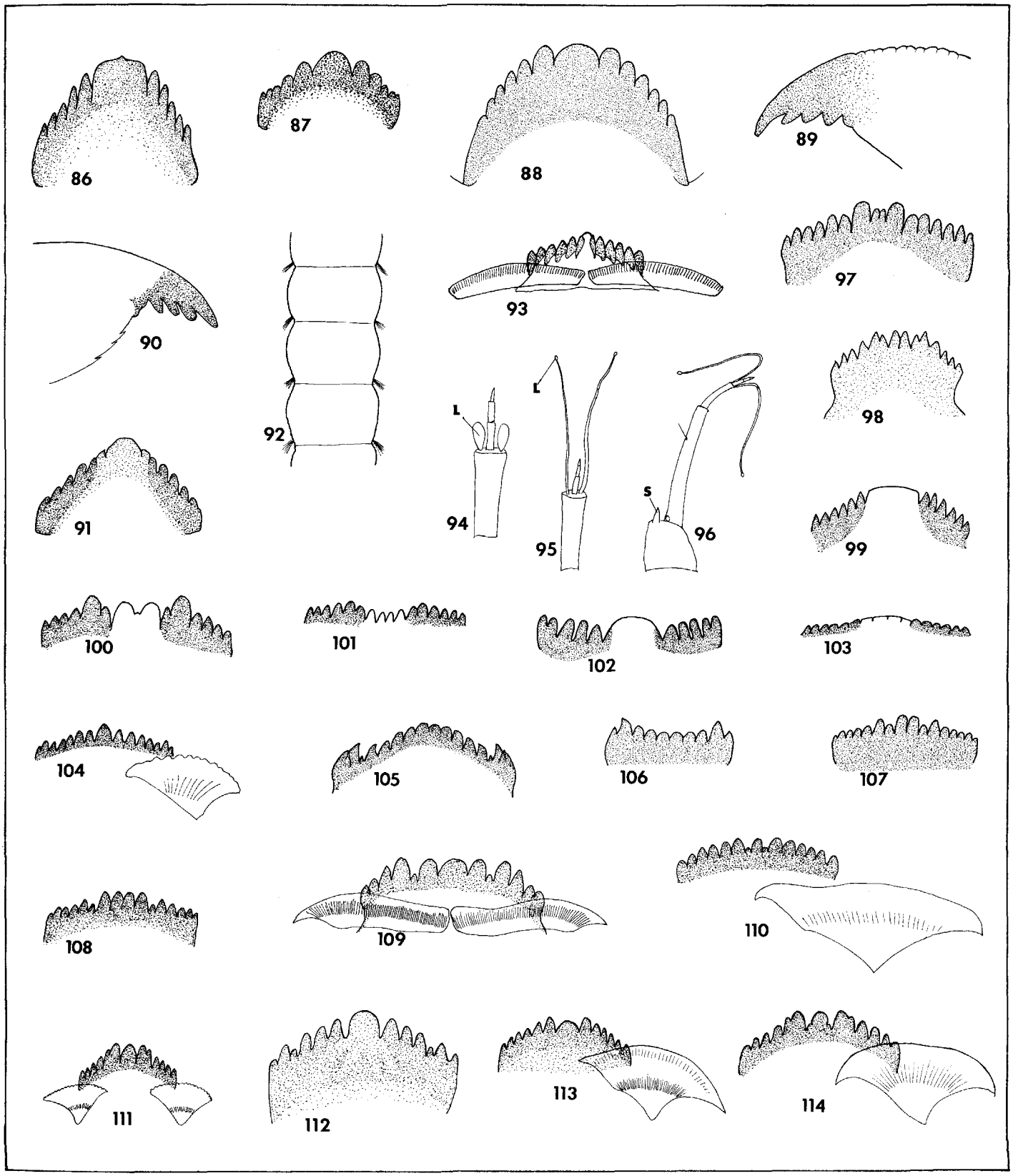

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GLOSSARY OF TERMS USED IN KEYS

angulate — forming an angle; not rounded.
annulate — ringed; surrounded by a ring of a different color; formed in ringlike segments.
annulus (annuli) — ring.
apex — that part of any structure opposite the base by which it is attached.
apical — pertaining to the apex.

basal — at or pertaining to the base or point of attachment to or nearest the main body.
beard — fringed with hair or long setae.
bifid — cleft, or divided into two parts; forked.
bifurcate — divided partly, or forked into two.
bilamellate — divided into two lamellae or plates.
brachypterous — with short or abbreviated wings.
bristle — a stiff hair, usually short and blunt.
bulbous — bulb-like; swollen.

carapace — a hard covering.
cilia — fringes; series of moderate or thin hair arranged in tufts or single lines.
ciliate — fringed with a row of parallel hairs or cilia.
clypeus — that part of the head between the frons and labrum.
creeping welt — a slightly raised, often darkened structure on dipteran larvae.
crenula — a small scallop.
crenulate — with small scallops, evenly rounded and rather deeply curved.
crochets — the curved spines or hooks on the prolegs of Lepidoptera larvae.
cupule — a cup-shaped segment at the base of the club on some antennae.

decurved — bowed or curved downward.

effaced — obliterated; rubbed out.
emarginate — notched; with an obtuse, rounded, or quadrate section cut from a margin.
epicranial suture — a Y-shaped suture on the dorsal surface of the head.

fibrilliform — in the form of many threads.
filiform — threadlike; slender and of equal diameter.
fossorial — formed for or with the habit of digging or burrowing.
frons — front of head between arms or epicranial suture.
frontal sutures — the arms of the epicranial suture.

galea — the outer lobe of the maxilla.
gena (genae) — the cheek; the part of the head on each side below the eyes, extending to the gular suture.
glossa (glossae) — one of the two median terminal lobes of the labium.
gula — the throat sclerite, forming the central part of the head beneath the genae.

hypopharynx — a structure on the upper and inner part of the labium.

impressed — pushed inward; shallowly depressed.
incised — notched or deeply cut into.
infuscate — smoky gray-brown, with a blackish tinge.
interocular space — the space between the eyes.

lacinia (laciniae) — the inner blade-like segment of the maxilla that bears brushes of hairs or spines.
lamella — a thin plate or leaflike process.
laminate — composed of or covered with thin plates.
lanceolate — lance- or spear-shaped; oblong and tapering to the end.
lentic — pertaining to still water.
ligula — the central, apical segment of the labium.
linear — straight; elongate; in the form of a straight line.
lotic — pertaining to moving water.
mentum — the distal segment of the labium bearing the movable parts and attached to the submentum.
mesal — pertaining to the middle; toward the middle.
moniliform — beadlike.
mouth hook — vertically oriented mandible-like structure in dipteran larvae.
muscle scar — a dark or light ovoid mark that contrasts with the background.

obsolete — mostly or entirely absent; indistinct; not fully developed.
occipital — of or pertaining to the occiput.
occiput — the back part of the head.
ocellus (ocelli) — the simple eye in insects consisting of a single, bead-like lens, occurring singly or in small groups.

pala — the much dilated anterior tarsal joint in Corixidae.
papilla (papillae) — a soft projection.
paraglossa (paraglossae) — the lateral terminal lobes of the labium.
phoretic — living on another animal, but not feeding on it.
pilose — covered with numerous soft, short setae.
pleuron — the pleural area (side) of each segment.
postocular space — space between the back of the eyes and the occipital opening.
process — a prolongation of the surface, or a margin, or an appendage; any prominent part of the body not otherwise definable.
proleg — any process or appendage that serves the purpose of a leg.
pruinose — as if frosted or covered with a fine dust.
pseudobasal — appearing to be basal.
pseudopod — a soft, foot-like appendage.
punctate — set with impressed points or punctures.

rastrate — covered with longitudinal scratches.
reticulate — covered with a network of lines.
rostrum — a beak; a snout-like projection of the head bearing the mouthparts.

scalloped — with the edge marked with rounded hollows, without intervening angles.
sclerite — any piece of the insect body wall bounded by sutures.
sclerotized — hardened and usually darkened.
scutellum — in Coleoptera and Hemiptera, the triangular piece between the bases of the elytra or hemelytra.
seta (setae) — slender, hairlike appendage; hair.
setose — furnished or covered with setae or stiff hairs.
siphon — a caudal respiratory tube of dipteran larvae.
spine — a multicellular, thornlike process or outgrowth of the cuticula not separated from it by a joint.
spinule — a very small spine.
spur — a spinelike appendage of the cuticula, connected to the body wall by a joint.
sternum — the entire ventral division of any segment.
stipes — the second segment of the maxilla, the segment to which movable parts are attached.
stria (striae) — a fine, longitudinally impressed line.
strigil — a dark, roughened structure on the dorsolateral portion of the abdomen of Corixidae.
subequal — almost or nearly equal.
submentum — the basal segment of the labium.

suture — a seam or impressed line indicating the division of the distinct parts of the body wall.

tergum — the upper or dorsal surface of any body segment of an insect.

tomentum — a form of pubescence composed of matted, woolly hair.

triquetral — triangular in cross-section.

trochantin — a small, forward projecting sclerite at the base of the trochanter.

tubule — a small, elongate tubelike structure.

vertex — top of head between eyes.

vestigial — small or degenerate.

vitta (vittae) — a broad longitudinal stripe.

whorl — a ring of setae about a joint or center — like spokes of a wheel.

ACKNOWLEDGMENTS

This research was supported by the College of Agricultural and Life Sciences and the Wisconsin Department of Natural Resources (under the Water Resources Research and Data Collection Program).

Edited by Ruth L. Hine

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