

MAYFLIES

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Mayflies are appreciated most by trout, trout fishermen, bridge nesting swallows, a handful of Ephemeropterists, and maybe by other mayflies. In general, they are loathed by collectors because they are hard to identify and because there are few insects less attractive than a shrivelled and faded mayfly impaled on a pin in a collection. This is a result of their delicate and fragile structure and, as a consequence, they are less well studied than some other insect groups of comparable size (approximately 500 North American species).

An adult mayfly in nature is a work of art and their transient beauty has inspired poets to write in many languages of the ephemeral nature of all living things, including ourselves. The popular conception of the short life of mayflies (*Ephemeroptera*) is, however, somewhat of a misrepresentation. Some do live but a day in the adult stage, such as our *Ephoron album* which are like a summer snowstorm as they emerge over the Saskatchewan River on August evenings, their reduced legs indicating how little time is spent on a solid surface. Then there is the more extreme case of female *Lachlania saskatchewanensis*, where the legs of the females are completely useless, probably decreeing that to alight is to die; I have seen adults of this species only as windrows of dead mayflies along the river shore. It is also true that the mouthparts of adult mayflies are reduced and functionless and they probably take no food or water as adults. But it must be remembered that the nymphal stage has lasted for months or in some cases years beneath the water surface.

This paper has two purposes, the first is to provide a means of identifying families of adult mayflies of North America (nymphs can be identified by using Lehmkuhl, 1975c), and,

second, to introduce the mayflies of Saskatchewan (See also Lehmkuhl, 1970). Identification of adults to family is considered difficult in some cases even by professional entomologists because all adults look quite similar (Figs. 1 and 2 illustrate two extremes) and the family characteristics are found in details of wing venation. I have departed from the usual "key" method of identification and have attempted to use in Table 1 and Figures 6-21 a modified Peterson Field Guide technique. There is no easy road to adult identification, so I would suggest that the first step is to use a 10X hand lens and sketch the major arrangement of veins in the specimen at hand. It may be necessary to remove the wing from the specimen to get clear view. Next, compare the drawing with the six categories in Figures 6-21 and select the correct one. Finally, go to the proper category in Table 1 which will lead you to the family name. A list of Saskatchewan families, genera, and known species is found in Table 2.

The mayflies of Saskatchewan present a most unusual and fascinating situation. While the number of identified species is about 60 (with a dozen or so yet to be identified), the number of genera (that is, major types) is about 35, and 12 of the 15 North American families can be collected in the province. Such diversity in a northern inland locality is unusual when compared, for example, to the "poor" fauna of Dragonflies, Damselflies and Alderflies.^{6 7} This variety of mayflies is not readily explained, but it probably has to do with the immigration from east, west, north and south, in combination with the glacial history and climate of the area. In terms of origin, our mayfly fauna invaded from all directions after the decline of the ice age. Based on current distributions,

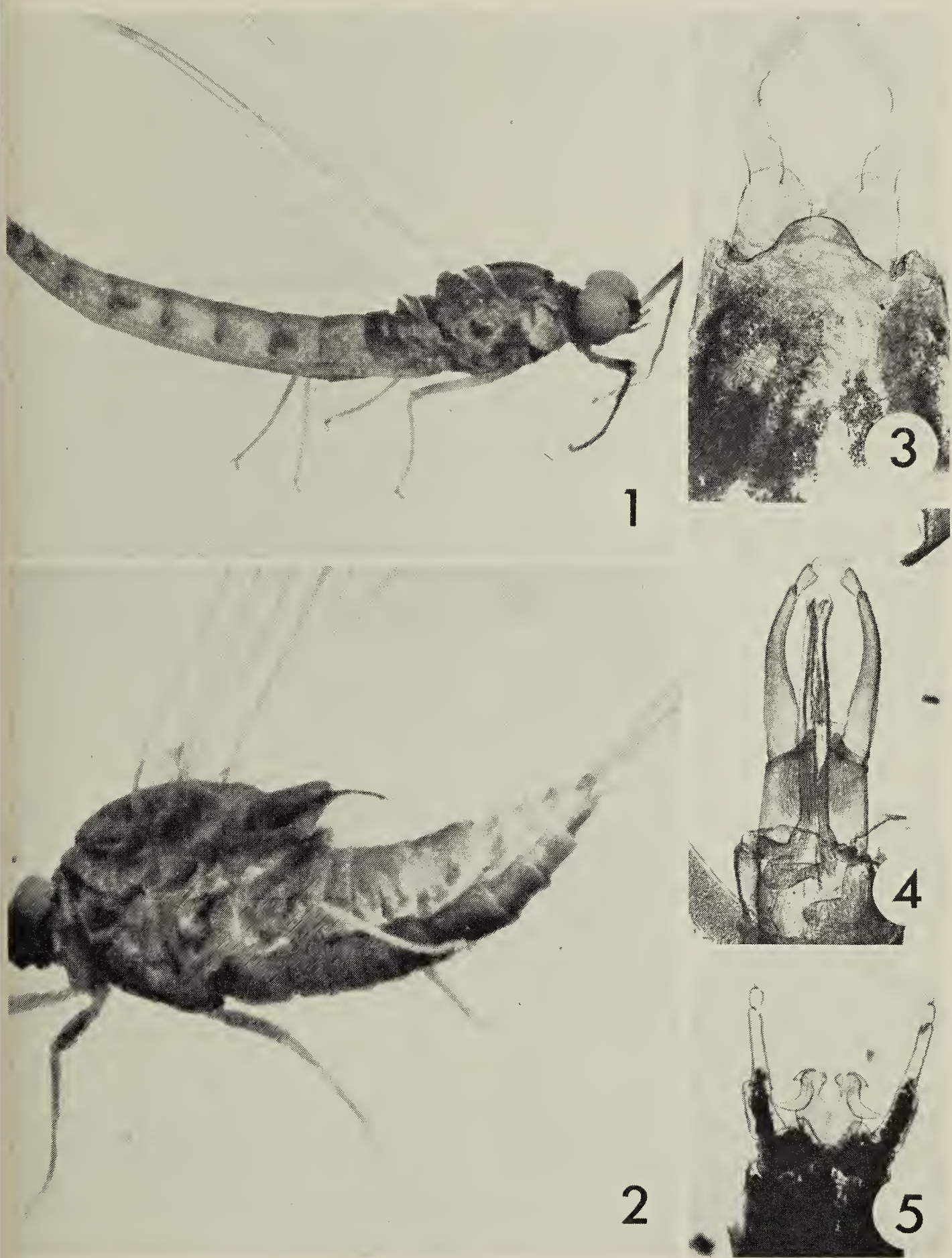


Figure 1. Adult male of *Analetris eximia*; Fig. 2. Adult female of *Baetisca bajkovi*; Figs. 3-5. male genitalia of *Analetris eximia*, *Paraleptophlebia praepecta*, and *P. debilis*.

there are four faunal regions in Saskatchewan: Boreal, Saskatchewan River, Cypress Hills and Prairie.

Few kinds of mayflies are found on the true prairie. Potholes are likely to yield only *Callibaetis* but occasionally *Caenis* or even *Siphonurus* may be encountered. The boreal forest is characterized mainly by a typical "eastern" assemblage of *Heptagenia* (Fig. 27) and *Stenonema*, plus widespread forms such as *Baetis* (Fig. 22), *Paraleptophlebia*, *Leptophlebia*, *Ephemerella* (Fig. 23) and *Tricorythodes* (Fig. 25).

Many western species reach their eastern limits in the Cypress Hills, including *Epeorus longimanus*, *Cinygma* sp., and *Ameletus* sp. Of most interest is the Saskatchewan River fauna where one can collect *Ametropus* (Fig. 24), *Metretopus*, *Dactylobaetes*, *Baetisca* (Fig. 35), *Brachcercus*, *Anepeorus*, *Pseudiron*, *Choroterpes*, *Traverella*, *Lachlania* (Fig. 31) *Ephoron*, *Analetris*, and *Isonychia*. The origin of this diverse assemblage, probably one of the most unusual in North America, is a chapter in itself which remains to be written, but see Lehmkuhl, 1970, 1972 and 1976.

The mayfly life cycle is relatively simple except for one unique stage, the subimago. This stage is found in no other insect. It emerges from the aquatic nymph and while it looks like an adult and is capable of flight, it differs in that it is sexually immature, the body is covered with a dull velvety cuticle which must be shed, and various body parts, such as legs or genitalia, may be underdeveloped.

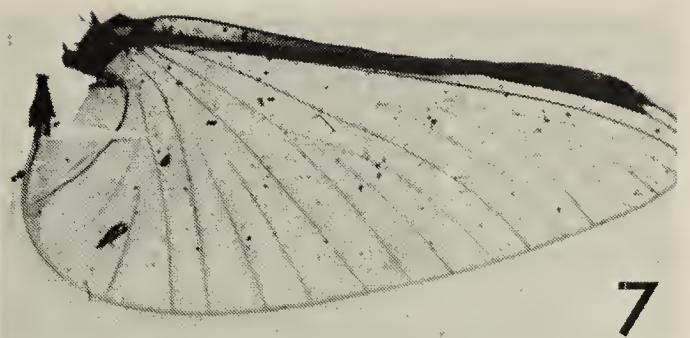
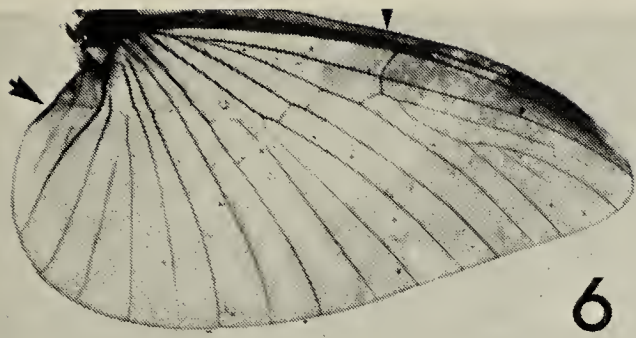
Adult males congregate in swarms, the size, timing and location of which varies greatly with the species. Ripe females fly into the swarm to be grasped from below by the long front legs and terminal abdominal "forceps" (Figs. 1, 3-5) of the male. Sperm is passed from the penis of the male (blade and rod-like structures in Figs. 3-5) to the genital openings on the underside of the body of the female. In many species the female quickly drops to the water surface and the eggs are released (Fig. 44). During swarming

and oviposition, birds, bats and fish take a heavy toll of adults.

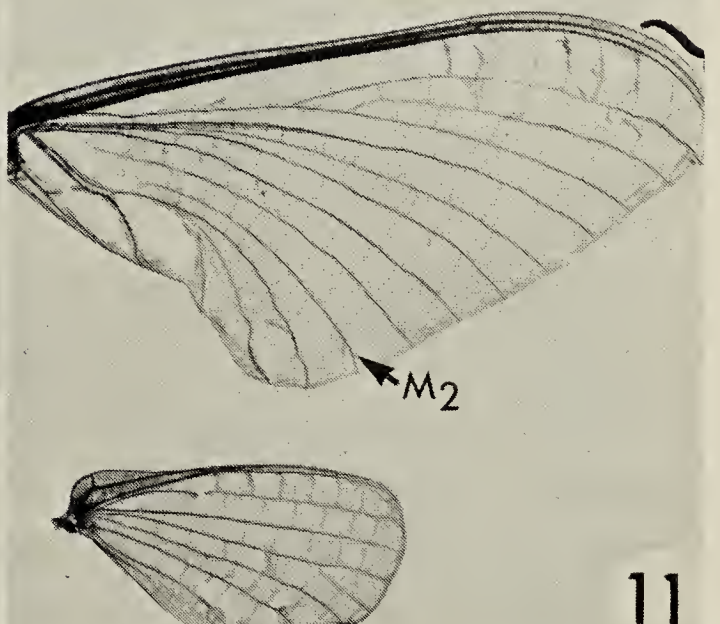
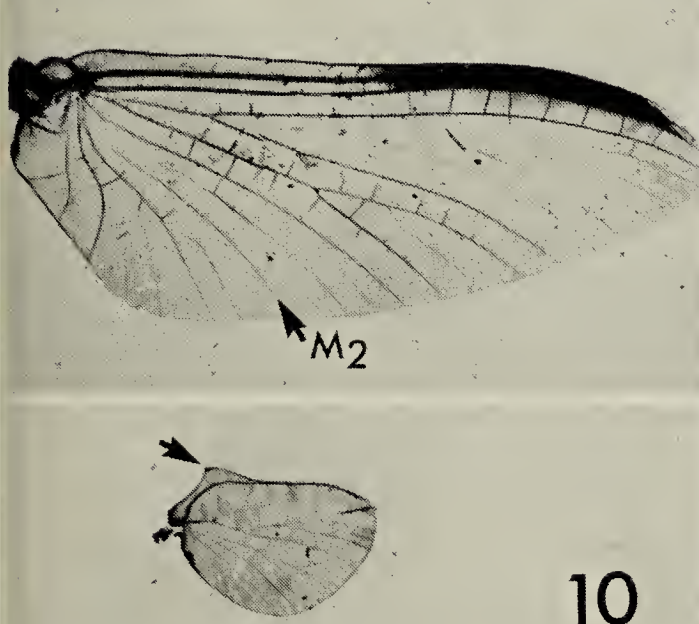
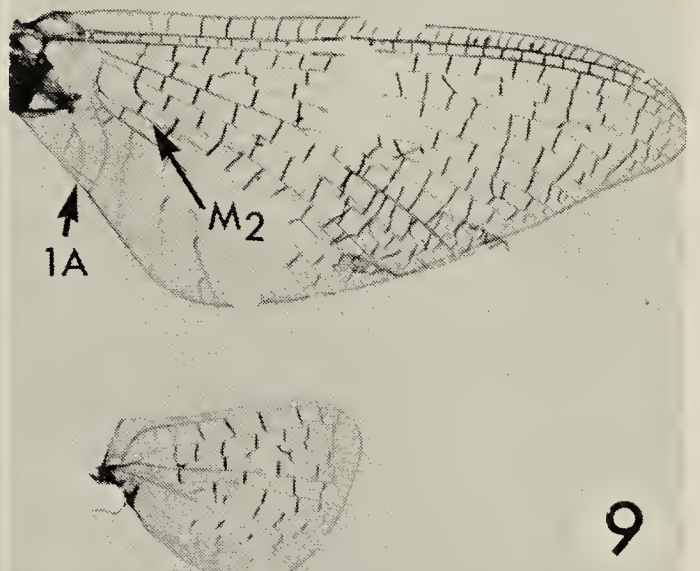
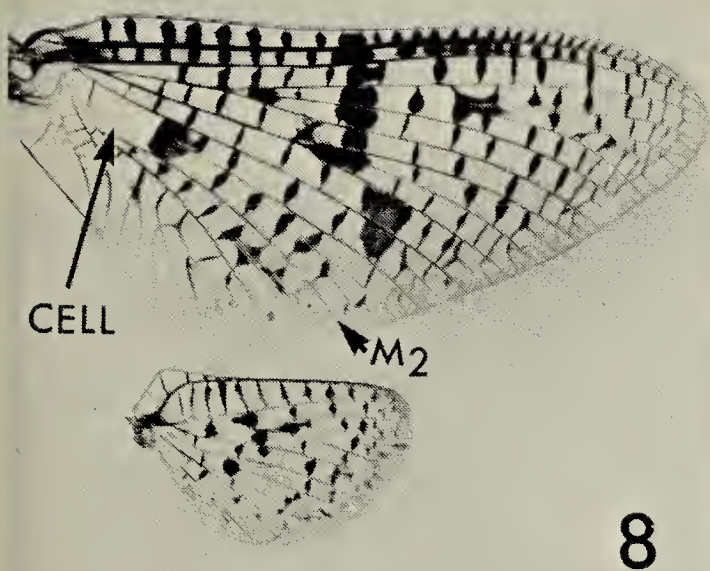
Eggs may have a smooth surface (Fig. 43) or they may have attachment structures of various types (Figs. 37, 39, 40). In *Baetis*, the female crawls beneath the water surface and lays eggs in neat square masses, often found in abundance on stones in mountain or boreal streams (Fig. 36).

Eggs hatch into nymphs, various types of which are illustrated in the figures. While adults look quite similar in all families, the nymphal stage shows great diversity. Basic mouthparts of a chewer, such as *Baetis*, are illustrated in Figure 38. These same structures may be modified into scrapers and filters as in Figure 41. Among burrowing mayflies mandibles may even be modified into forward projecting tusks as in Figures 42 and 26. Gills, which are found on the abdomen of all North American mayflies, are basically flat plates (Figs. 29 and 33a,b) but may be modified into rods, double plates, forks, filaments or brushes, depending on the genus and species (Figs. 28, 30, 34). Such readily seen differences makes identification of mayfly nymphs relatively easy.

Nymphs occupy a wide range of niches. Heptageniids (Fig. 27) are flat and live on rocks in streams where they scrape algae for food while *Baetis* (Fig. 22) may live on the same rock but the body shape is streamlined and fish-like. *Ephemerella* (Fig. 23), *Tricorythodes* (Fig. 25) and *Baetisca* (Fig. 35) all tend to be bottom sprawlers on gravelly or sediment substratum. All have plate-like or operculate (covered) gills to protect the respiratory surface from settling debris. *Ephemerella* (Fig. 42), along with *Hexagenia* (Fig. 26) and *Ephoron* are burrowers, making tubes in semi-impacted gravel or mud bottom of lakes and rivers. *Ametropus* (Fig. 24) and *Lachlania* (Fig. 31) are filter and particle feeders, the former anchoring itself on sand bars with 4 legs while snatching and sorting passing particles from the current; *Lachlania* grasps roots and stones in deep water and the



CATEGORY I. HIND WINGS ABSENT, BODY SIZE SMALL, APPROX. 1/4 INCH.



CATEGORY II. SHARP BEND NEAR BASE OF VEIN M_2 RESULTING IN LARGE CELL.

Figure 6. Wings of *Brachycercus*; Figure 7. *Tricorythodes*; Figure 8. *Ephemera*; Figure 9. *Potamanthus*; Figure 10. *Neoephemera*; Figure 11. *Totopus*.

rapid current of river while filtering food with the fringes of the front legs. *Isonychia*, not at all closely related to either, is also a filter-feeder. Additional Saskatchewan genera, illustrated in Lehmkuhl, 1975c but not here, are *Brachycercus*, *Epeorus*, *Paraleptophlebia*, *Ephoron* and *Siphonurus*.

Most mayfly nymphs are herbivorous, the sheep and rabbits of the aquatic insect world. A few local species are carnivores, and these rare insects inhabit one of the last unpolluted strongholds in the Saskatchewan River. They are *Anepeorus*, *Pseudiron* and *Analetris*.

Mayflies are a fascinating group of animals that have been relatively

poorly studied, thus leaving room for original discoveries by naturalists. Adults and nymphs are best preserved in alcohol or the adults may be mounted on pins. Nymphs are easily kept in well aerated aquaria where they can be studied. Mayflies are abundant and easily collected, the nymphs especially in flowing water, and the adults while swarming over water, resting on leaves near water, or at porch lights near water.

Acknowledgements: This article was based in part on the drawings of A. R. Brooks. Photographs were prepared by John Waddington, from specimens in the author's collection.

Table 1. Families of adult mayflies. Compare with Figures 6-21.

Category I — Hind wings absent, body size small, approx. 1/4 inch.

Caenidae — crossveins few, usually a single arch-like series of crossveins in basal area (Fig. 6).

Tricorythodae — crossveins faint, more numerous — 15 or more scattered through wing (Fig. 7).

Note: Some Baetidae lack a hind wing, but they differ from the above in that the lateral ocelli (simple eyes) are not more than 1/4 the size of the compound eyes while in the above the ocelli are about 1/2 as large as the compound eyes.

In all the following the hind wings are present (except some Baetidae, see above).

Category II — Sharp bend near base of vein M_2 , often resulting in a large cell near base of wing.

Polymitarcidae — Represented in our area by *Ephoron* (widespread) and *Tortopus* (Manitoba). Veins at front wing tip curve around margin (*Tortopus*, Fig. 11) or with front legs of male reduced to functionless stubs (*Ephoron*).

Potamanthidae — not found in our area. Vein 1A of front wing forked (Fig. 9).

Neoephemeridae — not found in our area. Sharp costal projection on hind wing (Fig. 10).

Ephemeridae — Large mayflies common in our area. Lack characters specified for above 3 but with prominent large basal cell (Fig. 8).

Category III — Front wing lacks forks in veins in outer half.

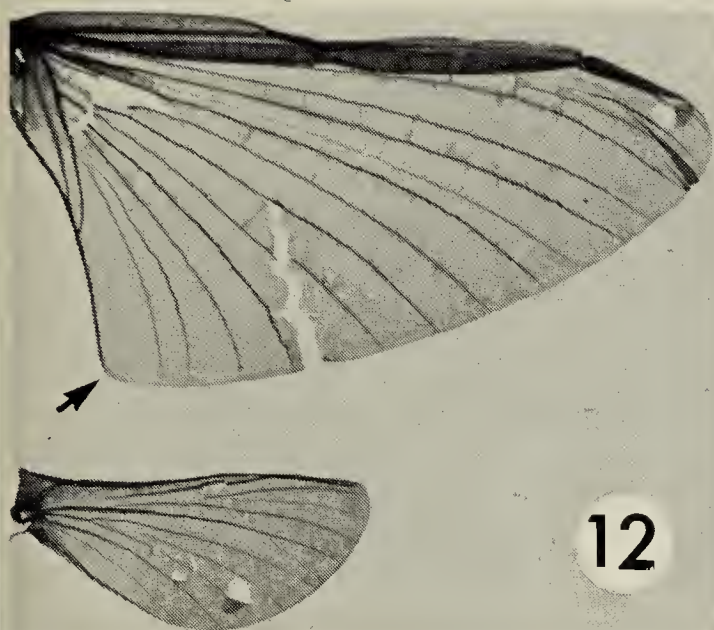
Baetidae — rear angle of wing rounded (Fig. 13); common in our area.

Behningiidae — rear angle of wing not rounded (Fig. 12); not found in our area.

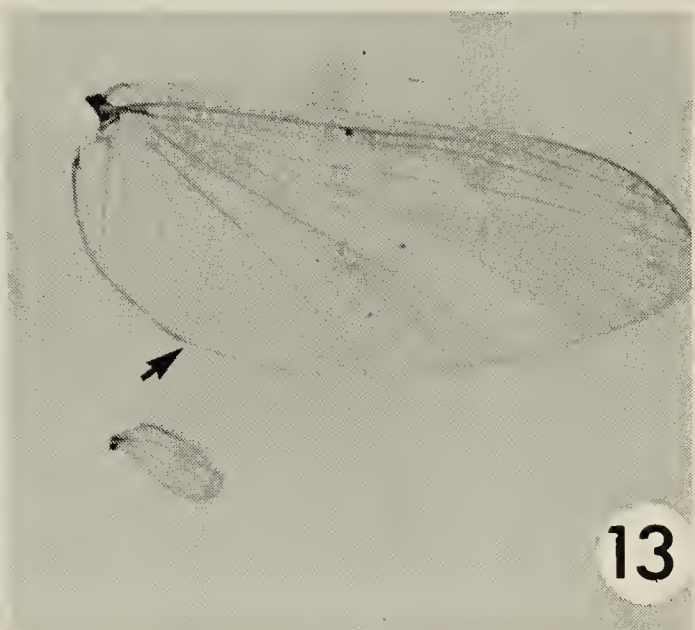
Category IV — Two pairs of longitudinal veins at hind angle of front wing. (*Note:* *Metretopus* (Ametropodidae) has only one pair of veins in this position).

Heptageniidae — Hind tarsi with 5-segments (Wing, Fig. 16) (except the rare *Pseudiron*, Fig. 14 which has 4 segments).

Ametropodidae — Hind tarsi 4-segmented. Wing Fig. 15.

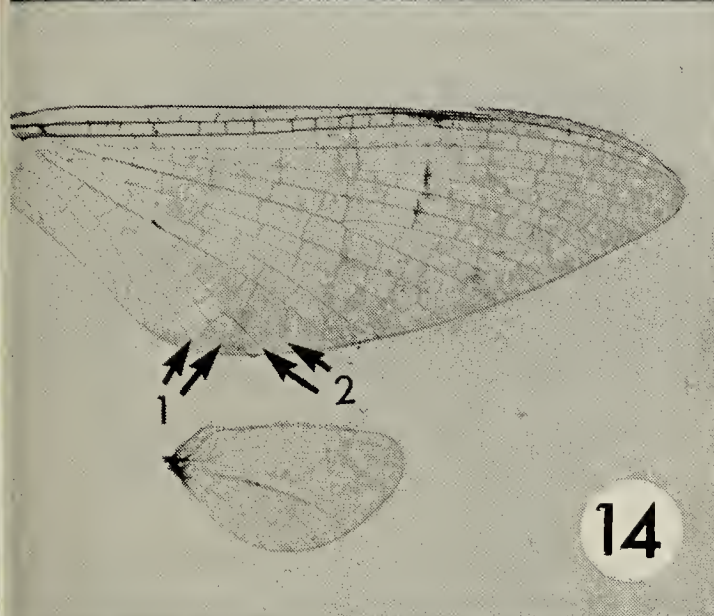


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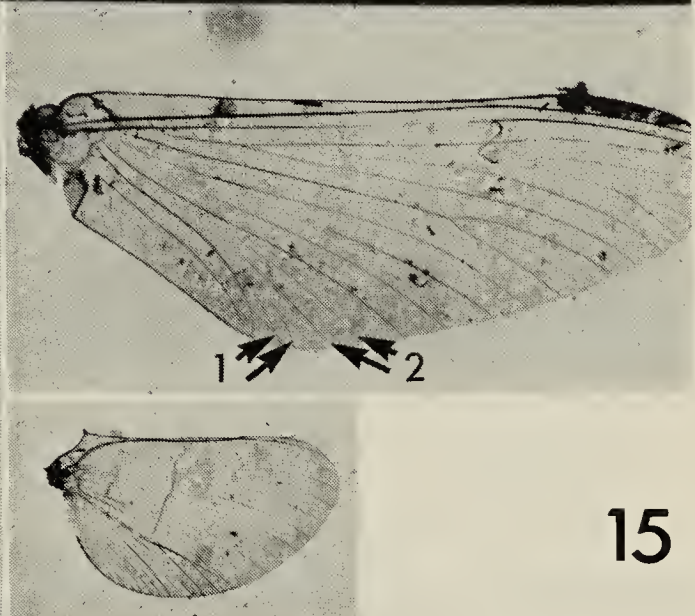


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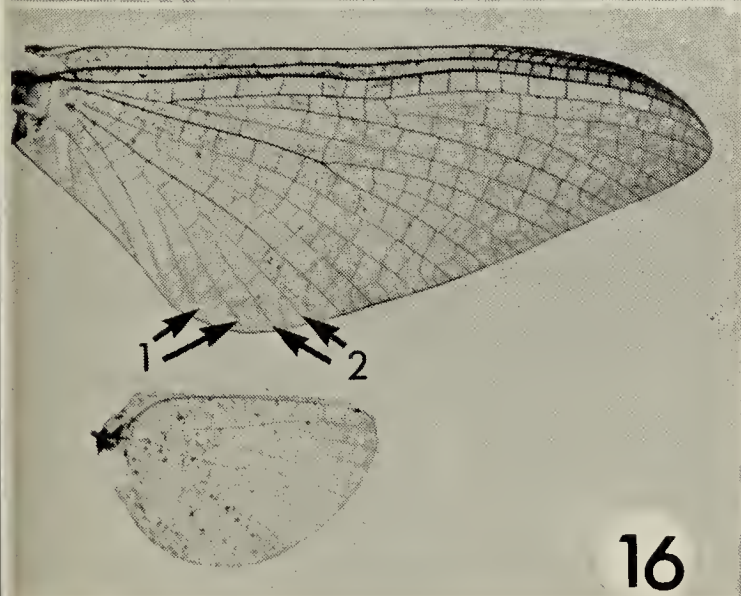
CATEGORY III. OUTER HALF OF FRONT WING LACKS FORKS IN VEINS. (SEE ALSO VI)



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CATEGORY IV.

TWO PAIRS OF LONGITUDINAL VEINS AT HIND ANGLE OF FRONT WING.

Figure 12 *Dolania*; Figure 13. *Baetis*; Figure 14. *Pseudiron*; Figure 15. *Ametropus*; Figure 16. *Epeorus*.

Category V — Without two pairs of longitudinal veins at hind angle of front wing, but with numerous veins attached to inner hind angle of wing.

Vein Cu_2 strongly curved.

Ephemerellidae — with 1 or 2 long intercalary veins (I) between vein Cu_1 and M_2 (Fig. 17).

Leptophlebiidae — without a long intercalary vein between Cu_1 and M_2 (Fig. 18).

Vein Cu_2 not curved.

Baetiscidae — Hind wing oval or round in shape, Fig. 20.

Siphonuridae — Hind wing triangular in comparison, Fig. 19.

Category VI — Venation reduced to 4 or 5 longitudinal veins in front wing.

Oligoneuriidae — the genus *Lachlania* in our area, Fig. 21.

Table II

A preliminary list of the mayflies of Saskatchewan based primarily on the author's collection.

Ametropodidae

Ametropus albrighti Traver
Metretopus borealis Eaton
Siphloplecton interlineatum (Walsh)

Baetidae

Baetis quilleri Dodds
Baetis vagans McDunnough
Baetis spp. (at least 7)
Callibaetis spp. (at least 3)
Centroptilum spp.
Cloeon spp.
Dactylobaetes sp.
Pseudocloeon spp.

Baetiscidae

Baetisca bajkovi Neave
Baetisca obesa (Say)

Caenidae

Brachycercus prudens (McDunnough)
Caenis simulans McDunnough

Ephemerellidae

Ephemerella aurivillii (Bengtsson)
Ephemerella grandis Eaton
Ephemerella inermis Eaton
Ephemerella lita Burks
Ephemerella simplex McDunnough
Ephemerella temporalis McDunnough

Ephemeridae

Ephemera simulans Walker
Hexagenia limbata

Heptageniidae

Anepeorus rusticus McDunnough
Cinygma sp.
Epeorus longimanus (Eaton)
Epeorus sp.

Heptagenia elegantula (Eaton)
Heptagenia flavescens (Walsh)
Heptagenia hebe McDunnough
Heptagenia pulla (Clemens)
Heptagenia solitaria McDunnough
Rhithrogena sp.
Stenonema interpunctatum (Say)
(now *Stenacron*)
S. tripunctatum (Banks)
S. vicarium (Walker)
Pseudiron centralis
Undescribed genus

Leptophlebiidae

Choroterpes albiannulata McDunnough
Leptophlebia cupida (Say)
Paraleptophlebia debilis (Walker)
P. praepedita (Eaton)
P. adoptiva (McDunnough)
P. moerens (McDunnough)
Traverella albertana (McDunnough)

Oligoneuriidae

Lachlania saskatchewanensis Ide

Polymitarcidae

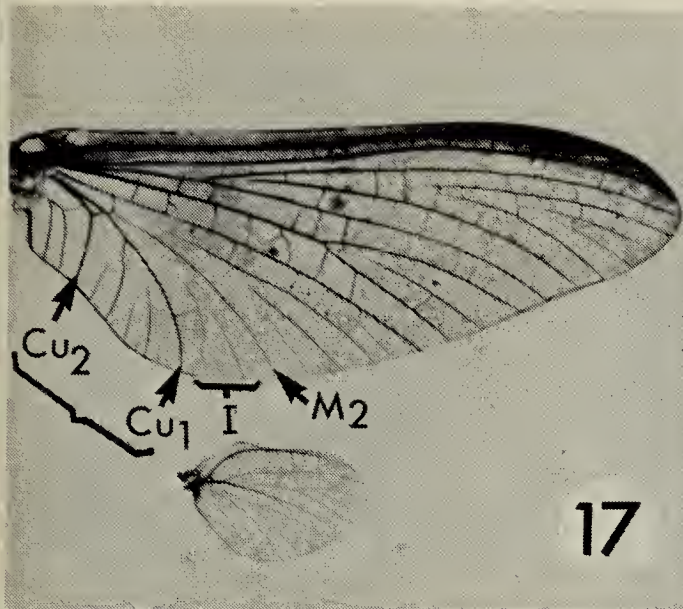
Ephoron album (Say)
Tortopus primus
— *Campsurus manitobensis* Ide
— Manitoba only.

Siphonuridae

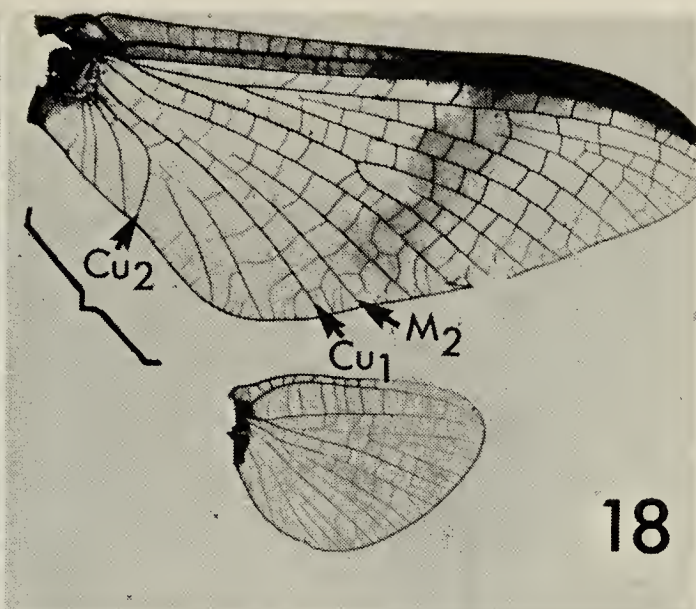
Analetris eximia Edmunds
Ameletus spp.
Siphonurus alternatus (Say)
Isonychia sicca (Walsh)

Tricorythodae

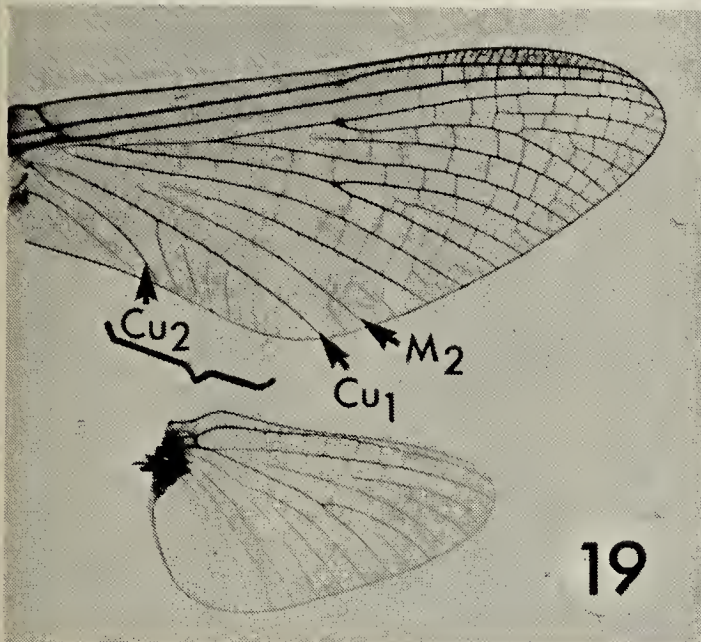
Tricorythodes fallax Traver
Tricorythodes sp.



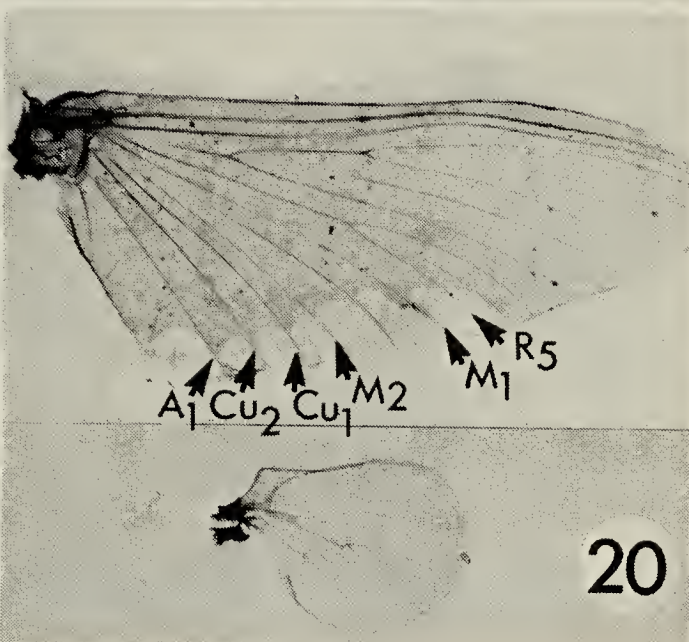
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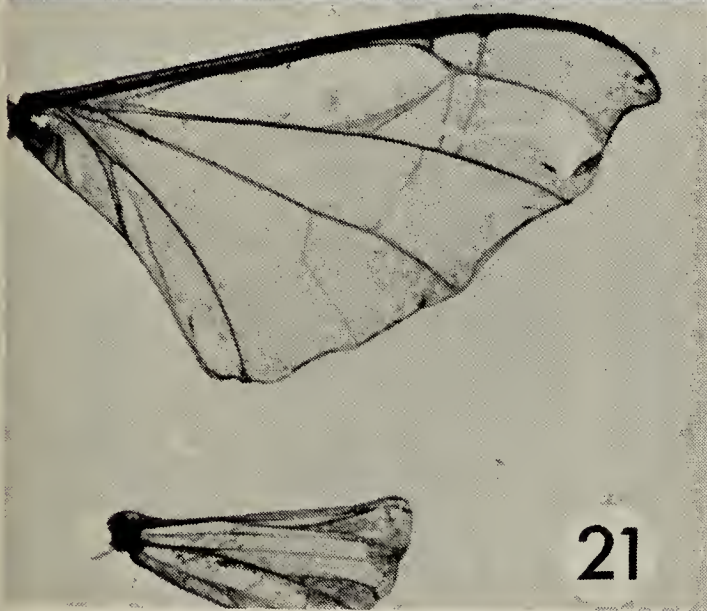


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CATEGORY V. WITHOUT VEIN PAIRS (SEE IV) BUT WITH NUMEROUS VEINS ATTACHED TO INNER HIND ANGLE OF WING.



21

CATEGORY VI.

VENATION REDUCED TO 4 OR 5 LONGITUDINAL VEINS IN FRONT WING.

Figure 17. *Ephemerella*; Figure 18. *Leptophlebia*; Figure 19. *Siphonurus*; Figure 20. *Baetisca*; Figure 21. *Lachlania*.

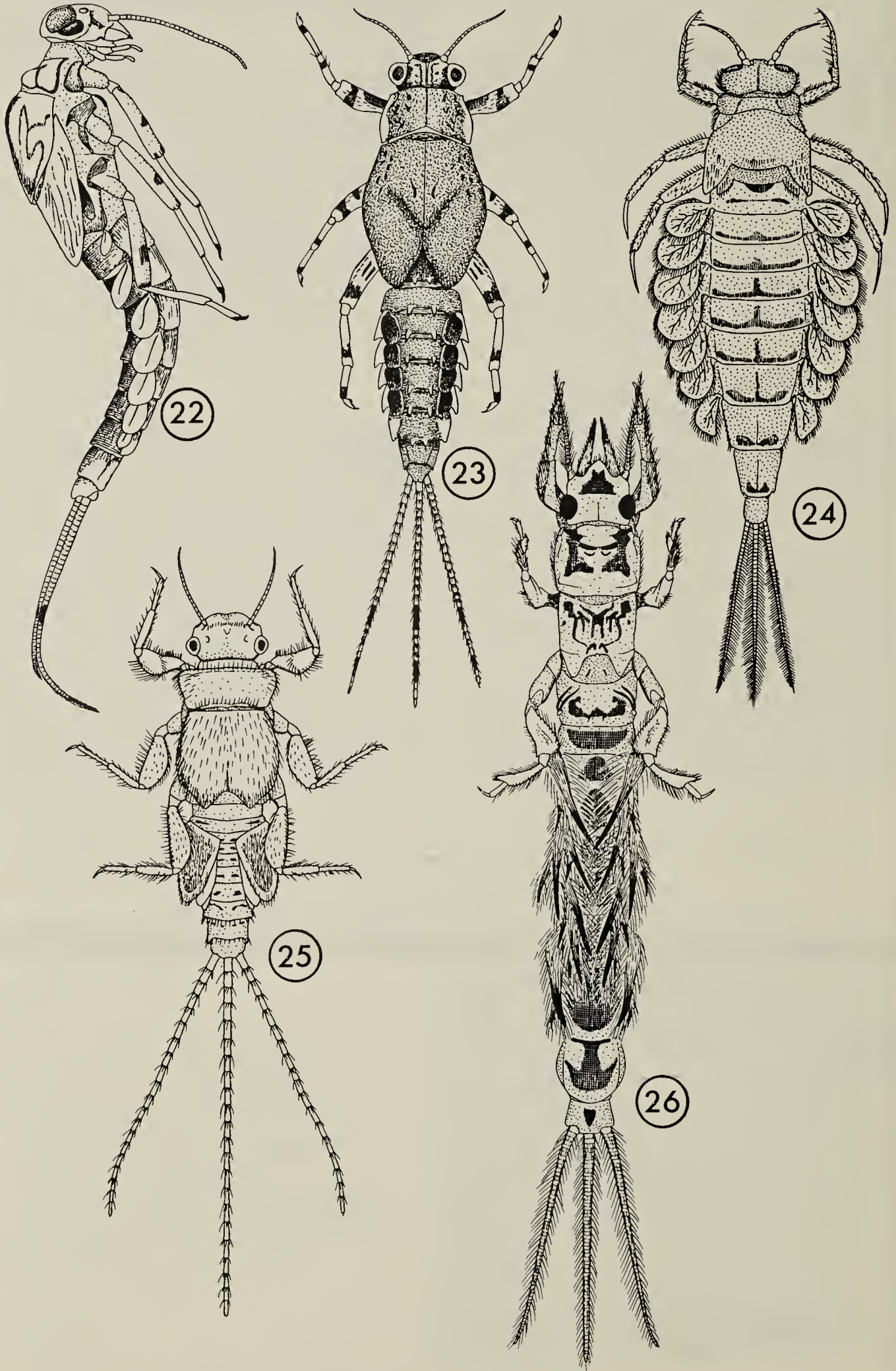


Figure 22. Nymph of *Baetis*; Figure 23. *Ephemerella*; Figure 24. *Ametropus*; Figure 25. *Tricorythodes*; Figure 26. *Hexagenia*.

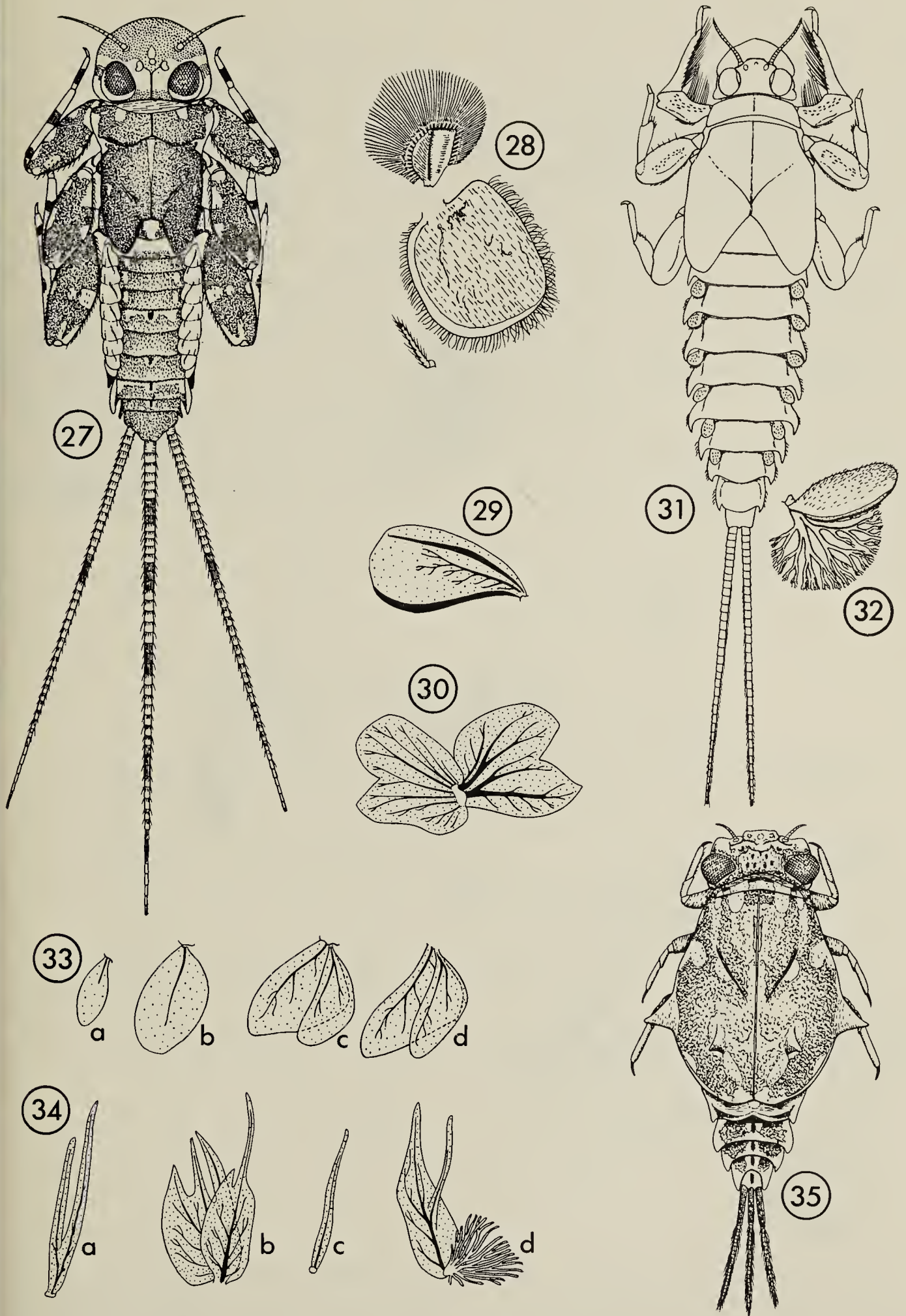


Figure 27. *Heptagenia*; Figure 28. Caenid type gill; Figure 29. Baetid type single plate gill; Figure 30. Double gill as in *Callibaetis*; Figure 31. *Lachlania*; Figure 32. gill of same; Figure 33. Transition from single to double gills as in *Baetidae*; Figure 34. Forked and double gills as in *Leptophlebiidae*; Figure 35. *Baetisca*.

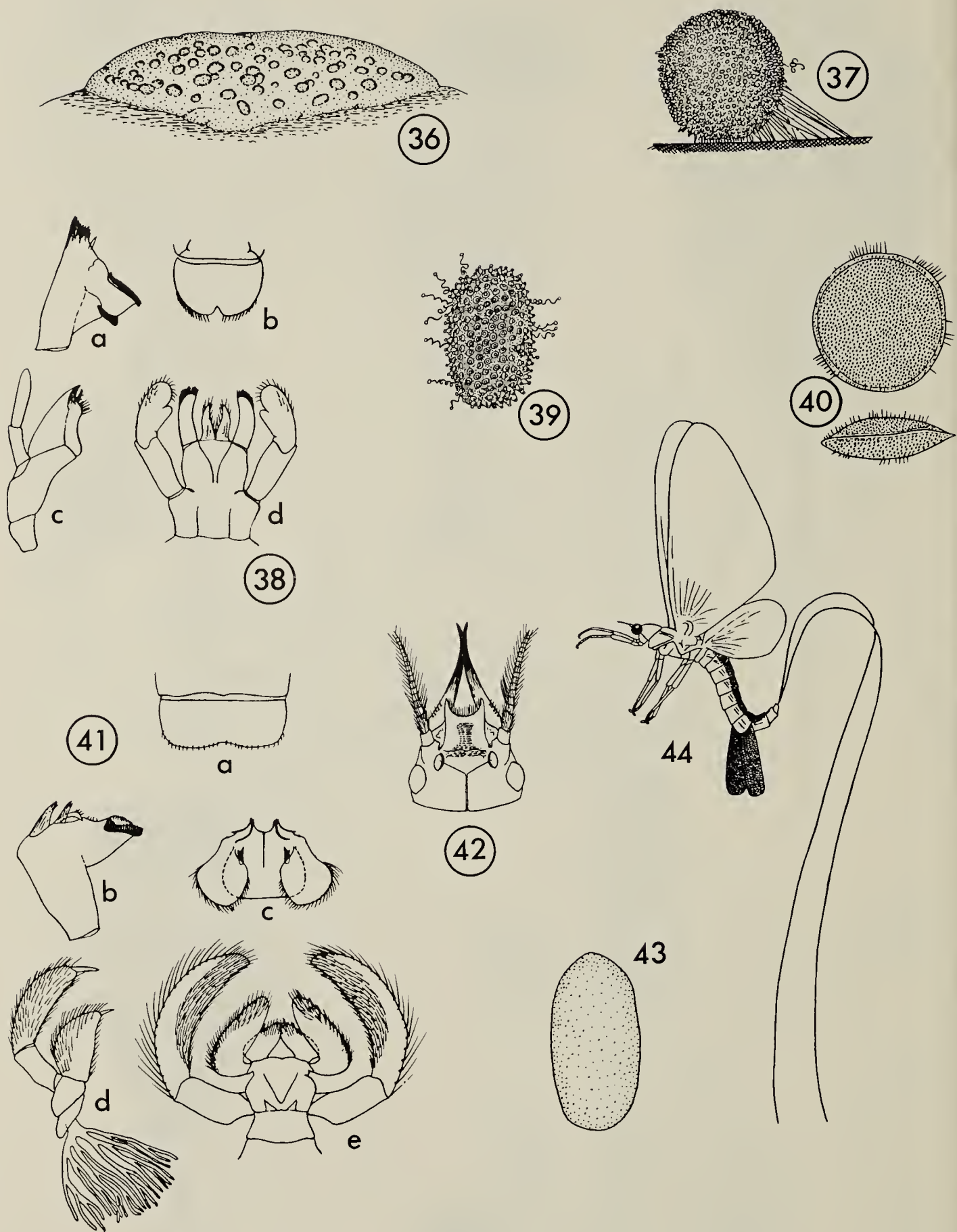


Figure 36. Mayfly eggs in gelatin mass, e.g., *Baetis*; Figure 37. Mayfly egg with attachment filaments; Figure 38. Nymphal mouthparts of chewing type, e.g., *Baetis*, a. mandible b. labrum, c. maxilla d. labium; Figure 39, 40. Mayfly eggs; Figure 41. Modified nymphal mouthparts; Figure 42. Modified tusk-like mandibles of *Ephemera*; Figure 43. Mayfly egg; Figure 44. Adult female with eggs.

ADDITIONAL READING

¹ALLEN, R. K. and G. F. EDMUNDS, Jr. 1965. *A revision of the Genus Ephemerella (Ephemeroptera, Ephemerellidae). VIII. The subgenus Ephemerella in North America.* Misc. Publ. Ent. Soc. Amer. Vol. 4 No. 6: 244-282. (See also I-VII in this series, complete citation of each given in No. VIII).

²BURKS, B. D. 1953. *The Mayflies, or Ephemeroptera of Illinois.* Bull. Ill. Nat. Hist. Survey Vol. 26 No. 1: 216 pp.

³EDMUNDS, G. F., Jr. and R. K. ALLEN. 1957. *A checklist of the Ephemeroptera of North America north of Mexico.* Ann. Ent. Soc. Amer. 50: 317-324.

⁴LEHMKUHL, D. M. 1970. *Mayflies in the South Saskatchewan River: pollution indicators.* Blue Jay 28: 183-186.

⁵————— 1972. *Baetisca (Baetiscidae, Ephemeroptera) from the western interior of Canada, with notes on the life cycle.* Canadian Journal of Zoology 50: 1015-1017.

⁶————— 1975a. *Saskatchewan Damselflies and Dragonflies.* Blue Jay 33: 18-27.

⁷————— 1975 b. *Alderflies.* Blue Jay 33: 152-154.

⁸————— 1975c. *Field guide to aquatic insect families.* Blue Jay 33: 199-219.

⁹————— In Press (1976) *Additions to the taxonomy, zoogeography, and biology of Analettris eximea (Acanthametropodinae: Siphonuridae: Ephemeroptera).* Canadian Entomologist.

¹⁰LEWIS, P. A. 1974. *Taxonomy and ecology of Stenonema mayflies.* U.S. Environ. Prot. Agency — 6704-74-006. 80 pp.

¹¹NEEDHAM, J. G., J. R. TRAVER, and YIN-CHI HSY. 1935. *The biology of Mayflies.* Comstock Publ. Co., Ithaca, New York.

¹²PETERS, W. L. and J. F. PETERS, eds. 1973. *Proceedings of the First International Conference on Ephemeroptera.* E. J. Brill, Leiden, Netherlands. 312 p.



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CORRECTION

Saskatchewan Damselflies and Dragonflies;

I have discovered an unfortunate error in the key to adult Dragonflies, *Blue Jay*, March, 1975, p. 25. Couplet 4 should read:

- 4a. Triangle (T) of fore and hind wings about equally distant from arculus and similarly shaped (Fig. 28) 5
- 4b. Triangle more distant from arculus in fore wing than hind wing (Fig. 27) **Common Skimmers (Libellulidae)**

I would also like to note the publication of Vol. 3 of Walker's *Odonata of Canada and Alaska*. All species of Canadian Odonata are now covered by this series:

WALKER, E. M. and P. S. CORBET, 1975. *The Odonata of Canada and Alaska. Libelloidea.* Vol. III, Univ. Toronto Press.

— Dennis Lehmkuhl

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BACTERIA FROZEN FOR AT LEAST 10,000 YEARS have been revived by researchers of the Darwin Research Institute, Dana Point, California. The bacteria may actually be as old as one million years and were found in core samples of permanently frozen ground from two sites in the McMurdo Sound region of Antarctica. Although only one of the bacteria samples began to grow into an unusual doughnut-shaped colony, both began moving when warmed and exposed to air. From *Water Newsletter*, May 16, 1974.