The specimen is a male. It has a wingspread just over 1 inch. On the upperside it is orange on the forewings and dark grey on the hindwings. Both fore- and hind-wings are crossed by a series of white spots. Our specimen is darker on the hindwings than those from much farther south, but it resembles specimens from North and South Dakota.

The Metalmarks resemble the gossamer-winged butterflies (*Lycaenidae*) but the males have forelegs that are not suited for walking and the part of these legs known as the coxae are elongated into spurs. They also have a humeral vein in the hindwing, which is lacking in the lycaenids. Many species have metallic marks in the wings that give them their common name.

Even where metalmarks occur, they are often difficult to find. This may be partly due to the fact that they will sometimes land in the shade on the underside of leaves. Perhaps this is why our specimen was active on a hazy day.

FIELD GUIDE TO AQUATIC INSECT FAMILIES*

by D. M. LEHMKUHL**

Among insects, something like 100 families of a dozen orders which include thousands of species can be found in the streams, rivers, lakes, bogs and springs of North America. Investigations of freshwater habitats by naturalists and students as well as by professional biologists have been hampered by this variety. Keys and guidebooks are too often non-existent, incomprehensible by the non-specialist, very expensive or out-of-print. The objective of this pictorial key and field guide is to provide a readily accessible and non-technical introduction to identification of most of the North American families of aquatic insects.

*Reprints are available from the author.

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The practical solution for teaching and survey purposes to the great diversity of insects has been identification to the order and family level. Identification to genus and species has remained the realm of the specialist. This should not be overly discouraging because it is often the family level that we treat as being significant in everyday life and it is this level that often has a common name. For example, mosquitoes are the Family Culicidae and black flies are the Family Simuliidae. Knowing this is probably ample for most people and it takes an above-average enthusiast to care which of the 7 genera and 37 species of mosquitoes is attacking him in Saskatchewan since all the welts look about the same. For those who do care, the necessary publications are listed at the end of this section.

This pictorial key should work for all of North America (with a western bias due to my personal experience). I have avoided technical terms and characters whenever possible. I have also attempted to use characters which can be seen with the naked eye or with a 10X hand lens; only rarely will a microscope be necessary. Thus, the key should be useful in field as well as laboratory and, hopefully, it can be used by anyone, regardless of background.

Plates and Illustrations. The important identifying features are illustrated diagrammatically in the nine plates of pictorial key. In the following six plates about two-thirds of the families treated in the key are illustrated by photographs. This is adequate for some groups such as the Stoneflies (Plecoptera) where all families basically look alike except for details described in the key. There are other look alikes also. Baetidae and Metretopodidae (not illustrated) resemble Siphlonuridae (Fig. 10). Ephemeridae resemble Polymitarcidae (Fig. 9). Tricorythidae resemble Caenidae (Fig. 4). Lestidae are similar to Coenagrionidae (Fig. 14). Macroveliidae (Fig. 27) look very much like Veliidae, Mesoveliidae and Hebridae. Nepidae resemble huge Hydrometridae (Fig. 26) and Naucoridae look like small versions of Belostomatidae (Fig. 22). Great variety can be found in the cases of Caddisflies while the larvae are quite uniform, yet differing as indicated in the key. In other groups, such as Mayflies (Ephemeroptera) and Flies (Diptera), so much diversity is found that some types are not illustrated.

Collecting and Preserving. We are concerned here with only the aquatic stages of insects and any aquatic habitat is likely to yield interesting specimens. No possibility should be overlooked because some specialized insect can be found in almost any type of habitat. Collecting in the same water area at different seasons will produce different kinds of insects and different stages of growth of the same insects.

Useful collecting equipment includes rubber boots, a white enamel pan or photographic developing tray, a pair of forceps, a "turkey baster", a notebook, and a net or two as sold by aquarium shops and biological supply houses. Place 1 or 2 inches of water from the pond or river into the white pan. Then sweep the net through vegetation or debris stirred up from the bottom and put the collected material into the pan. Rocks held over the pan can be rinsed off with the baster. A variety of life should be easily visible swimming around against the white background. Specimens can now be picked up with forceps or

baster and transferred to collecting bottles where they can be preserved in alcohol (80% ethyl is best, rubbing alcohol will work). All should be labelled with the location and date of collection and the name of the collector. Labels can be written in soft pencil or permanent ink and the label is best placed inside the vial or bottle. If desired, adult beetles (Coleoptera) and bugs (Hempitera) may be pinned.

Aquariums. Aquatic insects represent the full ecological spectrum — herbivores, decomposers, carnivores and even parasites (Hymenoptera, not in key). Thus the possibilities for observing ecological principles in an aquarium, or even keeping a few "pets", should not be overlooked.

Use of the Key. Begin at the top of the page and you will always find two opposing statements connected by a heavy line. Read each statement, decide which is true for your specimen, and then follow the heavy line leading from the true statement. You will then find another pair or triplet of contrasting statements. Again, decide which fits your animal and follow the "true" line. Sooner or later you will reach a name and you will have identified your specimen. Begin with the key to orders and then turn to the key of families for the appropriate order.

Scope of the Key. The key should work for all insects which live in or on water but one may sometimes find land insects which have fallen into the water. Beware of this. Since the objective of this key is primarily to identify the organisms, information on their biology and ecology will have to be obtained from other sources, some of which are at the end of this article. A brief summary of biological information is given in the table.

Possible Problems and Useful Hints. - Only *adult insects* have large wings which can be used in flight but sometimes the wings are difficult to recognize because they are modified into hard, shell-like structures (beetles and true bugs). If you are suspicious, try to lift the part in question with a pin. Mature nymphs have small non-functional wing buds which cannot be used in flight. *Collembola* are minute, often black, insects found on the surface of water. *Nymphs and larvae:* Young grasshoppers are typical insect nymphs while caterpillars and maggots are typical larvae. Forming a mental image of these contrasting types will help you make the proper selection at this step. *Non-Insects*: with the exception of Diptera larvae, most aquatic insects have six legs. If you find a specimen with more or fewer and if it is not in the key to families of Diptera, you are probably not dealing with an insect. Other keys must be used for non-insects such as the books by Pennak or by Ward and Whipple listed below.

Acknowledgements. I would like to thank John Waddington for taking many of the photographs and preparing the final plates. Drawings and photographs are based on specimens from the author's collection. A long succession of students in university and high school classes have squinted at mimeographed copies of the key as a test of its workability, and to them I am grateful. The editorial staff of the *Blue Jay*, especially Bernard Gollop and Ed Driver were helpful in every way and made preparation of the manuscript a pleasure.

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KEY TO THE ORDERS OF INSECTS FOUND IN OR ON WATER

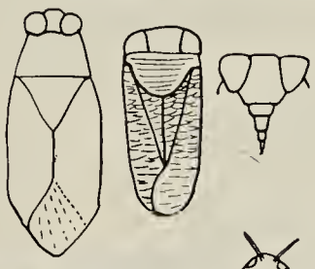
WINGS PRESENT AND WELL DEVELOPED, ADULT INSECTS.

WINGS ABSENT OR REPRESENTED BY WING BUDS ONLY. NYMPHS, LARVAE, PRIMITIVE INSECTS

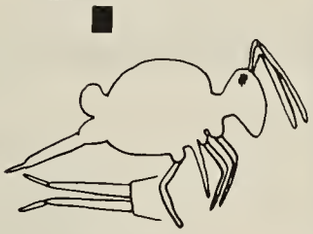
FRONT WINGS PRESENT AND MEMBRANOUS AS IN A HOUSEFLY, HIND WINGS ABSENT, REPRESENTED BY KNOBS. DIPTERA (FLIES)

FRONT WINGS SHELL-LIKE AND COVER ABDOMEN, HAVE A STRAIGHT SEAM DOWN MIDDLE OF BACK. COLEOPTERA (BEETLES)

FRONT WINGS LEATHERY, THE TIPS OF WINGS OVER-LAP: MOUTH IN FORM OF A BEAK. HEMIPTERA (TRUE BUGS)



SMALL INSECTS (1/8 INCH OR LESS) WITH FORKED SPRING UNDER REAR OF ABDOMEN. COLLEMBOLA (SPRINGTAILS)

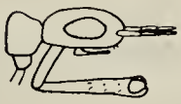


WITHOUT SPRING AND USUALLY LARGER

WING BUDS PRESENT ON THORAX (EXCEPT IN VERY YOUNG SPECIMENS) NYMPHS

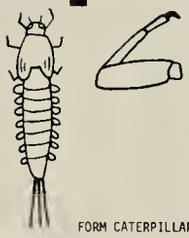
MOUTH IN FORM OF A BEAK HEMIPTERA (TRUE BUGS)

MOUTH COVERED BY AN ELBOWED MASK ODONATA (DRAGON AND DAMSELFLIES)



MOUTH NOT IN FORM OF A BEAK AND NOT COVERED BY A MASK

LEGS TERMINATE IN A SINGLE CLAW, TAILS USUALLY THREE, ABDOMEN USUALLY WITH LATERAL GILLS. EPHEMEROPTERA (MAYFLIES)

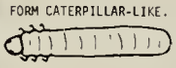


LEGS TERMINATE IN TWO CLAWS, TAILS ALWAYS TWO, NO LATERAL GILLS. PLECOPTERA (STONEFLIES)

WING BUDS NOT PRESENT ON THORAX LARVAE

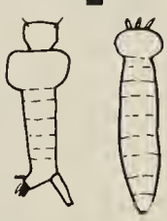
SIX LEGS PRESENT IN THORACIC REGION

FORM CATERPILLAR-LIKE.



FORM NOT CATERPILLAR-LIKE.

THORACIC REGION WITHOUT SIX LEGS: FORM VARIABLE BUT OFTEN MAGGOT-LIKE. DIPTERA (TRUE FLIES)



UNDERSIDE OF ABDOMEN WITH HOOKLETS ARRANGED IN CIRCLES OR OVALS. LEPIDOPTERA (MOTHS)

ABDOMEN WITHOUT CIRCLES OF HOOKLETS ON UNDERSIDE, BUT WITH HOOKED CLAWS AT END OF ABDOMEN: OFTEN IN A STONE OR LEAF CASE. TRICHOPTERA (CADDISFLIES)

¼ INCH IN TOTAL LENGTH OR LESS, WITH NEEDLE-LIKE MOUTH STYLETS (SISYRIDAE) NEUROPTERA (SPONGILLA FLIES)

WITH LONG LATERAL PROJECTIONS ON SIDES OF ABDOMEN.

ABDOMEN ENDS IN A SINGLE LONG FILAMENT (SIALIDAE) OR WITH TWO HOOKED CLAWS (CORYDALIDAE) MEGALOPTERA (ALDERFLIES)

ABDOMEN WITH NEITHER LATERAL FILAMENTS NOR NEEDLE-LIKE MOUTHPARTS. COLEOPTERA (BEETLES)

ABDOMEN ENDS IN FOUR CLAWS. GYRINIDAE (BEETLES)

KEY TO THE FAMILIES OF EPHEMEROPTERA NYMPHS

FRONT CORNERS OF HEAD CROWNED WITH HAIR. S.E. U.S. FROM SANDY RIVERS. UNCOMMON. BEHNINGIIDAE

FRONT CORNERS OF HEAD NORMAL, WITHOUT BRUSHES OF HAIR.

FRONT LEGS WITH NO LONG HAIRS, BRISTLES OR SHORT HAIRS AT MOST.

FRONT LEGS WITH CONSPICUOUS LONG INWAROLY DIRECTED FRINGES OF HAIRS.

THORAX EXPANDED TO A SHELL-LIKE STRUCTURE WHICH COVERS PART OF THE ABDOMEN, OFTEN WITH DORSAL OR LATERAL SPINES. BAETISCIDAE

THORAX NOT EXPANDED.

SIX PAIRS OF GILLS VISIBLE FROM DORSAL VIEW, GILLS OF SEGMENT ONE VENTRAL. UNCOMMON. OLIGONEURIIDAE

ALL SEVEN PAIRS OF GILLS VISIBLE FROM DORSAL VIEW. COMMON. ISONYCHIA, SIPHLONURIDAE

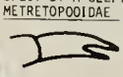
MANDIBLES NOT VISIBLE FROM TOP VIEW.

MANDIBLES ELONGATED INTO LARGE TUSKS WHICH ARE VISIBLE FROM TOP VIEW.

ABDOMEN WITH FIVE, FOUR, OR FEWER PAIRS OF GILLS

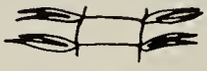
ABDOMEN WITH SIX OR SEVEN PAIRS OF GILLS.

CLAWS OF FRONT LEGS SPLIT BY A CLEFT. METRETOPODIDAE



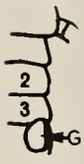
CLAWS OF FRONT LEGS NOT SPLIT BUT MAY HAVE TEETH.

GILLS PROJECT OUTWARD FROM SIDES OF ABDOMEN



GILLS CURVED OVER BACK OF ABDOMEN.

SEGMENT TWO LACKING GILLS. EPHEMERELLIDAE

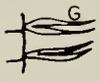


GILLS OF SECOND SEGMENT ENLARGED TO FORM A COVERING OVER THE GILLS BEHIND SEGMENT TWO.

COVER-LIKE GILLS RECTANGULAR AND MEET AT THE MID-LINE.

COVER-LIKE GILLS OF SEGMENT TWO TRIANGULAR AND NOT MEETING AT THE MID-LINE. TRICORYTHIDAE

GILLS OF ABDOMEN FORKED AND WITHOUT HAIRS ON EDGES PARALEPTOPHLEBIA, LEPTOPHLEBIIDAE



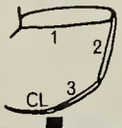
GILLS OF ABDOMEN FORKED AND WITH HAIRS ON EDGES. POTAMANTHIDAE

PROTHORAX (P) WITH SHARP FRONT CORNERS AND WITH A ROUNDED LOBE ON FRONT CORNERS OF MESOTHORAX (M). NEOEPHEMERIDAE

PRO AND MESOTHORAX NOT AS DESCRIBED. CAENIDAE

CLAWS OF ALL LEGS SHORT.

CLAWS OF MIDDLE AND HIND LEGS VERY LONG.



NO PROJECTION BETWEEN ANTENNAE. CAMPSURINAE, POLYMITARCIDAE

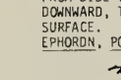
HEAD WITH A FORKED OR ROUNDED PROJECTION BETWEEN ANTENNAE.

BODY FLAT, EYES AND ANTENNAE ON TOP OF HEAD.

BODY NOT FLATTENED, EYES AND ANTENNAE ON SIDES OF HEAD.

CLAWS OF FRONT LEGS LONG AND WITHOUT HAIRS. PSEUDIRON, HEPTAGENIIDAE

CLAWS OF FRONT LEGS WITH HAIRS. AMETROPODIDAE, AMETROPUS



FROM SIDE VIEW TUSK CURVES DOWNWARD, TUSK WITH ROUGH SURFACE. EPHORON, POLYMITARCIDAE

FROM SIDE VIEW TUSKS (MANDIBLE) CURVES UPWARD. EPHEMERIDAE.

GILLS OF A SINGLE PLATE AND OFTEN WITH A TUFT OF HAIRS AT THE BASE. HEPTAGENIIDAE

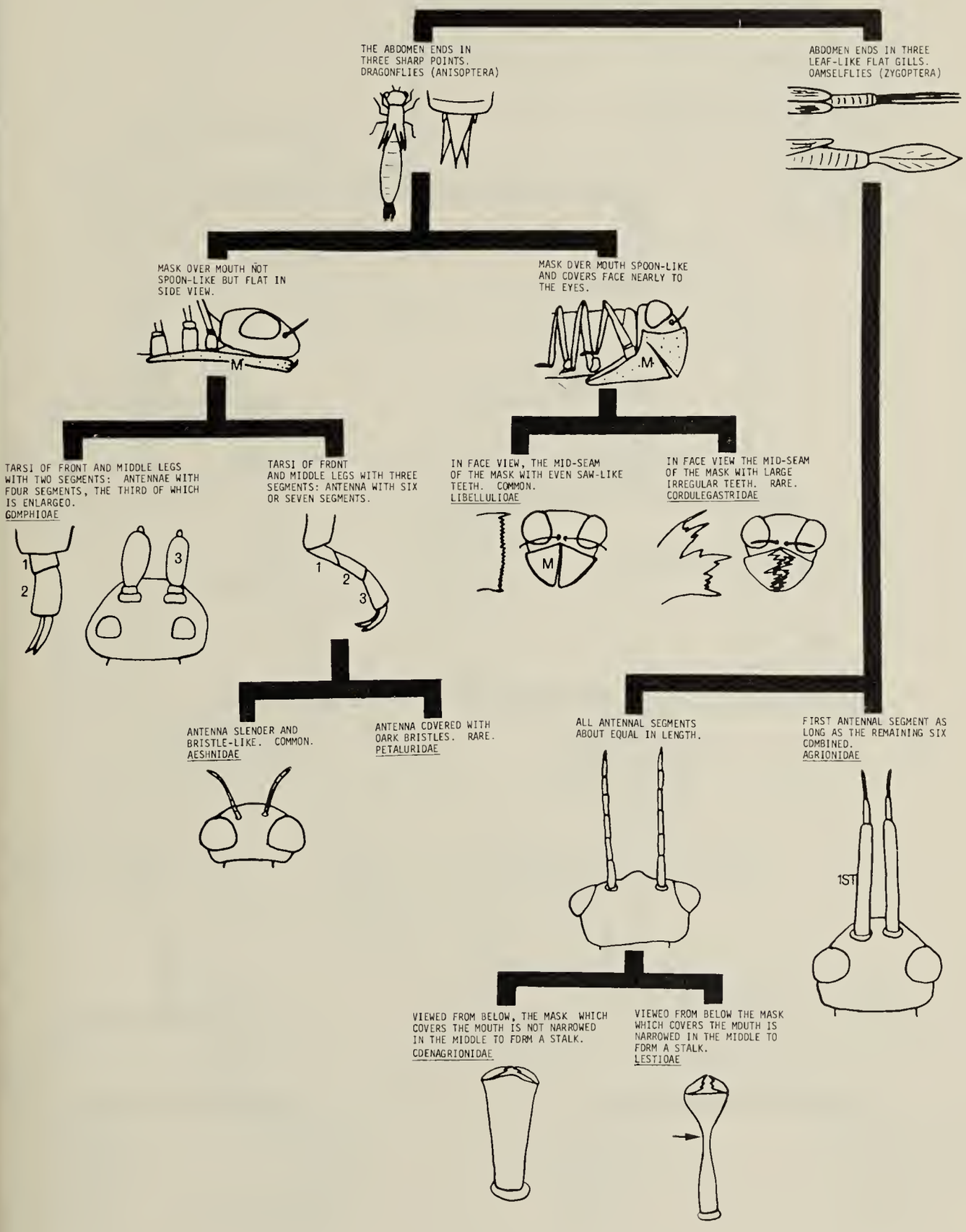
GILLS FORKED, OR CONSIST OF A CLUSTER OF FILAMENTS, OR OF DOUBLE PLATES WHICH TERMINATE IN A POINT. LEPTOPHLEBIIDAE

GILLS SINGLE OR DOUBLE PLATES, NONE FORKED.

ANTENNA MORE THAN TWICE AS LONG AS HEAD. BAETIDAE

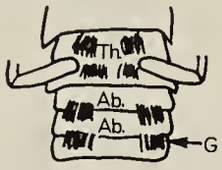
ANTENNA LESS THAN TWICE AS LONG AS HEAD. SIPHLONURIDAE

KEY TO THE FAMILIES OF ODONATA
(IMMATURE STAGES)



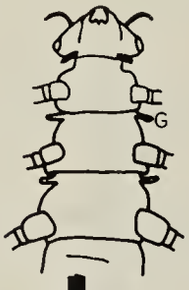
KEY TO THE FAMILIES OF PLECOPTERA NYMPHS

NYMPH WITH BUSHY GILLS (G) NOT ONLY ON THE VENTRAL THORAX BUT ALSO ON THE FIRST TWO SEGMENTS OF THE ABDOMEN.
PTERONARCIDAE

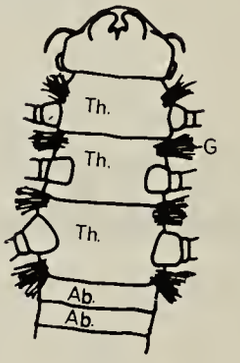


NYMPH WITH NO BUSHY GILLS ON THE FIRST TWO SEGMENTS OF THE ABDOMEN.

LARVA WITH ONLY SMALL FINGER-LIKE GILLS OR NONE AT ALL.



NYMPH WITH BUSHY GILLS ON THE THORAX.
PERLIDAE



THORACIC PLATE BEHIND HEAD AT LEAST ONE AND ONE-HALF TIMES AS WIDE AS THE HEAD ITSELF; WITH TWO SIMPLE EYES (SE).
PELTOPERLIDAE

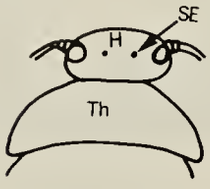
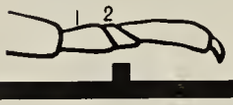


PLATE BEHIND HEAD ABOUT THE SAME WIDTH AS THE HEAD; WITH THREE SIMPLE EYES.

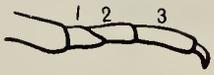
THE HEAD VIEWED FROM BELOW WITH MOUTHPARTS (LABIUM) AS ILLUSTRATED-WITH FOUR SMALL FINGER-LIKE PROJECTIONS WHICH WOULD ALL NEARLY TOUCH A LINE DRAWN IN FRONT OF THEM.
NEMOURIDAE

THE HEAD WHEN VIEWED FROM BELOW WITH MOUTHPARTS (LABIUM) AS ILLUSTRATED - WITH TWO FINGER-LIKE PROJECTIONS WHICH MEET A LINE DRAWN IN FRONT OF THEM.

SECOND TARSAL SEGMENT DISTINCTLY SHORTER THAN THE FIRST.



SECOND TARSAL SEGMENT ABOUT AS LONG AS THE FIRST.
SUBFAMILY TAENIOPTERYGINAE



WING PADS OF MATURE NYMPHS BENT AWAY FROM THE BODY AXIS.
SUBFAMILY NEMOURINAE

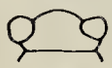
WING PADS OF MATURE NYMPHS NOT BENT AWAY FROM THE BODY AXIS.
SUBFAMILIES CAPNINAE AND LEUCTRINAE

NYMPHS WITH CERCI (TAILS) AT LEAST AS LONG AS THE ABDOMEN. BODY OFTEN WITH A DISTINCT COLOR PATTERN.
PERLODIDAE

NYMPH WITH CERCI ABOUT 1/2 AS LONG AS THE ABDOMEN; BODY OF UNIFORM COLOR.
CHLOROPERLIDAE

KEY TO THE COMMON FAMILIES OF AQUATIC HEMIPTERA

ANTENNAE SHORT, CANNOT BE SEEN FROM ABOVE.



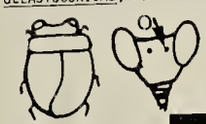
BEAK A DEFINITE THREE OR FOUR SEGMENTED ROD OR CONE; FRONT TARSI WITH ONE OR TWO CLAWS.

BEAK FUSED TO HEAD, NOT DISTINCT; TARSI OF FRONT LEGS SCOOP-LIKE. CORIXIDAE, WATER BOATMEN.

ABDOMEN WITH TWO LONG FILAMENTS AT END. NEPIDAE, WATER SCORPIONS.

NO LONG FILAMENTS AT END OF ABDOMEN; BODY NOT AS ILLUSTRATED.

SHAPE OF BODY TOAD-LIKE, OCELLI (O) PRESENT. GELASTOCORIDAE, TOAD BUGS.



OCELLI ABSENT; BODY SHAPE NOT TOAD-LIKE.

FRONT LEGS FLAT AND FORM A PINCER; HIND TARSI WITH CLAWS.

FRONT LEGS SOMEWHAT ROUNDED IN CROSS SECTION AND DO NOT FORM A DISTINCT PINCER; HIND LEGS WITH A FRINGE OF SWIMMING HAIRS AND TARSAL CLAW NOT EASILY VISIBLE. NOTONECTIDAE,

MEMBRANE OF WING WITHOUT VEINS (ARROW). NAUCORIDAE

MEMBRANE OF WING WITH A NETWORK OF VEINS. BELOSTOMATIDAE, GIANT WATER BUGS.

ANTENNAE LONG, EASILY SEEN FROM ABOVE.

HEAD NOT GREATLY ELONGATED; BODY SHAPE NOT AS ILLUSTRATED.

HEAD AS LONG AS ENTIRE THORAX; TOTAL BODY LENGTH 1/2 INCH OR LESS. HYDROMETRIDAE, MARSH TREADERS.

CLAWS ARISE FROM THE BOTTOM OF THE TARSUS AND NOT FROM THE TIP.

CLAWS ARISE FROM THE TIP OF THE TARSUS.

HIND LEGS VERY LONG, FEMUR EXTENDS BEYOND THE TIP OF THE ABDOMEN. GERRIDAE, WATER STRIDERS.

HIND LEGS NOT GREATLY ELONGATED, FEMUR WILL NOT EXTEND BEYOND THE TIP OF THE ABDOMEN. VELIIDAE

TARSI WITH THREE SEGMENTS.

TARSI WITH TWO SEGMENTS. HEBRIDAE

FEMUR OF HIND LEG ATTACHED TO ABDOMEN BY TWO SHORT SEGMENTS.

FEMUR OF THE HIND LEG ATTACHED TO THE ABDOMEN BY ONE SHORT SEGMENT, THE BASAL SEGMENT FORMS A FLAT TRIANGULAR PLATE FUSED TO THE ABDOMEN. SALDIDAE, SHORE BUGS.

TIBIA OF HIND LEGS WITH STIFF BLACK BRISTLES, THE LENGTH OF WHICH NEARLY EQUALS THE DIAMETER OF THE TIBIA. MESOVELIIDAE

TIBIA OF HIND LEGS WITH SHORT HAIRS, THE LENGTH OF WHICH EQUALS 1/3 OR LESS THE DIAMETER OF THE TIBIA. MACROVELIIDAE

KEY TO THE MAJOR FAMILIES OF TRICHOPTERA LARVAE

LARVA WITHOUT A CASE OR CASE NOT THE SHAPE OF A SNAILS SHELL.

LARVA WITH A STONE CASE THE SHAPE OF A SNAILS SHELL. HELICOPSYCHIDAE

CASE UNDER ¼ INCH IN LENGTH, FLAT, PURSE-LIKE, OF SILK AND FINE SAND. ABDOMEN OF LARVA ENLARGED. HYDROPTILIDAE

CASE ABSENT OR NOT SMALL AND FLAT.

END OF ABDOMEN WITH CLAWS MOUNTED ON A DISTINCT SEGMENT.

END OF ABDOMEN WITH CLAWS ATTACHED TO ABDOMEN ITSELF.

WITHOUT CASE, BUT LARVA MAY LIVE IN AN IMMOVABLE STONE RETREAT

WITH MOVABLE CASE, CONSISTING OF A MOUND OF STONES AND OPEN AT ENDS OR UNDERSIDE. GLOSSOSOMATIDAE

ONE PLATE ONLY BEHIND HEAD, SECOND AND THIRD REGIONS WITHOUT PLATES OR FRAGMENTS OF THEM. PHRYGANEIDAE

SCLEROTIZED PLATES OR FRAGMENTS OF THEM PRESENT ON SECOND AND THIRD THORACIC REGIONS BEHIND HEAD.

WITH THREE DISTINCT THORACIC PLATES BEHIND HEAD. HYDROPSYCHIDAE

WITH ONE OR TWO PLATES ONLY BEHIND HEAD, OR WITH FRAGMENTS OF PLATES.

CLAWS OF HIND LEGS MUCH SHORTER THAN CLAWS OF MIDDLE AND FRONT LEGS. MOLANNIDAE

CLAWS OF ALL LEGS ABOUT EQUAL IN LENGTH.

NO PLATE ON SEGMENT THAT BEARS ANAL CLAWS.

WITH A DISTINCT PLATE ON ABDOMINAL SEGMENT THAT BEARS ANAL CLAWS. RHYACOPHILIDAE

PLATE OVER MOUTH WITHOUT ROW OF SPINES.

PLATE OVER MOUTH (LABRUM) WITH A DISTINCT ROW OF BLACK SPINES. CALAMOCERATIDAE

PLATE BEHIND HEAD WITH A DISTINCT GROOVE ACROSS IT, CASE SQUARE OR ROUND. BRACHYCENTRIDAE

PLATE BEHIND HEAD WITHOUT GROOVE, AT MOST WITH A SHALLOW DEPRESSION: CASE OFTEN IRREGULAR, NEVER SQUARE.

PLATE OVER MOUTH (LABRUM) RECTANGULAR. PSYCHOMYIIDAE

PLATE OVER MOUTH EXPANDED LATERALLY. PHYLOPOTAMIDAE

ANTENNA MINUTE, LITTLE MORE THAN A SMALL BUMP.

ANTENNA LONG, LAST SEGMENT 3 OR 4 TIMES AS LONG AS WIDE. LEPTOCERIDAE

ANTENNA ARISING NEAR THE MANDIBLE OR CLOSER TO THE MANDIBLE THAN THE EYE: FIRST ABDOMINAL SEGMENT WITH A DORSAL HUMP. LIMNEPHILIDAE

ANTENNA ARISING NEAR THE EYE: FIRST ABDOMINAL SEGMENT WITHOUT A DORSAL HUMP. LEPIDOSTOMATIDAE

KEY TO THE COMMON FAMILIES OF AQUATIC BEETLES (ADULTS)

HEAD WITH TWO EYES ONLY.

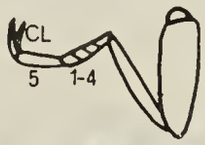
HEAD WITH FOUR LARGE ROUND EYES, TWO VISIBLE FROM ABOVE ANO TWO VISIBLE FROM BELOW. GYRINIOAE

HIND LEGS PROJECTING FROM BENEATH LARGE PLATES WHICH COVER MOST OF THE ABDOMEN. HALIPLIDAE

ABOOMEN WITHDUT LARGE PLATES.

CLAW AND LAST TARSAL SEGMENT NOT AS ILLUSTRATED.

LEGS AND CLAWS LARGE, THE LAST TARSAL SEGMENT AS LDNG AS THE BASAL FOUR SEGMENTS COMBINED.



ANTENNA ARISES FROM UNDER THE EYES AND IS ENLARGED AT END; FIRST ABDOMINAL SEGMENT NOT CUT IN TWO BY ATTACHMENT OF HIND LEGS. HYDROPHILIOAE

ANTENNA THREAD-LIKE, FIRST ABDOMINAL SEGMENT CUT IN TWO BY ATTACHMENT OF HIND LEGS.

ANTENNA THREAD-LIKE, NOT ENLARGED AT THE END. ELMIDAE

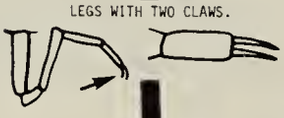
ANTENNA ENLARGED AND CLUB-LIKE AT END. HELOIDAE.

HIND LEGS FLATTENED AND WITH HAIR FRINGES AND INCONSPICUDUS CLAWS. OYTISCIDAE

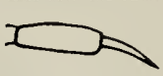
HIND LEGS NORMAL WALKING LEGS WITH CONSPICUOUS CLAWS AND ND HAIR FRINGES AMPHIZOIDAE

KEY TO THE COMMON FAMILIES OF AQUATIC BEETLES (LARVAE)

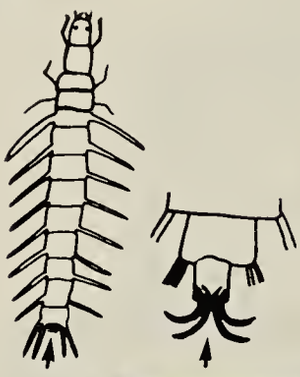
LEGS WITH TWO CLAWS.



LEGS WITH ONE CLAW.



LAST SEGMENT OF ABDOMEN WITH FOUR HOOK-LIKE CLAWS.
GYRINIDAE



LAST SEGMENT OF ABDOMEN WITHOUT FOUR HOOKS.

LEGS WITH FIVE SEGMENTS PLUS THE CLAW.
HALIPLIDAE

LEGS WITH FOUR SEGMENTS PLUS THE CLAW.

BODY VERY FLAT FROM SIDE VIEW, OVAL OR ROUND FROM TOP VIEW.
PSEPHENIDAE

BODY NOT FLATTENED.

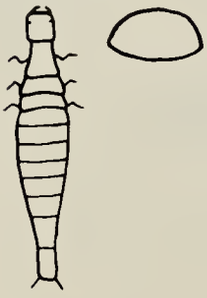
ANTENNA LONGER THAN THORAX.
HELOIDAE

ANTENNA SHORTER THAN THORAX.

MANDIBLES SMALL, NOT VISIBLE FROM ABOVE

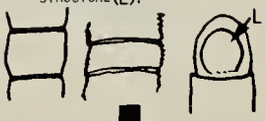
MANDIBLES LARGE AND SICKLE-LIKE, VISIBLE FROM TOP VIEW.
HYDROPHILIDAE

BODY ROUND OR OVAL IN CROSS SECTION; NO THIN PLATES ON SIDES OF ABDOMEN.
OYTISCIDAE



BODY FLATTENED IN CROSS SECTION, SIDES OF ABDOMEN EXPANDED INTO THIN PLATES.
AMPHIZOIDAE

BODY MADE UP OF A SERIES OF SEGMENTS WITH JOINTS BETWEEN; UNDERSIDE OF LAST SEGMENT OF ABDOMEN WITH A HINGED LID-LIKE STRUCTURE(L).



BODY FLESHY WITH WRINKLES TO INDICATE SEGMENTS.
CHRYSOMELIDAE

TWO CLAWS UNDER HINGED LID ON UNDERSIDE OF LAST SEGMENT OF ABDOMEN.
ELMIDAE

NO CLAWS UNDER HINGED LID ON UNDERSIDE OF LAST SEGMENT OF ABDOMEN.
DRYOPIDAE

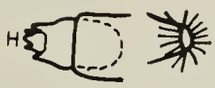
KEY TO THE COMMON FAMILIES OF AQUATIC DIPTERA LARVAE

LARVA WITH A DISTINCT HEAD CAPSULE (H), MOUTHPARTS, AND EYES.

LARVA WITH NO VISIBLE HEAD.

LARVA NOT AS DESCRIBED.

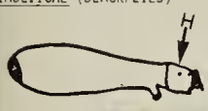
HEAD CAPSULE PARTLY VISIBLE BUT PARTLY WITHDRAWN INTO THORAX: BODY OFTEN COVERED WITH A CHALKY FILM: TIP OF ABDOMEN WITH A TUFT OF HAIRS.
STRATIOMYIIDAE



HEAD CAPSULE PRESENT BUT COMPLETELY WITHDRAWN INTO THORAX; HEAD CAPSULE INCOMPLETE POSTERIORLY.
TIPULIDAE

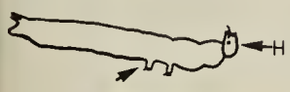
LARVA NOT AS DESCRIBED.

ABDOMEN ENLARGED SO BODY APPEARS CLUB-SHAPED: "FALSE LEG" LOCATED BEHIND HEAD: POSTERIOR END OF BODY WITH A CIRCLE OF HOOKLETS.
SIMULIIDAE (BLACKFLIES)



LARVA NOT AS DESCRIBED.

LARVA WITH TWO PAIR OF "FALSE LEGS" BEHIND HEAD.
DIXIDAE



LARVA NOT AS DESCRIBED.

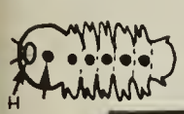
WITH AN ENLARGED AND SWELLED REGION BEHIND HEAD: WITH NO "FALSE LEGS".
CULICIDAE (MOSQUITO FAMILY)

LARVA NOT AS DESCRIBED.

WITH A LONG TUBE AT THE POSTERIOR END AND THREE PAIRS OF HOOKED "FALSE LEGS" BEHIND HEAD.
PTYCHOPTERIDAE

LARVA NOT AS DESCRIBED.

WITH A ROW OF SIX SUCKER-LIKE AREAS DOWN MIDDLE OF UNDERSIDE OF ABDOMEN. FROM MOUNTAIN STREAMS.
BLEPHAROCERIDAE

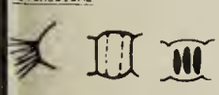


LARVA NOT AS DESCRIBED.

LARVA WITH A FORKED ANTENNA AND SIX PAIRS OF LATERAL "FALSE LEGS"; UNCOMMON, FROM MOUNTAIN STREAMS.
DEUTEROPHLEBIIDAE

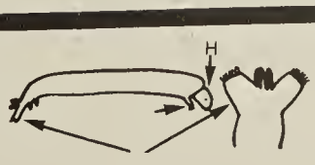
LARVA NOT AS DESCRIBED.

LARVA 1/8 INCH IN LENGTH OR LESS, EACH BODY SEGMENT SUBDIVIDED INTO THREE SUBSEGMENTS: ABDOMEN WITH AN APICAL TUFT OF HAIRS.
PSYCHODIDAE



LARVA NOT AS DESCRIBED.

LARVA WITH ONE "FALSE LEG" BEHIND HEAD AND TWO "FALSE LEGS" AT END OF ABDOMEN.
CHIRONOMIDAE

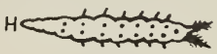


LARVA NOT AS DESCRIBED.

LARVA LONG, NEEDLE-LIKE AND LEGLESS WITH HEAD LONGER THAN WIDE OR WITH A HOOK AT THE POSTERIOR END OR WITH BOTH ANTERIOR AND POSTERIOR "FALSE LEGS" AND WITH DENSE HAIRS ON THE DORSAL SIDE OF THE BODY.
CERATOPOGONIDAE

LARVA NOT AS DESCRIBED.

LARVA WITH A FORKED "TAIL" FRINGED WITH HAIRS. FROM STREAMS.
RHAGIONIDAE

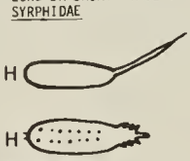


LARVA NOT AS DESCRIBED.

LARVA WITH A FORKED "TAIL" BUT WITHOUT FRINGES OF HAIRS. FROM SALT LAKES.
EPHYDRIDAE

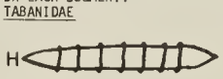
LARVA NOT AS DESCRIBED.

LARVA WITH A SINGLE LONG OR SHORT "TAIL".
SYRPHIDAE



LARVA NOT AS DESCRIBED.

LARVA POINTED AT BOTH ENDS AND WITH A GIRDLE OF "FALSE LEGS" ON EACH SEGMENT.
TABANIDAE



LARVA WITH TWO POINTS AND TWO "FALSE LEGS" ON THE TAIL END.
ANTHOMYIIDAE

LARVA WITH A STAR-LIKE DISK ON THE TAIL END.
SCIOMYZIDAE

TABLE 1

SOME CHARACTERISTICS OF THE FAMILIES OF NORTH AMERICAN AQUATIC INSECTS

Fig. No.	Orders and Families	Common Name	Prairie Province Distribution[1]	Habitat[2] (Exceptions	Food[3] occur)	Remarks
11,12	**Collembola**	**Springtails**	S,A,M	P	O,H	Surface, cosmopolitan
	Ephemeroptera	**Mayflies**				
1	Ametropodidae		S	R	O,H	Sand bars, Sask. Riv.
	Baetidae	Small Mayflies	S,A,M	R,S,L,P	O,H	Common, widespread
2	Baetiscidae		S,A,M	R	O,H	Sask. Riv., rare northern lakes
3	Behningiidae		—	R	O,H	Sand bars, southeast U.S.
4	Caenidae		S,A,M	P,R	O,H	Common, widespread
5	Ephemerellidae		S,A,M	R,S	O,H	Common, widespread
	Ephemeridae	Burrowing Mayflies	S,A,M	R,L	O,H	Burrowers, large lakes
6	Heptageniidae	Stream Mayflies	S,A,M	R,S	O,H,C	Flat rock clingers
7	Leptophlebiidae		S,A,M	R,S,L,P	O,H	Common, diverse group
	Metretopodidae		S,A?,M	R	O,H	Sask. River
	Neoephemeridae		—?	S?	O,H?	Uncommon in west
8	Oligoneuriidae		S	R	O,H	Saskatchewan River
9	Polymitarcidae		S,A,M	L,R	O,H	Burrowers, large lakes and riv.
	Potamanthidae		—?	R	O,H	Eastern
10	Siphlonuridae		S,A,M	R,P	O,H,C	Common, widespread, diverse
	Tricorythidae		S,A,M	S,R	O,H	Common, widespread
	Odonata	**Dragonflies and Damselflies**				
13	Aeshnidae	Darners	S,A,M	S,P	C	Common, widespread
	Agrionidae	Broad-winged Damselflies	S,A,M	S	C	Common, widespread
14	Coenagrionidae	Narrow-winged Damselflies	S,A,M	P	C	Common, widespread
	Cordulegastridae	Biddies	—?	S	C	Mountain streams
15	Gomphidae	Clubtails	S,A,M	R,S	C	Common, widespread
	Lestidae	Spread-winged Damselflies	S,A,M	P	C	Common, widespread
16	Libellulidae	Common Skimmers	S,A,M	P	C	Common, widespread
	Petaluridae	Graybacks	—	—	C	Rare, bogs
	Plecoptera	**Stoneflies**				
	Chloroperlidae	Green Stoneflies	S,A,M	R,S	C	Common
	Nemouridae	Spring Stoneflies	S,A,M	R,S,P	O,H	Common
	Peltoperlidae	Roachlike Stoneflies	A,M?	S	O,H	Common, mountains
	Perlidae	Common Stoneflies	S,A,M	R,S	C	Common, widespread
21	Perlodidae	Perlodid Stoneflies	S,A,M	R,S	C	Common, widespread
	Pteronarcidae	Giant Stoneflies	S,A,M	R,S	O,H	Common, widespread
	Hemiptera	**True bugs**				
22	Belostomatidae	Giant Water Bugs	S,A,M	P,L,S	C	Very large
23	Corixidae	Water Boatmen	S,A,M	R,S,L,P	O,H,C?	Common, widespread
24	Gelastocoridae	Toad Bugs	M	—	C	Western, on shores
25	Gerridae	Water Striders	S,A,M	—	C	Surface, still water
	Hebridae	Velvet Water Bugs	S,A,M	—	C	Shore debris
26	Hydrometridae	Water Measurers	S,M	P	C	Inconspicuous, 1/2"
27	Macroveliidae		—	—	C	Moss near water
	Mesoveliidae	Water Treaders	S,A,M	—	C	Surface, still water
	Naucoridae	Creeping Water Bugs	—	L,R,P,S	C	Often warm springs
	Nepidae	Water Scorpions	M	P	C	2" long
28	Notonectidae	Back Swimmers	S,A,M	L,P.S	C	Common, widespread
29	Saldidae	Shore Bugs	S,A,M	—	C	Shores
	Veliidae	Ripple Bugs	S,A,M	—	C	Surface, still water
	Megaloptera	**Dobsonflies, Alderflies**				
17	Corydalidae	Hellgrammites, Dobsonflies	M,A	S	C	Cosmopolitan
18	Sialidae	Alderflies	S,A,M	S,P	C	Common, widespread

TABLE 1 (Contd.)

SOME CHARACTERISTICS OF THE FAMILIES OF NORTH AMERICAN AQUATIC INSECTS

Fig. No.	Orders and Families	Common Name	Prairie Province Distribution[1]	Habitat[2] (Exceptions	Food[3] occur)	Remarks
	Neuroptera	**Lacewings**				
19	Sisyridae	Spongillaflies	S,A,M	P,S	C	On freshwater sponges
	Trichoptera	**Caddisflies**				
30	Brachycentridae	Brachycentrids	S,A,M	R,S	O,H	Common, widespread
31	Calamoceratidae	Calamoceratids	—?	S	O,H	Uncommon
	Glossosomatidae		S,A,M	R,S	O,H	Common, widespread
32	Helicopsychidae	Snail-case Caddisflies	S,A,M	R,S,L	O,H	Widespread, warm springs
33	Hydropsychidae	Net-spinning Caddisflies	S,A,M	R,S	O,H	Collect food in net
34	Hydroptilidae	Micro-caddisflies	S,A,M	R,S	O,H	Common, seldom collected
	Lepidostomatidae	Lepidostomatids	S,A,M	R,S	O,H	Fairly common
35	Leptoceridae	Long-horned Caddisflies	S,A,M	R,S,P,L	O,H,C	Diverse family
36	Limnephilidae	Northern Caddisflies	S,A,M	R,S,L,P	O,H	Common, widespread
37	Molannidae	Molannids	S,A,M	L	O,H	Common, northern lakes
	Philopotamidae	Finger-net Caddisflies	S,A,M	R,S	C?	Collect food in net
	Phryganiidae	Large Caddisflies	S,A,M	R,S,L,P	O,H	Common, widespread
	Psychomyiidae	Tube-making Caddisflies	S,A,M,	R,S	O,H,C	Collect food in net
38	Rhyacophilidae	Primitive Caddisflies	S,A,M	R,S	C,O	Mountain streams
	Lepiodoptera	**Moths**				
20	Pyralidae	Pyralid Moths	S,A,M	R,S,L	H	With case on aquatic plants
	Coleoptera	**Beetles**				
39,43	Amphizoidae	Trout-stream Beetles	A	S	C	Rare, mountain streams
40	Chrysomelidae	Leaf Beetles	?	P,L	H	Aquatic leafy plants
	Dryopidae	Long-toed Water Beetles	?	S	O,H	Stream bottoms
41,44	Dytiscidae	Predaceous Diving Beetles	S,A,M	R,S,L,P	C	Common, widespread
42,45	Elmidae	Riffle Beetles	S,A,M	S,P	H	Common, widespread
	Gyrinidae	Whirligig Beetles	S,A,M	S,L,P	C	Common, widespread, surface
	Haliplidae	Crawling Water Beetles	S,A,M	P	O	Common, widespread
	Heloidae	Marsh Beetles	S,A,M	—	O	Damp areas, moss
46	Hydrophilidae	Water Scavenger Beetles	S,A,M	R,S,L,P	O,H	Common, widespread
47	Psephenidae	Water-penny Beetles	—	S	H	Mountain streams
	Diptera	**Flies**				
	Anthomyiidae	Anthomyiid Flies	S,A,M?	P	O,H	Few aquatic species
48	Blephariceridae	Net-winged Midges	A	S	O,H	Mountain streams
49	Ceratopogonidae	Biting Midges	S,A,M	R,S,L,P	C	Common, widespread
50	Chironomidae	Midges	S,A,M	R,S,L,P	O,H,C	Common, widespread
51	Culicidae	Mosquitoes	S,A,M	P	O,H	Any standing water
	Deuterophlebiidae	Mountain Midges	A?	S	O,H	Mountain streams
52	Dixidae	Dixid Midges	S,A,M	P	O,H	Common, widespread
	Ephydridae	Shore Flies	S,A?,M	L	O,H	Salt Lakes
	Psychodidae	Moth Flies	S,A,M	—	O,H	Moist areas
	Ptychopteridae	Phanton Crane Flies	S?,A,M	—	O,H	Moist areas
53	Rhagionidae	Snipe Flies	A	R,S	O,H	Genus *Atherix*
	Sciomyzidae	Marsh Flies	S,A,M	—	C	Prey on snails
	Simuliidae	Black Flies	S,A,M	R,S	O	Common filter feeder
54	Stratiomyidae	Soldier Flies	S,A,M	S	O	Seldom collected
	Syrphidae	Flower Flies	S,A,M	P	O	Rat-tailed maggots
55	Tabanidae	Deer and Horse Flies	S,A,M	P	O	
56	Tipulidae	Crane Flies	S,A,M	R,S,L,P	O	Common, widespread

[1]S-Saskatchewan
A-Alberta
M-Manitoba
—Absent

[2]R-Rivers
S-Streams
L-Lakes
P-Ponds

[3]O-Omnivorous
H-Herbivorous
C-Carnivorous

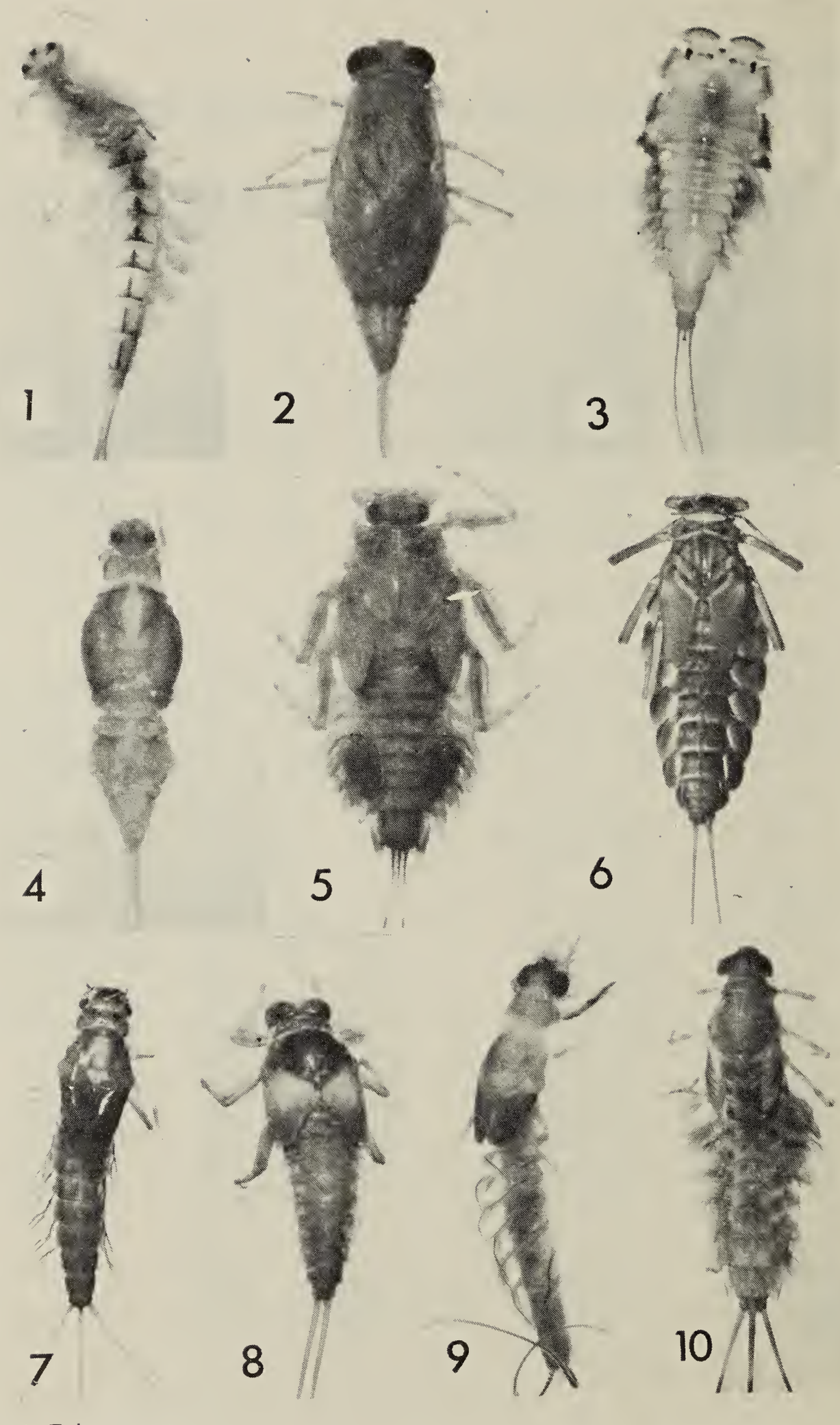


Plate 1. Ephemeroptera
Fig. 1 Ametropodidae; Fig. 2 Baetiscidae; Fig. 3 Behningiidae; Fig. 4 Caenidae; Fig. 5 Ephemerellidae; Fig. 6 Heptageniidae; Fig. 7 Leptophlebiidae; Fig. 8 Oligoneuriidae; Fig. 9 Polymitarcidae; Fig. 10 Siphlonuridae.

Plate 2. Collembola, Odonata, Megaloptera, Neuroptera and Lepidoptera
Figs. 11 and 12 Collembola; Fig. 13 Aeshnidae; Fig. 14 Coenagrionidae; Fig. 15 Gomphidae; Fig. 16 Libellulidae; Fig. 17 Corydalidae; Fig. 18 Sialidae; Fig. 19 Sisyridae; Fig. 20 Pyralidae.

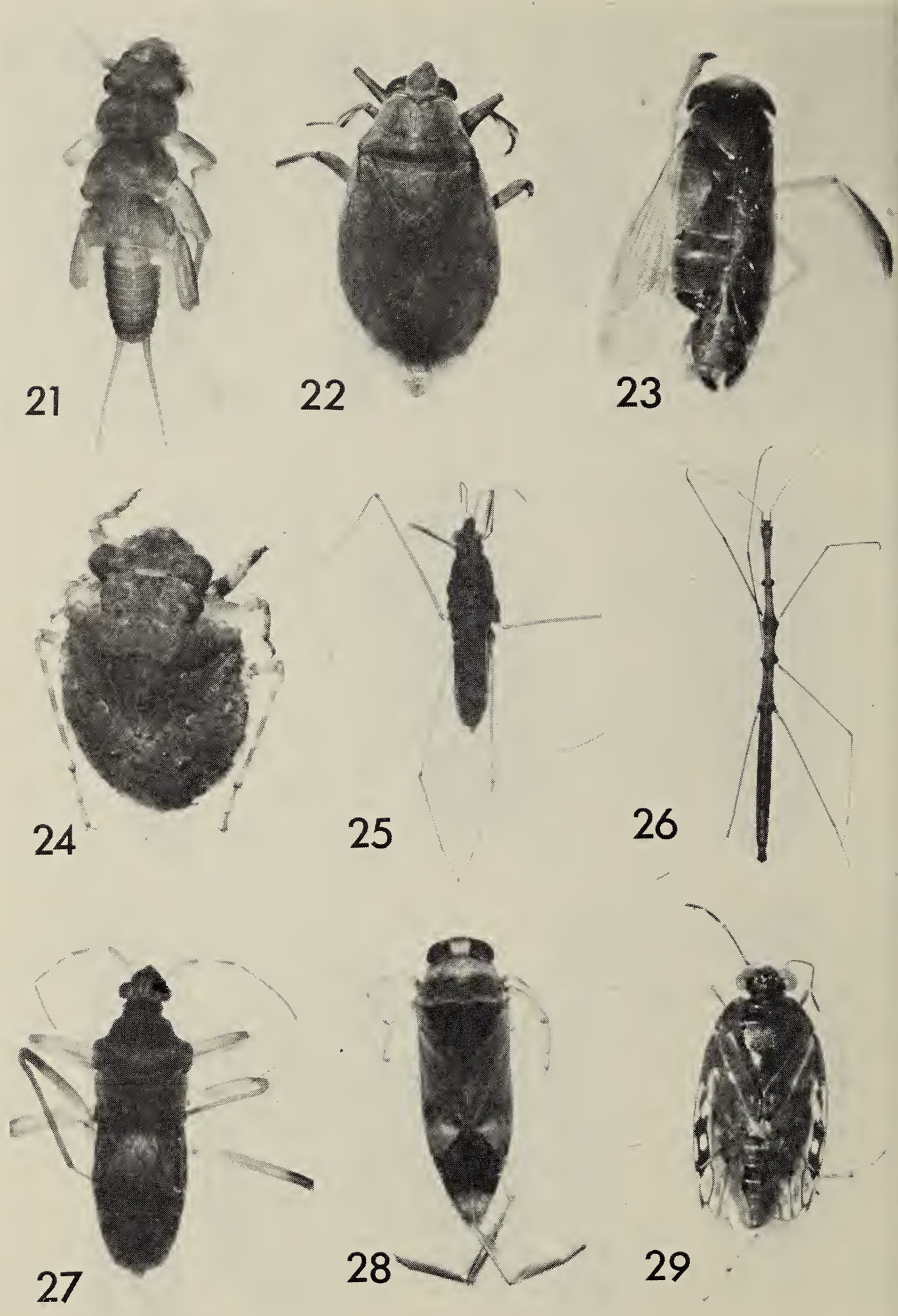


Plate 3. Plecoptera and Hemiptera

Fig. 21 Perlodidae; Fig. 22 Belostomatidae; Fig. 23 Corixidae; Fig. 24 Gelastocoridae; Fig. 25 Gerridae; Fig. 26 Hydrometridae; Fig. 27 Macroveliidae; Fig. 28 Notonectidae; Fig. 29 Salididae.

Plate 4. Trichoptera
Fig. 30 Brachycentridae; Fig. 31 Calamoceratidae; Fig. 32 Helecopsychidae; Fig. 33 Hydropsychidae; Fig. 34 Hydroptilidae; Fig. 35 Leptoceridae; Fig. 36 Limnephilidae; Fig. 37 Molannidae; Fig. 38 Rhyacophilidae.

Plate 5. Coleoptera
Fig. 39 Amphizoidae; Fig. 40 Chrysomelidae; Fig. 41 Dytiscidae; Fig. 42 Elmidae; Fig. 43 Amphizoidae; Fig. 44 Dytiscidae; Fig. 45 Elmidae; Fig. 46 Hydrophilidae; Fig. 47 Psephenidae.

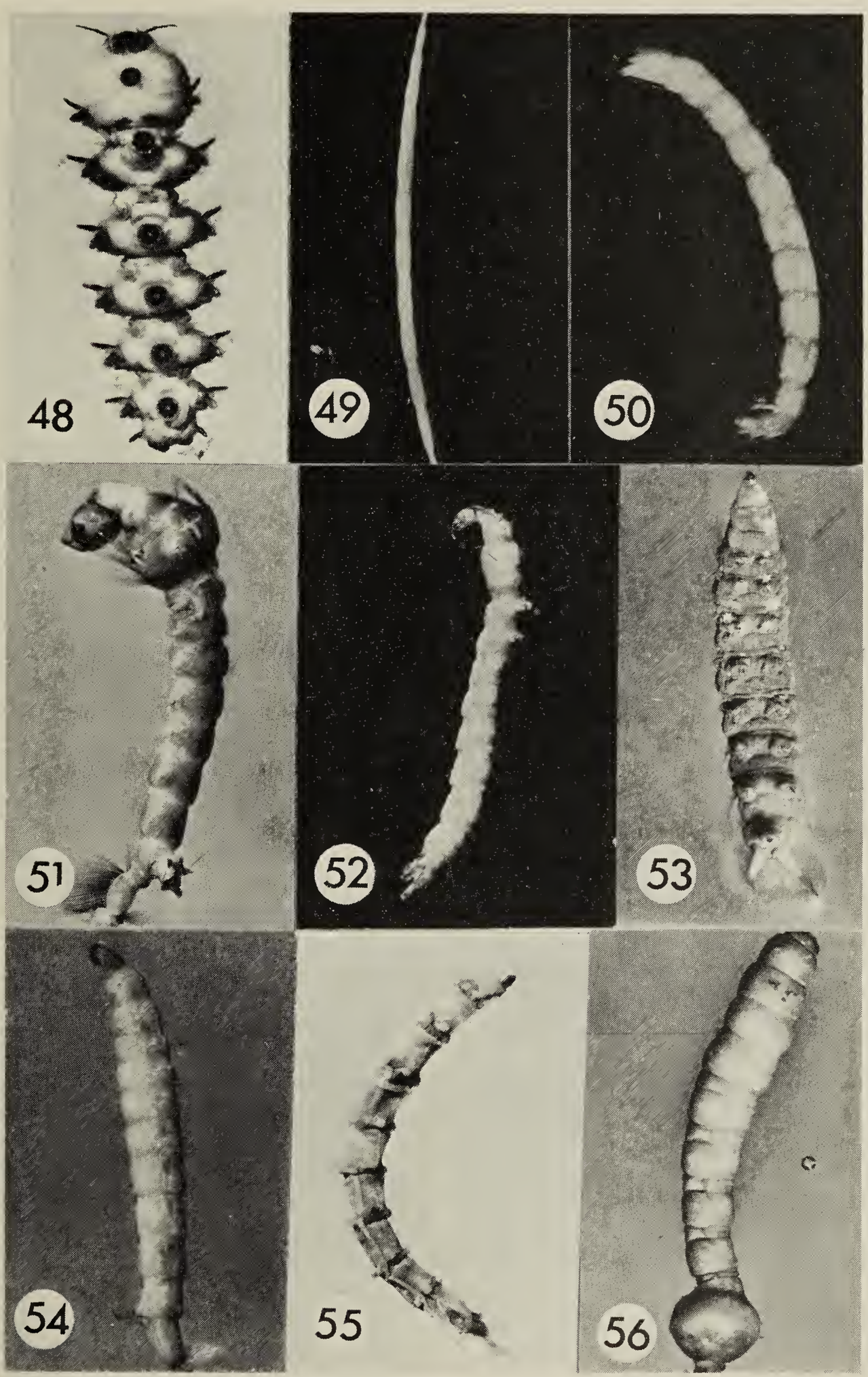


Plate 6. Diptera

Fig. 48 Blephariceridae; Fig. 49 Ceratopogonidae; Fig. 50 Chironomidae; Fig. 51 Culicidae; Fig. 52 Dixidae; Fig. 53 Rhagionidae; Fig. 54 Stratiomyidae; Fig. 55 Tabanidae; Fig. 56 Tipulidae.