THE IMMATURE STAGES OF *Cenocorixa bifida* (HUNG.) AND *C. expleta* (UHLER) (HEMIPTERA: CORIXIDAE)

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INTRODUCTION

In a study of the ecology and physiology of Corixidae living in a series of soda lakes in central British Columbia, it was essential to identify the larval instars of two species of *Cenocorixa*, which often occur sympatrically. This was necessary in order to work out the details of the life cycle and be able to identify with certainty, insects used in experiments. This paper describes the immature stages of these two species, *C. bifida* (Hungerford) and *C. expleta* (Uhler). Both species have been previously recorded from British Columbia by Lansbury (1960).

MATERIALS and METHODS

The immature stages were obtained in two ways. Firstly, regular samples of larvae were obtained in field collections. Secondly, eggs were obtained from adult insects and reared. Gravid females were taken from White Lake and Long Lake in the Cariboo region of central British Columbia in April 1966 and were transported to the laboratory in one gallon Thermos jugs, half filled with water. Insects were then placed in natural lake water in plexiglass dishes with vegetation and nylon netting for them to cling to. At 20°C and under natural light conditions, females laid eggs within 48 hours. These eggs were separated from the insects at frequent intervals: this was to prevent them being used as food by the females. Batches of eggs were placed in finger bowls with the appropriate water and kept at 20°C and under natural light conditions. Larvae on emergence were fed every other day on young brine shrimp (*Artemia salina* (L.)) which were hatched separately in the corresponding lake water. In this way, *C. bifida* was reared to the adult instar and *C. expleta* through the first three larval instars.

All drawings have been made with a squared reticule eye-piece or Camera Lucida, using both compound and stereo-zoom microscopes. The spines on the hind femora of larvae were usually only clearly visible when legs were mounted in polyvinyl lactophenol or other similar mountant and viewed at magnifications over 150x.

The terminology and characters utilized in the larval descriptions follow Cobben & Pillot (1960). However, I have interpreted the surfaces of the legs differently. The surface of the hind leg seen in dorsal view is morphologically the posterior surface and is so interpreted. Likewise the surface seen ventrally is the anterior face, the morphological ventral surface being the one towards the insect body when it is at rest or swimming.

EGGS

To date it has not been possible to distinguish between the eggs of the two species. Both have top-shaped eggs, with a very short stalked disc, smooth chorion, height 0.78 mm. and width 0.57 mm. The egg of *C. bifida* is shown in Fig. 1, just before hatching. At eclosion, the apex of the chorion splits into 6-8 wedges.

In the laboratory, *C. expleta* usually laid eggs on the walls of the container, while *C. bifida* laid most eggs on the vegetation or plastic screen. In the field, *C. expleta* has been found to lay eggs on rock boulders and *bifida* on vegetation, often in the leaf sheath of somewhat decayed submerged grasses. However, this may not be the only oviposition habit of the two species.

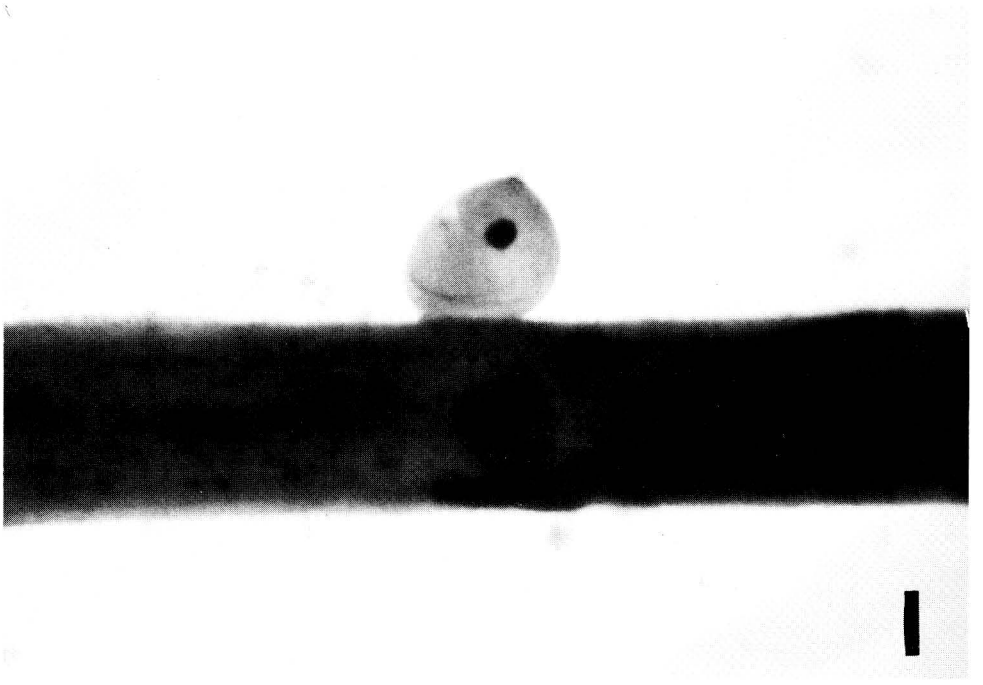


Fig. 1—Photograph of the egg of **Cenocorixa bifida** just before hatching.

LARVAE

(1) General description of *Cenocorixa* larvae:

Rostrum with transverse furrows; frons not greatly hirsute; eyes red. Pala spatulate; middle legs with tarsus longer than tibia; hind tibia posteriorly with a row of 7 moveable spines. Metasternal xiphus short and equilateral. Abdomen laterally moderately convex; dorsal abdominal scent gland and opening on tergum III obsolete; scent glands and ostioles on terga IV and V distinct, the ostioles paired; abdomen without distinct colour pattern.

Latter instars with a dense hair covering on mesonotum, but without this reaching anterior margin (Fig. 6); hairs on median area of anterior mesonotum short; mesonotum with hind margin covered with long hairs only in middle, the lateral areas bare and relatively broad. Metanotum without long hair covering, but with sparse short and slender setae; inner margin of wing pads with line of dense long hairs. Most instars with a distinct comb on hind tibia distally on posterior side.

(2) Separation of species

The following couplet will separate the larvae of *C. bifida* from those of *C. expleta:*

Pala with apical lower palmar bristle situated on a distinct prominence; terminal claw relatively slender, hardly thicker than preapical lower palmar bristle (Fig. 9) . . . . . *C. bifida*

Pala with apical lower palmar bristle situated on an indistinct prominence; terminal claw distinctly thicker than preapical lower palmar bristle (Fig. 10) . . . *C. expleta*

With the above characters, it is possible to separate the species in each larval instar and in the adult.

(3) Key to larval instars

The following key will separate the instars in both *C. bifida* and *C. expleta.*

1. Meso and metanotum with covering of long hairs on at least part; hind femur with tuft of long hairs antero-ventrally and with 4 short bristles dorsally; hind tibia with row of dense swimming hairs posteriorly . . . . . 3.
— Meso and metanotum without long dense hair covering; hind femur without tuft of long hairs antero-ventrally, but with 5 long outstanding setae dorsally; hind tibia without row of dense swimming hairs posteriorly, only a few scattered hairs present. . . . . 2.
2. Postero-lateral corners of mesonotum curved distinctly caudad; hind tibial comb with 2 spines; hind tibia with 5-7 long hairs posteriorly. . . . . second instar
— Postero-lateral corners of mesonotum not curved distinctly caudad; hind tibial comb of a single spine; hind tibia with 2-3 long hairs posteriorly. . . first instar
3. Hind tibial comb with 4 spines; long hair covering on mid-line of mesonotum not reaching posterior margin; fore wing buds overlapping less than half of the hind wing buds; fore wing buds not reaching base of abdomen. . . . . third instar
— Hind tibial comb with 6 or 8 spines; long hair covering on mid-line of mesonotum reaching posterior margin; fore wing buds overlapping more than half of hind wing buds; fore wing buds reaching base of abdomen. . . 4.
4. Hind tibial comb with 6 spines; wing buds not completely overlapping but reaching second abdominal segment; fore wing buds reaching but not surpassing base of abdomen. . . . fourth instar
— Hind tibial comb with 8 spines; wing buds completely overlapping and reaching third abdominal segment; fore wing buds surpassing base of abdomen. . . fifth instar

(4) Description of larvae of *C. bifida*

Table I summarizes the most important characters of the larvae of *C. bifida*. The descriptions below omit most of the characters of instars found in the key. In the counts of spines on the femur, all totals cited omit the two apical spines found at the apex on anterior and posterior surfaces.

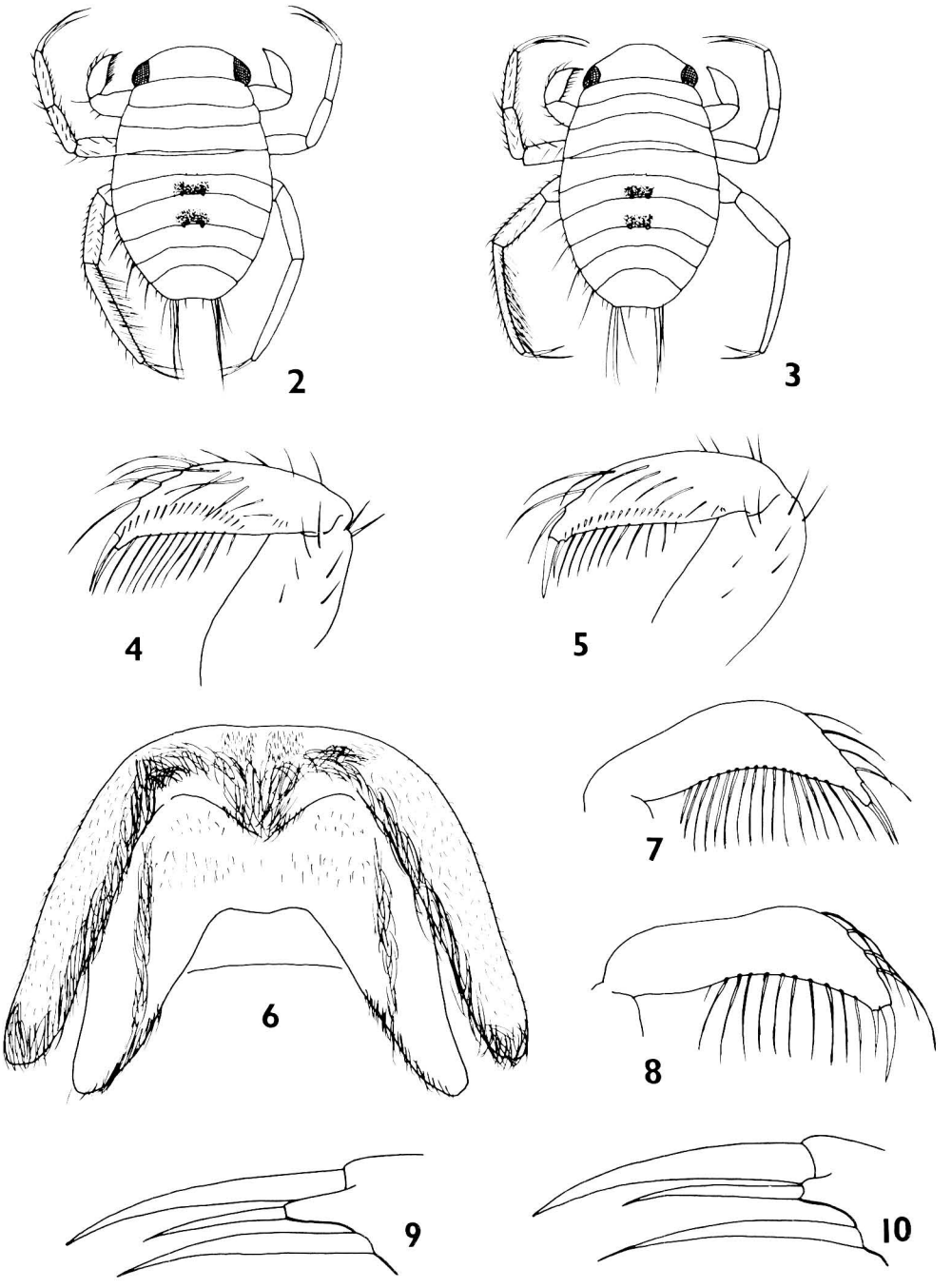
FIRST INSTAR (Figs. 2, 4, 11-12): pala with 12 lower palmar bristles; fore femur anteriorly with 4 spines; hind femur with 5 long hairs dorsally, 4 short spines posteriorly and 3 short spines anteriorly; hind tibia with 10 moveable spines dorsally.

SECOND INSTAR: pala with 14 lower palmar bristles; fore femur anteriorly with 4-5 spines; hind femur with 5 long outstanding hairs and a slender apical bristle dorsally, posteriorly with 4-6 short spines and anteriorly with 3-4 slender spines; hind tibia with 10-11 moveable spines dorsally, these all of similar size.

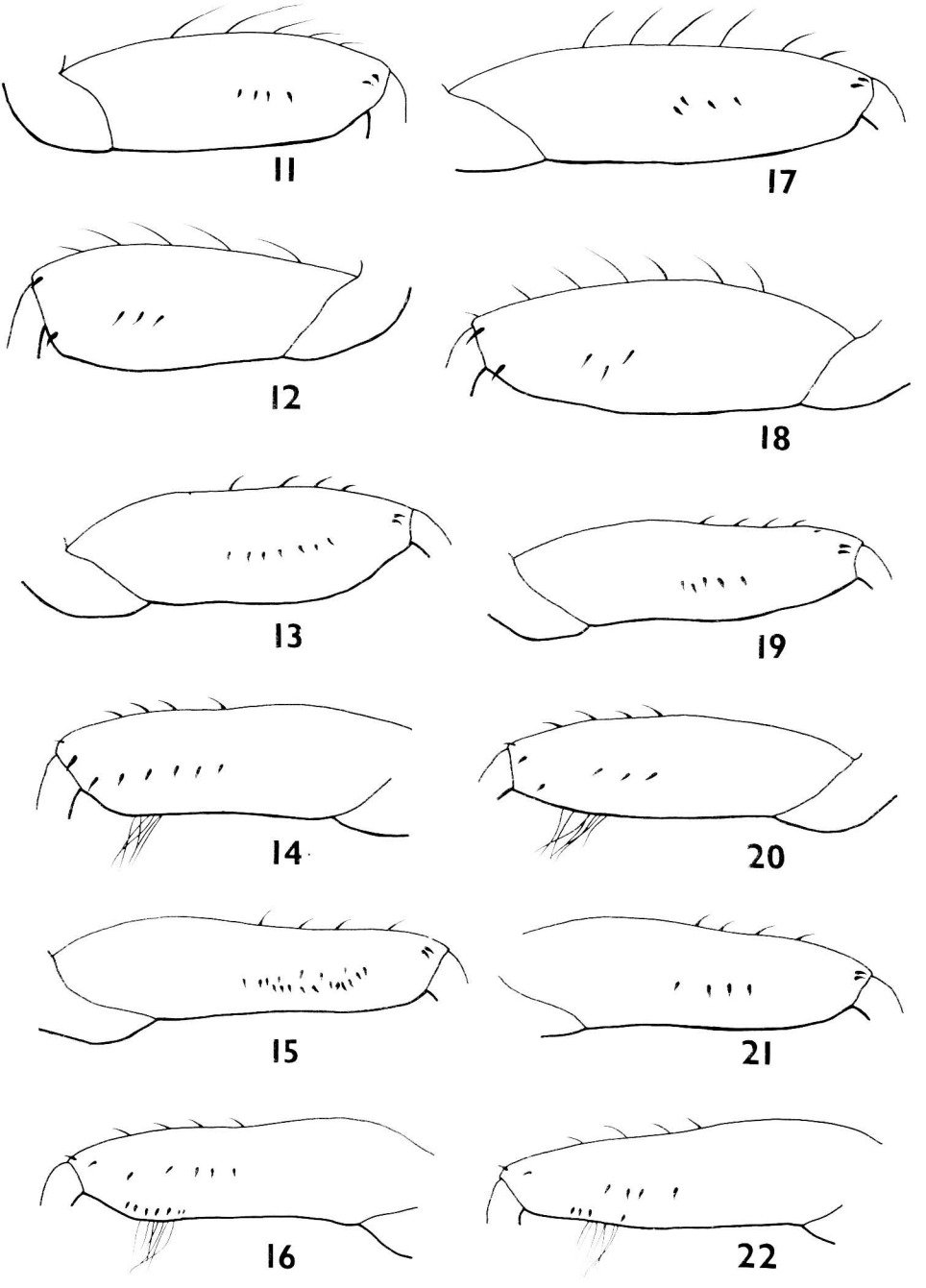
THIRD INSTAR (Figs. 13-14): pala with 14-17 lower palmar bristles; fore femur with 6-8 spines anteriorly; hind femur with 4 short bristles dorsally, 5-8 short spines posteriorly and 4-5 short spines anteriorly; hind tibia dorsally with 12-16 moveable spines, the basal 1-4 shorter than rest.

FOURTH INSTAR: pala with 18-19 lower palmar bristles; fore femur with 13-14 spines anteriorly; hind femur with 4 short bristles dorsally, 7-11 short spines posteriorly and a row of 4-5 short spines anteriorly; hind femur antero-ventrally with 4-5 short spines at base of subapical tuft of hairs; hind tibia dorsally with 14-16 moveable spines, the basal 2-4 shorter than rest and often paired.

FIFTH INSTAR (Figs. 7, 15-16): pala with 18-20 lower palmar bristles; fore femur with 16-22 spines anteriorly; hind femur with 4 short bristles dorsally, 12-26 posteriorly and 3-7 anteriorly; hind femur antero-ventrally with 4-7 short spines at base of subapical tuft of hairs; hind tibia dorsally with 15-19 moveable spines, the basal 3-5 being shorter than rest and usually paired.



Figs 2 - 10—2, First instar larva **C. bifida;** 3, First instar larva **C. expleta;** 4, Anterior view of pala of first instar **C. bifida;** 5, Anterior view of pala of first instar **C. expleta;** 6, Dorsal view of meso and metanotum of fifth instar **C. bifida;** 7, Posterior view of pala of fifth instar **C. bifida;** 8, Posterior view of pala of fifth instar **C. expleta;** 9, Anterior view of apex of pala of fourth instar **C. bifida;** 10, Anterior view of apex of pala of fourth instar **C. expleta.** [Drawings not to same scale.]



Figs. 11 - 22—Hind femur of larval instars. 11 - 16, **C. bifida;** 17 - 22, **C. expleta:** odd numbers posterior view, even numbers anterior view. 11 - 12, First instar **C. bifida;** 13 - 14, Third instar **C. bifida;** 15 - 16, Fifth instar **C. bifida.** 17 - 18, First instar **C. expleta;** 19 - 20, Third instar **C. expleta;** 21 - 22, Third instar **C. expleta.**
[Drawings not to same scale.]

Table 1. Structural characteristics of larval instars of C. bifida and C. expleta LA = length from anterior of mesonotum to end of abdomen; measurements are the mean of 10 insects; spine counts the range of 10 insects.

Species	Instar	Lower palmar bristles	Spines on fore femur Anterior	Ventral	Anterior	Posterior	Spines on hind tibia Dorsal	Head width	Length (LA)	Abdomen width
bifida	1	12	4	0	3	4	10	0.75 mm.	1.15mm.	0.90 mm.
	2	14	4-5	0	3-4	4-6	10-11	1.00	1.70	1.33
	3	14-17	6-8	0	4-5	5-8	12-16	1.40	2.65	1.65
	4	18-19	13-14	4-5	4-5	7-11	14-16	1.75	3.35	2.20
	5	18-20	16-22	4-7	3-7	12-26	15-19	2.25	5.20	2.45
expleta	1	10-11	4	0	3	4	10	0.75	1.30	0.93
	2	11	4	0	5	5	12	1.00	1.95	1.15
	3	11-12	4-6	0	3-5	4-5	13-14	1.30	2.65	1.60
	4	11-12	9-13	3-6	3-4	3-6	14-17	1.65	4.00	1.85
	5	11-12	14-27	3-7	2-4	4-6	15-17	2.15	5.60	2.40

(5) Descriptions of larvae of *C. expleta*

The descriptions below follow the plan used for *C. bifida* above. Table I summarizes the main taxonomic characters.

FIRST INSTAR (Figs. 3, 5, 17-18): pala with 10-11 lower palmar bristles; fore femur with 4 spines anteriorly; hind femur with 6 long hairs dorsally, 4 short spines posteriorly and 3 slender spines anteriorly; hind tibia dorsally with 10 moveable spines.

SECOND INSTAR: pala with 11 lower palmar bristles; fore femur with 4 spines anteriorly; hind femur with 5 long outstanding hairs and a preapical bristle dorsally, 5 short spines posteriorly and 5 short spines anteriorly; hind tibia dorsally with 12 moveable spines.

THIRD INSTAR (Figs. 19-20): pala with 11-12 lower palmar bristles; fore femur with 4-6 spines anteriorly; hind femur with 4 short bristles dorsally, 4-5 short spines posteriorly, 3-5 short spines anteriorly; hind tibia with 13-14 moveable spines dorsally, the basal 3 shorter than rest.

FOURTH INSTAR: pala with 11-12 lower palmar bristles; fore femur with 9-13 spines anteriorly; hind femur with 4 short bristles dorsally, 3-6 short spines posteriorly and 3-4 short spines anteriorly; hind femur antero-ventrally with 3-6 short spines at base of subapical tuft of hairs; hind tibia with 14-17 moveable spines dorsally, the basal 3-5 shorter than rest.

FIFTH INSTAR (Figs. 8, 21-22): pala with 11-12 lower palmar bristles; fore femur with 14-27 spines anteriorly; hind femur with 4 short bristles dorsally, 4-6 short spines posteriorly and 2-4 short spines anteriorly; hind femur antero-ventrally with 3-7 short spines at base of subapical tuft of hairs; hind tibia dorsally with 15-17 moveable spines, the basal 4-5 shorter than rest and often paired.

(6) Duration of immature stages.

The duration of the embryonic development of *C. bifida* from White Lake has been determined for eggs laid in White Lake water and at temperatures of 10°C and 20°C. The duration of the larval instars at 20°C has also been measured (Table II).

Table II—Duration of larval instars of **Cenocorixa bifida** in White Lake water, at 20°C and fed every other day on **Artemia salina.**

Instar	Duration
First	4 - 5 days
Second	4 - 5
Third	4 - 5
Fourth	5 - 7
Fifth	6 - 9
Total	23 - 31

At 20°C the eggs took 7-9 days to hatch, while at 10°C they took 44-46 days to hatch. The larval period at 20°C took 23-31 days.

DISCUSSION

Hungerford (1948) has given a figure (p. 13) of the various shapes of eggs in the Corixidae. Both the shape of the egg and the mode of attachment to the substrate is variable. While in the Micronectinae the eggs are elongate and attached longitudinally to the substrate without a special attachment disc, those of the Corixinae are characteristically top-shaped with a button-like attachment disc, borne at the end of a stalk of varying length. The chorion is also variable in surface texture, being smooth or with surface projections. The eggs of *Cenocorixa* are thus typical of the subfamily Corixinae.

Cobben & Pillot (1960) have considered the characteristics of importance in the identification of the fifth instar larvae of *Micronecta, Cymatia, Corixa, Hesperocorixa, Glaenocorixa, Sigara, Arctocorixa* and *Callicorixa*. I can find no description of the larvae of *Cenocorixa* in the present literature. It is evident that the latter instars of *Cenocorixa* are very similar to those of the genera *Sigara, Arctocorixa* and *Callicorixa* in the pubescence on the mesonotum.

The character of the apical spine of the pala and the prominence at the base of the apical lower palmar bristle serves to separate larvae of *C. bifida* from those of *C. expleta*. The larval instars are also easy to key out in each species.

The study of *Cenocorixa* suggests that it should be possible to key out the last three larval instars of most Corixid species, since the characters of the fifth instar are usually also found in the third and fourth instar. However, the first two instars lack many of these essential characters, and may prove extremely difficult to identify when a mixture of species occur together.

The great transformation between the second and third instar larvae in *Cenocorixa,* also occurs in other Corixidae, for example *Palmocorixa buenoi* Abbott (Hungerford, 1919). Not only does this involve the external characters cited, but there is also great changes in the internal anatomy at this time.

The duration of the immature stages in *C. bifida* at 20°C and fed on *Artemia salina* every other day, is 23-31 days. Since it is possible to lengthen the egg from 7-9 days at 20°C to 44-46 days at 10°C, it seems likely that the larval instars would also take much longer to develop at lower temperatures, and so the life cycle at different times of year would not occupy the same developmental time period. Griffith (1944) reports 35 days as the developmental time for *Ramphocorixa acuminata* (Uhler) and 36 days for *Corisella edulis* (Champion), but notes a great variation in rearing experiments. These differences could have been due to different feeding rates and/or different temperatures: no temperature data are given in the paper.

Acknowledgements

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A BRITISH COLUMBIA RECORD FOR *Xenos peckii* KIRBY

A male *Polistes fuscatus variatus* Cresson parasitized by *Xenos peckii* Kirby was among various wasps collected August 5, 1947 after they had settled for the night on mullein, *Verbascum thapsus* L., 2 miles south of Vernon, B.C. The parasitized wasp had two male strepsipteran pupae protruding from its abdomen, one laterally from between the 5th and 6th terga, the other ventrally from between the sterna of the same segments. The wasp and the parasites were identified in 1958 by Dr. R. M. Bohart, University of California, Davis, Calif. One of the parasites is in the collection of the University of British Columbia, Vancouver, B.C.

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