0.28 to 0.42 mm. long, bearing 1 oval sensorium; IV, 0.25 to 0.37; V, 0.23 to 0.29; VI, 0.1 to 0.13 + 0.4 to 0.6 mm.; rostrum surpassing second coxae, rostral IV + V 0.11 to 0.13 mm. long and acutely conical, tip needle-like; hind tibiae 0.66 to 1; hind tarsi 0.1 to 0.14; cornicles pale to slightly dusky, 0.13 to 0.26 long with weak flange straight or at an angle; cauda 0.21 to 0.26 mm. long.

Collections. On *Artemisia* in Utah at Ash Creek, Washington County, April 25, 1935 (Knowlton-Smith); Dry Lake, August 10, 1927 (Knowlton). On *A. tridentata* at Minkcreek, Idaho, August 16, 1927 (Knowlton).

Taxonomy. This species runs to *C. brevinectarius* in Gillette and Palmer's key (Ann. Ent. Soc. Amer. 27:144), from which it differs in: Cornicles longer than hind tarsi; cornicles more than half the length of the cauda; paler antennae and shorter antennal segments; only 1 sensorium upon antennal III. It differs from *C. heterohirsutus* in having only fan-shaped hairs upon head; cornicles shorter than cauda.

Capitophorus zoomontanus n. sp.

Apterous vivipara. Color grayish-green; body rather slender, 1.9 to 2.3 mm. long; body with numerous fan-shaped hairs; hairs on vertex 0.04 to 0.05 mm. long; antennae dusky beyond middle of IV; antennal III, 0.75 to 0.81 mm. long, with 1 to 2 rounded sensoria; IV, 0.86 to 0.97; V, 0.76 to 0.8; VI, 0.2 to 0.24 + 1.03 to 1.3 mm. long; rostrum surpassing second coxae; rostral IV + V acute, tip needle-like, 0.09 to 0.11 mm. long; hind tibiae 1.4 to 1.8; hind tarsi 0.15 to 0.19; cornicles pale, rather cylindrical, 0.61 to 0.77; cauda pale, 0.26 to 0.32 mm. long.

Collections. On *Artemesia* at a 7600-foot elevation in Daniels Canyon, Utah, July 13, 1927, and at summit of this canyon August 16, 1935 (Knowlton).

Taxonomy. This species closely resembles *C. longinectarius* G. and P., from which it differs in having short, inconspicuous hairs on antennals I and II; rostral IV + V shorter than hind tarsi; more cylindrical cornicles, which usually are shorter than antennal V.

Types in the collection of the senior author. Paratypes of most species in the U. S. National Museum and the collection of the junior author.

THE SIGNIFICANCE OF THE OUTGROWTHS ON THE PROTHORAX OF ECDYONURUS VENOSUS FABR. (EPHEMEROPTERA).

BY F. P. IDE,
University of Toronto.

In 1930 Dr. R. H. Emslie turned over to the author a small collection of mayfly nymphs collected by him in streams in Scotland. Among them was a small series of nymphs of *Ecdyonurus venosus* Fabricius in different instars collected at Tummel Bridge and Bridge of Weir. This species is unique in having prominent postero-lateral extensions of the prothorax resembling the wing-pads of the meso- and metathorax (Figs. 1 & 8).

Vayssiere (1882) has described the anatomy of this nymph in detail under the name *Heptagenia longicauda* and refers to these structures as prolongations. Enough material was included in Dr. Emslie's collection to show that these prothoracic processes grow back in much the same manner as the wing

pads to a certain point but never develop into wings and are not represented in the adult, except possibly by the thin posterior flange of the segment.

The growth of the mesothoracic wing-pads of *Heptagenia pulla* Clem., a similar type of nymph found in America, has been studied. The lengths of the wing pads of about two hundred and fifty individuals of the last seven instars were measured. To compensate for differences in size of nymphs the length obtained for the wing-pads was divided by the length of the seventh abdominal segment for each individual. The factors (length of mesothoracic wing-pad by length of seventh abdominal tergum) thus obtained were plotted in a frequency diagram from which the mode of the factor for each instar was determined.

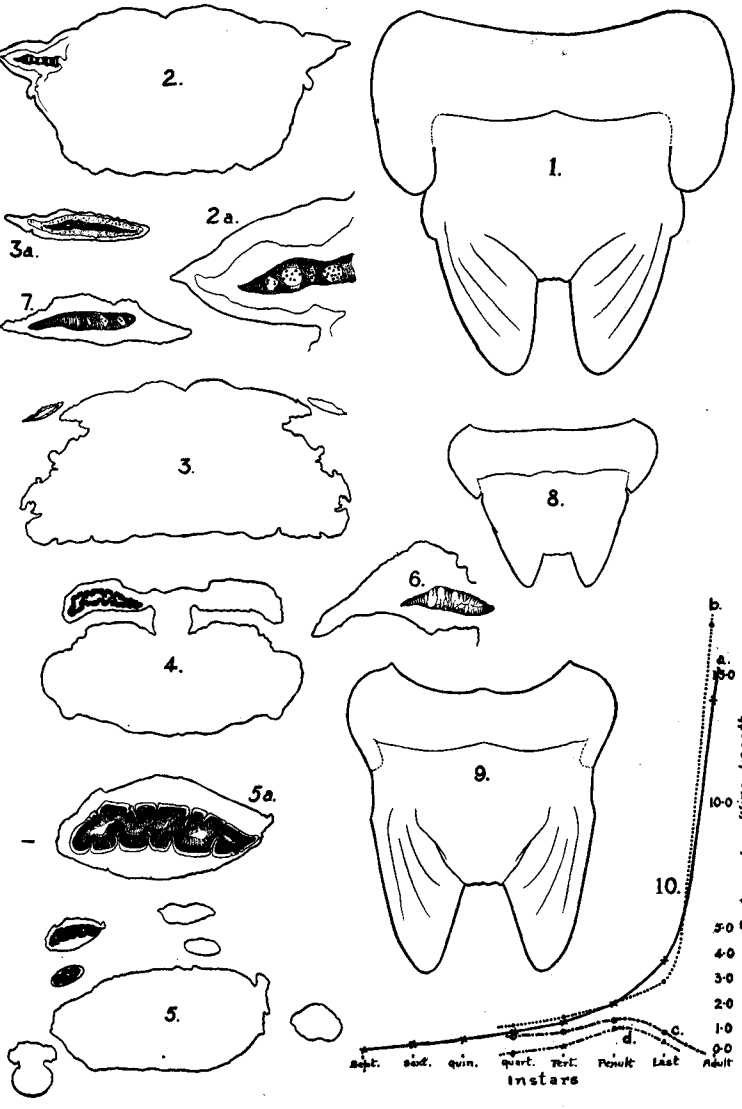
The line "a" of Fig. 10 is the result of plotting the factors, determined as described above, against the number of the corresponding instar including also the imago.

In the graph the interval between each instar is equal since the duration of each instar was not known. Line "b" of the same figure shows the plotting of similar factors for the instars of *E. venosus* represented in the collection. The points in this curve are based on the measurement of a few nymphs only and therefore probably do not represent accurately the mode for the instars. The last nymphal instar was not represented in the collection but the point has been included on the graph, the measurements being taken from Eaton's figure (1888). The point on the curve for the adult is based on the measurement of one individual. Both these curves, in their upward swing, illustrate the relative growth of the wing-pads.

Measurements of the prothoracic extensions treated in the same way as those of the mesothoracic wing pads to give a factor for each instar are shown graphically in lines "c" and "d" of fig. 10. The measurements used in plotting line "c" were made from the posterior border of the prothorax to the tip of the extension whereas those used in plotting line "d" were of the length of the free portion of the process only. The process is fused to the mesothorax as far as the point X shown in Fig. 1, beyond which it is entirely free. Both of these lines indicate that the prothoracic extensions grow out in much the same way as the wing-pads. They grow at an accelerated rate until the second last instar when there is a retardment in growth rate, they drop behind, and in the adult have practically disappeared.

In figures 2 to 5 are illustrated transverse sections of a nymph of the penultimate instar which is about to transform into the last instar. The cuticle of the meso- and methathoracic wing pads of the enclosed nymph is very much folded showing that there will be a great expansion of these structures at ecdysis. In contrast the cuticle of the prothoracic extensions (Figs. 3 and 3a) is not folded in a like manner and this is what one would expect from the appearance of these structures in the last instar. The graphs "c" and "d," Fig. 10, show that the growth increment of these extensions is practically nothing between the penultimate and last instars.

It was hoped that a nymph of the third last (tertiult) instar would be found which was about to shed its skin, but such a nymph was not available in the limited amount of material at my disposal. One would expect that the pro-



ECDYONURUS VENOSUS FABR.

thoracic extensions of the enclosed penultimate instar would be much folded since it is between the tertiult and penultimate instars that these structures increase at the maximum rate. Sections of an early tertiult nymph (Figs. 6 and 7) show that the hypodermal cells in the prothoracic extensions are of a similar type to those in the meso- and metathoracic wing pads with this difference, that they are much less crowded together.

Handlisch (1908) figures in his atlas five insects of the carboniferous order Palaeodictyoptera which have prominent lateral prothoracic extensions. These five insects belong to five different families of the order so that these structures were of wide occurrence. They are thought to be the homologues of wings and to represent an antecedent condition in the evolution of wings in which they were not moveable and functioned as gliders. The fact that these processes are lateral in Palaeodictyoptera is not disturbing since nymphs of members of the same order show the meso- and metathoracic wing pads also projecting laterally. They are thought by Comstock (1918) to have been terrestrial nymphs on this account.

In the nymphs of Ephemeroptera and Protephemeroptera the meso-and metathoracic wing-pads project backwards and the prothoracic extensions also project backward and are distinct from the flange which frequently borders the lateral margins of the pronotum.

There has been no data available on the growth of the prothoracic extensions in Palaeodictyopteran insects. For this reason it seemed desirable to describe in this paper the growth of similar wing-like prothoracic lobes of Ephemerid nymphs as an additional point in support of the theory that they are homologous with wings and not special nymphal structures. The fact that they do not persist in the adult does not rule out the possibility of their being a recapitulation of an adult structure in an ancestral type. There is a parallel to this phenomenon in the disappearance of the median caudal filament in the adults of many mayflies. Frequently the adult will have no or a very reduced median filament whereas the nymph of the same species will have a median filament as well developed as the lateral filaments. Within the order Ephemeroptera the three tailed condition is probably primitive since it is so universal a characteristic of the families in the group and is found in the Protephemeroptera.

The question might be raised as to whether the family Heptageniidae to which *E. venosus* belongs is a primitive group within the order. Spieth (1933) in his discussion of the phylogeny of Ephemeroptera places the family Heptageniidae in what he considers the most primitive superfamily, namely the Siphlonuroidea. The family Siphlonuridae in his arrangement is, however, more primitive than the Heptageniidae within the superfamily.

It seems probable that the extensions of the prothorax in *E. venosus* are homologous with wing-pads and that they are governed by the same growth centre as that controlling the growth of the mesothoracic and metathoracic wings. The growth compartment, to use Huxley's term (1931), is not as restricted in this form as in the other species of mayflies and affects the prothorax also as it did apparently in some of the Palaeodictyoptera.

In most members of the family Heptageniidae to which *E. venosus* belongs the prothorax of the nymph is intimately fused to the mesothoraxx at the sides

but becomes free again in the adult condition. This fusion is illustrated in Fig. 9 of the pro- and mesothorax of *Heptagenia pulla* Clem. It is possible that this is a fusion of the prothoracic processes to the sides of the mesothorax.

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Explanation of Plate 13

Figures 1-5, penultimate nymphal instar of *E. venosus;* 1. Prothorax and mesothorax; 2. transverse section through prothorax; 2a. enlarged lateral border; 3. transverse section through mesothorax showing posterior extensions of prothorax; 3a. enlarged prothoracic extension; 4. transverse section through posterior portion of mesothorax showing bases of mesothoracic wing-pads; 5. transverse section behind thorax showing meso-and metathoracic wing-pads; 5a. enlargement of mesothoracic wing-pad; 6. enlargement of transverse section of prothoracic extension of tertiult instar of E. *venosus*; 7. transverse section of metathoracic wing-pad of tertiult instar; 8. pro- and mesothorax of a young nymph of *E. venosus* showing an early stage in the development of the prothoracic extensions; 9 pro- and mesothorax of a nymph of *Heptagenia pulla* showing fusion of the prothorax to the mesothorax at the sides; 10. graph showing growth of wings during the later nymphal instars and adult of *H. pulla* and *E. venosus;* 10a. mesothoracic wings of *H. pulla;* 10b. mesothoracic wings of *E. venosus;* 10c. prothoracic extensions of *E. venosus* measured from the posterior border of the prothorax; 10d. the free portion (point X to apex) of the prothoracic extensions.

ANNUAL MEETING ENTOMOLOGICAL SOCIETY OF ONTARIO

The Seventy-third Annual Meeting of the Entomological Society of Ontario will be held at the Dominion Parasite Laboratory, Dundas St. E., Belleville, on Thursday and Friday, November the 19th and 20th, 1936.

A meeting of the council will be held on Wednesday evening, November 18th, at 8.15, in the Dominion Parasite Laboratory.

Titles of papers should be in the hands of the Secretary by November 1st. The presentation of a paper during the general meeting should not exceed 15 minutes. This limit does not apply to the manuscript. Please advise of time required for the presentation of your paper and whether a lantern is required.

L. S. McLAINE, President. R. H. OZBURN, Secretary.

A. B. BAIRD, Chairman of the local committee.

Mailed Saturday, October 31st, 1936.