

LIBRARY OF THE
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

NOTICE: According to Sec. 19
(a) of the *University Statutes*,
all books and other library
materials acquired in any man-
ner by the University belong to
the University Library. When
this item is no longer needed
by the department, it should
be returned to the Acquisition
Department, University Library.

ILLINOIS NATURAL
HISTORY SURVEY



**IDENTIFICATION and DESCRIPTIONS OF
THE ULTIMATE INSTAR LARVAE OF
Hydraecia immanis (Hop Vine Borer)
and *H. micacea* (Potato Stem Borer)
(Lepidoptera: Noctuidae)**

George L. Godfrey



Biological Notes No. 114

Illinois Natural History Survey
Champaign, Illinois February 1981

State of Illinois
Illinois Institute of Natural Resources
Natural History Survey Division

Identification and Descriptions of the Ultimate Instar Larvae of *Hydraecia immanis* (Hop Vine Borer) and *H. micacea* (Potato Stem Borer) (Lepidoptera: Noctuidae)

George L. Godfrey

The distribution of and economic damage caused by two species of stalk and root boring noctuid caterpillars, *Hydraecia immanis* Guenée (hop vine borer) (Fig. 1) and *H. micacea* (Esper) (potato stem borer), are being monitored by entomologists in several regions of the USA, especially Illinois, Iowa, Minnesota, New York, and Wisconsin, because of recent problems associated with these species in field and sweet corn (*Zea mays* L.). (*Hydraecia* has been used by many North American authors, but Nye [1975] pointed out that it is an unjustifiable emendation of *Hydraecia*.) In the corn growing areas of these states one or both species have caused rather extensive, although localized, feeding damage.

H. immanis is native to North America, and the moth occurs from "Quebec to Virginia, west to the west coast" (Forbes 1954). Its caterpillar has been reported from corn before, but its greatest previously associated economic damage has been with hop (*Humulus lupulus* L.) (Hawley 1918). Two other recorded hosts are *Silphium* sp. (Compositae) and *Lupinus microcarpus* Sims (Leguminosae) (Tietz 1972). Reared adults of *Hydraecia immanis* from Cicero, Illinois, are in the collection of the Illinois Natural History Survey, with host-plant labels corroborating Tietz's published record of *Silphium*, but I do not know of any sources that authenticate the association with *Lupinus microcarpus*, a western plant species that occurs on Vancouver Island and coastal Puget Sound, extends southward to Baja California, and also is found in Chile (Hitchcock et al. 1961).

Hydraecia micacea is a polyphagous Palearctic species that apparently was introduced to the New World in Nova Scotia and New Brunswick around the turn of the century (Gibson 1909). Gibson (1909) recorded the localities of the first corn associations for the larva of *H. micacea* in North America as Mahone, Nova Scotia, 1906, and Tramore, Ontario, 1907. The distribution of *H. micacea* in the USA until recently was confined to the extreme northeastern states, perhaps due in part to the barrier afforded by the Hudson and St. Lawrence river valleys, the Great Lakes, and the several mountain ranges in that area. But Muka (1976 and personal communication) reported infestations of *H. micacea* in field corn in 1975 in New York (St. Lawrence, Franklin, Clinton, and Essex counties). He and Professor John G. Franclemont (personal communication) subsequently have seen *H. micacea* on corn in several other New York counties

(Monroe, Orleans, Niagara, Jefferson, Lewis, Oneida, Herkimer, Wayne, Cayuga, and Oswego) and *H. immanis* in Onondaga County.

Farther west, larvae of *Hydraecia* have been seen in field corn during June in increasing numbers since 1976 in a region that centers on northern Illinois, southwestern Wisconsin, southeastern Minnesota, and northeastern Iowa (Fig. 2). The area of most severe infestation to date has been in Fillmore County, Minnesota, necessitating the replanting of 2,000 acres of corn in 1979 (S. F. Tutt personal communication). There is some confusion regarding the identity of *Hydraecia* found in field corn in the Midwest as a result of tentative determinations applied to larvae collected in the field. The most widely circulated name has been *H. micacea* (Fig. 3), but adults reared from larvae collected in Illinois during 1978 were identified by me and later confirmed by Franclemont as *H. immanis* (Fig. 4). A reared adult from Fillmore County, Minnesota, in 1979 proved to be *H. immanis* also.

The ultimate larval instar of each species has been described several times. Bethune (1873) gave the earliest account of the larva of *H. immanis* although at the time he acknowledged not knowing its identity. The first published association between the larva and moth of *H. immanis* is Comstock's (1883). Some of the earliest larval descriptions of *H. micacea* by North American entomologists, in addition to Gibson's (1909), are Brittain's (1915 and 1918). Presently, no taxonomic literature exists that can be reliably used to identify and separate the mature larvae of *H. immanis* and *H. micacea*. Hence, the following comparative larval descriptions and illustrations are provided to promote positive determinations. Other species of North American *Hydraecia* (dependent in degree on the generic definition of this taxon) may feed on corn, but *H. immanis* and *H. micacea* are the only ones positively associated to date. I believe that the following information will aid in monitoring distributional changes and in the development of pest management



Fig. 1.—Dorsal view of mature larva of *Hydraecia immanis* (about 2.0X life size).

This paper is published by authority of the State of Illinois and is a contribution from the Section of Faunistic Surveys and Insect Identification of the Illinois Natural History Survey. Dr. George L. Godfrey is an Associate Taxonomist at the Survey.

Cover illustration.—Larva of *Hydraecia immanis* and damaged cornfield in Clayton County, Iowa (Photographs by Jerry DeWitt, Extension Coordinator, Integrated Pest Management, Iowa State University, Ames, Iowa).



Fig. 2.—Distributional records of *Hydraecia immanis* larvae in Illinois and neighboring states.

programs for *H. immanis* and *H. micacea*. The morphological terminology and abbreviations used in this paper have been used previously (Godfrey 1972).

DESCRIPTIONS

Hydraecia immanis Guenée

General. Head smooth, width 3.00–3.58 mm. Body uniformly cylindrical, length 29–35 mm; ap-

pers smooth, but numerous, minute granules visible at 100X, especially along anterior edge of cervical shield. All setae simple, body setae arising from conspicuous pinacula. Prolegs present on Ab3–6 and 10; subequally developed. Crochets uniordinal and in mesoseries.

Head. Postgenal sutures parallel to each other; length of epicranial suture 1.56 times distance from apex of frons to Fa's (Fig. 9); distance F1–F1, 0.50–0.72 mm; AFa cephalad and AF2 caudad of frons apex; A1–3 form obtuse angle at A2; distances P1–P1 and P2–P2 subequally spaced; P1's distinctly closer to epicranial suture than to L; L cephalad of juncture of adfrontal ecdysial lines; margin of antennal socket convexly produced; distance Oc1–Oc2, 0.10–0.14 mm; Oc2–Oc3, 0.06–0.08 mm; Oc3–Oc4, 0.05–0.07 mm.

Mouthparts. Mediobasal area of oral surface of



Fig. 3 and 4.—Adults (males) of *Hydraecia*. 3, *H. micacea*; 4, *H. immanis* (0.92X life size).

labrum has scattered, thin, short spines. Hypopharyngeal complex (Fig. 10): spinneret elongate, tubular, narrowing distad, with acute apex greatly surpassing tip of Lp2; length about 2.9 times that of Lps1. Length of Lps1, 2.1 times that of stipular seta, 13.0 times that of Lp1, 6.0 times that of Lps2, 4.3 times that of Lp2. Distal region without spines except for very short, fine ones laterad; proximomedial region lacks spines; proximolateral region bears numerous thin spines that become stouter and longer proximad. Mandible (Fig. 11): two outer setae present, closely spaced; inner tooth absent; inner ridges reduced, terminating before cutting edge; first outer tooth reduced, triangular, inconspicuous; outer teeth 2–5 triangular; sixth outer tooth reduced, rounded.

Thorax. Segment T1: SD1 and SD2 setal insertions contiguous with or slightly separated from lateral edge of cervical shield (Fig. 5 and 14); interspace D1–D1 about 0.68 times the distance XD1–XD1; D2–SD2 about 2.3 times the distance SD2–XD2; seta SD1 minute, inconspicuous; L2 insertion minute, seta absent; spiracle broadly elliptical, length about 2.0 times width, major axis passing caudad of SD and SV setal insertions. Segments T2 and T3 (Fig. 14): distance D1–D2 about 0.8 times distance D2–SD2; SD1 hairlike; coxal bases distinctly separated. Tarsal setae 1–3 slightly thickened, 4 merely setose; base of tarsal claw reduced, weakly convex.

Abdomen. Segment Ab1 has 2 SV setae. Segments Ab2–6 have 3 SV setae each, 1 each on Ab7 and Ab8. Chaetotaxy of Ab6, Ab7 as in Fig. 15. Segment Ab9: SD1 semihairlike, much thinner and shorter than D1 and D2. Segment Ab10: posterior margin of anal shield entire; anal shield convex with but slight transverse depression before posterior margin; subanal setae unmodified, subequal to lateral setae of anal proleg.

Coloration (Fig. 1). Head orange to reddish brown (head of earlier instars may be yellow), essentially immaculate, some specimens show very faint reticulation; clypeus ranges from solid orange to dark brown; ocelli and ocellar area dark brown to black; mandibles reddish brown to black. Body ground color sordid white, underlaid by transverse, violet bands on segments T2 through Ab8; bands interrupted by thin, white continuous middorsal and subdorsal lines (Fig. 6) (violet bands fade before prepupal stage); conspicuous dark brown to black pinacula present dorsally, subdorsally and laterally; setae white; spiracles brown with black peritremes; cervical shield (Fig. 5) glossy, pale brownish orange, with distinct black anterolateral margin; anal shield dark brown to black; cervical and anal shields interrupted by thin, whitish middorsal line.

Material examined. ILLINOIS: De Kalb, 23 June 1965, corn, H. B. Petty, 1 larva; Boone County, 10 June 1976, *Zea mays* L., C. Bremer, 2 larvae; Carroll County, 14 June 1978, *Zea mays* L., 4 larvae; Boone County, June 1978, *Zea mays* L., C. Bremer, 1 larva; Stephenson County, June 1979, corn, 6 larvae. IOWA: Clayton County, 12 June 1978, corn, 1 larva;

Winneshiek County, 15 June 1979, corn, 2 larvae. MINNESOTA: Houston County, 22 June 1976, P. Sreenivasam, 7 larvae; Fillmore County, 22 June 1979, corn, J. Lofgren, 11 larvae; Fillmore County, June 1979, corn, S. F. Tutt, 8 larvae. NEW YORK: Onondaga County, Pompey, 7 July 1978, corn, A. A. Muka/M. E. Philipps, 3 larvae. WISCONSIN: Racine, 24 June 1926, International Harvester Company, 1 larva; northern Iowa County, 26 June 1979, corn, P. Pellitteri, 2 larvae; Richland County, near Excelsior (Dobbs' Farm), 19 June 1979, field corn, J. M. Scriber, (12 larvae), 25 June 1979 (31 larvae), 3 July 1979 (24 larvae).

Hydraecia micacea (Esper)

General. Head smooth, width 2.75–3.16 mm. Body uniformly cylindrical, length 25–31 mm; appears smooth, but numerous, minute granules visible at 100X, most distinctive along anterior edge of cervical shield. All setae simple, body setae arising from conspicuous pinacula. Prolegs present on Ab3–6, 10; subequally developed. Crochets uniordinal and in mesoseries.

Head. Postgenal sutures parallel to each other; length of epicranial suture 1.51 times distance from apex of frons to Fa's (Fig. 12); distance F1–F1, 0.44–0.52 mm; AFa cephalad and AF2 caudad of apex of frons; A1–3 form obtuse angle at A2; distances P1–P1 and P2–P2 subequally spaced; P1's about 0.33 times closer to epicranial suture than to L; L cephalad of juncture of adfrontal ecdysial lines; margin of antennal socket distinctly flanged outward; distance Oc1–Oc2, 0.08–0.10 mm; Oc2–Oc3, 0.05–0.08 mm; Oc3–Oc4, 0.04–0.06 mm.

Mouthparts. Mediobasal area of oral surface of labrum has thin, short spines. Hypopharyngeal complex (Fig. 13): spinneret elongate, tubular, bluntly tipped, with apex distinctly surpassing tip of Lp2; length about 2.3 times greater than length of Lps1. Length of Lps1, 1.7 times that of stipular seta, 6.7 times those of Lp1 and Lps2, 5.0 times that of Lp2. Distal region bare except for few, scattered, short, stout spines located laterad; proximomedial region lacks spines; proximolateral region bears short, stout spines, length increasing proximad. Mandible (Fig. 11): two outer setae present, closely spaced; inner ridges reduced, terminating before cutting edge; first outer tooth reduced, rounded.

Thorax. Segment T1: SD1 and SD2 setal insertions very narrowly separated from edge of cervical shield (Fig. 7 and 16); interspace D1–D1 about 0.66 times the distance XD1–XD1; D2–SD2 about 1.9 times the distance SD2–XD2; seta SD1 minute, inconspicuous; L2 insertion minute, seta absent; spiracle narrowly elliptical, sides of peritreme nearly parallel to each other, spiracle length about 2.4 times width, major axis of spiracle caudad of SD and SV setal insertions. Segments T2 and T3 (Fig. 16): distance D1–D2 about 0.8 times distance D2–SD2; SD1 hairlike; coxal bases distinctly separated. Tarsal setae

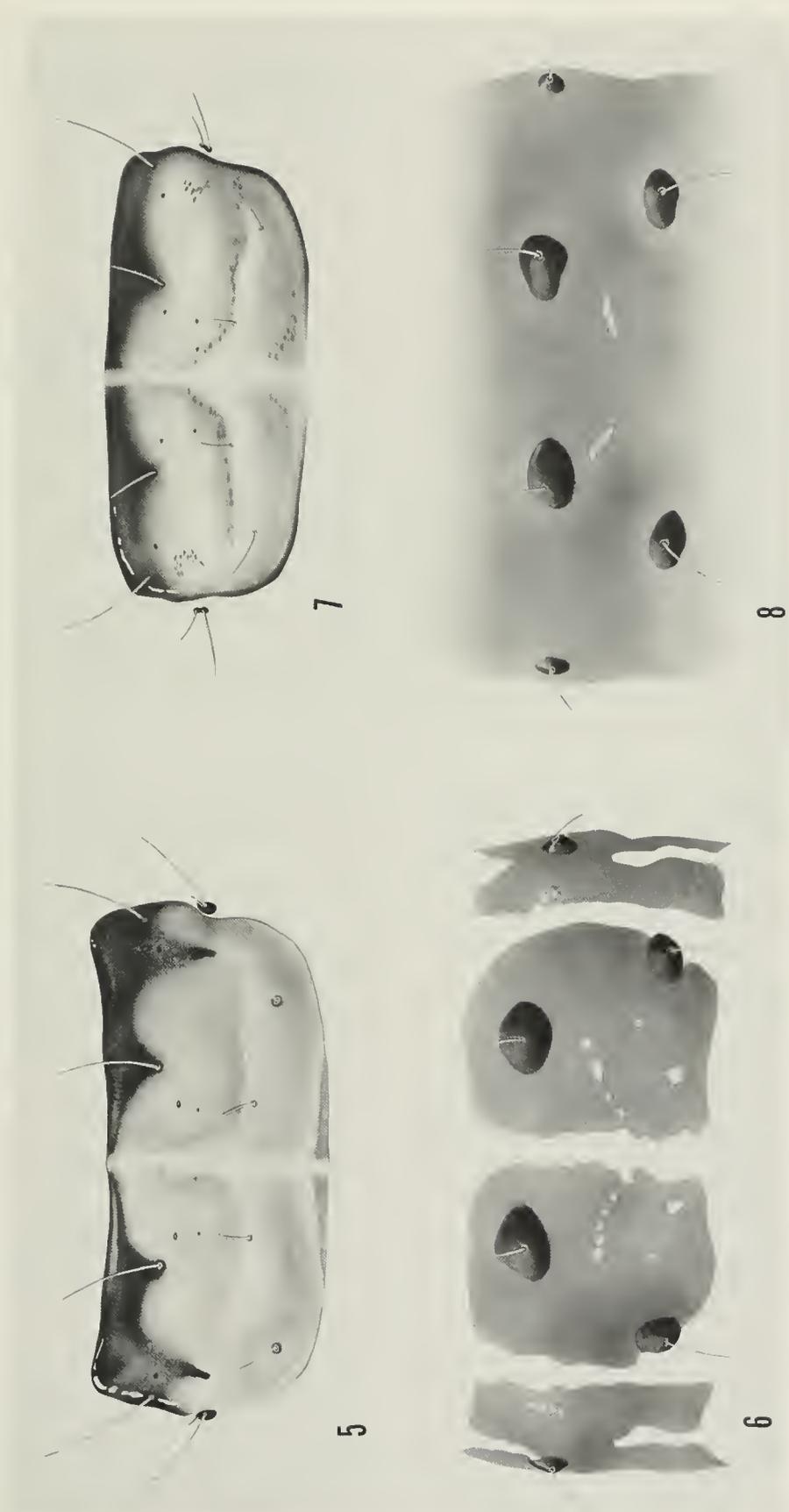


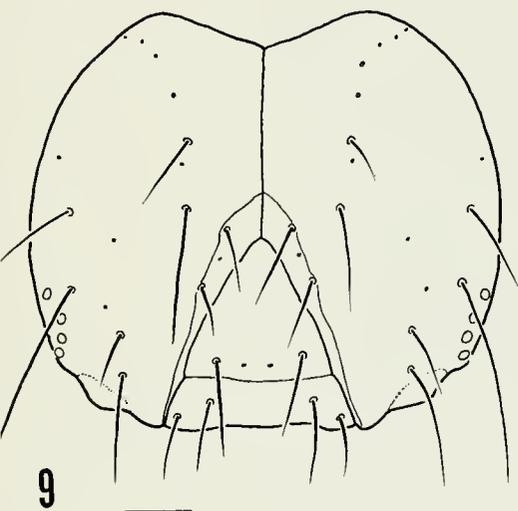
Fig. 5-8.—Dorsal views of cervical shields on prothoracic segments (top row) and third abdominal segments (bottom row) of larvae, showing differences of transverse banding. 5 and 6, *H. immanis*; 7 and 8, *H. micaca*.

1-3 slightly thickened, 4 merely setose; tarsal claw base reduced, weakly convex.

Abdomen. Segment Ab1 has 2 SV setae. Segments Ab2-6 have 3 SV setae each, 1 each on Ab7 and Ab8. Dorsal and lateral chaetotaxy of Ab6, Ab7 as in Fig. 17. Segment Ab9: SD1 semihairlike, much

thinner and shorter than D1 and D2. Segment Ab10: posterior margin of anal shield entire, dorsal surface of anal shield evenly convex except for pinacula; subanal setae unmodified, subequal to lateral setae of anal proleg.

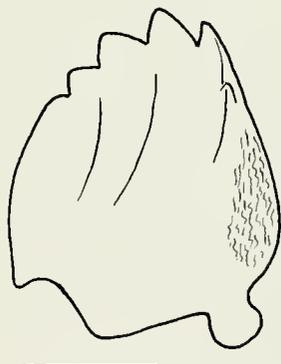
Coloration (in part, translated from Beck 1960).



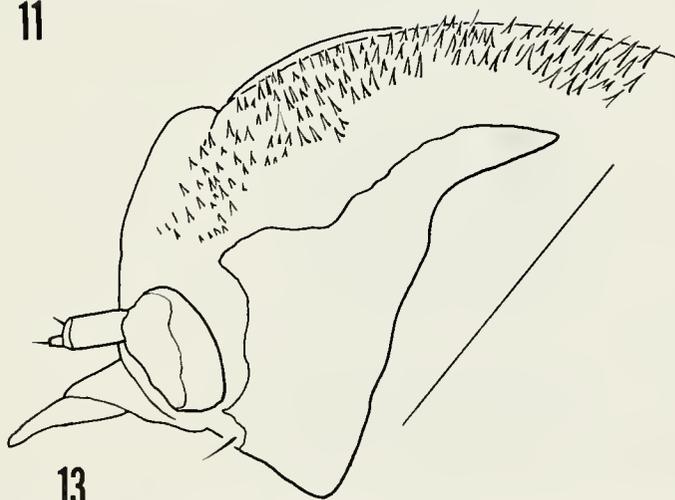
9



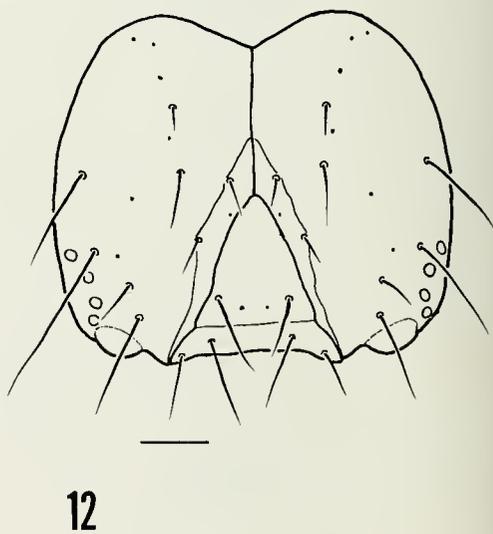
10



11



13



12

Fig. 9-11.—Mature *Hydraecia immanis* larva. 9, frontal view of head capsule; 10, left lateral view of hypopharyngeal complex; 11, oral surface of left mandible. Fig. 12 and 13.—Mature *H. micacca* larva. 12, frontal view of head capsule; 13, left lateral view of hypopharyngeal complex. Scale lines equal 0.5 mm.

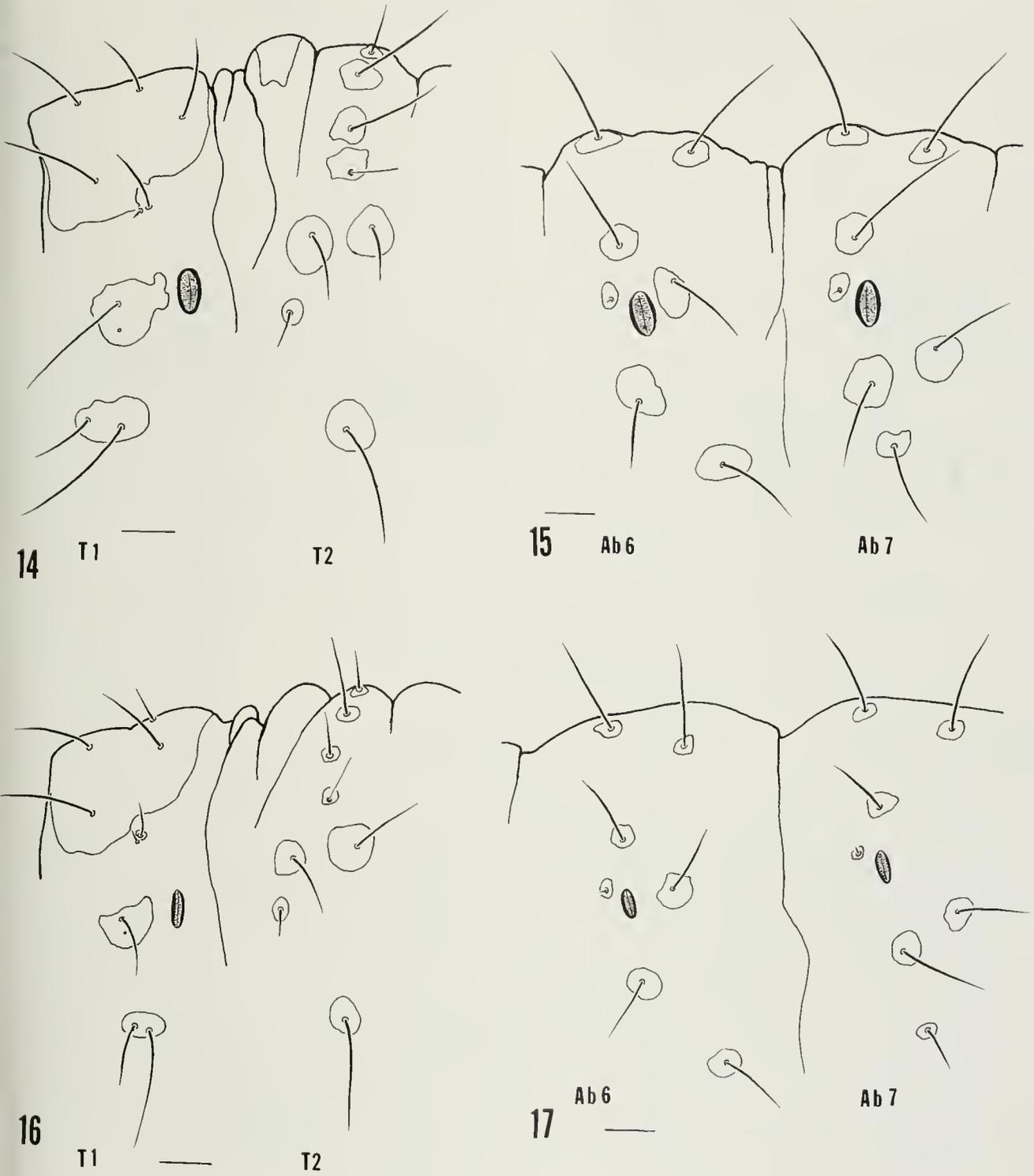


Fig. 14 and 15.—Mature *Hydracacia immans* larva. 14, prothoracic (T1) and mesothoracic (T2) segments (dorsolateral aspects); 15, sixth (Ab6) and seventh (Ab7) abdominal segments (dorsolateral aspects). Fig. 16 and 17.—Mature larva of *H. micuca*. 16, prothoracic and mesothoracic segments; 17, sixth and seventh abdominal segments. Scale lines equal 0.5 mm.

Head reddish brown, ocellar area slightly darker; mandibles dark brown to black. Body ground color whitish gray tinged with red, continuous transverse bands (Fig. 8); pinacula conspicuous, dark brown to black; cervical shield (Fig. 7) glossy, pale yellowish brown, with wide, dark brown anterior border, thin

brownish lateral and posterior borders, thin whitish middorsal line. Anal shield varies from yellow to dark brown.

Material examined. NEW YORK: Monroe County, Hamlin, 8 June 1978, corn, A. A. Muka/M. E. Phillips, 4 larvae; Lewis County, near

Constableville, 6 June 1979, corn, J. G. Franclemont, 9 larvae. NEWFOUNDLAND: Lamaline, September 1976, boring in potato stem, 2 larvae. QUEBEC: Drummondville, 21 June 1978, boring in iris stem, 1 larva.

DISCUSSION

The ultimate instar larvae of *Hydraecia immanis* and *H. micacea* can most accurately be distinguished from each other by collectively examining the spinneret, hypopharynx, color pattern of the cervical shield, shape of the prothoracic spiracle, and dorsal transverse banding on the abdominal segments.

The spinneret of *H. immanis* is acutely pointed and the hypopharyngeal spines are very fine and numerous (Fig. 10). In contrast, *H. micacea* is characterized by having a bluntly tipped spinneret and stout spines on the hypopharynx that are less numerous (Fig. 13). The characteristics of the spinneret and hypopharynx remain unchanged in preserved specimens and can be seen easily with a dissecting microscope at 50–100X magnification after the removal or abduction of either mandible. Using these characteristics is disadvantageous if field-collected larvae must be kept alive.

The cervical shield of *H. immanis* has a dark anterior border that is wider laterally than medially (Fig. 5). This border on *H. micacea* (Fig. 7) is also dark but is nearly of equal width across the cervical shield and thinly extends around the lateral and posterior edges. The maculation of the cervical shields is useful for identifying living or freshly preserved larvae, but the thin, dark lateral and posterior borders on *H. micacea* can be difficult to see on old, poorly preserved specimens.

The prothoracic spiracle of *H. immanis* tends to be broadly elliptical (Fig. 14), while that of *H. micacea* is narrowly elliptical (Fig. 16). These differences can be used cautiously to diagnose either the living or preserved larvae of the two species but should not be used solely.

The transverse banding on the abdominal segments, as detailed in the above descriptions, is species specific and easily interpretable in living specimens at the onset of the ultimate larval instar. However, the diffuse, continuous transverse bands on *H. micacea* and the bands of *H. immanis*, which are interrupted by the middorsal and subdorsal lines, may be lost entirely shortly prior to the prepupal stage. It is the implied constancy of the interspecific differences of the transverse banding that presents difficulty in Crumb's (1956) identification key.

ACKNOWLEDGMENTS

This research was supported in part by funds from US EPA Grant R805429 (University of Missouri), subcontracted to the Illinois Agricultural Experiment Station. I thank Dr. John G. Franclemont (Cornell University) for his numerous contributions to this work, including invaluable information, discussions, resolution of identifications, and the donation of study material. Additional loans of specimens were arranged by Ms. Suzanne Allyson (Canadian National Collection) and Dr. Philip J. Clausen (University of Minnesota). I appreciate the provision of field collections and unpublished information by Drs. Jerry R. DeWitt (Iowa State University), Donald E. Kuhlman (University of Illinois), Arthur A. Muka (Cornell University), J. Mark Scriber (University of Wisconsin), and John L. Wedberg (University of Wisconsin) and Messrs. Rick Foster (Iowa State University), John A. Lofgren (University of Minnesota), Phillip Pellitterri (University of Wisconsin), and Samuel F. Tutt (Balaton, Minnesota). Drs. DeWitt, Franclemont, Kuhlman, Muka, Scriber, and Wedberg and Mr. Lofgren also reviewed the manuscript. I am grateful to Mr. John P. Sherrod for his continuous-tone drawings of the cervical shields and abdominal segments. Messrs. Lloyd LeMere and Les Woodrum, Illinois Natural History Survey Illustrator and Photographer, respectively, provided technical advice and assistance with the other illustrations. Mrs. Bernice Sweeney graciously typed the drafts of this paper, which was edited for publication by Robert M. Zewadski, Technical Editor of the Survey.

LITERATURE CITED

- BECK, H. 1960. Die Larvalsystematik der Eulen (Noctuidae). Abhandlungen zur Larvalsystematik der Insekten. No. 4. Akademie-Verlag, Berlin. 406 p.
- BETHUNE, C. J. S. 1873. Insects affecting the hop. Pages 27–34 in Report of the Entomological Society of Ontario, 1872. Toronto.
- BRITTAI, W. H. 1915. *Hydraecia micacea* as a garden pest. Nova Scotia Entomological Society Proceedings 1: 96–97.
- . 1918. Notes on two unusual garden pests in Nova Scotia. Pages 94–99 in Forty-eighth Annual Report of the Entomological Society of Ontario, 1917. Toronto.
- COMSTOCK, J. H. 1883. The hop-vine borer, or hop grub. American Agriculturist 42: 275.
- CRUMB, S. E. 1956. The larvae of the Phalaenidae. U.S. Department of Agriculture Technical Bulletin 1135. 356 p.
- FORBES, W. T. M. 1954. Lepidoptera of New York and neighboring states. Noctuidae. Part 3. Cornell University Agricultural Experiment Station Memoir 329. 433 p.
- GIBSON, A. 1909. *Hydraecia micacea*, Esp. in Canada. Pages 49–51 in Thirty-ninth Annual Report of the Entomological Society of Ontario, 1908. Toronto.
- GODFREY, G. L. 1972. A review and reclassification of larvae of the subfamily Hadeninae (Lepidoptera, Noctuidae) of America north of Mexico. U.S. Department of Agriculture Technical Bulletin 1450. 265 p.
- HAWLEY, I. M. 1918. Insects injurious to the hop in New York with special reference to the hop grub and the hop redbug. Cornell University Agricultural Experiment Station Memoir 15:141–224.
- HITCHCOCK, C. L., A. CRONQUIST, M. OWNBEY, and J. W. THOMPSON. 1961. Vascular plants of the Pacific Northwest. Part 3: Saxifragaceae to Ericaceae. University of Washington Press, Seattle. 614 p.
- MUKA, A. A. 1976. A new corn pest is south of the border. Hoard's Dairyman 121:688.
- NYE, I. W. B. 1975. The generic names of moths of the world. Vol. 1. Noctuoidea (part): Noctuidae, Agaristidae, and Nolidae. British Museum (Natural History), London. 568 p.
- TIETZ, H. M. 1972. An index to the described life histories, early stages and hosts of the macrolepidoptera of the continental United States and Canada. Part 1. Allyn Museum of Entomology, Sarasota, Florida. 536 p.

