LIFE HISTORIES OF THE NEW YORK SLUG CATERPILLARS.—X-XI.

PLATES III-IV.

By HARRISON G. DYAR, A.M., PH.D.

Euclea delphinii *Boisduval.*

1797—*Phalæna cippus* ABBOT & SMITH, Lep. Ins. Ga. II.
1832—*Limacodes delphinii* BOISDUVAL, CUVIER'S An. Kingdom (Griffith), pl. CIII, fig. 6.
1841—*Limacodes cippus* HARRIS, Ins. Inj. Veg. 303.
1854—*Limacodes querceti* HERRICH-SCHAEFFER, Ausser. Schmett. fig. 174.
1854—*Limacodes quercicola* HERRICH-SCHAEFFER, Ausser. Schmett. fig. 175.
1855—*Euclea cippus* WALKER, Cat. Brit. Mus. pt. V, p. 1143.
1855—*Euclea viridiclava* WALKER, Cat. Brit. Mus. V, 1154.
1860—*Euclea pænulata* CLEMENS, Proc. Acad. Nat. Sci. Phil. XII, 159.
1860—*Nochelia tardigrada* CLEMENS, Proc. Acad. Nat. Sci. Phil. XII, 160.
1864—*Euclea monitor* PACKARD, Proc. Ent. Soc. Phil. III, 337.
1864—*Euclea ferruginea* PACKARD, Proc. Ent. Soc. Phil. III, 337.
1864—*Euclea bifida* PACKARD, Proc. Ent. Soc. Phil. III, 338.
1882—*Euclea querceti* GROTE, Check List, 17.
1882—*Euclea quercicola* PILATE, Papilio, II, 67.
1887—*Euclea elliotii* PEARSALL, Ent. Amer. II, 209.
1891—*Euclea cippus* DYAR, Trans. Am. Ent. Soc. XVIII, 151.
1891—*Euclea cippus* var. *interjecta* DYAR, Ent. News, II, 61.
1891—*Euclea cippus* SMITH, List Lep. 28.
1892—*Euclea querceti* KIRBY, Cat. Lep. Het. I, 547.
1894—*Euclea delphinii* NEUMOEGEN & DYAR, Journ. N. Y. Ent. Soc. II, 67.

LARVA.

1832—BOISDUVAL, Cuvier's An. Kingd. (Griffith), pl. CIII, fig. 7.
1860—CLEMENS, Proc. Acad. Nat. Sci. Phil. XII, 160.
1878—ANDREWS, Psyche, II, 272.
1881—FRENCH, Papilio, I, 144, 145.
1890—PACKARD, 5th Rept. U. S. Ent. Comm. 144.
1891—DYAR, Trans. Am. Ent. Soc. XVIII, 152.
1893—PACKARD, Proc. Am. Phil. Soc. XXXI, 89, 101.
1894—DYAR, Ann. N. Y. Acad. Sci. VIII, 214.
1895—COMSTOCK, Man. Stud. Ins. 223; fig. 258.

SYNOPSIS OF VARIETIES OF THE MOTH IN NEW YORK.

Form delphinii. Green confined to a small triangular basal patch and subapical dots (plate III, fig. 1).

Form querceti. The basal green patch has a short projection on the outer side (plate III, fig. 2, left wing).

Form interjecta. A row of green dots connects the basal and subapical green marks (plate III, fig. 3, right wing).

Form viridiclava. The green forms a continuous band, bordering the cell, notched on the outer side (plate III, fig. 4).

Form elliotii. The green band encroaches on the cell, or even surrounds the discal dot (plate III, fig 5).

SYNOPSIS OF VARIETIES OF THE LARVA.

Form A.—Flesh colored, horns and ridges bright red shading to pinkish; black lines all present, waved, confluent, forming irregular areas about the glandular dots; no quadrate spots; often no detachable spines (plate III, fig. 9).

Form B.—Sordid purplish, the black lines shaded; horns and ridge broadly bright ferruginous, broken on the interspaces, 6–7, 9–10 and 11–12 by quadrate dark brown spots.

Form C.—Dorsum sordid purplish, sides green; marks as in form B (plate III, fig. 6).

Form D.—Green, the black lines faint; horns and ridge yellow, broken by quadrate spots as in form B (plate III, fig. 8).

Form E.—Green, the ridge and horns red; quadrate brown spots on joints 3–4, 4–5, 6–7, 9–10 and 11–12 (plate III, fig. 7).

SPECIAL STRUCTURAL CHARACTERS.

These characters have been already given for the Florida form (see Journal N. Y. Ent. Soc., iv, 125). In the New York forms there are usually no caltrope patches on the subdorsal horns of joint 13. The patch on the lateral horn of joint 12 is present when there is only one pair of detachable spines (on joint 13), but absent when the second pair is present, and even absent in stage vii, before the spines have appeared, so that it may be determined in this stage whether there will be one or two spine patches. The second pair of spine patches appears above this horn (lateral of joint 12) and replaces the caltropes functionally; but probably the spines are not homologous with caltropes as we formerly supposed (Journal, iv, 3, foot note) since both may be present on the same horn and the caltropes abruptly disappear before the spines, not being converted into them.

Our larvæ do not hide by day so persistently as the Florida form, though the habit is present in some degree.

AFFINITIES, HABITS, ETC.

The range of variation in the moths as they occur in New York is illustrated on the plate (figs. 1 to 5). The variation of the amount of green on the fore-wings is from *delphinii*, the minimum, to *elliotii*, the maximum. The ground color also varies from dark ferruginous brown

to ocherous brown and the bright red shade bordering the green outwardly may be distinct or wanting.

The forms have a certain dependence on locality. In the Hudson valley the *delphinii* form predominates, rarely becoming as green as *viridiclava*; on Long Island the tendency is towards green and the *elliotii* form is frequent. The species ranges to the South, our locality being toward its northernmost extension. In the southern part of Florida the *delphinii* form appears, approaching the true *cippus* of Dutch Guayana. According to Cramer's figure, *cippus* is a brown moth with three green patches, the third at the end of the cell, apparently. This is a form which our species has no tendency to assume, and if it really extends into South America, it is more likely to be represented by *Euclea æmilia* Stoll, which differs from the *delphinii* form in having the basal patch yellow, instead of green, a variation which is occasionally indicated in New York specimens.

Euclea dicolon Sepp, is also nearly related, but has a very differently colored larva. In the Mississippi valley and Texas, the forms *pænulata* and *incisa* occur. The larva of the latter is unknown and I have no opinion as to its relation to our species; but the larva of *pænulata* as described by Professor French does not differ from those which have produced *viridiclava* and *elliotii* here. The moth of *pænulata* is only slightly more green than *elliotii* and it seems probable that it is a variety of our species.

The variation in the larvæ is considerable. In our preliminary synopsis (Journal III, 146), we recognized *pænulata* as distinct from *delphinii* on the characters of the number of detachable spine patches and coloration; but further experience renders this view untenable. There is a certain local tendency coupling the forms of larvæ with the moths as indicated in our table. In the Hudson valley the larvæ are generally green with red or yellow horns, the subdorsal band broken by brown spots and the four spine patches well developed. On Long Island the terra cotta form prevails, though not exclusively, without the brown spots and with feebly developed spine patches. However, rarely the terra cotta colored form has four spine patches; such a larva produced a moth of *elliotti*. Then the Florida larvæ, having the characters of *pænulata* in the unbroken subdorsal band and single pair of spine patches, but the green color of *delphinii*, have recently been described in this journal. The moths were *delphinii*, and thus all the differential characters have vanished, leaving a single variable species with a tendency towards local forms.

The species is single brooded in New York. The moths fly in the last of June and in July. The eggs are deposited in the evening, before ten o'clock, usually singly, or but few together, not in the rather large patches of *Sibine*. They hatch in seven days. The larvæ pass through the usual eight stages, occasionally nine. In this case a stage is interpolated between the last two. It usually is like stage VII, but may be like the last stage with the presence of detachable spines. The first stage is quickly passed through without feeding, but afterwards development is more slow. Mature larvæ may be found in September.

The coloration of these larvæ is much less conspicuous than that of *Sibine stimulea* and their defensive armor is weaker in proportion, the spines being distinctly less venomous.

Miss Morton has obtained fertile eggs of the Long Island form from cocoons collected by Mr. Doll. The youngest larvæ which I have found in the field have been in stage III.

CRITICISM OF PREVIOUS DESCRIPTIONS.

The references to Abbot & Smith, Harris, Morris, Packard and Duncan, given in Edwards' catalogue of transformations of N. A. Lepidoptera under the heading *E. cippus*, do not refer to this species, but to *E. indetermina* or *S. stimulea*. The present references are to descriptions or figures of the mature larva and cover the principal colorational forms. This larva has been on the whole so slightly investigated that there is little of a positive nature to correct. Dr. Packard's latest description is full and very good. He says "there seem to be no caltropes . . . in the cuticle of this genus," but above (page 90) he describes "a pale brown patch like a mass of sand" on the upper side of the lateral horns of joints 6 to 11, which are really the patches of caltropes, though he failed to recognize them. The detachable spines are correctly located, but not described in detail. The lateral horns are not referred to their respective segments, and the position of the spiracle on joint 5 is not described.

Dr. Packard's remarks on page 91 agree with my own views, except that I regard this species as tending to become protectively colored, the bright warning color having partly disappeared. Hence the habits of concealment exhibited by the larvæ.

DESCRIPTION OF THE SEVERAL STAGES IN DETAIL.

My description of these stages of the Florida form will suffice for the New York ones. At first all are alike, though the mature larva is

so various. There is usually no permanent color till stage IV and after that the differently colored larvæ gradually differentiate themselves. I have followed out the full life history of the Long Island form in two instances, but do not find enough to warrant redescribing the stages in full.

Food-plants.—Oak, chestnut, bayberry, *Andromeda*, beech, sour gum (*Nyssa*) and wild cherry.

EXPLANATION OF PLATE III.

Fig. 1. *Euclea delphinii*, natural size.
" 2. Form *querceti*.
" 3. Form *interjecta*.
" 4. Form *viridiclava*.
" 5. Form *elliotii*.
" 6. Larva from Dutchess Co., form C.
" 7. The same, form E.
" 8. The same, form D.
" 9. Larva from Long Island, form A.
" 10. A short horn of subdorsal row × 45, with adjacent skin granules.
" 11. A detachable spine of the Florida larva × 175.
" 12. The same from a Long Island larva with one pair of patches.
" 13. The same from a larva with two pairs of patches.
" 14. A spine without the basal bulb; rare; × 175.
" 15. An unusually short spine; Florida larva.
" 16. A caltrope from among the detachable spines.
" 17. Caltropes in position on a lateral horn × 175.

Parasa chloris *Herrich-Schäffer.*

1854—*Neæra chloris* HERRICH-SCHAEFFER, Ausser. Schmett. fig. 176.
1864—*Limacodes viridus* REAKIRT, Proc. Ent. Soc. Phil. III, 251.
1881—*Parasa fraterna* GROTE, Papilio, I, 5.
1882—*Parasa fraterna* GROTE, Check List, 17.
1891—*Parasa chloris* DYAR, Trans. Am. Ent. Soc. XVIII, 154.
1891—*Parasa chloris* SMITH, List Lep. 28.
1894—*Parasa chloris* NEUMOEGEN & DYAR, Journ. N. Y. Ent. Soc. II, 72.

LARVA.

1864—REAKIRT, Proc. Ent. Soc. Phil. III, 251.
1887—HY. EDWARDS, Ent. Amer. III, 169.
1891—DYAR, Trans. Am. Ent. Soc. XVIII, 154.
1893—PACKARD, Proc. Am. Phil. Soc. XXXI, 91.
1894—DYAR, Ann. N. Y. Acad. Sci. VIII, 217.

SPECIAL STRUCTURAL CHARACTERS.

Dorsal space broad, of nearly even width, except at the extremities, where it narrows considerably. The dorsum rises abruptly to a maxi-

mum at joint 5 and then slopes to the tail, the slope becoming steeper after joint 11. Lateral space broad, nearly perpendicular and continuous in direction with the broad, not retracted subventral space. Subdorsal ridge well indicated by the abrupt change in direction between back and sides; lateral ridge slight; subventral edge prominent, two setæ on each segment. Horns at first as well developed as usual in the group (larvæ of type 2), but soon reduced, finally to small rounded spinose buttons. The subdorsal horns of joints 3, 4, 5, 8, 11 and 12 remain longer than the rest; that on joint 13 becomes early consolidated with its fellow into a tail directed posteriorly, at first cleft and spiny, later more uniform. The lateral horns are all small, subequal, situated on joints 3, 4, 6 to 12 as usual. The head is concealed under joint 2, but this joint is scarcely retracted, its spiracle remaining exposed by a lateral retraction of joint 3. The spiracle on joint 5 is moved up out of line with the rest, all being plainly visible, as the whole subventral region is freely exposed.

After stage I, the spines on the horns are of the stinging type, but they are gradually reduced in size and number and become functionless. In the last stage they are so much aborted that they are imperfectly erected after the molt and the group remains pointing inward over the back in the case of the larger horns. The small, black, piercing caps remain and the spines do not become setiferous, except in the case of some of the smallest anterior horns.

Depressed spaces feebly developed, represented by black spots; (1) round, distinct, paired; (2) and (3) tiny dots, segmental; (4) distinct, narrowly elongated and slightly oblique, in the middle of the lateral space; (7) slightly elongated, alternating with the spiracles; (8) a tiny dot above the subventral edge.

Skin covered with very small, dark, pointed spines, which become round, clear granules just above the subventral edge only. Small patches of caltropes are present on the upper side of the reduced lateral horns on joints 6 to 12. No detachable spines.

AFFINITIES, HABITS, ETC.

This larva seems to represent a recent offshoot of the main stem of the spined Eucleids. In its first stages it is very closely allied to *Euclea*, but finally the colors and armor degenerate and the shape is altered to one adapted for concealment. This direction of modification is indicated in both *Euclea delphinii* and *Adoneta spinuloides*, but here it is fully carried out. The tail, which is so like that of *Packardia* and *Euli-*

macodes, is homologous with neither, as it is composed of the two subdorsal tubercles of joint 13 united, and not of a simple prolongation of the body. While the larva departs so widely from the primitive form of the spined Eucleids, the moth is generalized. I take the green thorax and band on the fore wings to be the primitive pattern of maculation, as it appears almost identically in both this species, and *Euclea indetermina*, whose larva are so different, and reappears in many South American and Indian species. *P. chloris*, then, is a form belonging to the most typical group of spined Eucleids, the moth unmodified, but the larva recently specially adapted.

The larvæ are found on the lower branches of trees, not on low bushes or brush. A rather low overhanging limb in a well shaded place is a favorite location. The eggs are laid singly, but often several on the same leaf and not infrequently of two or more ages, as different moths tend to select the same branch for oviposition. The eggs are laid from the middle to the end of July; the larvæ become mature at the end of August and during the most of September. They rest on the undersides of the leaves, feeding singly.

Eggs of this species occurred to me rather numerously at Bellport, Long Island, and this life history was worked out from them. The eggs are not as difficult to detect as usual on account of their proportionate large size.

CRITICISM OF PREVIOUS DESCRIPTIONS.

The published descriptions refer only to the mature larvæ, and are not as full as could be desired. Both Edwards and Packard speak of the subdorsal horns as "retractile tubercles." I think this term misleading. The horns have the normal structure, though short and degenerate, and only appear to be retracted by the movements of the flexible skin. Dr. Packard figures the spines and skin spinules (compare Plate IV, figs. 12, 13 and 14) with rather small magnification; but no one else has even attempted to treat of the finer structure, and the early stages have been altogether neglected.

DESCRIPTION OF THE SEVERAL STAGES IN DETAIL.

Egg.—(Plate IV, fig. 8.) Elliptical, flat, transparent and very shining; 1.6 × 1.2 mm. Reticulations angular, linear, irregular, distinct. The leaf is perfectly visible through the eggs, which resemble spots of moisture or some clear gummy substance.

Stage I.—(Plate IV, figs. 1 and 2.) Elliptical, dorsum broadest centrally, narrowed at the large horns; sides perpendicular. Horns

arranged exactly as in Euclea, from which the larva is indistinguishable. Color all opaquish white, no marks. Length 1.2 mm. The larva does not feed in this stage.

Stage II.—Horns rounded, large, the subdorsals on joints 3, 4, 5, 8, 11 and 12 with many black-tipped spines, those on joints 6, 7, 9 and 10, with one or two spines. Lateral horns moderate, rounded, spined. Color all ground glass white. Skin finely granular; segmental incisures cleft-like; depressed spaces not indicated. Body widest at joint 5, narrowing a little toward the ends. Subdorsal horns on joint 13 small, approximate, projecting posteriorly to form a subquadrate tail. Later a chocolate brown shade appears dorsally on joints 3 and 4, the highest part of the body, which slopes backward from this point. Toward the end of the stage the full markings of the next stage may be assumed. Length 1.2 to 2.1 mm.

Stage III.—Elongate, the sides parallel, joints 3 and 4 a little the highest; subdorsal horns elongate rounded, those on joints 3, 4, 11 and 12 large, 8 moderate, the rest with but one or two spines; lateral horns very small with five or six spines, those on joints 3 and 4 the largest. Color honey yellow, a white line along subdorsal ridge, the pair connected by a narrow angular bridge on joints 5 and 11; dorsum on joints 3, 5 and 11 chocolate brown; a brown line along the lateral horns. Depressed spaces (1) and (2) indicated, faint, also the large lateral ones (4). Skin nearly smooth, finely remotely granular or punctate. The tail horns are partly fused into a short, cleft, spiny process; spines black tipped; head pale brown, eye black. Length of larva 2.1 to 3 mm.

Stage IV.—As before, the dorsum rather broad. Long horns large, rounded, whitish, with brown tips, short spined, the one on joints 8 and 13 white. Short subdorsal horns and the lateral ones of joints 6 to 12 small, inconspicuous, concolorous; a short notched tail. Body all brown, except a space in the dorsum on joints 6 to 10, which is greenish; a narrow white subdorsal line with white bridges as before, but on joints 5, 11 and 12; a white line along the subventral edge; a faint darker line along the lateral horns. Largest depressed spaces moderate; skin as before. Length, 2.9 to 4.5 mm.

Stage V.—Dorsum of joints 3, 5, 11 and 13, lower half of sides and tips of subdorsal horns on joints 3 to 5 dark brown; the rest of the body fleshy brown; dorsal vessel greenish; a fleshy pink tint along the subdorsal ridge with a narrow bridge on joints 5, 11 and 12; a pink line along subventral edge. Bases of subdorsal horns on joints 3 to 5, all of horns 8, 11 and 12 and the short, approximate tail-like pair fleshy pink;

other horns obscure. A broken, double, waved, pale addorsal line. Depressed spaces very obscure. Skin sparsely, very finely granular. Horns moderate, with slender, black-tipped spines. The anterior end of the larva is darkly colored, joint 11 conspicuously pale. Length 4.4 to 6.2 mm.

Stage VI.—Horns rounded, small, the subdorsals on joints 11 to 13 pinkish white, the rest brown, concolorous; proportions as before, tail cleft. Body dark-brown dorsally, and on the upper half of the sides, marked with paler as before; the lines on the ridge and the bridges rather faint. Central dorsal and waved addorsal faint, broken white lines. Horns all spined, but the spines on joints 4 and 5 point inward, not erected. Length 5.9 to 8.5 mm.

Stage VII.—(Plate IV, fig. 9, ventral view). Fleshy brown; dorsal and waved addorsal broken, segmentary, salmon marks; thorax and subventral edge shaded darker; subdorsal horns of 11 light. Horns short, rounded; tail slightly cleft, spiny. Dorsal paired dark dots (1) joined by a whitish band; (4) oval, dark, narrow holes low down on the sides. A narrow salmon line along the subdorsal ridge edged with dark above; sides with four salmon lines; a conspicuous pinkish line along subventral edge, bordered above by crimson and brown. Horns all dark except the subdorsals on joints 11 to 13; the long ones form rather large buttons. The shape is like the mature larva. Length 7.5 to 13 mm.

Stage VIII.—Tail pointed, spinose sometimes still cleft. Caltropes present (Plate IV, figs. 13 and 16) on the lateral horns of joints 6 to 12 in a large patch, the caltropes themselves with larger side spines than usual. Skin finely, rather densely spinulated (Plate IV, figs. 10, 13 and 14), much as in *Sibine stimulea*. Color without dark shades, the ground a sordid greenish marked with the numerous waved salmon-colored lines (Plate IV, figs. 3, 4 and 5), brighter posteriorly. There are five in the dorsal space, five in the lateral space, all somewhat confused. A narrow blackish line on subdorsal ridge, none on the lateral one. Subventral edge broadly pink, edged above by a dark red line. Depressed spaces (1) small, paired; (4) narrow elongate; (7), round, pit-like; (8) indicated, all blackish—no others. Horns short, the large ones with the spines turned in (Plate IV, fig. 11) dark, those on joints 11 and 12 whitish, contrasting. Shape as described above. In some examples the posterior portion of dorsal space is of a very bright, fiery color. Length 10.6 to 20.3 mm.

Food-plants.—Oak, chestnut, wild cherry, hickory and bayberry.

EXPLANATION OF PLATE IV.

Fig. 1. Larva stage I, side view.
" 2. The same, front view,
" 3. Mature larva, enlarged, side view, feeding.
" 4. The same, front view.
" 5. The same, back view.
" 6. Feeding traces of stage II.
" 7. The same of stage III.
" 8. Egg.
" 9. Ventral view of larva, the body shrunken preceding a molt, enlarged.
" 10. Skin granules at subventral edge, grading into the general spines above.
" 11. One of the large horns of subdorsal row, the spines imperfectly erected × 50.
" 12. Tip of spine, more enlarged.
" 13. Horn of lateral row, showing caltrope patch and skin spines.
" 14. Skin spines of same region, more enlarged.
" 15. Spines from a different region.
" 16. Caltropes, × 225.
" 17. *Parasa chloris*, natural size.

NOTE ON MR. GROTE'S REMARKS ON THE SATURNIANS.

BY HARRISON G. DYAR.

Mr. Grote's reply to my criticism on his paper "Die Saturniiden" is disappointing. I had hoped that he would adopt my suggestion to take three or four entirely different characters, work each out independently in the same manner as he has done for vein IV^2 of primaries and let the evidence from these show whether his classification or mine was the nearest the natural one. Instead Mr. Grote defends his classification on the original grounds and misstates (unintentionally of course) and belittles the larval characters. The matter is certainly simplified by "setting down the loss of the pair of anal tubercles solely to the Citheroniinæ." The only objection that I know to this ingenious solution is that it is not a statement of fact. But, seriously, it remains that the genealogical tree deduced by Mr. Grote is contradictory to the one that I have made on larval characters. My original statements are not affected, so far as I can see, by Mr. Grote's insistance on the importance of his characters; it is open to me to insist equally on the importance of mine. Collateral evidence only can decide the question, and this Mr. Grote has not adduced. In reply to Mr. Grote's kind wish to convert me to his viéws, I again point out the path to that end, or at least the path which must lead to the end of a mutual agreement, whether on Mr. Grote's system or mine, or some other more natural one, which we neither have thought of.