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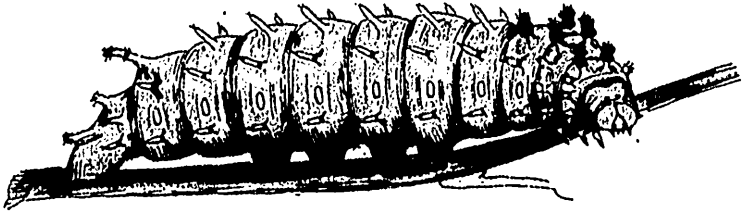

G.J.Bowles

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MATURE LARVA OF SAMIA COLUMBIA

THE CANADIAN

ENTOMOLOGIST.

VOLUME X.

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London, Ontario,

ASSISTED BY

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NOTES ON LYCAENA PSEUDARGIOLUS AND ITS LARVAL HISTORY.

BY W. H. EDWARDS, COALBURGH, W. VA.

On one of the last days of June, 1877, I observed a female *pseudargiolus* hovering about a flower-stalk of *Cimicifuga racemosa*, and it occurred to me that here might be the food plant of the summer brood of this butterfly, which I had for years been in search of. And thereupon I captured this female and confined her in a muslin bag upon one of the stalks. Two days after I found several eggs and also young larvæ, which last must have come from eggs laid some days before. This led me to examine other stalks, and I found quite a large number of both eggs and larvæ. The plant is called hereabouts "rattle-weed," and grows abundantly in the edges of the woods throughout this region. It sends up a stalk, sometimes branching, four or five feet, terminating in a spike or spikes, six to ten inches long, of round, greenish-white buds, which stand upon short stems and are arranged in rows about the stalk, diminishing in size till they reach the pointed top. The lower buds, when about the size of a pea, open first, and the flowering proceeds gradually up the spike, so that buds are found through a period of from four to six weeks. The flowers exhale an intensely sweet odor. The larva of *pseudargiolus*, during its younger stages, is white and so near the color of these buds that they are well protected and difficult to find. In the later stages it may be white or greenish, and often there are a few black or brown patches irregularly scattered over the surface. When mature it is one-half inch long, and is onisciform, like all Lycaenid larvæ. The head is very small and is placed on the end of a long green neck, which, at the junction, is of the diameter of the head, but gradually enlarges and seems to be fixed at the extreme hinder part of the next (or second) segment, which segment is hollowed out to form a sheath for it. In the last larval stages the top of this segment is elevated and transversely compressed, and leans forward, shielding

the head as the larva moves about. When at rest the neck and head are wholly withdrawn, and as the former, when fully extended, is considerably longer than the depth of the second segment, it must possess much elasticity.* The larva feeds on the inner part of the bud, and to get at this cuts away the surface on one side till a hole is made just big enough to admit its head; and as it feeds the second segment is pressed hard against the bud so as to permit the utmost elongation of the neck. Thus it is enabled to eat out the contents of the bud, and only desists when there remains but the empty shell. When so engaged the anterior segments are curved up and the others rest on the stalk of the plant. But very small larvæ rest wholly on the bud, curving about it. I have not seen

* NOTE.—In a recent paper by Mr. Scudder, "On the Classification of Butterflies with special reference to the position of the Equites or Swallowtails," Trans. Am. Ent. Soc., vi., 69, 1877, the special object of which is to argue for the degradation of the Papilioninæ, I find the following lines: "The Equites and Ephori" (by this last obsolete appellation the uninitiated may understand some division which includes the Lycaenidæ) . . . "*are closely related to each other and disagree with all other groups in the retractility of the head of the caterpillar.*" This sweeping assertion is fortified by a quotation thus: "I do not know that attention has ever been drawn to this feature in the caterpillars of Equites since the time of Denis and Schiffermuller, who say, Syst. Verz. Schmett. Wien., 161, 1775, 'When at rest the head is nearly half concealed by the extended epidermis of the first body segment, and can be compared with nothing in other butterfly caterpillars, excepting the complete retractility of the head in Lycaenids.'" I observe that the authors quoted by Mr. Scudder do not say that the head is retractile, but that it lies "nearly half concealed by the extended epidermis of the next segment." There is nothing that can properly be called retractility of the head in any *Papilio* larva ever bred by me, and this will cover *ajax*, *troilus*, *asterias*, *turnus*, *cresphontes* and *philenor*. The head of *Lycaena* pushes out like the upper joint of a microscope and it is as completely retractile as the head of a turtle. The head of *Papilio* is partly covered by the extended epidermis of the next segment, which forms a sort of collar, and this segment is unusually broad as compared with larvæ of other families, probably in order to afford room for the tentacles and muscular apparatus connected with them. As the larva feeds, the head has a vertical movement, and when the jaws are raised, the top of the head is turned down a little into the collar. But as to any ability in *Papilio* to push out and draw in its head beyond that of any species of the Nymphalidæ, for example, it does not exist. A caterpillar of *Argynnis* will rest on its hinder legs and extend its body fifty per cent. beyond the length it assumes when at rest, and unless its joints were cast iron, some power of extension must belong to every jointed creature; and the neck of the caterpillar, which is nothing but the connection between the first and second segments, stretches just as the rest of its body stretches, perhaps a little more, but in no different manner. That is another thing from "retractility." One might as well say that a man's head is retractile when he wears a high shirt collar.

one of the larvæ on this plant eating an opened flower, but they destroy the buds extensively, and on examining any of the spikes many buds will be found drilled, though often no larva is seen upon it. This disappearance of the larva I attribute principally to spiders, as I found many of them on the plants.

I very soon noticed that ants also frequented the spikes and supposed that the honey-sweet flowers drew them, but presently saw an ant running up and down the back of one of the larvæ, drumming and gesticulating with its antennæ, and was surprised to find that the larva, though feeding, did not seem in the least disturbed at the treatment, neither withdrawing its head from the bud nor wincing in the body. It evidently knew well who was treating it so familiarly. Had it been touched by an ichneumon fly or had such an insect approached it nearly without touching, it would have displayed alarm instantly. A little farther search showed other ants, and sometimes several of them, busy about other larvæ, running from one to another on different parts of the spike and always repeating the same drumming motions, stopping often to lick the surface, as it seemed to me, and the presence of ants became a sure indication of larvæ and saved me much trouble in searching for the latter.

The next day I went to the wood with my hand glass and watched for a long time to see what the ants sought. The first day I had seen two species of ants engaged, each of medium size, but I now found a third and very small species operating in the same manner, and in one case six of these were busy over one larva. But the movements of all the species were similar. They ran up and down and across the bodies of the larvæ, working their antennae violently, keeping their mandibles close to the surface, which they often stopped for an instant to lick. The whole upper side of this larva is covered with little glassy stellar processes, five or six rayed, scarcely raised, and from the centre of each springs a short filamentous spine. Where the surface is white these processes are white, but on the dark spots they are dark, and on these last they seemed to be less regularly stellate. The ants attended most diligently to the last two or three segments, and especially to the back of the 11th, but they certainly licked the surface at the junction of these segments and elsewhere along the body towards the head. I thought there might be some exudation from the surface, and perhaps from the stellar processes, as I saw no special organs for excreting.

Some of these larvae I sent to Mr. Lintner, at Albany, N. Y., asking

him to subject them to a more powerful glass than any I had, and give me the result. He presently (10th July) wrote: "Mr. Peck and myself have both carefully examined the larvae for the gland which you thought might exist on the abdomen (11th segment), but we find none. . . But why did you not speak of the two processes near the hind end of the body and suggest that these might be secretory organs? If the ants really obtain some sweet matter from the larvæ, then these are the organs through which it is emitted. They could hardly have escaped your notice, as they are visible to the naked eye, and distinctly under the magnifyer. They are two short cylindrical projections, of perhaps twice the length of their diameter, giving out at their tops twenty or more barbed hairs. I could not determine whether these hairs covered the entire top, but I rather thought that they proceeded from a fissure extending across it, which perhaps could be dilated or contracted at will."

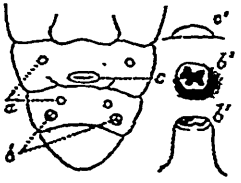
On reading this I at once made an excursion for more larvæ (now 13th July, and the flowers fast disappearing), and was fortunate in finding half a dozen. I also captured two of the ants and confined them with larvæ in a glass; so kept them for two days, examining them repeatedly. The ants were not restive under confinement, but devoted themselves to the larvae, being almost all this time near them, going from one to another, at intervals operating after the manner before described. But at the end of the second day, getting impatient at the decrease or withholding of the object they sought, and making no allowance for the deficient food and untoward circumstances of the larvae, they began viciously to bite and mangle them, and I was forced to conclude my observations and save any unhurt subjects in alcohol. All this time I was unable to discover the organs to which Mr. Lintner had called my attention. I was more certain, however, that whatever the ants were after came from the last three segments, and they constantly returned to the 11th. I had to regret that my attention had not been called to the whole matter a few weeks earlier.

But I sent one of the larvae obtained 13th inst. to Mr. Lintner, and he wrote me thus on the 16th: "The larva came safely, but has since died from want of proper food. We could not find the organs on it of which I wrote you. They were not visible. After its death I discovered one, and by means of pressure disclosed the other. In the latter the armature of hairs was not thrown out, but I could discover them within the organ. I think they will prove to be excretive."

I had a large number of chrysalids from the larvae obtained, and at intervals a single butterfly would emerge. Thus one male 19th Aug., after about thirty days in chrysalis. Sept. 1st, one male; and during my absence from home, some time between 3rd Sept. and 20th, one female emerged, and these were all. The other chrysalids will give butterflies next spring. During the period between the forming of the chrysalids and 1st September I occasionally saw a few examples of the butterfly on the wing, one here and one there, but there certainly was no regular brood subsequent to July. And all the butterflies seen were smaller than those of June, and corresponded in this respect with those that emerged in my boxes. Such of the females as appeared in September were just in time for the fall food plant of the species, *Actinomeris squarrosa*, which begins to bloom then. I have formerly related the discovery of the larvae of *pseudargiolus* on the flower heads of this plant by Mr. T. L. Mead, and that the butterflies which emerged in the spring from the chrysalids of *pseudargiolus* were proved to be *violacea;* CAN. ENT. vii., p. 81. This fall I was absent till 20th Sept., and until the few plants of *Actinomeris squarrosa* known to me and near at hand were nearly or quite out of bloom, and I failed to find any of the larvae. It is true that in confinement they will eat the flowers of *Actinomeris helianthoides*, an excessively common plant here, but it would be useless to search on this for the larvae because it is so common, and I am confident they always prefer the other when to be had. But 12th October I chanced to be some miles away from home and to find on the edge of a corn-field several plants of *squarrosa* in full bloom. These I examined one by one till I found twelve larvae in various stages up to last. It is worth notice that whereas the summer larvae, feeding on *Cimicifuga*, are white and of the color of their food, in the fall, feeding on a yellow flower, they are dusky and green. I watched carefully for ants and presently had the satisfaction of seeing one come across the flower head to one of the largest larvae. It manipulated it for a moment and then departed, and seemed to me to have expected something from the larva and to have gone off disappointed. This *Actinomeris* is as bitter as the summer plant is sweet, and it is less likely that the larvae living on such food would exude or secrete saccharine matter than in the other case. I immediately sent the largest larva to Dr. Hagen, and in due time received a card with his reply: "Dr. Mack found directly three secretory organs." The next day a letter, thus: "I have examined carefully your larvæ, and some in alcohol of *Lycaena argus* and *corydon*. All

have the organs alike. On the penultimate segment you find outside and behind the stigmata two large white spots, each one of which evaginates a white membranous tube, just like the finger of a glove, the top of which is not entirely drawn out. I have seen the tube frequently, and if I blow a little the tube is invaginated instantly. On the antepenultimate segment is a larger and transversal opening behind and between the stigmata near the apical border. It looks like a closed mouth with its lips, but I have not seen anything protruding from it. But in an alcoholic larva of *argus* I saw an ovoid evagination." Recently I sent Dr. Hagen mature larvæ of *comyntas* in alcohol, and he writes: "I was able to ascertain exactly the same parts and in same situations as in *pseudargiolus*."* Dr. Hagen also referred me to a paper by M. Guenée, Ann. Soc. Ent. de France, ser. iv., vol. 7, 1867, pp. 696–7, and plate 13, in which are described and figured similar organs in *Lyc. lactica*. Guenée relates that while observing the larva of *lactica*, he noticed two openings altogether like those of the stigmata and nearly of same size. At first he thought they were superfluous stigmata, and puzzled himself with conjecturing the object of them; but as he turned the caterpillar about in order to see the partings of these openings which seemed to be different from the stigmata, the larva, which this handling disturbed, suddenly made to leap out of these holes a peculiar body which he cannot compare to anything better than to the tentacles which certain polypi put forth at will. "This is a soft, cylindrical organ, the extremity of which is furnished with little fleshy points resembling hairs, some standing upright, some radiating from a point on the summit. This singular object placed under the highest power of the microscope, these apparent hairs are seen to be long tentacles and themselves bristle with fleshy spines. Those at the circumference

* The accompanying figure represents the last segments of *pseudargiolus* larva, and the position of these organs:



a—stigmata on 11th and 12th segments; *b*—spots resembling stigmata on 12th segment; b^1—processes issuing therefrom; *c*—opening on 11th segment; c^1—ovoid membrane.

The processes b^1 are but partly protruded and as Dr. Mack saw them.

are pretty regularly arranged, and sometimes lie flat on the cylinder (probably when they have just emerged from the opening, or are about to return), sometimes stand out in a threatening manner. But it is on the summit that these tentacles are most numerous, piled up, lying one upon another and in all directions, so that it is impossible to count them. The caterpillar has the power of protruding these organs at its will, either one alone or both together. It throws them out like the tentacles of *Papilio* or the horns of snails. Sometimes it shows but half their length, and then the tentacles expand but little or none at all; sometimes it projects them fully, making the tentacles radiate in all directions. Most often it allows itself to be handled, tickled, pricked, without exposing them, which seems to exclude the idea that these organs are means of defence or of intimidation. . . . The observer will readily cause them to appear by pressing the larva from head to anus.

"But this is not all, and our caterpillar presents another singularity. At the summit of the 10th segment" (*i. e.*, 11th, counting the head as first) "is found still another opening, this time unique, placed transversely and surrounded by a raised pad, about which the granulations which cover the body of the caterpillar become particularly dense. From the middle of this opening (boutonnière, button-hole), comes forth, at the will of the caterpillar, a sort of transparent, hemispherical vesicle, which gives escape to a fluid sufficiently abundant to form a good sized drop, which reproduces itself when it is absorbed. The caterpillar only secretes this fluid when it is disturbed, imitating in this respect *cucullia* and many other larvae which disgorge by the mouth a colored fluid, doubtless with the intention of driving away their enemies. As to the end which nature proposes by this exceptional structure, it is not easy to divine it. The explanations which one has imagined in some analogous circumstances appear to me too forced that I should expose myself in risking new ones." The figures illustrating this description represent a cylindrical tube, bulbous toward the summit, and bristling with feathery-looking tentacles. This corresponds with Mr. Lintner's description of "barbed spines," and with a pen and ink sketch which he also sent me. But he represented the tube as wholly cylindrical, not at all bulbous, and there is probably a specific difference in this respect.

I learned from Mr. E. T. Cresson, to whom I had mentioned the facts observed in June, that Rev. H. C. McCook, of Philadelphia, had seen something of the same nature, and I wrote Mr. McCook to inquire. He

replied that he saw, last spring, a small green larva on the blossoms of *Cimicifuga racemosa* and a black ant attending it. "The ant directed strokes of its antennae upon the tail of the larva incessantly; larva moved a little; ant ran up and down and up other stems and returned; strokes renewed upon the tail; larva moves its head; strokes directed toward the head; larva moves round the stem; ant off, and in a moment returns, with strokes." He observed this proceeding from 10 a. m. to 12 m., and adds: "I am at a loss to explain these strange manipulations. My first idea was that the ant was seeking to tempt the larva to loosen its hold upon the plant and then seize it for food. But I soon found that the purpose was at least friendly." The plant, it will be noticed, is the same as that fed on by *pseudargiolus* in Virginia.

It is clear, therefore, that the larvae of several species of *Lycaena* have one or more special excreting organs, and that one species at least is regularly attended by formicidians for the sake of the excreted fluid. And it is probable that the quantity of this and perhaps its attractiveness depends on the nature of the food plant. Also that all the organs are generally concealed. I was not able to distinguish them upon any living larva even after my attention was called to them, though I saw the mark on 11th segment, which proved to be one of the openings. I took those on 12th segment for stigmata, which they resembled. But in one larva now in alcohol I find the two tubes partly protruding and easily to be seen with the naked eye. And as the ants were eagerly licking the surface in the vicinity of these organs, as well as just at them, the fluid may escape without their protrusion and overflow the surface. That either of these organs is used for defence is not shown by any evidence, and, as M. Guenée intimates, the probability is all the other way. The secretion is attractive, not repulsive like that which poisons the air from the tentacles by the head of *Papilio*.* Whether

* In the paper "On the Classification," &c., Mr. Scudder supports his argument for degradation of Papilio by this discovery of M. Guenee. Mr. Wallace had claimed, and properly, that the possession of such a peculiar structure as the scent organ of Papilio larva, with tentacle, muscular apparatus, &c., for frightening away its enemies, is a mark of high development, and that its presence in one group and absence in every other is a proof of a very ancient origin and of very long-continued modification, Nat. Select. Am. Ed., 135. Mr. Scudder thus disposes of the whole matter: "*Extensive fleshy organs* do occur in other groups. Guenee discovered them *on the abdominal segments of certain blues*," &c. . . . "yet nobody on that account claims for them a high rank."

the secretion is confined to the opening on 11th segment, or is also given by the tubes on 12th, remains to be determined by farther observations.

I find no mention in any author accessible to me of ants attending lepidopterous larvae. Kirby & Spence (Longman, 1856), p. 336, say: "Not only the Aphides yield this repast to the ants, but also the Cocci, with whom they have recourse to similar manœuvres and with equal success; only in this case the movement of the antennae over their body may be compared to the thrill of the finger over the keys of a pianoforte." (This describes well the movements over our larva.) "Even beetles are occasionally made cows of by *Formica flava*, which keeps in its nest *Claviger foveolatus*, and obtains from the bristles terminating its elytra a gummy secretion which it uses for food," &c. And Mr. Belt, "Naturalist in Nicaragua," p. 227, describes the attending of larvae of leaf-hoppers by ants, but even this careful observer does not seem to have noticed the ants with lepidopterous larvæ.

The history of *pseudargiolus* in Virginia is this: In the early spring *violacea* appears, a very distinct form, and characterized by dimorphism in the female, some of that sex being blue, others black. The eggs laid by *violacea* give larvæ from which comes *pseudargiolus* last of May, but the food plant of such larvæ is not yet known—possibly *Cornus*. The female *pseudargiolus* lays eggs on *Cimicifuga racemosa*, and most of the resulting butterflies over-winter, to produce perhaps *violacea*, but also perhaps the typical *pseudargiolus* again (which of the two I hope to ascertain by March, 1878). But a small percentage, say five, of these chrysalids give butterflies at irregular intervals during the same year, at least as late as September, and the earliest of these, if I may judge by what I have seen in the field as well as by the results in my boxes this summer, are males, the females mostly if not wholly emerging latest. These butterflies are always smaller than the parents (the typical *pseudargiolus*), some not much, however, but nearly all considerably, and these last are nothing more nor less than what I named, described and figured (But. N. A., I, pl. 50) as *neglecta*. I cannot see any distinction between them and examples of *neglecta* from New York. Besides the difference in size there is usually but not always some in the shade of upper surface between these and *pseudargiolus*, and on the under side the marginal crescents and discal spots are usually but not always more decided than in the latter. The intermediate examples may be called small *pseudargiolus* or large *neglecta*. There is no regular second summer brood—that is, there are

but two regular annual broods of this species, the *violacea* of March and *pseudargiolus* of May. The individuals which chance to emerge in July, August and September are *neglecta*, and irregular. But their females lay eggs upon *Actinomeris squarrosa*, and the chrysalids then resulting give *violacea* the next spring. That is a peculiar history, and I know no other which runs parallel with it. In the case of *L. comyntas*, one brood succeeds another all the season and there are four or five of them here. And I have found none of the early chrysalids to over-winter. The chrysalis period in *comyntas* is very short, about eight days, whereas it is from thirty to sixty in case of *pseudargiolus* where the butterflies emerge the same season.*

The typical *pseudargiolus* is also found in Pennsylvania, but *neglecta* is most common there, and farther north to Canada, except in rare instances, this last is the only one. Mr. Scudder, in the paper referred to, ENT., viii., gives the history of *neglecta* in N. England, and it corresponds curiously with the history of *pseudargiolus* which I have related, though he derived it almost if not quite altogether from field observation of the butterfly: "The eggs are probably laid in the middle and latter end of June and most of the caterpillars become full grown in the early part of July; how long a time is passed in the chrysalis is unknown, but the earliest butterflies of the second brood appear about the first of July, and continue to emerge until the first of August . . . and in spite of their great delicacy these insects may still be seen in September; . . . probably the eggs are laid in August, the caterpillars attaining their growth in the latter part of September, and transforming to chrysalids before winter." I have no doubt this conjectural account is in the main a correct one, or in other words, that *neglecta* behaves at the north just as its other form and other self does here.

And I fully believe that *lucia* is nothing but a northern spring form of the same species—that is, it either occupies the place of *violacea* in some, or is a co-form with it in many, localities. I suggested the relation-

* Mr. Scudder, CAN. ENT., viii., 64, says: "Mr. Abbot, in Georgia, years ago raised *pseudargiolus* (or what he called *argiolus*) in March from caterpillars which went into chrysalis the last of April of the preceding year." I do not know where Mr. Scudder learned this, for it is not so stated in the Insects of Georgia. The text says that the caterpillar was found, and "the first change (*i. e.*, to chrysalis) took place on the 16th of June and the fly appeared nine days afterward."

ship between *lucia* and *neglecta* in my paper first referred to, ENT., vii., 82, and Mr. Scudder made the matter more probable by his relation of the history of these two forms or species, ENT., viii., 64, considering it possible that *lucia* was a boreal and colline form of *violacea*, but appearing a little earlier in the season. I have undoubted *lucia* in company with *violacea* from Anticosti; in same way, both forms from Maine; also from New York, and *lucia* grades into *violacea* unquestionably. From Colorado I have *lucia*, *violacea* and *neglecta*. In the account given in But. N. A. of *neglecta*, I find a statement which was not explainable at that time, but which the observations of this year make clear, namely, that "in June, 1866, at Coalburgh, *neglecta* appeared in large numbers, while I scarcely saw a dozen *pseudargiolus*, usually so abundant. In the following years (1867–1868) *neglecta* has again been rare in this district." Plainly enough, owing to insufficient food for the larvæ sprung from eggs of *violacea*, caused by an unpropitious spring, the butterflies were reduced in size, and while I could find few *pseudargiolus*, everywhere *neglecta* had taken its place. Being one and the same species, that is exactly what would occasionally take place, and it is to abundant food on the other hand and unusually favorable larval conditions that here and there to the northward a few typical *pseudargiolus* appear when all the others flying are *neglecta*. Now after writing these last lines, it occurred to me to look up my journals for 1866. I find therein that the season was late, the first examples of *violacea* being seen April 1st, whereas in other years I had found them from 10th to 15th March. On 4th April the mercury reached 90° and *violacea* is recorded as abundant. Immediately after which followed cold and wet (always disastrous to butterflies after extreme heat, which has caused them to emerge from chrysalis prematurely), and this bad weather lasted through April and most of May. Up to 10th June all butterflies are mentioned as being very scarce (because the early brood had been more or less destroyed by the cold). On 16th June, and again 28th June, I record that not a *pseudargiolus* had so far been seen that year, but that all which had appeared were *neglecta*. How, two years after, I came to state that a dozen *pseudargiolus* had been seen in 1866 I cannot now remember, but probably I then concluded that the larger and paler examples of what I first called *neglecta* were properly small *pseudargiolus*.

DESCRIPTION OF THE PREPARATORY STAGES OF L. PSEUDARGIOLUS.

EGG—Diameter, .02 inch; round, flat at base, flattened at top, the

micropyle depressed; color delicate green, the surface covered with a white lace-work, the meshes mostly rectangular, with raised points at the angles. Duration of this stage 4 days.

YOUNG LARVA—Length, .04 inch; onisciform, sub-cylindrical, flat beneath with retractile legs; the dorsum high, rounded, smooth, shining; color, pale greenish-white; on either side of the medio-dorsal line a row of white clubbed hairs, one at the posterior end of each segment; other similar hairs about base of body; head very small, obovoid, black, retractile.

AFTER FIRST MOULT—Length, .1 inch; nearly same shape, the dorsum sloping posteriorly from 4th segment; the sides sloping; the segments distinctly separated, rounded; color, yellow-white or buff; surface pubescent; head as before.

AFTER SECOND MOULT—Length, .14 inch; sub-cylindrical; thickest at 2nd and 3rd segments, the dorsum sloping posteriorly; segments well separated, rounded, the anterior edge of each on dorsum a little depressed; the 2nd broadened at top and covering the head; color yellow-white or buff; surface velvety, with a few recurved hairs along dorsum, others straight at base of body; the anterior edge of 2nd segment on dorsum fringed with rather longer and straight bristles.

AFTER THIRD MOULT—Length, .25 inch; flattened at base, the dorsum elevated into a rounded ridge, sloping posteriorly; the last segments flattened and 13 terminating roundly; the sides excavated; the 2nd segment compressed transversely, arched at top, bent forward; color variable, some examples greenish-white, some sordid buff; on middle of dorsum a dark vascular line; the dorsum from 3 to 11 pale, and occupied by a series of sagittate spots, each truncated at the next segment; the whole surface velvety; head obovoid, dark brown.

AFTER FOURTH AND LAST MOULT—Length, .36 inch.

MATURE LARVA—Length, .5 inch. Nearly as at preceding stage; onisciform, flattened at base; the legs retractile; the dorsum elevated into a rounded ridge which slopes back from 6th segment; the sides deeply excavated, and on middle of each segment from 3 to 11 a vertical narrow depression; the last segments flattened, the last of all terminating roundly, its sides narrowed and a little incurved; the 2nd segment flattened, arched, bent nearly flat over the head; the dorsal ridge is of a tubercular nature, standing on the body, and on each segment from 3 to

11 this ridge is distinct, cleft to the body ; color variable, some examples being white, some decidedly greenish ; many have the posterior slope of the 2nd segment black or dark brown ; some also have most of the dorsum dark brown, irregularly mottling the light ground ; some have only small brown patches disposed without rule on the dorsum, and mostly on the anterior segments ; the whole surface velvety ; this appearance is caused by minute stellate glossy processes, scarcely raised above the surface, only visible under a magnifyer, mostly six-rayed, and sending from the centre a concolored filamentous spine a little longer than the rays ; these stars are arranged in pretty regular rows, and are light except on the brown patches—there both star and spine is brown ; on the 11th segment, near posterior edge of dorsum, is a transverse slit, in a sub-ovoid spot, from which proceeds an ovoid membranous process ; and on 12, back of and between the stigmata, on either side is a mark like a stigma, but a little larger, from which proceeds a membranous tube, in form of a truncated cone, ending in a crown of feathery tentacles ; these three special organs are exposed or concealed at the will of the larva ; (similar openings are found in the two preceding stages of the larva, but less easily seen) ; head small, obovoid, dark brown, placed at the end of a long, pale-green, conical neck, which is retractile, both neck and head being covered by 2nd segment.

The foregoing descriptions are taken from the summer larvæ, feeding on flowers of *Cimicifuga racemosa*. The larvæ in the fall, feeding on flowers of *Actinomeris squarrosa*, differ much in color from the description after second moult, being generally in last two stages yellow-green and olive-green, the sides darkened, the dorsum lighter, and there is an absence of the brown patches seen in the summer larvæ ; the back of 2nd segment sometimes green, sometimes brown. On the dark shades of the sides the stellate processes are often pink.

Before changing to chrysalis the summer larvæ sometimes turn pink and from pink to brown, or become brown without the pink stage ; but others remain white, changing to sordid ; the body contracts to about .3 inch, and becomes rounded. Duration of larval stages 19 days.

CHRYSALIS—Length, .28 inch ; greatest breadth, .12 inch ; the ventral side straight, the dorsal rounded and evenly except for a very slight depression below the mesonotum ; both ends rounded ; the abdomen broadest ; color dark brown or yellow-brown, varying ; on dorsal part of abdomen on either side is a row of blackish dots, continued to

the mesonotum; some examples have the wing cases green tinted. Duration of this stage, in the few instances in which the butterfly emerges the same season, from 30 to 60 days, but most chrysalids pass the winter.

NOTES ON THE LARVA OF LYCAENA SCUDDERI.

BY THE EDITOR.

The announcement of the interesting discovery of honey tubes in the larvæ of *L. pseudargiolus*, and consequent attendance of ants, as detailed by Mr. W. H. Edwards in the present issue, brought to our mind the fact that we had observed ants attending the larvæ of *L. Scudderi* some ten years ago. We were under the impression that we had subsequently published a description of the larva and drawn attention to this fact of ant attendance, but on examination find that we omitted doing so, and take this early opportunity of giving the results of our observations in confirmation of this curious discovery by Mr. Edwards.

On the 22nd of July, 1867, we visited a locality where some three weeks previous *Lycaena Scudderi* had been very abundant, our object being to search for the larva of that species. After considerable effort we succeeded in finding a larva on the common blue lupin (*Lupinus perennis*), which afterwards proved to be that of *Scudderi*. This larva was feeding on the upper side of the leaf, and we were surprised at seeing several ants actively running about the leaf and repeatedly over the body of the caterpillar, without disturbing it in the least. The search being continued, several more larvæ were found, their discovery being made comparatively easy from the invariable presence of these active attendants, otherwise their color being so closely like that of the leaf, they would have been very difficult to find. We were unable then to account for the cause of the attendance of the ants, and for the placid behavior of the larvae under the circumstances. Doubtless this species in the larval state is furnished with similar secreting tubes to those described and figured by Mr. Edwards as occurring in *pseudargiolus*.

The following description of the larva was taken at the time.

Length half an inch ; body somewhat onisciform, distinctly annulated.

Head very small, black and shining, and drawn within the second segment when at rest.

Body above dull green with a velvety appearance, occasioned by the presence of many short, fine, whitish hairs and minute dots of a brownish color, neither of which were plainly visible without a magnifyer. A dorsal stripe of a deeper shade of green margined with a faintly paler hue. Sides of body striped obliquely with lines of a slightly paler shade of green. A lateral cream-colored stripe close to under surface extending from the anterior portion of third segment backwards.

Under surface similar in color to upper, with a darker shade having a faintly bluish tinge along the middle; feet and prolegs tipped with pale brown.

One specimen became a chrysalis on the 28th of July, and produced the imago on the 8th of August.

MISCELLANEOUS MEMORANDA.

BY C. E. WORTHINGTON, CHICAGO, ILL.

Larva of *Arzama obliquata* Grote.—Found April 23rd, under the bark of a dead maple about three feet from the ground, where it had made for itself an oval cavity in the dust.

Head small and black ; head and first four segments flattened above ; 1st segment black, edged with light brown and with a light brown dorsal stripe ; remaining segments dull olivaceous brown, slightly pubescent, and having the greasy appearance of an *Agrotis* larva. No dorsal stripe back of 1st segment ; 1st and 2nd segments project laterally over stigmata ; immediately below the stigmata on each side is a faint, narrow, brown stripe, below which the color is much lighter. Anal segment with a fleshy fold slightly resembling that of *Catocala crataegi*.

Length 2 inches. Diameter not taken, but is small in proportion.

Pupated April 27th, without spinning a cocoon. Pupa light reddish brown without markings, 1½ inches long and very slender. Imago—May 18th; ♂.

The situation in which the larva was found, the small head and general appearance indicate a subterraneous habit, and, indeed, aside from its extreme slenderness, the resemblance to some species of *Agrotis* is striking.

Larvæ of *Hemileuca maia*, May 30th, in considerable numbers on Willow. These larvæ are gregarious while young, but after the 3rd moult scatter, and deserting the willows, appear to eat anything that falls in their way. I have seen during the summer (July and August) individuals several miles from the marshes and upon almost every plant I can name. Imagoes abundant in October in the morning, but on every occasion, though hundreds might be taken before 12 o'clock, not one could be found after 1 o'clock.

Pupæ of *Smerinthus excaecatus* beneath willows. Imagoes in June. Much larger and more highly colored than in eastern examples.

S. modesta from larva found on Cottonwood.

August 6th—*Erebus odora* ♀ in the water closet of a business block in the heart of the city. The apparent fondness of many rare species of Lepidoptera for a fetid odor leads me to suggest the experiment of sugaring a few trees apart from the others with ale and molasses, in which some assafœtida has been dissolved.

August and September—Larvæ of *Ennomus alniaria* abundant on maple. This larva evidently changes its color somewhat with different food, as these closely resemble the bark of this tree. Imagoes in Sept.

Larva of *Apatela americana* abundant in same locality, but later in the month to be found clinging to the twigs, completely honey-combed by some species of *Chalcis (?)*.

Larvæ of *Sphinx chersis*, *S. gordius* and *D. undulosa* in company on black ash.

September 20th–October 3rd.—Eight examples of *Macrosila 5-maculata* from larvae which pupated in July. My experience with *P. achemon* would apply to this species also, as I had nearly full-grown larvae this year before my over-wintering pupae had fairly begun to emerge. I am informed that perfect imagoes are usually taken here in July and late in September, but have never seen one in the spring.

Early in August I took a *Papilio asterias* ♀ with large blotches of a yellow fungus, as yet unidentified, on the wings. The growth mentioned by Mr. Aaron may be something of this nature.

DESCRIPTION OF A NEW DREPANODES.

BY A. R. GROTE,

Director of the Museum, Buffalo Society Natural Sciences.

Notwithstanding the variability of *D. varus* Grote, of which species *D. sesquilinea* is stated by Dr. Packard to be the ordinary male form, there can be no doubt that a very interesting species from Maine (Prof. Fernald) and Massachusetts (Mr. Roland Thaxter) is distinct from any previously described. In this form the exterior line is *without* a costal angulation. It may be called

Drepanodes Fernaldi, n. s.

♀. Larger than the other species, light purplish brown. The two transverse lines composed of broken black lunules shaded with white. A black discal point on primaries. A median diffuse brown shade near the exterior line and continued on hind wings. The exterior line extends straight to costa near apices and is here not angulated; it is continued on hind wings, but merely as a white sub-lunulated line with black pointlets on the veins. Terminal space on fore wings shaded with brown. Fringes on both wings pale. Edge of secondaries brown. Beneath paler than above, sub-irrorate. A common white exterior lunulated line marked by black pointlets on the veins. Discal dots on both wings.

Expanse 31 mil. Two specimens examined, not differing in any way. The apices are acute, but not falcate. The costal edge is paler than the rest of the wing. The more brownish color and the peculiarities of the transverse line will at once distinguish this species. I am greatly indebted to Mr. Roland Thaxter for the type taken at Newtonville, Mass., June 16th, 1877.

A NEW HEPIALUS FROM NEW YORK.

BY A. R. GROTE, BUFFALO, N. Y.

Hepialus auratus, n. s.

This species is smaller and slighter than *argenteomaculatus,* and differs from any previously described from our territory by the gilded primaries, which are as brilliant as those of *Plusia verruca.* Dull lilac or pinkish fuscous. Fore wings falcate, with a fine brown line on submedian fold. Between the subcostal vein and submedian fold the wing is covered centrally with large patches of dead gold. There are two brown costal patches, between which are double pale lilac marks, the inceptions of the transverse lines, of which the outer beyond the outer brown patch is alone continuous, broad, irregular. Some dead gold patches about the discal mark, which is finely margined with brown, pyramidal, bright gilded. Three similar bright gilded, triangulate, brown-edged spots, form part of the subterminal line opposite the cell. Else the s. t. line is narrow and brownish, broadly margined by dead gold shading on either side. Hind wings pinkish fuscous with orange fringes. Beneath fuscous, without marks; external margin of primaries touched with orange; the short fringes shaded with orange on both wings.

Expanse 48 mil. Lewis Co., New York, July, Mr. W. W. Hill.

ENTOMOLOGICAL INDEX TO AGRICULTURAL REPORTS.

We have lately received through the kindness of the author, Professor Townend Glover, a most valuable publication entitled "Manuscript Notes from my Journal," being an Entomological index to the names, &c., of insects occurring in the annual agricultural reports published by the Department of Agriculture at Washington from 1854 to the present time, with a list of the vegetable and animal substances injured or destroyed by them.

This work is published in quarto form, and uniform in style with the previous works of the same author on Diptera, Hemiptera and Orthoptera, noticed in the earlier volumes of this journal. The first 77 pages is occupied with an alphabetical list of the names of the insects referred

to in the various reports, with brief explanatory references. Following this we have a list of insects to a greater or less degree beneficial by destroying noxious insects, a paragraph on other agencies referred to as useful in the destruction of insects, concluding with a list occupying 21 pages, also alphabetically arranged, of vegetable and animal substances injured or destroyed by insects.

The compilation of this work has been attended with much labor, and furnishes another evidence of the untiring industry of the author. It will prove an invaluable help to all who desire to consult the pages of these reports for information on Entomological subjects, and it is much to be regretted that the edition is not sufficiently large to make it accessible to all who may be interested in Entomology.

NOTE ON THE STRUCTURE OF NEPHOPTERYX ZIMMERMANI.

BY A. R. GROTE, BUFFALO, N. Y.

The following note on the structure of *Zimmermani* is taken from a MS. paper on the N. Am. *Phycidæ* which I am preparing for publication. I would be glad of more material in this group from any correspondents.

"*Pinipestis (sub-gen. nov.).*

Maxillary palpi alike in both sexes, concealed by the porrect labial palpi, which have the third article erect and exceed the front. Ocelli present. Male antennæ very slightly bent at base, where they show slight continuous scale-tufts; ciliate beneath. Fore wings with veins 4 and 5 running close together at base; these veins are seen to have a separate origin, 5 on the cross-vein close to 4, divaricating at one-third from base. Hind wings 8-veined; vein 5 running close to 4 at base, but separate and continuous with the discal cross-vein. Head behind with a thick transverse ridge of scales; clypeus with a bunch-like projection of scales centrally."

I have corrected my former statement as to vein 5, having made a fresh observation under a 1-inch objective. This correction will not allow of the species remaining under the sub-genus *Dioryctria* as defined by Heineman, and presumably establishes *Pin. Zimmermani* as distinct from the European *Dior. abietella*.

CORRESPONDENCE.

By this mail I send you a pair of *Nephopteryx Zimmermani* Grote. If I am not mistaken, they will interest you as a new and very destructive insect; and I think you are more interested in noxious insects than Entomologists generally are. There is scarcely a Pine more than 4 ft. high, on our grounds, that is not more or less affected by this borer.

I have found it on *Pinus strobus*, *P. rubra* or *resinosa*, *P. austriaca*, *P. sylvestris*, *P. cembra*, Corsican, Lofty Bothan and Russian Pines. *P. sylvestris* seems to suffer most, as the limbs, and often the main stem, are constantly breaking off. Only a few days ago one of our finest specimens of *P. strobus* (a tree over 30 ft. in height and almost perfect in shape) had about 6 ft. of the top broken off—the effects of this borer. I am in hopes that the small parasitic flies I found in the larva will soon get the upper hand, so as to keep them in check.

I have been after this borer for several years, but did not succeed in getting the perfect moth until the summer of 1876, and until then supposed they were only on *P. sylvestris*. CHAS. D. ZIMMERMAN.

571 Main St., Buffalo, N. Y., Dec. 26, 1877.

[The specimens so kindly sent by our esteemed correspondent reached us in good order and will prove a valuable addition to our collection, for which we tender our sincere thanks.—ED. C. E.]

May I suggest that the "seeming growth" on the eye of *Papilio philenor*, to which Mr. E. M. Aaron calls attention at p. 200, is probably the pollinia or pollen masses of one of the Orchidacea, objects which have before now puzzled unbotanical Entomologists. Of course, without seeing the things in question, I can only suggest this as a probable explanation. In Mr. Darwin's work on the "Fertilization of Orchids," as well as in the works of other authors on the same subject, will be found lists of the insects on whose proboscises (generally—or at least near that organ) pollinia have been noticed. Examples have also come under my own notice. Mr. Aaron should watch the butterflies, and if he finds them visiting any Orchidaceous flower, let him take a fine pin or grass stalk, and inserting it into some of these flowers, gently, and in the same manner in which the insect would insert its proboscis, the result will probably show him the way in which the apparent growths are deposited.

F. BUCHANAN WHITE, Perth, Scotland