

III.—*Studies on the Life-history of some Bombycine Moths, with
Notes on the Setæ and Spines of Certain Species.*

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The attempt has been made in this and other articles, so far as material and opportunity have allowed, to describe the transformations of some of our Bombycine moths, in the light of the recent very suggestive and stimulating work of Weismann, entitled "Studies in the Theories of Descent" (1882). Until within a few years the majority of descriptions of caterpillars have been prepared simply for the purpose of identification, or for taxonomical uses, and without reference to the philosophic or general zoological significance of these changes. The transformations of some of the European Sphingidæ have been very carefully worked out by Weismann, and also by Poulton, but it is believed that the life-histories of the lower, more generalized Bombyces, especially of the Notodontidæ, Ceratocampidæ, Saturniidæ, Hemileucidæ, Cochliopodidæ, and Lasiocampidæ, will bring out still more striking and valuable results, inasmuch as they, or forms near them now extinct, are believed to be closely similar to the stem-forms from which all the higher Lepidoptera have probably been evolved.

The aim therefore in such studies should be—

1. To treat the larvæ as though they were adult, independent animals, and to work out their specific and generic as well as family characters.
2. To trace the origin of mimetic and protective characters, and to ascertain the time of larval life when they are assumed, involving—
3. The history of the development of the more specialized setæ (hairs), spines, tubercles, lines, spots, and other markings.¹

¹ Besides the work of Weismann, compare also the suggestive papers of E. B. Poulton, in Transactions of the Entomological Society of London, 1884-88, and my papers: Proceedings of the Boston Society of Natural History, xxiv-v, 1890-91.

4. To obtain facts regarding the ontogeny of our native species and genera, which when added to what we know of the life-histories of European, Asiatic, and South American Bombyces, may lead to at least a partial comprehension of the phylogeny of the higher Lepidoptera, viz., those above the Noctuina and Geometrina, and the Microlepidoptera.

Thus far we have obtained facts sufficient, we believe, to enable us to make a more natural classification than heretofore of the families or groups of the Bombyces and allied forms, and these facts are in general, though not always, correlated with the characters of the imagines. The Notodontidæ appear to stand at the base of the Bombycine series, the Ceratocampidæ stand next above them, and from the latter have arisen the Saturniidæ and the Hemileucidæ, while the Coeliopodidæ may have originated from the Saturniidæ, or an allied but extinct group. On the other hand, the Lasiocampidæ may have been the stem-forms from which the Liparidæ, Aretiidæ, Lithosiidæ, and Zygaenidæ, with their allies, have sprung.

In describing caterpillars, particularly those of the Bombyces, I have been particular to distinguish between the three thoracic and the abdominal segments, because the former usually differ in the number, arrangement, and relative size of the tubercles, warts, and other markings, from the abdominal segments. The warts or tubercles also are grouped into dorsal, subdorsal, and often a supra-spiracular (though this may in some cases be the subdorsal row) and an infra-spiracular row or series.

The author hopes finally to embody in a monograph of the Bombyces, which he has in preparation, not only the following but other descriptions. And he would be thankful to collectors and students for the eggs and larvæ needed to enable him to fill up the gaps in our present knowledge of the group, also for such specimens for illustration; as the aim in the final monographic work is to illustrate, so far as practicable, each stage of each species, the earlier stages to be drawn enlarged to the same proportions as the full-grown larva, or larger, when the details need such enlargement.

I have given below a list of the species and genera of which I would like the eggs or larvæ in different stages, and I venture to indulge the hope that my friends will co-operate in rendering the work as complete as possible—for without such aid no single person can hope to make such a work at all complete or satisfactory.

Should any one rear any of these Bombyces, with a view to publication, I should be greatly obliged for alcoholic specimens of the eggs and different larval stages, which might be sent after such descriptions were published. Such specimens would be carefully kept and returned. It will only be by such co-operation that we shall arrive at a fair knowledge of the transformations of this extensive group.¹

LIST OF DESIDERATA IN THE COMPLETION OF THE LIFE-HISTORIES OF
THE PRINCIPAL GENERA OF BOMBYCES AND ZYGENIDÆ.

NOTODONTIDÆ.

- Glyphisia lintneri*, *danbyi*, *ridenda*, and any other species of this genus except
trilineata, eggs and larvæ of any age.
- I. phodonta angulosa*, " " "
- Datana ministra* and other species, " " "
- Notodonta stragula*, young larvæ.
- Nerice bidentata*, eggs and larvæ in all stages.
- Scirodonta bilineata*, eggs and young larva (stages I-IV).
- Heterocampa marthesia*, eggs and stages I-II.
- " *guttitata*, eggs and stage I.
- " *obliqua*, eggs and all stages.
- " *subalbicans*, eggs and earlier stages.
- Litodonta hydromeli*, eggs and larvæ in all stages.
- Cernia apollonaris*, " " "
- " *scitiscrupta*, " " "
- " *multiscripta*, " " "

CERATOCAMPIDÆ.

- Sphingicampa*, any species but *bicolor*, eggs and larvæ in all stages.
- Citheronia sepulchralis*, " " "

SATURNIIDÆ.

- Saturnia galbana*, eggs and larvæ in all stages.
- " *mendocino*, " " "
- Polytissima ceanothi*, " " "

¹ It is earnestly hoped that any one receiving this article will kindly reciprocate by sending the eggs and larvæ of whichever of the following moths they can, packed in tin boxes, to the author at Providence, R. I., or during July and August, at Brunswick, Maine.

HEMILEUCIDÆ.

Hemileuca maia, eggs and larvæ in all stages.

" juno,	"	"	"
" yacapai,	"	"	"
<i>Euleucopheus tricolor</i> ,	"	"	"
<i>Hyperchira pamina</i> ,	"	"	"
<i>Coloradia pandora</i> ,	"	"	"
<i>Quadrina diazona</i> ,	"	"	"

COCHLIOPODIDÆ.

Isa (Sisyrosea) inornata, eggs and young larva.

<i>Limacodes scapha</i> ,	"	"	"
<i>Phobetron pithecium</i> ,	"	"	"
<i>Monoleuca semifascia</i> , or any other species, eggs and young larvæ.			
<i>Euclea penulata</i> ,	"	"	"
<i>Parasa chloris</i> ,	"	"	"
<i>Packardia elegans</i> ,	"	"	"

PLATYPTERICIDÆ.

Prionia bilineata, eggs and larva in all stages.

LASIOCAMPIDÆ.

Thauma ribesii, eggs and larva in all stages.

<i>Gloveria arizonensis</i> ,	"	"	"
<i>Gastropacha americana</i> , and other species, eggs and larva in all stages.			
<i>Clisiocampa constricta</i> , eggs and larva in all stages.			
" strigosa,	"	"	"
" crosa,	"	"	"
" fragilis,	"	"	"
<i>Artace punctistriga</i> ,	"	"	"
<i>Tolyte vellela</i> ,	"	"	"
<i>Tolyte laricis</i> ,	"	"	"

LIPARIDÆ.

Parorgyia achatina, eggs and larva in all stages.

<i>Laria rossii</i> ,	"	"	"
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ARCTIIDÆ.

Nemecophila, any species, eggs and larva in all stages.

<i>Kodiosoma</i> ,	"	"	"
<i>Leptarctia</i> ,	"	"	"
<i>Antarctia</i> ,	"	"	"
<i>Platarctia</i> ,	"	"	"
<i>Callimorpha</i> ,	"	"	"

LITHOSIIDÆ.

<i>Hypoprepia fucosa</i> , eggs and larva in all stages.			
<i>Crambidia pallida</i> ,	"	"	"
<i>Clemensia albata</i> ,	"	"	"
<i>Argyrophyes cilicoides</i> ,	"	"	"
<i>Crocota</i> , any species,	"	"	"
<i>Emydia ampla</i> ,	"	"	"
<i>Ameria unicolor</i> ,	"	"	"
<i>Euphanessa mendica</i> ,	"	"	"
<i>Eithene subjecta</i> ,	"	"	"

ZYGÆNIDÆ.

<i>Cydusia aurivitta</i> , eggs and larva in all stages.			
<i>Anatolmis protei</i> , etc., eggs and larva in all stages.			
<i>Lycomorpha pholus</i> , etc.,	"	"	"
<i>Pyromorpha dimidiata</i> ,	"	"	"
<i>Triproctris smithsonianus</i> ,	"	"	"
<i>Harrisina americana</i> ,	"	"	"
<i>Acolithus falsarius</i> ,	"	"	"
<i>Gnopheta vermiculata</i> , etc.	"	"	"
<i>Ctenucha ochroscapus</i> ,	"	"	"
<i>Scopis fulvicollis</i> , etc.,	"	"	"
<i>Syntomeida ipomæa</i> ,	"	"	"
<i>Cosmosoma omphale</i> ,	"	"	"
<i>Ciris wilsoni</i> ,	"	"	"
<i>Psychomorpha epimenis</i> ,	"	"	"
<i>Edwardsia brillians</i> ,	"	"	"
<i>Atypia mariposa</i> , etc.,	"	"	"
<i>Pseudalypia crotchii</i> ,	"	"	"

FAMILY PLATYPTERICIDÆ.

Notes on the early stages of DRYOPTERIS ROSEA.

The final stage of this species was described in my paper, "Life-history of *Drepuna arcuata*" (Proc. Bost. Soc. Nat. Hist., xxiv, 489), and since then Mr. Bridgman has reared it from a *Viburnum* (probably *V. lentago*), the smallest larvæ occurring in Providence in the second week in July, and representing the vernal or spring brood. He has made excellent colored figures, from which we draw up the following descriptions.

Compare also Mr. H. G. Dyar's descriptions in *Psyche* v, 421,

and vi, 179. He thinks there are six stages, and that it hibernates in the 4th or 5th stage.

Stage II?—Length 7 mm. Feeding on the ends and also eating very ragged holes out of the side, so that the young brown larva closely mimics the ragged portions projecting from the edge of the hole; the tail could be easily mistaken for one of the lower filaments of the withered edge of the leaf. Head as wide as the body, with two large rough finely tuberculated conical processes on the vertex; they are more conical than those in the next stage. There are two smaller dorsal tubercles on the prothoracic segment, and a single large flattened rounded one on the 3d thoracic segment. The body tapers slowly from the 1st thoracic segment to the tail. The skin is rough, with four transverse rows of fine granulations on each segment, and the body is pale brown, like a withered leaf, while the tail, which is now simple, straight, though spinulated, is scarcely twice as long as the body is thick on the 5th abdominal segment.

Stage III.—July 14. Length 10 mm. The body and the proportion of the tail and the shape of the tubercles as before, but the body is darker than before, and the tail is now concolorous with the body. This stage corresponds to the dark brown hibernation-stage of the autumn brood of larvæ.

Stage IV.—July 18. Length 16 mm. In this stage the characteristics of the last one are assumed, though the tail is still straight, but with two paler long rings, the base and tip being darker. The head narrows above and ends in two conical tubercles which are not rough as before; it is dark in front, with a distinct V-shaped yellow clypeal spot. The body is brown, with a broad paler dorsal stripe, which encloses the stout short tubercle on the 3d thoracic segment, and contracts on the 3d and 4th abdominal segments. There are two parallel oblique pale brown lateral stripes, the front one beginning at the base of the 3d thoracic legs and extending upwards and backwards to the hinder edge on the back of the 1st abdominal segment; the second one of the same length and blending with the dorsal stripe on the back of the 3d abdominal segment.

The last stage (length 22 mm.) was attained July 23d. It differs from the preceding stage chiefly in the paler head, without the conspicuous yellow spot, and in the tail being swollen in the middle and slightly at the end.

Late summer brood.—Several larvæ were kindly sent me by Mr. Tallant, from Columbus, Ohio, September 10; they were found

feeding on the haw. They did not molt or grow, and undoubtedly the species hibernates in this stage.

Stage II or III.—Length 6 mm.; of the tail 2 mm. The head is as wide as the body in the middle, the skin rough and warty; the vertex ending in two high conical tuberculated protuberances which rise high above the level of the prothoracic segment. The head is smoother in front than on the sides, being freer from the tubercles; it is of the same color as the body, but the two protuberances on the vertex are paler than below, corresponding to the lighter more ashen hue of the upper side of the body. The 1st thoracic segment with the front edge considerably raised and thickened, bearing two sharply conical warted tubercles about one-half as large as the two on the head and situated directly behind them. The 1st is not quite so wide as the 2d thoracic segment, but it is slightly wider than the abdominal segments, which are all of the same width as far as and including the 6th, when the body gradually tapers to the tail, or tail-like suranal plate which forms a long cylindrical appendage gradually tapering to the rather obtuse end; it is tuberculated like the rest of the body, and a little darker in some specimens; it is as long as abdominal segments 3 to 6 taken together. The skin of the body is coarsely tuberculated, forming whitish close-set granulations; the segments are transversely wrinkled, four wrinkles to a segment, in the middle of the body. On top of the 3d thoracic segment is an irregular rounded knob or tubercle, the surface of which is granulated, but not differing in color unless a shade darker. At the base of both the thoracic and abdominal legs are short stiff depressed hairs. The color of the entire body, including the legs, is of a uniform dark walnut-brown.

FAMILY PSYCHIDÆ.

The larva of *LACOSOMA CHIRIDOTA* Grote.

I am indebted to Mr. James Angus, of West Farms, New York, and to Miss Caroline G. Soule, of Brookline, for the material (sent in September) from which the following description has been drawn up. See also Dr. Riley's notes on this caterpillar.¹ Mr. Angus

¹ Fifth Report U. S. Entomological Commission, on Insects Injurious to Forest and Shade Trees, by A. S. Packard. See (p. 141) Riley's notes on its habits, and his description with my description of his alcoholic specimen.

writes me that his larvæ occurred on the swamp oak. Though belonging to the Psychidæ, both in their larval structure, as well as their cases, and the characters of the moths, the two American genera *Lacosoma* and *Perophora* differ remarkably from the normal members of the family. The larvæ of both genera live upon the oak.

In the present form the case is made by simply folding over one oak leaf on each side of the midrib, so that it is flat, one edge being thin, and the other full and thick. It is difficult to dislodge the caterpillar from its roomy sack, and in this respect it is just the reverse in its habits from the ordinary leaf-rollers; this is perhaps due to its heavy and highly modified body, since if it had to leave its case and drop to the earth, it would perish. Still it can readily turn around within its roomy case. It is, as Riley states in his brief description of the habits of *Perophora melsheimeri*, like the latter "active and savage," as when I attempted to draw it out of its case it would vigorously bite at the end of my forceps, an unusual trait in caterpillars. On finally removing it from its case without injury it was very sluggish and did not stir while I was examining it. I put it back in the box in which it was sent, and in the course of an hour it had found its case, and had sewed up and mended the side of its case which I had to open in order to draw it out without injuring it, as it promised to be a difficult task to remove it without rupturing the body.

The special and striking adaptation of this larva to its life in a loose case, which shows that it, with *Perophora*, is a stem-form, connecting the normal Psychidæ with ordinary Bombycine caterpillars, is seen in the following points:—

1. The obsolete dorsal lines and stripes of the middle of the body, this portion not being occasionally exposed to the light, as are the head- and tail-end. This plainly indicates the origin of this form from a larva which may have fed on leaves, whose body was continuously striped from head to tail, and which had the general habits and mode of ornamentation of larvæ, for example like those of the Phycitæ, which are more or less chestnut-brown, striped with darker, and which live among leaves or masses of their castings, and which live partly shut up from the light. The cause, then, of the atrophy of the normal markings is the absence of light.

2. The small middle abdominal legs, which owe their reduction in size to disuse. In this respect this larva connects the apodous Psychid caterpillars with normal ones.

3. But the most striking adaptive features are: (a) the peculiar shape of the head, and also (b) of the suranal plate, both being steeply inclined planes, and both serving as stoppers to close each end of the case; both being broad, rounded, and the surface not only sloping, but also so colored as to cause it to be easily confounded by the observer with the exterior of the sack. This is an adaptation in direct relation to the form of its case, and must have been due to the transmission of acquired characters during the lifetime of its ancestors, after they had begun to construct cases.

4. The body so flattened that the spiracles can be seen from above.

Its case is not so regular in form as that of *Perophora*; it is quite irregular on the edges, the midrib on one side projecting in front and behind; it is about an inch long and three-quarters of an inch wide.

Full-grown larva —Length 25 mm. (one inch). The head and body are somewhat flattened, so that the spiracles can be seen from above. The head is large, broad, and flattened, the dorsal surface forming a rather steeply inclined plane, like that formed by the dorsal surface of the suranal plate. The surface of the head is rough and corrugated. It is pale yellowish clay-brown (luteous), mottled with dark brown on the side; but in the middle and in front dark brown. The mandibles are dark brown, very solid and thick at the end. The antennae are normal. There are no traces of the remarkable bulbous appendages characteristic of *Perophora*. The labrum is dark brown. The head is as wide as the prothoracic segment, which is narrower than the rest of the body. The 2d and 3d thoracic segments increase in breadth, while the body is thickest just behind the middle, not decreasing in width until the 8th segment. The end of the body is broad and rounded. The suranal plate is large, broad, and well rounded behind; with the surface slightly convex and considerably inclined so as to form a close stopper for the posterior opening of the case; on the dorsal surface are two quadrant-shaped rough semi-chitinous pale, parchment-like areas, provided with a few whitish hairs arising from minute warts.

The body is smooth, nearly hairless, the minute setae being short, erect, blunt at the end, the two largest ones being situated on the 9th abdominal segment. The body is flesh-colored above and slightly luteous or clay-yellow on the sides; the body in my specimen was not quite so dark as Riley describes. The spiracles are conspicuous, black-brown, pale in the middle. The dorsal surface of the pro-

thoracic segments is occupied by a large subchitinous plate, with a pale median line, bordered on each side by a dark shade, also followed on each side by a broad dark band, which is continued on to the two hinder segments, and becomes on the 1st abdominal segment split into two faint lines. This line on the prothoracic segment is succeeded by two oblique dark stripes, the lower one situated just above the spiracles, and twice as long as the upper of the two. The dorsal surface of the abdominal segments with four diffuse obsolete dusky stripes, not reaching the 7th and 8th segments, but on the 8th and 9th segments and on the suranal plate, these lines reappear again (since this end as well as the front end of the body is often exposed to the light) and form two parallel much broken and irregular bands which make a chain of about six pairs of dusky spots. The two subdorsal bands are much broader, and each form a series of about six dusky irregular spots; the lower line partly including the 8th spiracle. There is a broad dusky band on each side of the thoracic segments, at the base of the legs. The middle abdominal legs are very short, but the hooks are very numerous and form two complete alternating circles; the anal legs are much larger than the others, and are also pale. The thoracic legs are dusky amber in color, the general effect however being pale.

The larva is fierce and courageous, and its unusual shape adapts it for resisting the attacks of birds which might endeavor to draw it out of its case. When attacked from behind, it will turn around quickly in its case and present its hard head to receive further attacks; its jaws being unusually solid, with a thick cutting edge. Moreover, even when seized, it can shorten and dilate the body, so that when seized by forceps or by the bill of a bird it can prevent or hinder its assailant from pulling it out of its case.

The larva of *PEROPHORA MELSHIMERII* Harris.

Séveral specimens were received from Prof. Otto Lugger, of St. Anthony's Park, Minn., where it seems more common than in southern New England. His specimens were received September 13th, and being kept in a warm room they mostly pupated, and a male issued from the case October 31st, and a female November 4th. She laid from 75 to 80 eggs.

Egg.—Length 1.7 mm.; diameter 0.7 mm. Long and slender, cylindrical, slightly curved; both ends alike. They are fixed by one end, adhering by a gluey mass to the surface on which they

are deposited. The shell is ornamented with a longitudinal series of parallel fine delicate ribs, between which are cross ribs, parallel and very near together; on the upper (micropylar?) end of the egg are faintly marked, rude, slightly raised polygonal cells, and at the extreme end is a group of more raised smaller areas. Color yellow.

It will be interesting to examine the freshly hatched larva, and I should be greatly obliged for a lot of fertilized eggs.

Young larva.—Length 9 mm. It is now of the same general shape and colors as the full-grown worm. The head is dark chestnut, as is the now well-developed prothoracic shield. The shape and pale color of the end of the body are as in the fully-grown worm.

The case is at this time very irregular, much more so than that of the fully-grown larva; it is lined with silk, with which the "frass" or casting are somewhat intermixed.

The case of the worm in the last stage is about an inch and a quarter long, and half an inch wide; it is flattened cylindrical, and formed of two leaves properly trimmed and sewed together; the midrib of each half extending along near the middle of each surface. Each end of the case is closed after preparation by an orbicular flat silken lid, fastened all around.

Full-fed larva.—Length 30 to 38 mm., when retracted about 15 or 20 mm. The head is large, about as wide as the prothoracic segment; somewhat flattened in front on the face, which forms a declivity adapted to form a stopper to the opening of its sack; the cuticle is dense black, deeply rugose and corrugated, especially on each side of the clypeus; the region of the vertex is rough and coarsely punctured, but without the irregular furrows of the anterior region or face. The mouth-parts are all black; the mandibles unusually thick and strong, and rounded on the cutting edge. The antennæ are very extensile, long, thick, and well developed. But this larva is especially remarkable for new structures not known to exist in any other caterpillars, viz., a pair of long appendages, the use of which is quite unknown. They arise by a slender stalk behind and a little above the eyes, on each side of the head; the base is cylindrical, but the appendage soon becomes flattened or compressed, and flattened bulbous at the end. The structures are brittle, not flexible, and they easily break off; they are about as long as the head.

The prothoracic segment is dorsally black-brown, solid, chitinous, thick, smooth and shining, forming an unusually solid shield, which

is crossed by fine impressed lines; there is a pale median line. The 2d and 3d thoracic segments are slightly wider than the prothoracic. The abdominal segments gradually increase in width to the end of the 8th segment. The skin is covered with coarse and dense granulations, and in general is of a dark brown walnut-color, but paler on the 2d and 3d thoracic and 1st and 2d abdominal segments, these being dull flesh-colored, and faintly showing two parallel dorsal and two wider subdorsal dark-brown stripes, which become obsolete on the 3d and succeeding abdominal segments. The whitish granulations are less dense on the 3d and succeeding segments than on the front or striped portion of the body.

The terminal segments of the body are singularly modified; when retracted the body is thickest in the region of the 5th and 6th segments, but when extended to its full length the 8th abdominal segment is as wide as any; the hind edge of this latter segment is raised into a high, thick, pale flesh-colored fold, which takes the place of the suture between the 8th and 9th segments. The 9th segment is remarkably large and specially modified, having a sublunate dorsal surface, and separated by a slight, sometimes well-marked, ridge from the suranal plate; this ridge is not directly transverse, but is composed of three curvilinear portions, a middle and two lateral ones. The suranal plate is not quite so wide as the 9th segment, but very large, broad, rounded, with the edge a little thickened and the surface rapidly sloping downward and backward; the surface of this (10th) and the 9th segment taken together form an admirable and perfect stopper, or back door, closing the end of the case. The skin on this portion is (evidently from frequent use) dense and thickened, and further strengthened by the granulations, which all over the 9th segment and the suranal plate are densely crowded, extending on to the middle of the upper or dorsal surface of the 8th segment. This portion of the 8th segment is pale flesh-colored (without any rosy or pink tint) and is concolorous with the pale hue of the 9th segment, together with the 10th, or suranal plate. The impressed lines and punctures of this region are more or less blackish.

The body beneath on the anterior half is dark brown, becoming paler behind. The thoracic legs are black; the abdominal ones of the same color as the segments bearing them, with the addition of a slight reddish tint and with a chitinous light pithy piece above the plantæ. On top of each thoracic segment are two dark minute

piliferous warts, but on abdominal segments 1 to 7 are four piliferous warts arranged in a trapezoid, and they are black, flattened, and more or less radiate in appearance.

The body is not quite so much flattened as in *Lacosoma*, so that the spiracles are not so distinctly seen from above as in that genus; they are black, those on the 8th abdominal segment about one-third larger than those on the 7th segment, and they are more easily seen from above.

Compared with *Lacosoma*, *Perophora* differs in the presence of the singular appendages of the head, in the broader, flatter, more inclined face, the perfectly black prothoracic shield, which in *Lacosoma* is banded, and is not black and opaque; in the presence of whitish granulations, *Lacosoma* being without any; in the 9th abdominal segment being without any suture, but on the contrary having a ridge instead, where in *Lacosoma* the 9th segment is normal, being separated by a well-marked suture from the 8th segment, and also separated by a suture from the suranal plate. In *Perophora* the suranal plate is more highly specialized and modified, broader, and granulated. Also the bands on the end of the body of *Perophora* are entirely effaced, while they are retained in *Lacosoma*.

Thus *Lacosoma* is, as regards the larval characters, the less modified genus, and is more like the larvæ of the normal Psychidæ, such as *Æceticus* and *Thyridopteryx*.

As the females of the two genera mentioned are winged like the males, they are evidently in this respect, as well as in the larval characters, less modified and more generalized Lepidoptera than the true Psychidæ, and they should for these reasons be referred to a distinct subfamily of the group, which may be called *Lacosominae*.

The adaptational characters of *Perophora* are the following:—

1. The large, solid, dark head serving to stop up the anterior entrance to its case.
2. The consolidation of the 9th and 10th abdominal segments, the entire dorsal surface forming a solid, firm, oblique surface to close the posterior, or, in fact, either opening of its case, and thus to resist the attacks of insectivorous birds.
3. The wonderful power of shortening its body and thus dilating it so as to enable it to retain its hold in its case and prevent its being drawn out by birds.
4. Its stout jaws enable it to bite firmly.
5. Its unusually fierce and courageous disposition, undoubtedly

developed as the result of successfully withstanding the attacks of birds.

Pupa, ♂.—Length 12 to 13 mm. It is moderately stout, and differs considerably from the normal shape. The head is armed with two stout curved high prominent ridges, converging in front and nearly meeting and almost touching the apex of the raised very distinct clypeus. On the prothoracic segment is a high thin median dorsal ridge; the continuation of it on the rest of the thorax is low, but rather more marked than usual. The sutures between the six basal abdominal segments form deep dorsal furrows, the front edge of which is raised, with a row of teeth projecting over the furrow, the hinder edge of which is toothed, but the teeth form rather long straight ridges. The end of the body is blunt or docked, and armed with four small spines on each side, two of them on the outside near together. On the surface of the 9th segment are a few minute sharp spines. The head and thorax are a little darker than the abdomen, the body in general being of the usual chestnut or mahogany-brown.

NOTES on the habits of the newly-hatched larva of
THYRIDOPTERYX EPHEMERIFORMIS.

The habits of the freshly-hatched larva of this insect have already been well described by Dr. Riley in his Bulletin No. 10, Division of Entomology, on Shade-tree Pests, U. S. Dept. Agr., Washington, and the following observations may serve to supplement his.

From eggs kindly sent me by Dr. Riley, the larvæ hatched in a warm room April 17th; they were found late at night, 11 o'clock, in large numbers in a box on my study table and had eaten little holes in the cloth covering. On the next morning some of them had begun to make hat-like loose cases of the bits of cloth and paper. One in particular, enclosed in a corked vial, had bitten out rather large round mouthfuls or pellets of the cork and fastened the bits together by silken threads, forming a loose sheet or rug-like mass, in which the larva rolled about so as loosely to attach itself to the silken threads, the mass forming a rude band encircling the end of the body. One was seen to lie on its back in a rude heap of the cork pellets, and by rolling over in it had formed a wide girdle or loose band which nearly met around the body, the gap across the metathoracic tergite being filled up in three or four minutes more by three or four bits of cork (see Riley's Fig. 8, c, d); during this process the little restless creature would lie on its back

and sometimes on its side, occasionally stopping to bite out with its jaws additional pieces of the cork.

They apparently do not take food until their case is completed. In ten minutes this narrowest part on the back of the thorax was three times as wide as at first, there being three rows of chips, the case being nearly half completed in about half an hour.

During this operation the head constantly moved to and fro, the labial spinneret giving out the silk thread, and fastening the cork pellets together, the insect stopping now and then to bite off new pieces of cork.

In 26 minutes from the time the band was bridged over by one pellet, the case was so far completed that only the end of the body projected out of it, and now instead of lying down on its side or back, the tail or end of the short body was held more or less erect, and was either withdrawn or pushed out, the basket-like case being built out or added to on the anterior edge. I could finally see the edge of the hole at the bottom of the basket drawn in by the crotchets of the anal legs. To steady itself it would extend and withdraw the terminal half of the body while completing the case.

In walking the third pair of legs are both moved together simultaneously, like a fork, and are extended forwards as if all of one piece, thus propping up the body, while the two anterior pairs are moved.

In one hour it had begun to walk around the end of the cork, having been previously busied with making its case. I should estimate that in general it requires between one and two hours for a larva of this age to construct its basket.

FAMILY LIPARIDÆ.

The life-history of *ORGYIA ANTIQUA* (Linn.).

The eggs, kindly sent from Salem, Mass., by Miss Mary Nichols, hatched May 15th. The larva was described May 18th. The second molt took place the morning of the 22d, the third molt on the morning of May 26th; the molts being nearly simultaneous in the brood. I fed it on Wisteria, at Providence, R. I.

Egg.—Length .8–1 mm. Short, broadly cylindrical. The upper end which the larva breaks off on hatching is depressed or crater-like with a thick swollen edge around it. The surface under a triplet is seen to be not very highly polished and closely pitted,

and under a $\frac{1}{2}$ -inch objective the shell is seen to be coarsely, deeply and irregularly pitted, the hexagonal shape of the edge of the pits being nearly effaced. The larva often after hatching eats more or less of the shell.

Larva, stage I.—Length 4 mm. Head black, two-thirds as wide as the body. The prothoracic segment is as wide as the body behind; it is black above in the middle; on each side is a large reddish-ochreous tubercle directed obliquely outward and giving rise to about twelve long, mostly blackish (a few gray) hairs, which, like all the others, are finely spinulated. The other two thoracic segments are pale flesh-colored with a whitish tint, with a transverse row of blackish-brown piliferous warts, of which the two in the middle are much smaller than the one on each side. Abdominal segments 1-4 dark varnish-brown, with large dark piliferous warts; segment 5th colored like the 2d and 3d thoracic, being whitish-greenish pale carneous, with two minute but conspicuous piliferous warts. The three following segments with the general color, tubercles, and hairs as on abdominal segments 1-4. On segment 8 is a roundish dark dorsal patch enclosing two dorsal blackish piliferous warts, the skin bordering the patch being reddish-carneous. The lateral row of black hairs and those at each end are about three-fourths as long as the body; the longest hairs, a pair on each segment, arise from the sides of the prothoracic and 8th abdominal segments. The eversible glands in this stage are not noticeable and are not seen unless attention is specially called to them; only the one on the 6th abdominal segment is to be distinctly seen, that on the 7th segment is less apparent and not bright colored. Duration of the stage 7 to 8 days.

Larva, stage II.—Length 6-8 mm., varying somewhat in size. Head black. The two lateral prothoracic tubercles are now very large, pale coral-red on the basal two-thirds, black at the end, the hairs arising from them are black. On the top between the tubercles is a large black patch. The top of the 2d thoracic segment is whitish, but the small dorsal tubercles, which are unequal in size, are dark. The top of the 3d thoracic segment is pale, whitish, bordered with ochreous, and bearing small pale piliferous warts. Abdominal segments 1-4 are velvety black on the back, edged with a narrow ochreous line, each segment bearing two large black piliferous warts. The body is now a little humped over the 1st and 2d abdominal segments. The 5th segment is yellowish-white above,

with piliferous warts of the same size. Behind this segment the body above is blackish, with a subdorsal line on each side, which unite on the 9th segment, which is above pale ochreous. The body beneath is livid. The thoracic legs are blackish, the abdominal legs pale livid. Many of the dorsal thoracic and lateral abdominal hairs are pale gray. *The two eversible glands are now bright coral-red*, as bright colored and as distinct as in the final stages. At the end of this stage, just before the molt, there are visible a few feathery black hairs on the inner side of the two dorsal tubercles of the 8th abdominal, and in some individuals they are present on the inner side of the dorsal tubercles on the 1st and 2d abdominal segments.

Larva, stage III.—Length 10 mm. At first the larva is scarcely larger than in the preceding stage just previous to molting. The head is black as before. The lateral prothoracic tubercles are pale Indian-red with black between them, *and give off a pencil of piume-like hairs, thickest at the end.* This and the other pencils are as well developed proportionally as in the full-fed larva. The top of the 2d and 3d thoracic segments white and edged with ochre as before. *The four median dorsal tufts, one each on the four basal abdominal segments, are now well developed*, the two in front being *dark smoky-brown*, the two behind *snow-white*, the 4th one being somewhat smaller than those in front. The 5th segment is white above, ochreous on the side, as in stage II. *The 8th segment bears a thick long tuft of black feathery hairs*, as well developed in proportion as in the adult. The row of largest lateral tubercles is now conspicuous, *the warts being bright flesh-colored* instead of black, as before. The hairs, especially along the sides of the body, are denser, more numerous, than before.

Note.—Two days later, in a few, the two anterior dorsal median abdominal tufts have faded almost white, while the two posterior are straw-yellow. In most, however, the two anterior tufts remain black, the two posterior ones having changed to straw yellow. Length of stage about 5 days.

Stage IV.—Molted May 31st, some as late as June 1st. Length 17 mm. The chief change is that each of the four dorsal tufts has now become pale buff-yellow, though immediately after molting the two anterior tufts are at first dusky, gradually becoming paler. The subdorsal rows of these tubercles on each side are coral-red, and the upper lateral row of piliferous warts are now bright coral-red, while lower down there is a small bright yellow dot, one on each segment

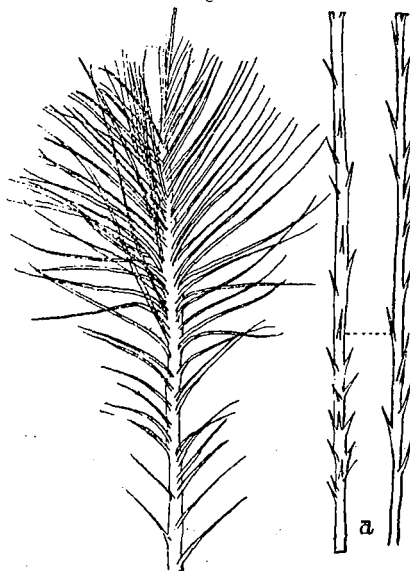
between the piliferous warts. A small slender white lateral pencil on 3d thoracic segment, and a thicker black one on 1st abdominal segment of about the same length. The other black pencils are a little longer than before. The 2d and 3d thoracic segments have a pair of small dorsal yellow transverse slashes on each side, and the dorsal tubercles on these two segments are bright yellow and very conspicuous. The prothoracic piliferous tubercles are still bright Indian-red. The lateral pale hairs along the body are whiter and denser than before. The head is black, not coral-red as in *O. leucostigma*.

June 7th several began to spin a cocoon (♂?). June 8th, 4 or 5 cocoons. The ♀ larvæ were still molting June 14th; none yet in cocoon; I think the ♀ larva must molt oftener than the ♂.

Variation in the four dorsal tufts of last stage: Some are all cream-white, others are buff-yellow, in others the 2 anterior dusky, and 2 posterior buff-yellow, and in one specimen of the 2 anterior tufts, one is dusky and the 2 posterior are snow-white.

Of 12 cocoons, all up to June 15th seemed to be ♂. June 18th, 2 ♂ moths appeared!

Fig. 1.



One of the black plumose hairs taken from a lateral prothoracic tuft is represented at Fig. 1; *a*, portions of a simple, spinulated hair.

Recapitulation of appearance of early larval features.

1. Appearance in stage III of the pencils on the prothoracic and 8th abdominal segments.
2. The four median dorsal tufts on the four basal abdominal segments well developed in stage III.
3. The warts of the lateral row become bright flesh-red in stage III.
4. The two dorsal eversible glands become bright coral-red in stage II. Thus, all the features of the full-grown larva, such as the high colors and the white and black tufts or pencils, which render it so conspicuous, appear in the 3d stage.

The early stages of *ORGYIA LEUCOSTIGMA* (Abbot and Smith).

Larva, stage I.—(Drawn up from alcoholic specimens from Dr. Riley.) Length 3.5 mm. The head is small and not so wide as the body. It is deep chitinous or amber-ochreous. The body is rather long and slender, cylindrical, pale yellowish flesh color, with two broad irregular, dark, more or less broken subdorsal lines, which are most distinct on the abdominal segments, the space between the lines being sometimes irregularly bridged over by off-shoots from the main lines.

The 1st thoracic segment is slightly wider and larger than those behind it, but looks larger than it really is from the pair of very large lateral piliferous tubercles which cause the larva to resemble that of a *Clisiocampa* or rather a *Gastropacha*. These tubercles are large, prominent, and rounded, bearing about 20 spinulated hairs of varying length, the longest being about two-thirds as long as the body. All the hairs are brown, some being paler and taper to a point. There are no clavate hairs on the body. The piliferous tubercles on the 2d and 3d thoracic tubercles corresponding to the lateral prothoracic ones above described are slightly smaller than those on the succeeding or abdominal segments; the latter, *i. e.*, the subdorsal ones arising from the dark subdorsal lines, all being of the same size. The two subdorsal lines run between two rows of tubercles, the inner row being one of the two dorsal median rows; the tubercles of these two median rows are much smaller than the outer rows, the latter set being a continuation of the large prothoracic "lateral" ones. Now those of the two medio-dorsal rows are small in front, but become larger on the 6th, 7th, and especially the

8th abdominal segment, giving a slightly humped appearance to this segment, from which the body falls off to the anal tip. There is no prothoracic shield.

The rudimentary eversible glands are difficult to detect. I can not with a Tolles triplet or $\frac{1}{2}$ in. objective detect them on the 6th and 7th segments. They must be rudimentary and much smaller than any of the tubercles and must be colorless.

It will be observed that in this stage when the larvæ are small, they show none of the markings of the later stages, not needing the danger signals, though they are undoubtedly thinned out at this time by insects and birds.

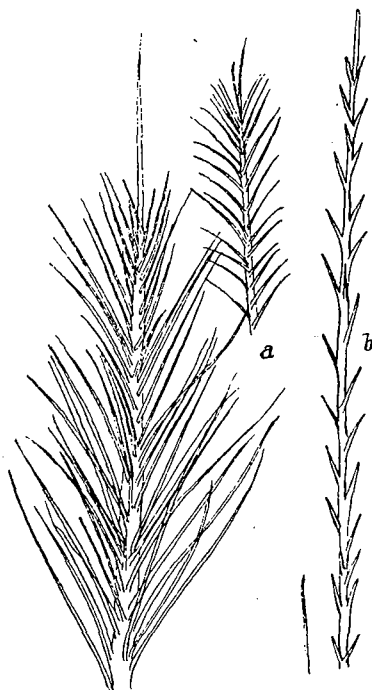
Stage II.—(Found on Wisteria, June 15th.) Length 5 mm. Head not so wide as the body. Prothoracic segment very wide, with two very large prominent lateral tubercles extending out as far as the front of the head, and each bearing a short black pencil which is not so long as the body is wide. Yellow hairs project over the head from the front edge of the prothoracic segment; they are unequal in length, the longest ones being nearly as long as the worm itself. The body is blackish, the lateral black line of stage I being now very broad; connected by a black band on the hinder edge of the prothoracic segment, while the end of the body is black above and encloses the two retractile pale yellowish papillæ. From the 2d thoracic to the 5th abdominal segment extends an irregular broad yellowish band ending in a broad squarish, yellowish patch, free from papillæ, and situated on the 5th abdominal segment. The front edge of the 1st thoracic segment is luteous. The sides of the body low down and beneath are greenish, with a faint yellowish tinge.

Stage III.—(Observed June 17th.) Length 6-7, and at end of stage, 10 mm. It has now assumed the characters of the last stage. The head is at first amber-colored, afterwards deepening. There are two dark pencils $\frac{1}{3}$ as long as the body, and 4 white tufts, one each on the first four abdominal segments. The two eversible glands are now coral-red. A velvety-black dorsal band extending from and enclosing the white tufts to the end of the body. The sides of the body are of a peculiar bluish-gray. A dense anal tuft arises from the 8th abdominal segment, giving rise to feathered hairs like those on the full-fed larva, but not so well developed. Most of the other hairs are whitish, some of them dark.

Fig. 2 represents the end of a black plumose hair from a prothoracic tuft in the last stage; a, a similar hair of stage III, showing

the simpler shape, with much fewer plumules; *b*, the end of an ordinary spinulated hair.

Fig. 2.



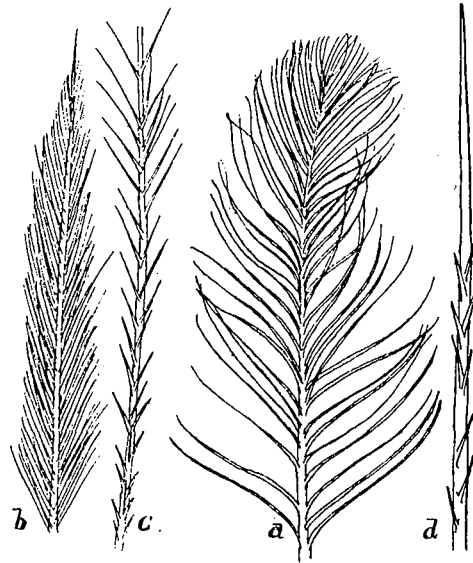
For comparison a plumose hair of *Parorgyia parallela* is represented in Fig. 3; *a*, a hair taken from the dorsal tuft on the 8th abdominal segment; *b*, a very long and slender hair from a prothoracic tuft; *c*, the base of *b*; *d* a spike-like spinulated seta intermingled with the plumose hairs of the dorsal tuft.

Recapitulation of the more salient ontogenetic features.

1. The two dorsal eversible glands become bright coral-red in stage III.
2. Appearance in stage III of the lateral prothoracic pencils, and of the 4 dorsal abdominal tufts.
3. The dense dorsal tuft on the 8th abdominal segment, consist-

ing of feathered hairs, is well developed in stage III, though not so large in proportion as in the final stage.

Fig. 3.



Notes on the transformations of *ORGYIA CANA* Hy. Edwards.

Mr. Dyar has already given a detailed description of the life-history of this species in *Psyche*, VI, No. 189, January, 1892. He describes seven larval stages. The following notes are based on a brood hatched from eggs kindly sent me by Mr. Dyar from the Yosemite Valley, September 25th; they hatched in Providence on the 30th of the May following, and fed on young tender oak leaves. I publish them as they contain references to the glandular hairs and a few points not noticed by Mr. Dyar.

Larva, stage I.—Length 3 mm. Head, body, and hairs all black, except the hairs situated low down on the sides, where they are gray. The pair of lateral piliferous tubercles on the sides of the prothoracic segment is very distinct and prominent. All the hairs (except those low down on the sides of the body, where they are gray) are black, and of the same general length as in the freshly hatched larva of *O. leucostigma*. Two days after hatching the body is

slightly longer and somewhat paler, especially on the 2d and 3d thoracic segments, and on the 5th, 6th, and 7th abdominal segments, but the piliferous tubercles are black, and contrast with the livid black color of the segments. The dorsal tubercles on the 5th, 6th, and 7th abdominal segments are situated on a pale straw-yellowish field, as seen under a $\frac{1}{2}$ -inch objective.

The shorter hairs on these three abdominal segments bear and are enveloped by drops of a clear fluid; but these drops were not seen on the hairs of the other segments.

I was unable to detect on the living larva placed under a $\frac{1}{2}$ -inch objective the dorsal eversible glands, but I could see five or six bulbous pediculate processes, which are most numerous on the back of the 7th abdominal segment. The fluid envelops the hairs, and is evidently exuded from them; on the other hand, the hairs situated on the other segments both in front and behind do not exude the fluid.

End of stage I.—About five days after hatching and just before the first molt. Length 5 mm. The body is now paler than before, livid, and marbled above and on the sides with white, with a yellowish patch on the hind edge of the prothoracic segment, which grows wider backwards covering the back (tergum) of the 3d thoracic segment. On each of the 5th, 6th, and 7th abdominal segments is a dorsal yellowish patch, more distinct than in the early part of this stage. The glandular hairs are as at first, being especially developed on segment 7, where six are seen, and there are no signs of the eversible glands.

Stage II.—June 6th. Length 4-6 mm. All the larvæ with two distinct corat-red eversible glands on the 6th and 7th abdominal segments, and the short dorsal black tufts have appeared. The head is still entirely black. The yellow patches on the thoracic and the 5th abdominal segment are as before. The piliferous tubercles are still black, the body dull livid, marbled with dull porcelain whitish. A few white hairs arise from the dorsal surface of the thoracic segments, and a few from the dorsal surface of the 2d and 3d abdominal segments. The lateral tubercles on the prothoracic segment are large and prominent, but there are as yet no long lateral or dorsal pencils, though on the 2d and 3d abdominal segments is a pair of short thick dorsal tufts, but none on the other segments.

On June 7th A. M. the larva had increased to 8-9 mm. in length, and the white hairs were more conspicuous.

Stage III.—Molted the second time June 10th. Length 11 mm. Now the pair of prothoracic black pencils formed of feathered hairs, and a short thick dorsal one on the 8th abdominal segment have appeared. Two snow-white dorsal tufts, one on the 3d and a much smaller one on the 4th abdominal segment are now present. The dorsal and subdorsal warts on the abdominal segments are now bright rust-red, and very conspicuous. The body is jet-black, and there are no lateral tufts. The white hairs on the sides of the body are longer and more numerous and dense than before. The generic characters are nearly all assumed at this stage, as in the other species.

Stage IV.—June 15th–17th, molted again. Length, without the pencils, 15 mm. The head is still black, with a whitish labrum. There are two long black prothoracic pencils of feathered hairs, and a single median dorsal one on the 8th abdominal segment. Two brown-black tufts on abdominal segments 1, 2, each, succeeded by a white dorsal tuft on the 3d, and one on the 4th segment. The piliferous warts are now brighter red. Most of the hairs are white. The yellow patches on the thoracic and on the 5th abdominal segments are distinct. It is now a gaily marked caterpillar.

Last stage.—(July 12th.) Length 18–20 mm. The head is entirely black, except the labrum, which is yellow. The body is black, with faint yellowish patches along the sides, but along the back deep velvety black. A pair of stout prothoracic pencils. No lateral pencils; a thick medio-dorsal oblique black pencil. The head is partly concealed from above by a thin broad sheet of white hairs arching over from the prothoracic segment. There are 4 thick short dorsal black tufts of the usual wedge-shaped form, the outer hairs on the base being white, though the 2 anterior tufts are in one example tawny, and in the centre black, while the two posterior tufts are white, the central hairs being somewhat buff-colored. The piliferous warts are bright brick-red, but not of so bright a coral-red hue as the two dorsal eversible glands. The hairs arising from the piliferous warts are white, with scattered black ones, all, as usual, radiating, and of different lengths. There is a brown and yellow dorsal spot and two unequal subdorsal ones on each side of abdominal segments 4 to 7. There are four flattened broad dorsal piliferous warts on the front edge of the prothoracic segment, and which are reddish-yellow behind. A pair of yellow dorsal spots on the front edge of the metathoracic segment. A broken yellow

lateral line, or rather a series of curved broad bright sulphur-yellow spots each situated on the sutures between the two lateral piliferous warts; these are especially noticeable on the abdominal segments.

The cocoon.—One July 10th. It is rather broad and rounded, whitish, with numerous yellow hairs, some white ones, and a few black ones mixed with them. Just where these yellow hairs come from I do not understand, as there are none on the larva, unless they have changed in color since death.

The first larval stage of *ORGYIA DEFINITA* Packard.

This stage has already been described by Mr. Dyar in *Psyche*, VI, September, 1891, 145.

They hatched June 19th-21st. The freshly hatched larva differs from the other species in being pale whitish, tawny, or luteous. The body is almost white, including all the legs. The head is pale honey-yellow. The body is a little flattened, with the prothoracic tubercles large and prominent. The hairs are all pale tawny, with no dark ones; those on the sides of the body and at each end very long, some of them rather longer than the body. Otherwise the larva is of the same general shape, and without tufts or pencils or eversible glands, as in the freshly hatched larvæ of the other species of the genus.

FAMILY ARCTIIDÆ.

The transformations of *HALESIDOTA CARYÆ* Harris.

The latest and fullest description of the different stages is by Miss C. G. Soule in *Psyche* (VI, 158); she states that the larva molted six times. Mr. Dyar gives nine stages (*Psyche*, V, 422).

A batch of eggs received from Mr. H. Meeske hatched June 19th, A. M.; all (over a hundred) hatching nearly simultaneously. The freshly hatched worms devour a part of the empty egg-shell, before beginning to feed. They feed well on the elm, also will eat the leaves of the wild cherry and chestnut. It is a remarkably beautiful and conspicuous caterpillar.

Egg.—Diameter 0.8 mm. Hemispherical in shape, the dome rather high; green when first laid. The shell is very thin and glassy, when empty reflecting the colors of the rainbow; the surface is smooth, and under a $\frac{1}{2}$ -inch objective is seen to be indistinctly pitted

with shallow polygonal areas, with an indistinct very slightly raised edge. The micropyle forms a distinct rosette at the apex of the dome, composed of oval wedge-shaped areas. The larva escapes through a wide elliptical opening, and does not invariably eat up its shell.

Larva, stage I.—Length 2.5 mm. Described two or three hours after hatching. The head is very large and black, much wider than the body, which is pale livid flesh-color, with chestnut-brown warts, which are not so dark as the head. The prothoracic shield is large and broad, crescentiform. On the 2d thoracic segment are two double transverse warts, with a minute median wart between. On the 3d thoracic segment the two corresponding warts are less united, the inner ones larger than the outer, and sometimes a faint minute median one is indicated. The four dorsal warts on each abdominal segment are arranged in a trapezoid. Each wart bears a single hair. Suranal plate transversely elliptical. Duration of stage I about ten days (that of Miss Soule's brood about 6 days).

Stage II.—Described three or four days after the first molt, length 4 mm. The body is now pale, almost whitish-carneous, the head and warts strongly contrasting with the hue of the body. Usually but one, and no more than two hairs arise from the warts, and the hairs on the thoracic and last abdominal segments are longer than those in the middle of the body. The head is black and the prothoracic shield and warts are blackish-brown.

Towards the end of the stage (July 2) the larvæ are still gregarious. Length 6 mm. The head is now black, not so wide as the body, which is pale whitish as before, with black tubercles and whitish tubercles, a few longer hairs at each end of the body; they are sparse, with a few black ones intermingled. The warts are all black, with only from 1 to 3 hairs arising from each one. Duration of stage II about 10 days (duration stated by Miss Soule about 7 days).

Stage III.—Length 10 mm., becoming 13-14 mm. Described July 12th. The body is now thick, tapering at each end, shining pearly-white, with large black tubercles from which arise white hairs, of very unequal length, most of the longest ones equalling the diameter of the body; a few others, one from the side of each segment, being twice as long as any of the others. On 2d thoracic segment is a slender lateral black pencil of hairs, not so long as the body is thick, containing a single black hair which is twice as long

as the others. On each abdominal segment (1-8) is a pair of dorsal short, slender black pencils crossing each other, and arising from the forward pair of tubercles; there being none on the thoracic segments. All the legs, thoracic and abdominal, are black. As late as July 18th many were molting into this stage, having spun a carpet of silk on which to rest, and in which to fix their crochets during the process of exuviation.

Stage IV.—Length 18-20 mm. The body is now much larger and thicker than before, but the arrangement of the hairs and their color are as before, and the tubercles are of the same dark tint.

Full-fed larva, stage V.—Described September 25th. Length 35-38 mm. The head is entirely jet-black. The body is of a delicate pale bluish-white, with the sutures in front broadly painted with black, with irregular black spots and lines between the tubercles, which are also black. The body is entirely concealed from above by the very dense hairs, while on the sides the verticils are not so dense and the body appears through them. On the back the hairs are dense and evenly trimmed, while on the sides they are quite uneven. The hairs are in general snow-white, those on the sides spreading out widely, as in the other species. On the 1st abdominal segment is a pair of high, slender, lateral black pencils; and another pair slightly shorter on the 7th segment. Along the back is a series of 8 double wedge-shaped black median dorsal tufts, on each side of which and between which on each side is a subdorsal row of transverse linear black marks, forming the center of transversely elongated tubercles, the hairs radiating obliquely so as to leave the top of the tubercles exposed. On the sides is a series of round black tubercles, with several irregular black spots scattered below; still below which is a series of smaller lateral black tubercles giving rise to white hairs. A few black hairs on top of the thoracic segments and more dorsal black ones arise from the end of the body, some of them forming two slight pencils, each consisting of about 9 or 10 black uneven hairs.

The life-history of *HALESIDOTA MACULATA* (Harris).

I found the young larvæ from stage II to the full-grown larvæ feeding on poplar at Brunswick, Maine. Those in stage II occurred on the under side of the leaf, August 5-7.

Stage II.—Length 7 mm. The head is black, nearly as wide as the body, which is straw-yellow, with a black prothoracic shield,

which is moderately large, rounded on the sides in front, but angular on each side behind. The rather large tubercles in general bear from one dozen to two dozen spinose hairs. On the 1st abdominal segment is a large conspicuous transverse oval black spot, bearing a piliferous tubercle from which an irregular tuft of black hairs arises, and another on each side of the same segment also sending off a tuft of black hairs. On the 7th segment is a similar large conspicuous black swollen double wart. There is a large double dorsal black wart on the 8th segment from which arises a double black tuft. There are five black lunate warts on the side of abdominal segments 2-7, and on each of these segments are four dark greenish dorsal warts arranged in a trapezoid. *The dorsal black tufts present in the next stage are not yet indicated*, as the hairs in general are pale yellowish. The larva in this stage is a very conspicuous object, but yet very different from the full-fed larva. The thoracic and abdominal legs are blackish, the four pairs of middle abdominal legs paler.

Stage III.—August 10th to 18th. Length 13 mm. The characters of the full-grown larva are attained in this stage. The head is black, as wide as the body, *which is now entirely concealed by the hairs*, the latter arranged in dense bunches and of unequal length. A few long white hairs arise from the 1st to 3d thoracic segments; the other hairs are straw-yellow, except a row of eight double median dorsal black tufts, the first and last ones much larger than the others. There is a pair of lateral thick black pencils on the 1st and 8th abdominal segments. The tubercles giving rise to these pencils are surrounded by black, and there is a broad black lateral broken band connecting the black patches on the 1st and 8th abdominal segments; elsewhere the skin is pale. (In one specimen the broad lateral black band is wanting.) The generic characters appear in this stage.

Final stage.—September 3d, Maine. Length, when at rest, 25 mm. Body blackish, densely covered with deep lemon-yellow hairs so that it cannot be seen when the larva is at rest; they are longer on the sides than on the back, so that, as in the other species of the genus, the larva appears a little broader than high. Head black, clypeus and antennæ whitish; the head in general is provided with sparse unequal black hairs. The hairs on the thoracic segments are all lemon-yellow above, and low down on the sides they are also usually yellow, though sometimes black, according to

Saunders. On abdominal segments 1 to 8 is a row of eight double dorsal black tufts, appearing as if single wedge-shaped tufts; the first tuft is higher and narrower than the others; the 7th one much shorter and wider, the others in front gradually becoming more like it in shape, going backwards. A pair of lateral black tufts on the 1st and 7th abdominal segments, projecting slightly beyond the yellow hairs; the hinder pair is a little thicker than the front pair. From the thoracic segments arise about six slender long white pencils composed of few hairs which are nearly as long as the body is thick, and of uneven length. On the 8th and 9th segments are (in all) three pairs of similar pale, whitish, very slender tufts. The abdominal feet are pale livid; the thoracic feet are black.

For the sixth and seventh (last) stages, with a description of the cocoon and pupa, see Dyar (*Psyche*, VI, 165).

Life-history of *HALSIDOTA TESSELLATA* (Abbot and Smith).

The following notes were made while watching the development of a brood found feeding socially on the under side of a white ash leaflet at Brunswick, Maine, August 12th. The brood had evidently all undergone their first molt. When disturbed they fell off and let themselves down by a thread. (Since these notes were prepared Mr. H. G. Dyar has published in *Psyche*, VI, 164, descriptions of all the stages (nine) of this larva; but without giving measurement of the length of the larva, though careful measurements of the head are given.)

Stage II.—Length 6 mm. The body is rather broad and flattened, slightly decreasing in width to the end. The head is shining black, nearly as wide as the body. The body is greenish-yellow, with a livid hue; it is yellow on the three thoracic segments, and on the 8th abdominal. The piliferous warts are large, black, conspicuous, giving rise to sparse radiating bunches of grayish-white hairs of unequal length. Some of the dorsal hairs are blackish, and of these about half a dozen arising from the thoracic segments, and two from the 8th abdominal segments are about half as long as the body, the longest ones, however, occurring on the thoracic region of the body.

Stage III.—Length 12 to 15 mm. (Described soon after exuviation.) Now the generic characters are assumed. The head is entirely black, except the front of the clypeus, the lobes of the labrum, and the basal joint of the antennæ, which are white. The

body is in general black, honey-yellow on the sides, including the abdominal legs. The dorsal warts emit short radiating even white hairs; those low down on the sides spreading and much longer and more uneven. From the second thoracic segment long white hairs project over the head, with several black ones on each side. From the third thoracic segment arise two subdorsal oblique distinct black tufts. On abdominal segments 7 and 8 is a short conical double black dorsal tuft, that on the 8th segment twice as large as the one on the 7th segment, and from each side of the same segment projects a black pencil; among the black hairs composing the pencil is a white hair longer than any of the others. The base of the tubercle, from which the pencil arises, is whitish, and in part deep flesh-colored, and the spiracles of the ninth pair are white and conspicuous.

The end of stage III just before moulting.—(Described September 18th.) Length 14–20 mm. Head as before, black with the front part of the clypeus, the labial lobes and the basal joint of the antennæ white. The body is not entirely livid, blackish, there being a broad pale whitish band along the sides of the body between the white spiracles and the base of the legs. Along the back the median dorsal tufts on abdominal segments 1–6 of the two last stages are still wanting, so that the blackish body shows through the hairs. On the 7th abdominal segment is a median dorsal black double wedge-shaped tuft, and on segment 8th there are two double wedge-shaped black tufts, a little longer than in front, and composed of black hairs arising from the four dorsal tubercles of this segment; the outer of these warts have, arising from the side, the short radiating whitish hairs, the pencil of black hairs arising from the inner side, so that from one and the same tubercle originate short radiating whitish hairs, and also long black hairs. From the largest lateral tubercle on the same segment besides about sixteen whitish radiating hairs of unequal size and length, arises a pencil consisting of nine long black hairs. This pencil in the present stage is smaller and shorter than in the last stage, and easily overlooked. The anterior black pencils also arise from warts which also send off the short radiating hairs. The four anterior black pencils are also smaller and slighter, composed of a less number of hairs than in the last stage.

In this stage, also, in larvæ 20 mm. in length, the three thoracic segments are whitish behind on the back, and dusky in front.

Stage IV.—Length 24–25 mm. (Described September 18th.) The head as before. The radiating hairs are now whitish-yellow to pale

golden-yellow. The black pencils are now large and well developed, and now the first six abdominal segments have well-developed dorsal tufts. This is due to the increase in number and size of the hairs arising from the inner side of the median dorsal tubercles or warts. In the fully fed larva they are still denser, and form the series of median dorsal tufts, eight in all, one to each segment. Compared with the final stage, the body is still visible through the hairs, and the white infraspicular band is still in part retained, while the radiating hairs are paler, shorter and sparser, and less silky.

*Stage V and last.*¹—Length 30 mm. (Maine, on willow, September 10th to 15th.) It is of the same size as *H. maculata*,² also on the willow in Maine. The head is black, but with the anterior division of the clypeus, together with the basal joint of the antennæ, labral lobes, labium and maxillæ, white with a yellowish tint. The body is black, but beneath pale livid yellowish along the middle. Thoracic legs pale pitchy; abdominal legs pale flesh yellow. Spiracles whitish. The tubercles are black, but the hairs radiating from them are dense, and all uniformly pale golden-yellow, those of the dorsal median wedge-shaped tufts dusky at the end. The last of these tufts is slightly longer than the others. There are two long black pencils arising from the 2d thoracic segment and projecting nearly horizontally in front; a second pair of similar black pencils from the third thoracic segment, the latter giving rise to a pair of lateral whitish pencils. A few long black hairs are mixed with the long white hairs projecting from the prothoracic segment and reaching over the head. Two irregular white pencils, but slightly distinguishable from the other white hairs, project out from behind at the end of the body.

On the thoracic segments between the 1st and 2d pairs of black pencils are, on the 2d and 3d thoracic segments, two pale yellowish-ochre dorsal patches, which only become visible when it is creeping; in fact these two segments are yellowish-ochre above, with blackish patches.

¹ As those raised from the white ash were poorly and irregularly fed, they were much less developed than those feeding wild on the willow, and which reached maturity early in September. The ash caterpillars were only 25 mm. in length, and the yellowish hairs even much paler than in normal larvæ. The median dorsal wedge-shaped tufts in all are dusky at the end, the inner hairs of the tufts being blackish, either the whole hair or the ends only.

² In my report on Insects Injurious to Forest and Shade Trees, p. 353, this caterpillar is wrongly referred to as probably *H. maculata*.

Summary of the more salient ontogenetic features.

1. But a single hair arises from a tubercle in stage I (Dyar).
2. Several hairs arise from a wart in stage II.
3. The generic features begin to appear in stage III, since from the third thoracic segment arise two subdorsal oblique distinct black tufts; and on the 8th abdominal segment is a black pencil.
4. The abdominal segments 1-6 are provided in stage IV with well-developed dorsal wedge-shaped tufts like those in the last stage.

Note on *H. harrisi* Walsh.¹

This is the yellow variety of *Halesidota tessellata*, with a honey-yellow head and orange-colored pencils.²

Mature? larva.—This variety was found at Providence, R. I., September 15, 1890, by the roadside on the carraway. Length 18 mm.

The head is *honey-yellow*, the anterior division of the clypeus, with the labrum and antennæ, whitish. The body is so densely covered with uniformly silky-*white* hairs as to conceal it when at rest. There are no hairs of any other color except the four anterior dorsal pencils, which are of a *rich ochre-orange buff color*; of these the front pair arise from the 2d segment, and the hinder pair from the 3d thoracic segment. There are two shorter lateral pairs of white pencils, one in front arising from the 2d thoracic, and the other from the 3d thoracic segment.

From the 8th abdominal segment a pair of dorsal pencils of white hairs project outward and backward, while a few long hairs project back horizontally from the very end of the body.

There is a pale chitinous broad and short prothoracic shield divided into two halves by a pale line.

The body is whitish, with a lateral row of large black patches situated on each segment near the spiracles when they are present; the latter are ringed with black, and lower down is a row of large irregular black patches at the base of the legs. The thoracic and

¹ For interesting remarks and descriptions of the *seven* stages of this form see Dyar (*Psyche*, VI, 162); in this paper Mr. Dyar regards *H. harrisi* as a distinct species from *H. tessellaris* of Abbot and Smith, as the larvæ differ in their first as well as later stages, and he finds differences in the male genitalia.

² *Proc. Bost. Soc. Nat. Hist.*, IX, 1864. Walsh does not mention the color of the head in either of his two forms of *tessellata*.

abdominal legs are all pale whitish, like the body. All the setiferous tubercles are white like the body.

This larva is entirely unlike the 4th stage of normal *H. tessellaris* (Abbot and Smith).

The egg and mature larva of *EUCHETES COLLARIS* Fitch.

The larva (♀) occurred at Brunswick, Me., on the dogbane (*Apocynum androsæmifolium*), August 16th. On the 25th it spun a cocoon.

August 29th the pupa was still whitish. The moth appeared in the breeding-box on May 27th succeeding. For some eggs I am indebted to Mr. H. Meeske.

Egg.—Diameter 0.7 mm. Of the usual hemispherical shape, the dome moderately high, and at the apex slightly raised. The shell is thin, glassy, and perfectly smooth under a $\frac{1}{2}$ -inch objective, with no traces of pits or polygonal areas.

Freshly-hatched larva.—(Described from several alcoholic specimens.) Length 2 mm. Head scarcely wider than the body, pale whitish flesh-colored; the eyes situated on a dusky patch; with a few scattered dusky hairs. The body is cylindrical, whitish, with pale umber-brown piliferous warts. Prothoracic shield rather large and broad, with a pale median suture, partly dividing it into two parts; each half bearing two piliferous warts in front, and three behind. The 2d and 3d thoracic segments with suboval dorsal warts each bearing two unequal black hairs, the longest ones nearly twice as long as the body is thick. The subdorsal and lateral warts each bear a shorter single white spinulated hair. Along all the abdominal segments are two additional small hemispherical approximate dorsal warts, each bearing a single dark hair; these, in addition to the dorsal two-hair-bearing tubercles of the 2d and 3d thoracic segments. On each side of these abdominal segments not bearing legs, are two piliferous warts below the lateral ones. All the abdominal legs have a longitudinal large dusky patch on the outside, which is also present on the anal legs. The longest hair arises from the 1st abdominal segment, and these two are twice as long as the body is thick. All the hairs are spinulated as usual in the family. The abdominal legs each bear but four unguis.

Full-fed larva.—Length 22 mm. The body is cylindrical, rather thick, pale whitish, and completely concealed by beautiful long silky woolly slate-gray hairs; the longer hairs being considerably

longer than the body is thick; the shortest ones are of the same color as the longest. The spiracles are pale, surrounded with a narrow black ring. The piliferous tubercles are pale, but mostly speckled with dark at the origin of the hairs.

The larval stages of *LEUCARCTIA ACRÆA* (Drury).

It feeds voraciously on plantain leaves, and makes a great quantity of frass. The eggs were laid June 19th, at Brunswick, Me., the larvæ hatching June 25th, in the morning, their first act, after breaking out, being to devour the shell.

Egg.—Diameter 0.6–7 mm. Hemispherical, rather high, white, with a coarsely pitted surface as seen under a triplet; under a $\frac{1}{2}$ -inch objective the deep pits are seen to be closely crowded, and surrounded with smooth swollen polygonal edges; the pit itself being rounded. The larva eats away the upper half of the shell, the edge being scalloped, each scallop representing the cut made by the jaws.

Larva, stage I.—Length slightly over 2 mm. The body is pale or somewhat dusky flesh-colored, without any reddish tint. The head is shining black, large, wider than the body. The prothoracic shield is well-developed, crescent-shaped, contracted in the middle, the surface on each side gibbous; dark chestnut. The piliferous warts are rather large and quite convex. The two dorsal tubercles of 2d and 3d thoracic segments bear two hairs, the lateral ones bearing each two hairs. The abdominal dorsal tubercles all bear but a single long spinulated hair, except the lateral ones, which bear two small short hairs of unequal length; all the subdorsal warts bear but a single hair. Some of the hairs are nearly as long as the body. The double dorsal row of small warts are rather peculiar. The thoracic legs are chestnut, the abdominal ones of a dusky flesh color. There are 2 sets of unguis on each abdominal leg.

It moulted June 30th to July 2d, the duration of the stage being about 5 or 6 days.

Stage II.—Length 5. mm. The head is, after it has fed a few days, narrower than the body, chestnut-black; the clypeal and labral region pale flesh. The body is pale greenish, with yellowish tints. The prothoracic plate is now divided into halves. The tubercles are dark, the hairs blackish. The dorsal and subdorsal warts bear usually five hairs, one very long, the four others shorter

and smaller, varying in size; the longest ones are three times as long as the shorter ones; the lateral warts still bear but two hairs. There is a subdorsal row of reddish-brown irregular spots, and another similar row on the sides low down. The thoracic and abdominal legs are blackish.

It molted July 10th to 12th; the duration of the stage being about 10 days; and was described after molting on the 12th of July.

Stage III.—Length 15 mm., finally becoming 20 mm. The head is small, black; the body thick, tapering at each end. All the tubercles are black, with black and white hairs of unequal length, the longest equalling the diameter of the body. A broad, somewhat broken white, conspicuous dorsal line finally becoming yellow. An interrupted yellowish broad band on the side, bounded above and below by a whitish-yellowish line somewhat wavy, and interrupted by the yellow patch on each segment forming the broken band; the tubercles being situated in the yellow patches, one in each; they are black at each end of the body, but yellowish or nearly so in the middle segments. All the legs are blackish.

Molted July 20th to 25th; the length of this stage being about 10 days.

Stage IV.—Length 35 mm. Much as before, but much larger, the pale yellowish dorsal line is now wanting and the entire dorsal region has become dark leaden-gray, with short spreading verticillate hairs on the two middle rows of tubercles, the subdorsal ones giving out longer unequal hairs, which are more or less leaden-gray. There are now two parallel lateral rows of small bright yellow spots; between each set of spots are two light reddish-brown tubercles which give off gray hairs, mixed with whitish ones. The hairs cover the body more densely than before; and the head is black and the body beneath deep leaden-gray. All the feet, both thoracic and abdominal, are black. The spiracles are whitish on a blackish field. The head with the clypeus above and the antennæ are yellowish, but the yellow spot on the clypeus is smaller by one-half than in stage III.

It molted again July 30th to 31st, hence the length of stage IV was about 10 days.

Stage V and last.—Length 35 to 40 mm. A great change takes place at this molt. Now the hairs are long and slender, fine and soft, and most of them as long as the body is thick, with a few at

each end of the body twice as long as the others, the long ones more numerous at the end than on the thoracic segments. The dorsal hairs are sable-brown-black, so thick that the outlines of the body can be scarcely seen through them; the warts are also dark, though the lateral warts are still reddish-tawny. From the lower side of the supra-spiracular tubercles arise hairs which are all reddish-tawny; those arising from the upper edge are reddish at base, and blackish on the end, or remainder of the hair. The lateral hairs are bright tawny. The light buff-colored spiracles are now very conspicuous, and are situated directly in front of the large tubercles.

Note. There is a tendency in this and other Arctians to become, after the 2d molt, much more hairy, so as nearly to conceal the body, and thus, as by this time they feed in more conspicuous situations, they are less edible to birds and less exposed to attacks by ichneumons and Tachinæ.

This is now a very handsome caterpillar, the close dorsal hairs, like the fur of the sable in general appearance, contrasting with the bright tawny hairs on the sides, the bright conspicuous spiracles showing through them.

Life-history of *Pyrrharcia isabella* (Abbot and Smith).

Dyar remarks that this larva has ten stages, *Psyche*, V, 422.

The eggs of this moth were received from Mr. H. Meeske, of Brooklyn, N. Y., and were laid in confinement May 12th. The larvæ were active, feeding on the wild cherry; after hatching they scatter, and eat away the surface of the under side of the leaf, not eating holes in the leaves. Another set of eggs, laid in a small patch, was found on the under side of an oak leaf at Brunswick, Maine, July 6th, hatching a day or two later.

Egg.—Diameter 0.7 mm. Hemispherical, but the dome is quite high and regularly rounded, white, smooth and shining, and smooth seen under a Tolles triplet, but under a Tolles $\frac{1}{2}$ inch-objective the shell is seen to be marked with a network of very fine, minute, quite irregular polygonal areas, bounded by very slightly thickened edges, as if they were the imprint of the cellular walls of the oviduct.

Larva, stage I.—Length 2.5 mm. Hatched June 14th. Head dark chestnut, moderately large, no wider than the body. Prothoracic shield moderately large, irregular in shape, with a transverse furrow behind the middle; on the front arise four hairs, and on the

hind edge are two hairs. The 2d and 3d thoracic segments bear each a transverse row of four flattened dark brown conical tubercles; the two inner and larger of which bear two hairs. All the abdominal tubercles bear but a single hair.

The median dorsal tubercles (two on each segment and wanting as usual on the thoracic segments) are elongated, while the outer ones are irregularly rounded; the lateral tubercles are rather narrow and elongated parallel with the length of the body. The hairs are long and spinulate. A few hairs are longer than usual; these arise from the 2d and 3d thoracic and also the 8th abdominal segments, and are about a third as long as the body.

Stage II.—Length 4-5 mm. Described about one day after the first molt. The head is as wide as the body and of a dark chestnut-brown. The prothoracic shield is distinct, crescent-shaped. All the warts are concolorous in hue, moderately dark chestnut, and most of them bear 5-6 hairs. The dorsal thoracic hairs are about twice as long as the body is thick, as also are those on the 8th abdominal segment, but the others are rather shorter, and all the hairs are uniformly of the same rather dark brown color, of the same hue as the head. There are about 10 spinulose hairs arising from the larger dorsal tubercles. The body is livid purplish all over, the piliferous warts are now higher and fuller, but are chestnut-colored, with a slight ruddy or purplish tint. The body is fuller and thicker than before, while the hairs are somewhat shorter, and all are of the same dark-brown color. The small median dorsal tubercles bear 2 to 3 hairs, and the larger ones from 10 to 12 hairs.

When 5 mm. long, later on in this stage, the body is purplish pale flesh-colored; the warts purplish and quite convex, the hairs all dark and longest on the 2d and 3d thoracic segments, those on the other segments only a little longer than the body is thick. The body beneath is paler.

One about to molt is 7 mm. long. The body is mottled with short irregular purplish lines, and there is an irregular lateral broken pale narrow line. The warts are black at the end, and there is no difference in the color of the hairs on any part of the body, all of them being nearly black, with no reddish ones.

Stage III.—Molted June 29th, and described before beginning to eat on that date. Length 7 mm. The body is now stouter, and the hairs on the three thoracic and 1st abdominal segments, also on segments 7 to 10, are black-brown as before, while those on the

middle of the body (abdominal segments 2 to 7) are much paler, being of a brown flesh-color, though with no reddish tint; among the pale flesh-brown hairs are a few scattered black lateral and dorsal ones. The tubercles are large, bearing numerous hairs. The head is uniformly of a pale horn color.

On June 30th, the colors of the black and of the tawny-brown hairs are now respectively more pronounced and dissimilar, so that we have indicated the differences in color between the reddish abdominal segments 2-7 and the bluish hairs of the rest of the body, characteristic of the mature larva. A dorsal pale indistinct stripe is present.

Stage IV.—Length 15 mm. A specimen bred from the oak is now almost exactly like the adult. The head is dark chestnut, and the five succeeding segments are black; the tubercles and hairs of the hinder edge of the 2d abdominal, and the whole of the three succeeding segments (3-6) scotch-snuff reddish-brown or tawny, exactly as in the full-fed larva, while the 8th to 10th segments are black with black hairs and tubercles. On the 2d thoracic segment are a few reddish hairs. A few hairs in front and on the hinder end are nearly or quite twice as long as the others, which in general are about two-thirds as long as the body. The thoracic feet are black; the abdominal feet dark, with the plantæ flesh-colored. This caterpillar remained alive and without molting till the 8th of September. I saw several full-grown larvæ September 8th.

It appears from the above-stated facts that the characters of the mature larvæ, *i. e.*, the dense hairs, those on the 3d-6th abdominal segments being reddish, are indicated in stage III, and completely appear in stage IV.

The freshly-hatched larva of SPILOSOMA VIRGINICA (Fabr.).

Eggs laid May 20th and hatched June 2d to 4th; mostly dead, but one or two hatching June 5th.

Larva just hatched. Length 2 mm. Body pale greenish; head large, slightly wider than the body, dark chestnut-brown; the two sides full and swollen, with a pale suture between. All the piliferous warts dark chestnut, conical, very distinct, contrasting with the pale greenish body. Hairs blackish, very long, some of them over one-half as long as the body. A faint crescent-shaped prothoracic

shield bearing two transverse rows of piliferous warts. No middle dorsal small twin warts on the thoracic segments.¹

A very dark almost black Aretian was found crawling in the city of Providence September 26th, from which I reared a moth of this species. I describe the larva as follows:—

Full-grown larva.—Length 35–38 mm. Body dull smoky black, with white spiracles. The hairs all black, except a dark reddish tan-brown shade on the abdominal segments. The head is rather small, black, the clypeus, antennæ, and labrum, as well as mouth-parts, pale greenish. The body is of the same general shape as that of *P. isabella*, but the hairs are not so stiff or dense. The body is black, as are also the tubercles. The verticils are dense, composed of hairs of uneven length, those on the back (dorsal and subdorsal) of abdominal segments 3 to 7 are mostly dark reddish chestnut-brown, almost blackish, mixed with black ones, but the lateral tubercles all send off black hairs. Besides these there are a few very long hairs, which are grayish at the end, and these are a little more numerous at both ends of the body, a few more arising from the last three abdominal segments than from the three thoracic segments. Suranal plate and sides of all the black abdominal legs speckled with white granules like fine white sand (it does not brush off, and can't be sand!) Under side of the body dark livid smoky black. The thoracic legs are pitchy black, pale at the tip. A very richly colored velvety-black, handsome caterpillar.

The cocoon is unusually dark, being blackish-brown, while the moth, a male, had the black spot on the under side of the base of the forelegs unusually large; otherwise it does not differ from typical specimens.

A foxy-red larva of Spilosoma virginica (Fabr.).—Head, including the mouth-parts, amber. The body is livid black. No pale lateral band is visible, but the sides of the body, including the spiracles, are paler than above, and especially beneath. The spiracles are white. All the hairs are foxy reddish-brown, except those

¹ Mr. Bridgham's drawing of *S. virginica*, stage I, does not very well represent my larva, as in mine the head is wider than the body, dark chestnut, and not as he represents it pale, with two darker spots. The warts are also darker. The color of the body is good. The shape of the prothoracic shield differs, as in my larva it is crescentiform, not transversely oblong. Yet his drawing is not that of *H. cunea* or *A. virgo*!! I am, of course, sure my moth is *virginica* and not *cunea*.

of the prothoracic segment, and the sides, low down, of the 2d and 3d thoracic segments. Most of the hairs, especially along the back, are not quite so long as the body is thick; some are very long, as described in the yellow variety, and the lateral ones are less evenly cut and longer than the dorsal verticils. A few black hairs are mixed with the reddish ones along the sides. The tubercles are not foxy-red like the hairs. The thoracic legs are pale amber, while the abdominal ones are black, with pale plantæ.

The two last larval stages of *SEIRARCTIA ECHO* (Abbot and Smith).

The following descriptions have been drawn up from specimens from Punta Gorda, Fla., collected in March, 1891, and presented by Mrs. Slosson. They will feed on almost any kind of leaves. As my descriptions in *Psyche* (V, 351) were drawn up from colored figures, the following notes may take the place of my descriptions of the two last stages.

Larva, stage V?—Length 12 mm. The head is fully as wide as the body, ochre-yellow, concolorous with the setiferous tubercles, which are large, high, and prominent, bearing bristles as long, some longer than the body; they are black-brown, becoming ochreous at the base, while in front and at the end of the body there are a number of gray bristles. On each abdominal segment the two median dorsal small tubercles are crowded in front of the two much larger lateral ones. The segments are transversely banded with two parallel rows of cream-white irregular linear slashes, three in each row, varying somewhat in shape and in distance apart. The prothoracic segment is ochreous-yellow like the head. The body is dark black-brown, contrasting with the reddish-ochreous tubercles. (This does not entirely agree with Mr. Bridgman's figure of the 5th stage, as the head is *all* ochreous.)

Full-fed larva.—Length 30 mm. Head cherry-red all over; anterior division of the clypeus and the antennæ whitish. Tubercles reddish-ochreous; the hairs mostly reddish-ochreous at base and black on the outer half. Body dark Vandyke-brown. Prothoracic segment like the head, but of a duller hue. 2d thoracic segment with a pale cream-white spot in the middle, and a transverse whitish slash on each side, while behind is a faint cream-white broken transverse line; on the 3d thoracic segment are two transverse cream-white lines, and between them, but nearer the hinder

line, is a median and two lateral cream-white spots. Each abdominal segment with two similar transverse lines, without the intermediate spots; in the anterior line is a dilatation in the middle. In the hinder abdominal segments the hinder of the two cross-lines may be obsolete or represented by a median and a lateral spot. (It agrees very well in general appearance with Bridgham's drawing of the sixth stage, also in the position and color of the tubercles and of the markings, allowing for variation in the latter.

Egg.—Diameter 0.9 mm. Hemispherical in shape, rather high. The empty shell is thin, glassy, and seen under a triplet to be rather coarsely pitted; under a $\frac{1}{2}$ -inch objective the pits are deep, of uneven size, round, but bordered with a raised swollen irregularly polygonal margin. The egg is much like that of *Leucartia acraea* in shape and ornamentation, the pits being very similar.

The fully-grown larva of *ECPANTHERIA SCRIBONIA* (Stoll).

I found a larva on the alligator pear (?) growing on Mr. McCormick's grounds at Lake Worth, March, 1891. It will feed on geranium, and will eat almost anything except orange leaves. Very hardy, standing transportation to the North well.

Length 60 mm. The head is black, becoming cherry-red on the sides and along the front at the base of the labrum. Body deep velvety-black, and with dense fascicles of long dense barbed brown-black hairs.

When the caterpillar is in motion the sutures on opening are seen to be stained with Indian red or brown madder, forming a conspicuous stripe.

All the eight stages of this species, raised from Florida, have been described at length by Mr. Dyar in the Canadian Entomologist, XXIII, 106.

The full-fed larva of *ECPANTHERIA PERMACULATA* (Pack.).

I received two larvæ, from one of which this moth was reared, from Mr. Th. D. A. Cockerell, of West Cliff, Colorado. He wrote me under date of April 28, 1890, that the caterpillars were collected near Grape Creek, West Cliff, April 28, 1890, and he sent me the brief description, from life, given below. Mr. Cockerell was unacquainted with the food-plant.

The caterpillar began to pupate between May 9th and 15th, spinning a slight cocoon between the leaves offered the larva (which, however, took no food). The imago appeared about a month later, viz., June 19th.

Mature larva.—"Length about 30 mm. Head shining black; body purplish-gray; each segment with dark tubercles (twelve on most of them), each emitting a bunch of shortish spinulated hairs. These hairs are of two colors, the anterior part of the bunch being black, and the posterior pale shining ochreous. Legs reddish-ochreous." (Cockerell.)

The partial life-history of *UTETHEISA BELLA* (Linn.).

The eggs and freshly-hatched larvæ were kindly sent me by Miss Caroline G. Soule. The food-plant was *Myrica gale*. The eggs are laid in confinement, either singly or in patches. The young larva was described August 1st.

Egg.—About half a millimeter in diameter. When alive it appeared on the leaf to be hemispherical, though rather high, but the alcoholic specimen is certainly spherical. Under a Tolles triplet magnifying 10–12 diameters, the living egg is seen to be smooth, shining, with no pits or granulations. The color was not noted; but the alcoholic one is yellowish. Under a $\frac{1}{2}$ -inch Tolles objective the shell also appears to be smooth, with no granulations visible.

Larva, stage I.—Length 2 mm. Head large, considerably wider than the body; dark chestnut-brown, being of the same color as the piliferous tubercles. The body is pale greenish with a yellowish tinge. It slightly narrows from behind the head to the end. The prothoracic plate is rather large, bearing four setæ on the front edge, and four others on the hind edge. The dorsal tubercles on the 2d and 3d thoracic segments each bear two hairs, the lateral warts each bearing one. The dorsal abdominal tubercles on segments 1 to 7 each bear a single hair, though the largest lateral one on the 8th segment bears 3 hairs, and the dorsal ones each 2 hairs. The dorsal abdominal tubercles are arranged in a trapezoid, the two in front nearest the median line are larger than those behind, instead of being much smaller, as in typical Aretians, such as *Spilosoma*, *Leucaretia*, etc., moreover the trapezoid forms a moderate curve rather than an exact trapezoid. Under a $\frac{1}{2}$ -inch Tolles objective the hairs are seen to be very minutely spinulose and tapering; they

are all dark brown, and their average length is a little longer than the body is thick. The plantæ in the alcoholic specimens are borne on a very long stalk. Each planta bears four hooks.

For the full-grown larvæ I am indebted to Mr. Otto Seifert, who sent me several which he collected in New Jersey early in October.

Last stage.—Length 23 mm. The body is cylindrical. The head is rather small, being about one-half as wide as the body in its middle; it is pitch-red, or reddish-chestnut, smooth, and shining. The body tapers towards each end, and is armed with moderately large, acutely conical though not very noticeable tubercles, each of which gives rise to a single long, thick spinulated hair, the four (on each segment) dorsal tubercles each bearing a black hair; those on the sides of the body bearing shorter, smaller white hairs. The body is beautifully variegated with black, yellow, and white. The segments are black above, with two transverse rows of cream-white angular spots, the sutures broadly marked with buff-yellow. A lateral broken, irregular broad cream-white line. The abdominal legs are buff-yellow, with a dusky patch on the outer side. The thoracic legs are entirely black. The body beneath is buff-yellow.

The life-history of *CRENUCHA VIRGINICA* (Charp.).

In the Proceedings of the Essex Institute¹ I described the transformations of this moth, including the two later stages, which I supposed to be the fourth and fifth. During the summer of 1890 I was able to complete the life-history of this interesting form, and the following notes may be added to those already published. The 6th and last stage was described in my first paper.

The males appear to be more common than the females, and were abundant on the shores of Casco Bay, Maine, at Merepoint, Brunswick; but about three miles from where they were observed in 1862. In 1863 a larva in the fourth stage was observed as early as May 16th, while June 6th of the previous year, larvæ both in the fourth and last stages of growth were observed, a few mature caterpillars crawling restlessly about. June 13th the larva began to construct its cocoon, and it pupated four days later, and after remaining in the pupa state nearly a month, the moth emerged July 15th. The eggs were laid in a patch side by side, as in the case of *Aretians*. The young hatched July 28th, so that the egg state lasted a little less than two

¹ Vol. IV, No. 1, Notes on the Family *Zyganidæ*, April, 1864.

weeks. In 1890 a larva in stage IV was observed feeding on grass June 22d, and two days later a full-fed caterpillar was found; they were observed more frequently a week or two later, but the last fully-fed caterpillar was seen July 27th. The first appearance of the moths in 1890 was July 13th, when three males entered the window in the night attracted by the light, and males appeared sooner and were afterwards much more numerous than the females. Confining a number of both sexes eggs were laid July 27th to 28th, and these hatched August 8th to 10th, so that the duration of the egg or embryo state is between ten or eleven days and two weeks.

Egg.—Length 0.8 mm. or a little less than a millimeter. The egg is regularly hemispherical in shape (not spherical, as stated in 1864), slightly higher than broad. Under a Tolles triplet of high power the shell is seen to be very finely, minutely pitted, but under a low power appears to be smooth and shining. Under a Tolles $\frac{1}{8}$ -inch objective the surface of the shell is seen to be divided into very minute quite regular polygonal areas, bounded by a slight ridge; from this ridge on one side of the area project horizontally across the middle of the area one, or more usually two very delicate slender tapering hair-like processes nearly reaching the opposite side of the polygon.

The eggs are deep yellow when laid, remaining so till the embryo forms, when they are dark ash-colored, darkest above.

Larva, stage I.—Hatched August 8th to 10th. Length 2.5 mm. Head black, smooth, shining, and rather broader than the body. The body tapers slightly to the end; it is at first light yellowish, afterwards becoming darker. In the older, darker ones the body is pale flesh-color, as usual in Aretians. The prothoracic shield is moderately large, being antero-posteriorly quite short, but, rather broad, sublunoid; it bears on its front edge four piliferous warts, all of nearly the same size, and each bearing a single hair, which is fine, tapering, like those on all the rest of the body, there being apparently in the *Zygænidæ*, as in the Aretians, no bulbous glandular hairs. There are no piliferous warts or hairs on the hinder edge of the shield. On each of the two other thoracic segments there are but two large dorsal flattened piliferous warts, which are oval, each bearing three long black hairs, the longest being about twice as long as the body is thick.

Abdominal segments 1 to 8, with four dorsal flattened piliferous warts, each bearing a single hair, arranged in an obscurely marked

trapezoidal manner. The two median ones are hemispherical, situated on each side of the median line, the opposing sides being straight and parallel. There are four lateral warts; the upper one much larger than the others; the 2d minute, situated behind and below the uppermost; the 3d and 4th are narrow and long, the 3d being situated directly beneath the 1st.

On the 9th abdominal segment the four piliferous warts of the other segments are coalesced into two large flattened warts, each bearing three setæ. On the 10th and last segment is a large dark suranal plate with irregular edges, bearing on each side 3 to 4 hairs. All the warts are dark horn-color, and most of the hairs arising from them are dark, some almost blackish, and about half as long as the body.

Stage II.—Molted August 18th to 20th. Length 5 mm., becoming August 25th 7 mm. in length. The head is black, rounded, not so wide as the body. The prothoracic shield as in stage I. The 2d and 3d thoracic segments each with two large widely separate dorsal black warts, bearing about 14 hairs of unequal length, both white and black, the longest of which are about one-quarter as long as the body. On each side are two lateral tubercles, slightly larger than the homologous ones on the abdominal segments, these, especially the upper one, on the 2d thoracic segment being larger than the corresponding one on the 3d thoracic segment.

On the abdominal segments (uromeres) are four dorsal piliferous tubercles arranged in a trapezoid, of which the two middle ones are subulate, the others round; the former bear 2-3-4 short fine hairs; the round ones from four to five longer and thicker hairs.

The body is chestnut-brown, but the warts are surrounded by pale carneous spaces; and the hairs above dark brown, becoming gray on the sides. There is a broad irregular brown dorsal band, and a broad irregular lateral chestnut-brown band, below and above which the body is pale whitish flesh-color, the flesh-colored lines afterwards forming the two lines so distinct in the next stage. The lower of these pale bands become towards the end of the stage a distinct, lateral white line, broken at the sutures; it surrounds the base of the third lateral tubercle, while the fourth and lowest tubercle is surrounded at base with an irregular whitish ring. This infra-spiracular line remains white throughout this stage.

The thoracic legs are chestnut-brown; the abdominal legs pale chestnut, the plantæ still paler.

Stage III.—Length 10 mm. Molted August 30th to September 1st. The characters of stage IV are now indicated. The head, however, is still shining entirely jet-black, and is rather narrower than the body. The body is black, with a subdorsal stripe at first white and afterwards becoming yellow as the larva becomes older and larger; also an infraspicular lateral wavy white longitudinal stripe, the latter the most sharp and distinct, and containing on each segment a black piliferous wart.

From the tubercles on the 2d thoracic segment long white and black hairs overarch the head; similar tubercles and hairs, but shorter, arise from the 3d thoracic segment. The dorsal tubercles are black, arranged in a trapezoid, and from each arises a verticil of 15-16 straw-yellow hairs varying in length. The verticils on the sides of the body are black, with shorter white ones intermixed.

On the first abdominal segment are *two twin dorsal black pencils* appearing as if one; they stand up straight, and are about as long as the body is thick. There are none on the succeeding segments until the 8th, which bears a black pencil not quite so thick as the anterior one, and more irregular, and directed backward. The thoracic and abdominal legs are black, the plantæ pale.

Stage IV.—Molted September 5th, and described the next morning. Length, directly after molting, 10 mm., afterwards reaching a length of 15 mm. Just after exuviation and when 10 mm. long, *the row of seven median dorsal double arched black tufts have appeared*, these being undeveloped in the previous stage. The body also is thicker, though at first little longer, and the verticils of hairs are longer, and the hairs themselves much more numerous and dense, so that the body and subdorsal stripes cannot be seen through them, though it can easily be in the third stage. The long dorsal hairs in front and at the end of the body are black; those on each side of the seven black median tufts straw-yellow, while the ground-color of the sides of the body, and the hairs low down, are black. *The head is black.* The lateral or infraspicular line is now white. A part of the overarching prothoracic hairs are white. All the legs are dark, the abdominal ones livid at the end and on the plantæ.

Not having carefully observed and noted all the transformations of an individual larva, I had supposed that there were only five stages, but while writing out these notes, one larva brought with me from Maine to Providence, and which was in the stage just

described, having an entirely black head and measuring 15 mm. in length, molted September 29th, and assumed a red head; and hence, as I am sure my first three stages are as above described, I feel quite confident that there must be five stages before the last, and that the fifth stage, next to be described, is the one in which the insect hibernates. The following description is taken from several specimens observed June 22d and later in the summer of 1890; my living one, just molted, being somewhat dwarfed. At first the head is entirely light chestnut-red, and the abdominal legs are of the same color.

Stage V.—Length 18 mm. *The head light chestnut-red*, becoming blackish in front. Body densely hairy, the head and body when not moving completely concealed by the dense stiff hairs, which are of even length. Those overarching the head and those on the sides of the body are coal-black. The verticils on the prothoracic segment and 9th abdominal segments are snow-white, and white hairs are mixed with the black ones on the sides. The dorsal hairs bright sulphur-yellow. There is a series of nine dorsal double median black tufts, the first pair of which are slightly larger and higher than the others, and directed a little forwards, while the last pair are directed obliquely backwards.

A broad, irregular brown, somewhat scalloped white subdorsal line, while the infraspinal line is decidedly narrower; it is scalloped or wavy and is bright snow-white, besides being much more distinctly seen than the subdorsal one.

In this stage it continues to feed conspicuously on grass, both in June, and the second brood in September, hibernating in this stage. It transforms into the last larval stage as early as June 24th, and in the summer of 1890, which was very favorable to caterpillar life, the full-grown larvæ were observed as late as July 27th.

Summary of length of the different stages.—Egg stage 11 to 13 days; larva, 1st stage 10 days; 2d stage 10 to 12 days; 3d stage 5 to 6 days; 4th stage? 23 days; 5th stage from late in September to late in June; prepupal stage 3-4 days; pupal stage 23-30 days, imago stage probably about two or three weeks.

Recapitulation of the more salient larval features.

1. As in Arctians and Lithosians no glandular hairs in stage I. Body and hairs as in Arctians. A well-developed prothoracic chitinous shield and suranal plate in stage I.

2. Great increase, in stage II, of hairs, the unipiliferous warts transformed to verticillate polypiliferous warts. At end of stage II the infra-spiracular white line appears.

3. Assumption in stage III of Glaucopidian characters. Appearance of the subdorsal white stripe, becoming yellow at the end of the stage. The yellow dorsal and subdorsal hairs appear. Appearance in stage III of the dorsal black tufts on abdominal segments 1 and 8.

4. Appearance in stage IV of black tufts on abdominal segments 2 to 7.

5. The head previously black, becomes red in the penultimate, or 5th, stage.

6. A decided change in coloration from the penultimate to the final stage, the hairs of the latter stage being all yellow, with no black dorsal tufts.

It will be seen that in stages I and II the larva resembles that of the Arctians; it is minute, not easily detected by birds, and feeds on the leaves of plants enjoying on account of its small size and neutral tints a comparative immunity from the attacks of birds and the visits of insects. When the spiny hairs become dense and gaily colored, and the larva a very conspicuous object, feeding as it does on the spears of grass, it is protected from birds and insects by its dense stiff spiny hairs, and like some, if not most, Arctian larvæ it is comparatively free from the attacks of ichneumons and Tachinæ; in fact I have not seen any *Ctenucha* larvæ which have been parasitized.

Whether the moths, which fly not very rapidly in the bright sun and are much exposed to the attacks of birds, are distasteful or not to birds remains to be proved by experiments, which I have been unable to make. They do not give out the strong odor of *Leucarcia* and other Arctian females.

Hibernation of the larva in the two last stages.—Like some Arctians, as *Pyrrharctia isabella*; *Ctenucha virginica* and the Rocky Mountain species (probably *Ct. cressonana*), kindly sent me by Mr. Cockerell, wintered over in the larva state, but while *P. isabella* hibernates in the final stage, that of *Ctenucha*, whether near the coast of New England or in the higher elevations of the Rocky Mountains, does not attain the final stage before the winter, as the eggs are not laid before midsummer (those of Arctians are laid early in June), so that the larva does not have time to com-

plete its growth before the autumnal frosts set in at the end of September, and it is thus compelled to winter over, as is the case with some butterfly larvæ, before the last stage. It will be interesting to ascertain whether this is the case with the more southern California species, and those of *Scepsis*.

The young larva of *CTENUCHA CRESSONANA* Grote?

In March, 1890, I received from Mr. T. A. D. Cockerell, of Cliff County, Col., a larva which had hibernated. It could not be kept alive. It is evidently a *Ctenucha* in the penultimate (5th) stage, and congeneric with *Ct. virginiana* in its hibernating or penultimate (5th) stage; and as *C. cressonana* is the common species in Colorado, I am disposed to refer it to that species.

When disturbed it lies curled up on its side, the black dorsal tufts projecting like spikes, and the head touching the tail.

Length 18-20 mm. The head is nearly as wide as the body, reddish-yellow, but not so deep red as in *Ct. virginiana*, and without the two diverging black bands in front. The body is not so densely hairy as in the 5th stage of *Ct. virginiana*, but is more as in stage IV of that species. The body is now scarcely concealed by the rather sparse hairs. The body is dark leaden, and the verticils of hairs are also dark. There is a distinct subdorsal yellowish, and a whitish lateral stripe. On the thoracic segments there are rather long hairs, which arch over the head. On each of the abdominal segments 1-8 there is a long double dorsal pencil of black hairs, the first one inclining forwards, and the last one backwards, the others being more or less erect. All the legs, both thoracic and abdominal, are yellowish, the latter distinctly so.

The larva of *PIRYGANIDIA CALIFORNICA* Pack.

These larvæ, two living examples (and others dead), were described May 5th, and others June 5th from life, while the colors were still fresh; most of them had pupated. They were sent April 30th by Prof. J. J. Rivers.

Full-grown larva.—Length 12-15 mm. The head is a little wider than the body; it is large, full, globose, smooth, with a few long scattered hairs; pale flesh-colored, with an oblong black patch on each side extending upon the black mandibles; labrum pale. The body is cylindrical, of the same width to near the end; the

8th abdominal segment being distinctly humped, while the segments are transversely wrinkled. The body is pale straw-yellow, with three broken reddish dorsal lines, the median one being the broadest and least broken; the space on each side whitish. Two parallel subdorsal distinct reddish lines enclosing a whitish band, connected in front by a transverse dark reddish-black line on top of the prothoracic segment. The upper of the two subdorsal lines dilates or spreads inward a little on the 1st, 3d, and 5th abdominal segments, and bends up angularly on the 8th, connecting with a transverse dark line crossing the hump. A similar one on the 9th abdominal segment. On the middle of the 5th abdominal segment the median line dilates into a large distinct transverse oblong reddish mark. There are two parallel longitudinal stripes on each segment above the legs, the lower broad and firm, the upper slight and broken up into spots. There are four pairs of well-developed middle abdominal legs; the 5th or anal pair being one-third smaller than the others. There are a few moderately long hairs on the back and sides of the body.

One example has black lines and marks on a greenish-yellow ground. This caterpillar is a true Agaristid in appearance, the hump being *well marked* and the body naked, as in that group, though not marked with transverse bars, as in *Alypia* and *Eudryas*.

Larva at close of final stage.—Length 18–20 mm. Several of the larvæ when older, having been observed June 17th, presented the following characters. Whether they had molted or not I did not observe. The description was drawn up from living examples, just before pupation, nearly a dozen of the lot having pupated. The head is large, rounded, as wide or slightly wider than the body, smooth, with a few hairs, and now the head is deep cherry-red. The body is smooth, of uniform thickness, with a decided, though not very large and prominent hump on the 8th abdominal segment, and with a few hairs, as before. Along the back are four rather wide broken yellow lines, more or less connected laterally; the lines are broken on the anterior slope of the hump, forming two lunate yellow dorsal spots on the 9th abdominal segment, and a single large yellowish spot on the 10th segment in front of the smooth rounded anal plate. Along the under side is a broad median livid yellowish-green band. Both the thoracic and anal legs are blackish; the four middle abdominal legs being reddish-lilac, and rather large

and long. The sides of the body are dark; the body itself in general dark blackish-brown.

In another and fresher specimen there is a bright yellow spiracular line, somewhat broken by the deep transverse wrinkles of the segments, while the entire under side, including the middle abdominal legs, is greenish-yellow.

In my Report on Forest Insects (1890) Fig. 39, by an unfortunate mistake, owing to lack of lettering, I copied Stretch's figure of *Leucarctia acræa* instead of his figure of Phryganidia. I am still inclined to follow Stretch in placing this moth in the Zygaenidæ; though it should be, as Butler claimed, associated with the "Dioptidæ." The larva of Phryganidia is smooth and humped, and thus very near the Agaristidæ, and quite unlike those of the Zygaenidæ, which are hairy; but the characters of the moth are like those of the Dioptidæ, of whose transformations nothing, I believe, is known.

As regards its venation, Phryganidia comes very near *Gnophæla vermiculata*; the number of subcostal branches of the fore wing is six (in *Ctenucha* five), but there is an independent vein, not present in *Gnophæla*. The median vein of Phryganidia differs in that the 1st and 2d branches arise at some distance from the discal vein.

In the hind wings the venation of Phryganidia is nearly identical with that of *Gnophæla*. I see as yet no good reason for placing Phryganidia in a separate family, nor for placing the "Dioptidæ," as Smith does, between the Psychidæ and Notodontidæ, as it has no affinities with either group.

FAMILY COSSIDÆ.

The freshly-hatched larva of *PRIONOXYSTUS ROBINIÆ* Peck.

The eggs were received from Mr. H. Meeske, and hatched on July 3d.

Egg.—Very large, length 2.7; greatest diameter 1.8 mm. Irregularly oval in shape, with the surface more coarsely pitted than in any lepidopterous egg I have examined. The shell is not very thick, but examined with a triplet is seen to be divided into unusually large shallow irregular polygonal areas. Under a $\frac{1}{2}$ -inch objective the areas are seen to be very irregularly polygonal, often nearly 4-sided and oblong; the areas are somewhat depressed and with raised edges, which, however, like the areas, are smooth, not granulated.

Stage I.—Length 8 mm. A very large larva for one in the first stage. The body is much flattened, somewhat Tortricid-like, tapering somewhat towards the end. The head is broad, flattened, dark chestnut. The prothoracic segment is broad and flattened, the prothoracic shield very large and thick, of the same color as the head. The body is pale flesh-colored; across the front of each segment is a broken reddish-pink line of spots, while on the end of each segment is a conspicuous broad band of the same color. The piliferous warts are dark and conspicuous, giving rise to a long slender hair, some of them as long as the body is broad, or a little longer. In some specimens the piliferous warts are almost reddish.

The subsequent changes are probably of little interest, as the adaptation of form to burrowing habits, so striking in the fully-developed larva, is already exhibited in the freshly-hatched caterpillar.