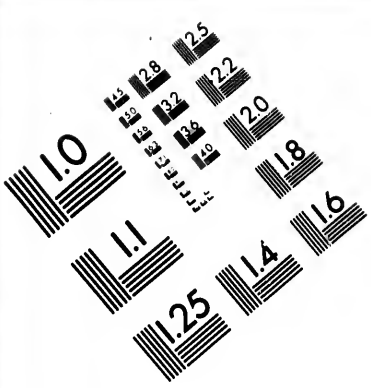

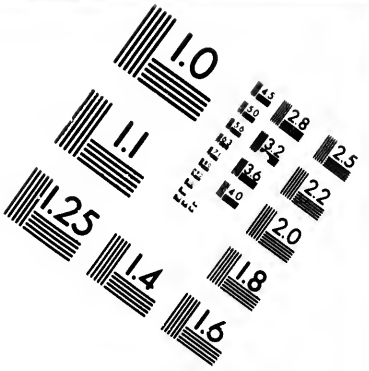

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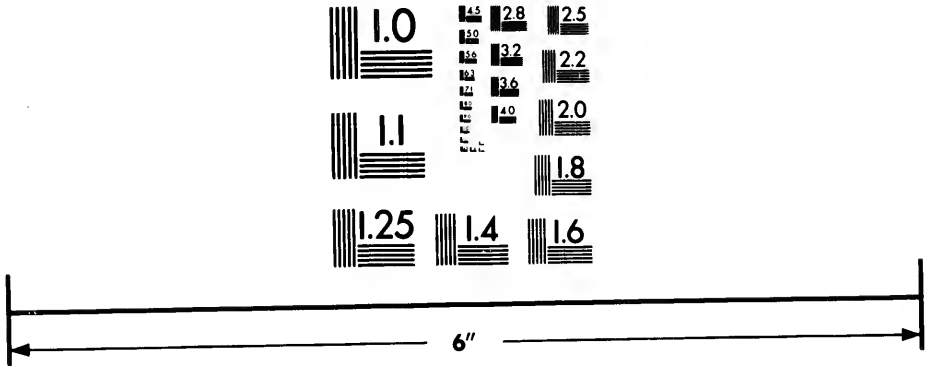

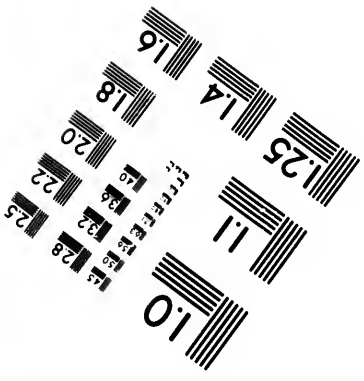

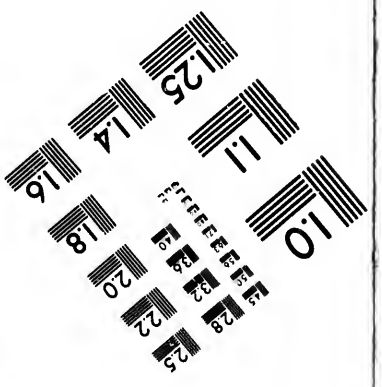

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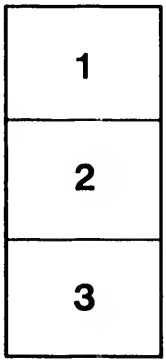
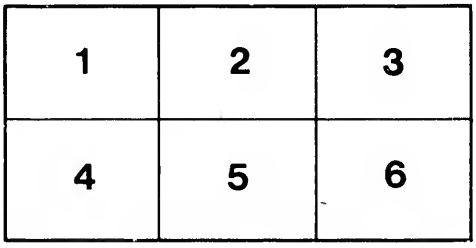




THE

BUTTERFLIES OF NORTH AMERICA

BY

WILLIAM H. EDWARDS

THIRD SERIES

BOSTON AND NEW YORK
HOUGHTON, MIFFLIN AND COMPANY
The Riverside Press, Cambridge
1897

REFERENCE

"When *Jupiter* and *Juno's* wedding was solemnized of old, the gods were all invited to the feast, and many noble-men besides: Amongst the rest came *Crysalus* a *Persian* prince, bravely attended, rich in golden attires, in gay robes, with a majesticall presence, but otherwise an asse. The gods seeing him come in such pompe and state, rose up to give him place, *ex habitu hominem metientes;* but *Jupiter* perceiving what he was, a light, phantastick, idle fellow, turned him and his proud followers into butter-flies: and so they continue still (for ought I know to the contrarie) roving about in pied coats, and are called *Chrysalides* by the wiser sort of men: that is, golden outsides, drones, flies, & things of no worth."

DEMOCHITUS JUNIOR, *The Anatomy of Melancholy.* 5th ed. 1638.

PREFACE.

Of the fifty and one Plates in the present volume, two — Parnassius and Chionobas XIII. — were drawn on the stone by Mrs. Peart; the rest, save one, by Mr. Edward A. Ketterer. The figures of the early stages of the species treated of are all after the original drawings by Mrs. Peart. As in the preceding Volume, I have received aid in obtaining eggs or larvæ from many correspondents, whose names are mentioned, but have been especially indebted to Mr. W. G. Wright and Mr. David Bruce, who have sent rare species, obtained at much expense, severe labor, and often real hardship.

Nearly half of the Plates are devoted to the sub-family of the Satyrinæ, and most of these to the genera which have naked pupæ; nearly all alpine or subarctic. Indeed, every authenticated North American species of Chionobas, except the Labrador and Alaska *Taygete*, is figured. Until these Plates appeared, no Erebia, and no Chionobas, except *Semidea*, either in Europe or America, was known in its preparatory stages; now the stages of twelve, and one stage of a thirteenth Chionobas are figured, besides Erebia and Neominois.

From the National Academy of Science an unsolicited grant of five hundred dollars was generously made towards the publication of this volume; and two grants, in all amounting to three hundred and fifty dollars, from the Elizabeth Thompson Science Fund.

It is nearly twenty-nine years since the First Part of Volume One was issued, as an experiment. What might follow no one concerned could conjecture; certainly no one looked beyond a possible single volume. At first there was difficulty in finding an artist who could faithfully portray the butterfly on stone, and two were tried, who were far from satisfactory. With Part Two (Argynnis VI.) came in Miss Mary Peart, who has supported the work to this day. I was fortunate from the start also in securing the coöperation of two such accom-

plished colorists as Mrs. Bowen and Mrs. Leslie, who had served their apprenticeship with Audubon, — both of them now gone.

"And now we are ariued at the last
In wished harbour where we meane to rest;
And make an end of this our iourney past:
Here then in quiet roade I think it best
We strike our sailes and stedfast Anchor cast,
For now the Sunne low setteth in the West."

WILLIAM H. EDWARDS.

COALBURGH, W. VA., *1st January*, 1897.

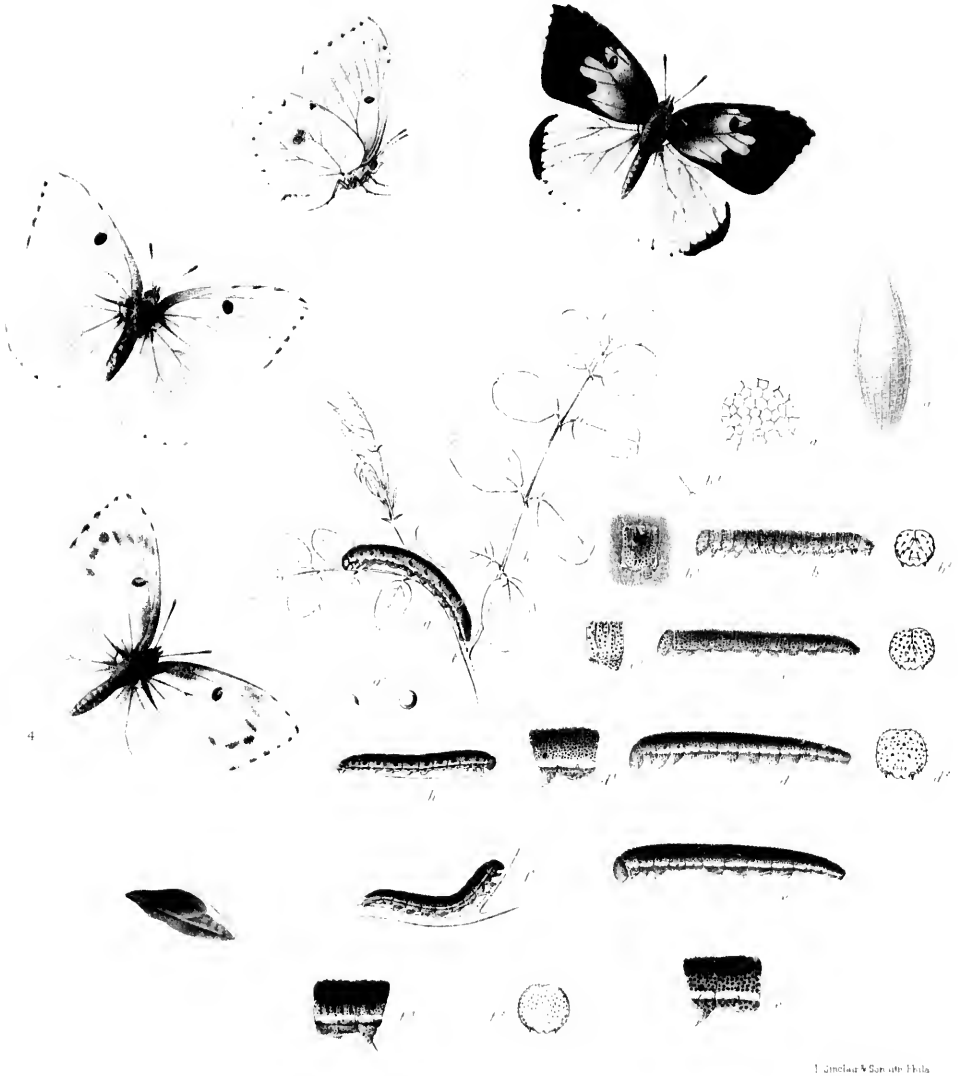
ALPHABETICAL INDEX.

NOTE. — The Plates and Pages of the bound Volume may be numbered in pencil according to this Alphabetical Index.

SYSTEMATIC INDEX.

NOTE. — This Index will enable the Binder to arrange the Plates

COLIAS.
I.



EURYDICE. VAR BERNARDINO 1.2 ♂ 3 ♀; VAR AMORPHÆ 4 ♀

a Ova magnified *f Larva mature nat size*
b Larva (young) *g h " mature vars*
c " 1st to 3rd moult *i Chrysalis*
k Food plant

ARGYNNIS.
II.

LAIS 1 2 ♂ 3 4 ♀.

COLIAS I.

COLIAS EURYDICE, 1-4.

Colias Eurydice (Eu-ryd'-i-ce), Boisduval, Ann. Soc. Ent. France, 1852. Edwards, But. N. A., Vol. I., pl. 16, p. 53. Form. AMORPHÆ, H. Edwards, Proc. Cal. Acad. Nat. Sci., 1876.

WHAT I supposed was the typical form of *Eurydice* was figured in Volume I. Boisduval says: "The yellow (of *Cæsonia*) is replaced by a vivid orange, and the fore wings have a violet reflection." It is impossible to represent in colors the peculiar reflection. It is also variable, some examples having scarcely any violet, others an excess, and my figure was made from one of the last. Mr. Henry Edwards called attention, in the paper above referred to, to the difference between the spring and autumn generations of this species, and regarded the former as the type. "The butterflies of spring make their appearance in April and May; the secondaries of the male are wholly bright orange, without any spots or marks on the margin, except some brown dots to note the termination of the nervules, while the female is immaculate. The autumn brood, however, appearing in July and August, have the secondaries of the male with a black marginal border, and the females have the margins distinctly marked with brownish patches, and rarely with a black sub-median band, composed of clouded patches, crossing the wing." (Fig. 4.) To the autumnal form Mr. Edwards gave the name AMORPHÆ. In same paper, mention is made of an example of *Eurydice* from Mendocino County, in which the "dog's head" is suffused with the richest purple.

From Mr. W. G. Wright, at San Bernardino, I have received many examples of the butterfly, and they are characterized by small size, and absence of any decided violet reflection. Often there is no reflection at all, and the color of the dog's head varies from a pale to a deep or indian yellow. From the same lot of eggs I have bred the larvæ to imago, and obtained these varieties. It is this small form, with yellow primaries, that I call var. BERNARDINO. The females have a large, deep brown or brown-black, discal spot on primaries, and often there are

traces of sub-marginal spots on same wings; on the under side the sub-marginal clusters of scales on both wings are usually conspicuous. (Figs. 1–3.) The preparatory stages of *Eurydice* are thus described: —

Egg. — Fusiform, thick in middle, tapering to a small rounded summit; the base flat; ribbed longitudinally, the number of ribs about eighteen, four or five of which end at nearly three quarters the distance from base to summit; they are low, narrow, of even height and width throughout, the spaces between flat and crossed by many fine horizontal ridges; the micropyle (Fig. a^2) in centre of a rosette of five hexagons, outside of which is a ring of cells of same shape but irregular; color yellow-green. (Fig. *a*.) Duration of this stage about five days.

Young Larva. — Length .1 inch; cylindrical, thickest on 2 and 3, tapering slightly to 12; each segment several times creased, and on the ridges so made are many black points, each giving a short black hair; scattered among these points are black tubercles, some with long black hairs, but most with white clubbed appendages (Figs. b^3, b^4); on front of 2 is a cross row of the hairs, five on either side, running from dorsum to base; on 3 and 4 are four each, also in front, but from 5 to 12 there are three of the white appendages on the side of each segment, a subdorsal one on the front ridge, an upper lateral on fourth ridge, a lower lateral on second ridge, or between second and third; these form three longitudinal rows, and the subdorsal extends over 4; 13 has three hairs in triangle on either side, and from 4 to 12, below spiracles, are two hairs each, the front one always a little below the other; color dull yellow-green; feet and legs same; head rounded, a little depressed at top; on either side of face are seven rounded tubercles, and two in the triangle, in all sixteen, each with long depressed black hair; color of head pale yellow-brown. (Figs. *b*, b^2.) Duration of this stage about four days.

After first moult: length .14 inch; rather more tapering, the ridges thickly set with black points, each with black hair; among these are small tubercles of same color, mostly on middle of each ridge and nearly equidistant, with longer hairs (Fig. c^3); color yellow-green; head nearly as before, somewhat broader in proportion across lower half; the tubercles and hairs much more numerous than before; color pale yellow-green. (Figs. *c*, c^2.) As this stage proceeds a yellowish basal stripe begins to show itself. To next moult four to five days.

After second moult: length .22 inch: color deep green; the points and tubercles as in previous stage; the basal white band distinct; just over it, on 3 and 4, on middle of the segment, a black, vitreous, round process, almost a hemisphere; head yellow-green, more thickly beset with tubercles than before, mostly small, but twelve, scattered among the others, are of larger size. (Figs. *d*, d^2, d^3.) To next moult three days.

After third moult: length .4; same color; in addition to the black processes on 3 and 4 is often a similar but much smaller one on each of the succeeding segments, but they are variable in number; the band has now an ochreous yellow discoloration at its lower edge, which deepens as the stage proceeds, becoming yolk-of-egg color; head as before. (Figs. *e*, e^2.) To next moult three days.

After fourth moult: length .6 inch; orange now appears in the band. To maturity about three days.

Mature Larva. — Length 1.1 inch; cylindrical, of nearly even thickness from 3 to 11; thickly covered with small black tubercles, each of which gives a very short, fine black hair; along base from 2 to 13 a narrow white band, through the lower part of which runs an orange stripe, often macular; on 3 and 4 each, over the band, on middle of the segment, is a vitreous, hemispherical process, black, with purple reflection; from the centre springs a very small hair, and around base is a cluster of minute black points (Fig. g^2); these processes on 3 and 4 are constant; often smaller processes of same character are found on part or all the succeeding segments to 9 or 10, the posterior sometimes greatly reduced; a ring of points similar to those about the glassy processes surrounds each hair on the mature larva (as the artist has endeavored to show in the enlarged segment, Fig. e^2); color dull green; under side blue-green; feet and legs same; head round, slightly depressed at top, much covered with fine black points, each with its short black hair. (Figs. *f*, f^2, f^3.) From fourth moult to pupation about six days.

There is some variation in the markings at last two stages; one larva had a narrow black band on middle of each segment, including 2 and 13 (as shown in Fig. *h*). Another had black beads sprinkled about as follows: on 2, one subdorsal; on 3, three high on side; on 4, two high on side; on 5 and 6, one subdorsal; on 8 and 10 each a short bar; in this last example, as occasionally happened with others, there were black lunate spots beneath the band, such as is commonly seen in *Eurytheme* and *Philodice*.

Another larva had spots from 3 to 11, most with an oblique black dash on lower side. (Fig. *g*.)

The larval measurements were taken at or near twelve hours from the egg and several moults.

Chrysalis. — Length .8 inch; breadth across mesonotum .19; across abdomen, .2 inch; greatest depth .28 inch; compressed laterally; the thorax on ventral side prominent and forming a narrow ridge; abdomen tapering, conical; mesonotum less prominent than in *Eurytheme* or *Philodice*, low, rounded, with a slight carina, followed by a small excavation; head case produced to a point, a little curved upward, with a regular slope on both dorsal and ventral sides, angular laterally; color apple-green; a white stripe often marks the side of abdomen. (Fig. *i*.) Duration of this stage nine or ten days.

The food plant of *Eurydice* is Amorpha Californica. (Fig *k*.) I have several of these from Mr. Wright, and they are growing in my garden. I also have received eggs and larvæ through the mails. The first sent reached me 2d April, 1883. The larvæ began to pass first moult 4th April; the second, 9th; third, 12th; fourth, 15th; to pupate, 23d; and the first imago appeared ten days later. Whole period from laying of egg to imago about 33 days.

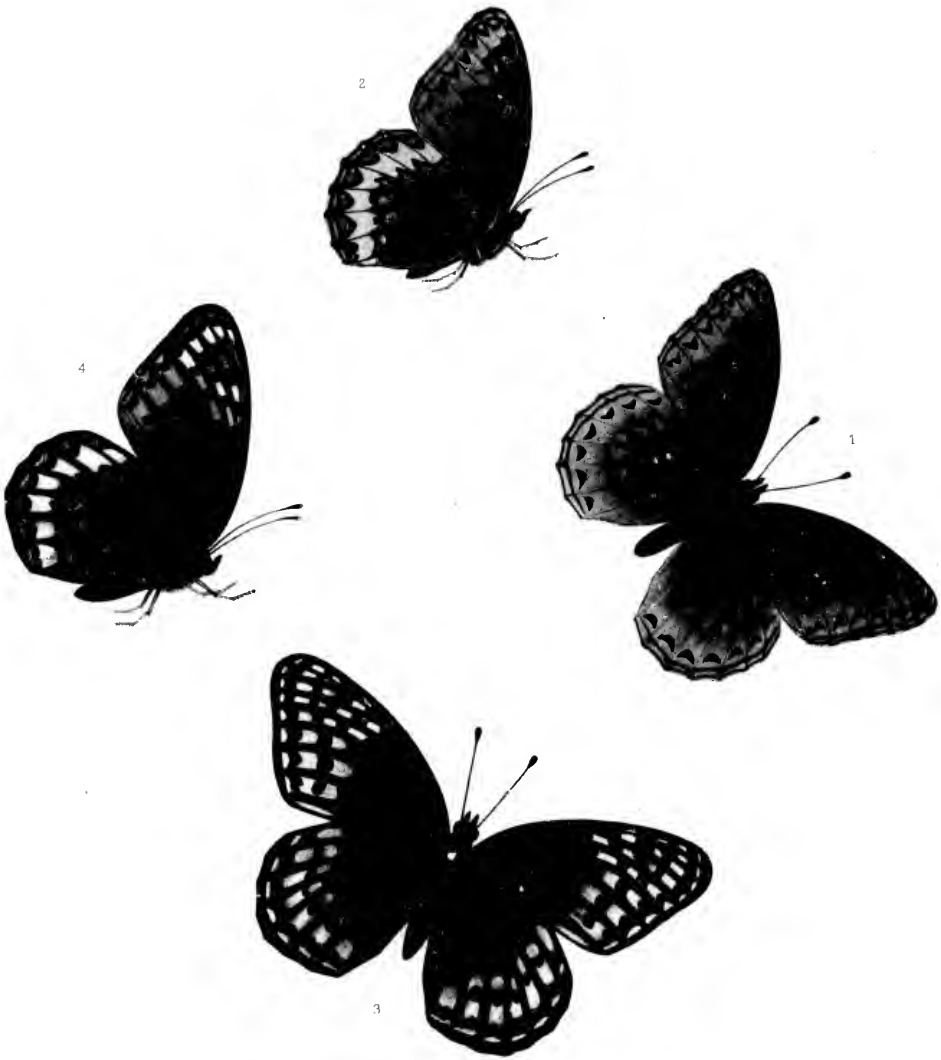
On 4th May, 1884, I received larvæ of all ages, about seventy. The black spots over the band varied greatly. All the mature larvæ had one each on 3 and 4. Of 37 examples, 23 had no other spots. One had spots from 3 to 9; another 3 to 10; but in both cases none on 5; four had spots from 3 to 10, five from 3 to 11, two from 3 to 12. These larvæ were attacked by a fatal disease, and I lost nearly all. A black speck would appear on middle segments and soon extend over the body. So pupæ that were at first apparently healthy died in same manner. Mr. Edwards, in the paper referred to, speaks of losing many chrysalids from a similar disease. I tried in vain, in 1883, to make the larvæ eat white clover (which several species of Colias will eat, though they may refuse red clover), but, in 1884, I succeeded, and on this plant the larvæ went to pupation. The habits, at all stages, are similar to those of *Eurytheme* and *Philodice*. When first hatched, they eat furrows in the surface of the leaf; after first moult, they eat the leaf; and they lie extended on the upper side along the mid-rib.

When the plate in Volume I. was published, 1870, little was known of the distribution of *Eurydice*. I quoted from Mr. Edwards, that the insect was rare and local; that its chief home was in Marion County, about thirty miles from San Francisco. It is now known to inhabit several counties of California from north to south. Mr. Henry Edwards writes: "I do not know how far south the species may fly, but certainly not as far as San Diego, the many collections I have seen from the neighborhood of that city containing not a single specimen. It is however quite probable that it may reach nearly as far. To the north, it is taken in Mendocino County, but not in Oregon, Nevada, or British Columbia. The food plant, Amorpha Californica, grows throughout Oregon, and, I think, even as far as Vancouver's Island, and it is somewhat odd that the range of the species should stop short, as it apparently does, about half way between San Francisco and the Oregon line. It is most common in the counties of Napa, Sonoma, and Mendocino, and never more than fifty or sixty miles from the coast. It frequents the lower ranges rather than the mountains, and I have never seen it in any part of the Sierra Nevada. I should say that its home is limited to about 400 miles at the utmost from north to south, and about sixty miles inland from the seaboard. It must therefore be regarded as an extremely local species." The mature larva and chrysalis described by Mr. H. Edwards, in Proc. Cal.

Acad. Nat. Sci., June 5, 1876, were much larger than any San Bernardino examples, the larva measuring 1.45 inch, the chrysalis .95 inch.

The several stages from egg to pupa are closely like other Coliades described in these Volumes. There is no generic difference whatever observable in any of these stages between *Eurydice* and *Philodice*. So far as I am acquainted with the butterflies, there is no case where a natural genus does not show its distinctive characters in the preparatory stages, either in all of them, or part. Hence I have declined to accept the genus Megonostoma, created by Reakirt, in 1863, to accommodate *Cæsonia* and *Eurydice*. There is no more natural genus than Colias, and it seems to me quite enough that the differences in the imagos, which are trifling at best, should be indicated by Groups, as I have treated them in my Catalogues.

ARGYNNIS.
I.



NITOCRIS 1 2 ♂ 3 4 ♀

ARGYNNIS I.

ARGYNNIS NITOCRIS, 1–4.

Argynnis Nitocris (Ni-to'-cris) Edwards, ♂, Trans. Am. Ent. Soc., V., p. 15, 1874; Mead, Rep. Wheeler Expedition, V., 751, 1875. ♀, Edwards, Can. Ent., XI., p. 82, 1883; ♀ aberr. *Nokomis*, Streeker, Rep. Ruffner Expedition, p. 1853, 1878.

MALE. — Expands 3 inches.

Allied to *Nokomis*. Upper side bright fulvous, much obscured from base to middle of disk, except upon a portion of the cell of primaries; both wings bordered by two parallel black lines, which, on secondaries, enclose a rather broad clear fulvous space, on primaries a narrow space cut by the black nervules; anterior to these lines, on primaries, a series of black lanceolate spots, the anterior ones connected and touching the inner line; on secondaries the spots are lunular, separated, and do not touch the line; the extra-discal spots on primaries are irregular in size and shape, rather sub-quadrate and lanceolate, on secondaries minute; the markings to base as in *Nokomis*, heavy on primaries, light on secondaries, the discal band on the latter being broken into small, separate, sub-lunular spots; fringes fulvous, on primaries black at tips of the nervules.

Under side of primaries red from base to hind margin, and over whole wing except a small area near apex, where it is bright ochre-yellow; a brown patch on middle of this area; the black markings repeated; the upper five sub-marginal spots enclose silver, and there are three silver spots on the patch.

Secondaries deep ferruginous-brown from base to the outer edge of the second row of spots, between this and outer row a clear ochre-yellow space; the hind margin same color as the disk, with an obscure appearance of fulvous between the nervules; all the spots well silvered; the seven sub-marginal are narrow segments of circles, and are edged broadly on anterior side by ferruginous-brown; those of the second row are rather small, mostly rounded, the one next inner margin sub-lunate; the third row consists of three large spots, the outer ones sub-lunate, the other rounded, and edged on posterior side by black; all the spots of the two rows edged heavily on basal side by black; in cell a round spot, and below

cell, an oval, both ringed with black; a silver patch at base of cell, and another at base of sub-costal interspace; shoulder and inner margin lightly silvered.

Body above fulvous, beneath same with many black and gray hairs; legs fulvous; palpi same, buff at the sides; antennæ fuscous above, fulvous below; club black, the tip fulvous or ferruginous. (Figs. 1, 2.)

FEMALE. — Expands 3 to 3.25 inches.

Upper side blackish-brown, darker than female *Nokomis*, the black markings from base to middle of disk nearly lost in the dark ground; the light spots as in *Nokomis*, and of a pale yellow color, except the small sub-marginal, which are whitish; the light spots of secondaries narrower than in most examples of *Nokomis*, owing to the broad edging of brown upon each nervule; they are also much dusted brown, particularly on the basal portion.

Under side of primaries deeper red than in the male, the sub-apical area clearer yellow. Secondaries of a darker brown, dusted ferruginous next base, the belt of a brighter yellow, divided into spots by the broad edging of the nervules; the silver spots generally as in the male. (Figs. 5, 6.)

I have not seen a male other than the one in my collection. This was taken in the White Mountains, northeast Arizona, in 1873, by Lieut. Henshaw, of the exploring expedition under Lieut. Wheeler.

Several females have been taken in Arizona, Colorado, and Nevada. Probably the species will be found in abundance in some of the valleys of southwest Colorado, and south Utah.

ARGYNNIS II.

ARGYNNIS LAIS, 1–4.

Argynnis Lais (La'-is) Edwards, Can. Ent., XV., p. 209, 1883.

MALE. — Expands 2 inches.

Upper side bright red-fulvous, somewhat obscured at base; both wings bordered by two parallel lines, the spaces between cut by the black nervules; the markings as in the allied species, but all slight; the common discal band broken into spots, which, on secondaries, are very small; fringes yellow-white, black at ends of nervules.

Under side of primaries cinnamon-red, paler next inner angle, the apical area buff; the upper sub-marginal spots enclose silver and there are two or three silver spots on the sub-apical patch.

Secondaries from base to outer side of the second row of spots dark brown mottling a yellowish ground; the belt beyond these spots pale yellow; all the spots small and well silvered, the outer row sub-crescent, the second row mostly oval.

Body above fulvous, beneath pale fulvous with many gray hairs; legs fulvous; palpi same, with black hairs at sides; antennæ black above, fulvous below, club black, ferruginous at tip. (Figs. 1, 2.)

FEMALE. — Expands 2.2 inches.

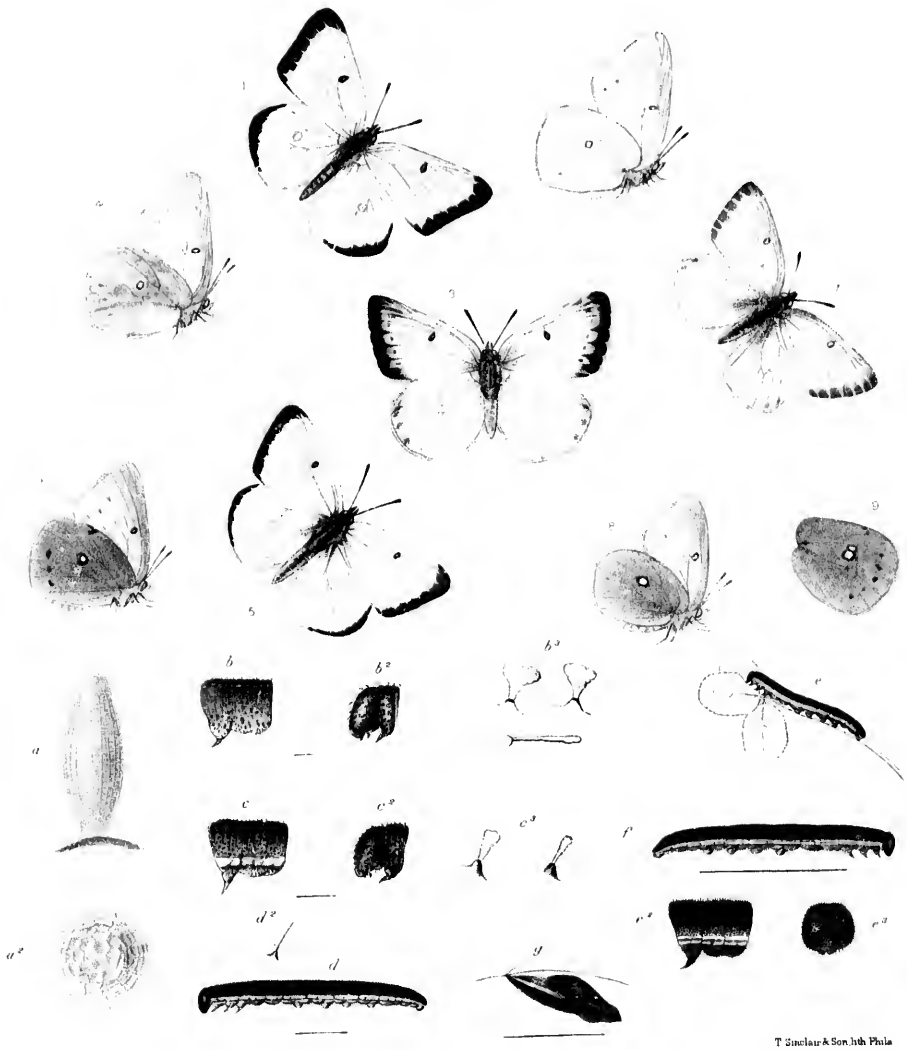
Upper side less bright, the base more obscured; the markings all heavier; the marginal lines more or less confluent on primaries; the discal band, in many examples, connected on primaries, but on secondaries as in the male.

Under side as in the male. (Figs. 3, 4.)

This pretty species is found in N. W. Terr., and was discovered by Captain Gamble Geddes, in 1883, at Edmonton, early in July. It was common and associated with *Cybele*. In 1884, Captain Geddes took it at Calgarry, in the foot-hills, flying with *Atlantis*. Also at Morley, in Kicking-horse Pass, in July and beginning of August, and at Laggan, at the summit of same Pass.

Mr. Thomas E. Bean, writing from Laggan, 13th September, 1886, says: "As to *Lais*, I can only speak of this region and McLean, 600 miles east of this. Here *Lais* appears not to fly at all. At McLean, it is the single common species of the larger Argynnis. It appeared quite freely along the railroad and about the station buildings. But its native haunts I found to be among the openings of the little groves of poplar and willow. I have the idea from the localities Captain Geddes gives that he took his specimens chiefly on the Red Deer River, and that is far to the west and north of McLean. Also he called it rare, from which I should consider that he was collecting away from its metropolis. I think that may be in the region about McLean."

COLIAS.
II.



T. Sinclair & Son, lith. Phila.

HARFORDII 1.2 ♂, 3.4 ♀
VAR. BARBARA 5.6. ♂ 7.8. ♀ 9 ♀.

a Egg	*magnified.*	*d* 3rd moult	*magnified*
b 1st moult	"	*e* 4th " *f* mature	*h.* "
c 2nd "	"	*g* Chrysalis	"

COLIAS II.

COLIAS HARFORDII, 1-9.

Colias Harfordii, Henry Edwards, ♂, Proc. Cal. Acad. Nat. Sci., February 5th, 1877. (Vol. VIII.)
C. Barbara, id., ♀, l. c. VII., 1877. W. H. Edwards, Papilio, IV. 2, 1884.

Primaries produced apically, the hind margins slightly concave or slightly convex.

1. Form Harfordii.

Male. — Expands 1.5 to 1.9 inches.

Upper side lemon-yellow, often lemon-chrome, the bases of wings not at all, or very little, blackened; the marginal borders of primaries of medium width, or narrow, black, dusted with yellow atoms, cut by the yellow nervules nearly to outer edge, of even width, extending but little way on either costal or inner margin, the inner edge more or less erose; discal spot pale yellow in a sub-oval black ring.

Secondaries have the borders varying in width like the primaries, and ending at lower median nervule; discal spot orange, pale to deep; fringes rose-pink, yellow at inner angles of primaries and outer angles of secondaries.

Under side pale to deep yellow; the discal spot of primaries as above; of secondaries, small, pearl-white, in a narrow red-brown ring; at base a few pink scales; no patch at outer angle; traces of sub-marginal spots, mere points, and not in complete series, often altogether wanting; the surface not dusted with dark scales, but immaculate; but some examples show a slight dusting, and some have a few scales at outer angle, suggestive of a patch.

Body above black, with long gray hairs, beneath yellow, the hairs on thorax tipped with roseate; collar same; legs same; palpi yellow, roseate at tip; antennæ and club brown-red above, more red below, the club tipped with ferruginous. (Figs. 1, 2.)

Female. — Same size.

Color delicate lemon-chrome; the border usually narrow, and of slight texture, scarcely wider at apex than elsewhere; but sometimes it is wider and heavier, with loose scales and points on the inner side, and advanced on costal margin about as in the male; in all cases it crosses the wing from margin to margin.

Secondaries either have no border, or there are a few black scales along outer angle, or small clusters on the anterior nervules; discal spot either wanting, or orange, pale to deep. Under side as in the male, slightly dusted. (Figs. 3, 4.)

2. Form Barbara.

Male. — Color of form *Harfordii*, varying like that, a little black at base; the under side much dusted; the sub-marginal markings varying from mere points to conspicuous spots, a small patch at outer angle; the discal spot often large, usually in a broad ring, or double ring, and sometimes duplex. (Figs. 5, 6.)

Female. — Color clear, pale, yellow (originally described as canary-yellow), the border slight, very narrow, and extending across the wing, but little wider at apex than elsewhere. Under side thickly dusted, the sub-marginal spots variable; the patch and discal spot as in male. (Figs. 7, 8, 9.)

These types run through both sexes; that is, the *Harfordii* male, as originally described, is matched with a female as immaculate as itself, and the *Barbara* female, as described, is matched with a male as much dusted and spotted as itself; and between the two extremes are intergrades. (Figs. 1 and 5 show the extremes of color in the males.)

Egg. — Fusiform, thick in middle, tapering to a small rounded summit; the base flat; ribbed longitudinally, the number of ribs being about twenty, four or five of which end at three quarters and more the distance from base to summit; they are low, narrow, and the spaces between are flat, and crossed by many fine horizontal striæ; the micropyle (Fig. a^2) is in centre of a rosette of five cells, hexagons, outside of which is a ring of cells, of same shape but irregular; all these roundly excavated; color yellow-green, in a short time changing to crimson, as do all Colias eggs. (Fig. *a*.) Duration of this stage about four days.

Young Larva. — Length .12 inch; cylindrical, a little thickest on 2 and 3; each segment several times creased, and on the cross-ridges so formed are many black points, each giving a short, black hair; scattered among these are long,

white, clubbed appendages; color brown-green; feet and legs green; head rounded, a little depressed at top, thinly furnished with black tubercles, each with black hair, longer than the hairs on body; color yellow-green. Duration of this stage about four days.

After first moult: length .16 inch; the ridges thickly set with black points, each with its short, black hair; there are also many white processes, which form five or six longitudinal rows on either side, those on dorsum and down to about mid-side, broad and thin at top, paddle-shaped, on remainder of side, and on front ridge of 2, long, tapering, club-shaped; on 2, longest and more numerous, and directed forward; head rounded, somewhat depressed at top, with black tubercles and many of the white clubbed processes. (Figs. b b^2.) To next moult about four days.

After second moult: length .28 inch; color dark green, very much as at previous stage; along base a yellow-white stripe; the white processes more numerous than before, less broad, rather club than paddle-shaped. (Figs. c c^2, c^3.) To next moult about three days.

After third moult: length .4 inch; color darker green; the basal stripe wider, with a yellow stain on middle of each segment; later a red streak appears on part or all the segments within this stripe; the white processes now replaced by short black hairs from conical tubercles, and around base of each is a ring cluster of black specks. Head as before, lighter than body. (Figs. d d^2.) To next moult about three days.

After fourth moult: length .55 inch; color dark green; the band white, with a macular red stripe. (Fig. e, natural size, e^2, e^3 magnified.) In three days from the moult the larva reaches maturity.

Mature Larva. Length 1.1 inch: cylindrical, thickest from 4 to 8; on the flattened ridges of each segment are many small, black, conical tubercles, each giving a short fine hair (as d^2; the same form of tubercle prevails through the last two stages, but they are more numerous in the final stage); on dorsum these hairs are gray, on sides and beneath, white; color light green; feet and legs pale green; along base, from 2 to 13, a white band through middle of which runs a red stripe, almost filling it, the ground below the stripe stained yellow; in one example, on segments 4 to 10 inclusive, was a small black patch to each under the band, but in all others there was no trace of this; head sub-globular, a little depressed at top; color green, somewhat lighter than the body, covered with black tubercles, the same size as on body, with black hairs. (Fig. f, magnified.) From fourth moult to pupation about five days.

CHRYSALIS. — Length .75 inch; greatest breadth .18 inch, depth .2 inch; compressed laterally, the thorax prominent; the head case pointed, beak-like, rounded on the ventral side, less so on dorsal; mesonotum rounded, rising to a low carina; color yellow-green, the abdomen more yellow, and granulated with paler, and along its side a bright yellow band, through which runs a red or an orange stripe; on ventral side, also, a row of small ferruginous spots; head case on ventral side at extremity and for a little way down the lateral ridges bright yellow; on middle of wing case a blackish dot, and a series of sub-marginal ones, one on each interspace. One example, instead of the ventral spots, had a reddish band across three segments. (Fig. *g*.) Duration of this stage nine to eleven days; of the larval stages about eighteen days; from laying of egg to the imago about thirty-one days.

C. Harfordii was described by Mr. Henry Edwards, 1877, from seven males, no female being mentioned; and in same paper *C. Barbara* was described from two females, the male said to be unknown. A year later, Mr. Edwards says that he is inclined to think *Barbara* is the female of *Harfordii*. In 1882 and 1883, Mr. W. G. Wright, at San Bernardino, several times took *Harfordii* males in copulation with *Barbara* females, as well as with females of their own type, and became satisfied that the two represented but one species.

In July, 1883, Mr. Wright obtained eggs by confining the females over Astragalus crotalaria. As these females were afterwards sent me, I was able to identify them all as *Barbara*. The first lot of eggs, ten in number, were six days in the mail, and, the heat not having been extreme, all but two had hatched on arrival, 13th. Next day came thirty-one young larvæ. I fed these on white clover, red clover being refused, but many died at every stage to pupation, either from change of food or climate, so that I got but two butterflies, a female on 6th August, a male on 8th. The female is the one figured Nos. 3, 4, *Harfordii* type. The male was of same type. From the result of this breeding, and Mr. Wright's observations in the field, it seems to me possible that the species may be seasonally dimorphic, *Barbara* representing the earliest brood of the butterflies from hibernating larvæ, *Harfordii* the later, or midsummer, but not so definitely as is the case with many species of butterflies. I have in vain endeavored to learn more about this matter by breeding, the distance and the heat in July making it almost impossible to transmit any eggs which will hatch on middle of the journey. The larvæ are pretty sure to die. Lots of eggs sent in '84, '85, failed to give me one larva. Mr. Wright got twenty larvæ of all sizes on the food plant, as late as 24th December, 1883, but of course it would have been of no use to transmit larvæ in winter, as I could not feed them.

As to the distribution of this species, it is common in the region about San Bernardino. Mr. Henry Edwards gives Santa Barbara and Santa Clara counties as localities; also Kern County.

Writing recently, Mr. Edwards says: "*C. Harfordii* was taken by me first near San Francisco, in Contra Costa County, which is as far to the north as I have ever heard of it. Its home seems to be in the southern part of the State, or rather from Santa Clara to San Bernardino."

Mr. Edwards also says: "The descriptions of these forms were read before the Academy, February 5th, 1877, but were only published in my extra advance sheets. The Academy stopped its publications with the 7th volume, and are only now about to renew them. My paper on Colias cannot therefore be referred to as being in the Proc. of Cal. Acad., though it will appear within a few months in Vol. 8."

The males of extreme *Harfordii* type come near the males of *C. Interior*, as will be seen by the Plate next following. This is a smaller species, — that is, no *Interior* are as large as the largest *Harfordii*, — with a much rounded apex to fore wing and a rounded hind margin. The border is wider, and extends farther along costal margin and it is deeply incurved. So that, while there is some resemblance in this sex there is more divergence. But in the females, the differences are emphatic. In *Interior*, the border is apical, as in the *Pelidne* subgroup, broad at apex, gradually narrowing on the margin, ending at some distance above the inner angle. It is a triangular border, in fact, as distinguished from a marginal border, such as *Harfordii* presents, and which is characteristic of other sub-groups in the genus. One species cannot be mistaken for the other.

So far as relates to the ornamentation of the under side, *Barbara* is nearest to the *Eurytheme* sub-group. So that the species in certain points resembles species belonging to two distinct sub-groups, a fact suggestive of the descent of all from a more or less remote common ancestor.

ARGYNNIS.
IV.

T. Sinclair & Son lith. Phila.

CORONIS 1.2 ♂ 3.4 ♀

ARGYNNIS IV.

ARGYNNIS CORONIS, 1-4.

Argynnis Coronis (Co-ro'-nis), Behr, "No. 2," Proc. Cal. Acad. Nat. Sci., II., 173, 1862; Edwards, Proc. Ent. Soc., Phil., III., 435, 1864. *Juba*, Boisduval, Lep. de la Cal., 60, 1869; ♀ *Neradensis*, Edw., But. N. A., I., pl. 33, figs. 3, 4, 1871.

Primaries long, narrow, moderately arched, slightly concave on hind margin.

MALE. — Expands 2.15 to 2.3 inches.

Upper side yellow-fulvous, but varying, many examples reddish; hind margins bordered by two parallel lines, which enclose narrow fulvous spaces between the black nervules; the sub-marginal lunules narrow, serrate or lunular, the extra-discal rounded spots small; the mesial band rather heavy on primaries, light on secondaries; the other markings as in the allied species; fringes luteous, black at the ends of the nervules.

Under side of primaries pale buff with a red or yellow tint, varying, the base and the median nervules red-brown, often much diluted; the sub-apical patch brown, with three silver spots, the upper four or five spots within the marginal lunules silvered.

Secondaries yellow brown from base to outer edge of second row of spots, mottled in shades, the band beyond clear and of the lighter shade; the spots large, well silvered; the outer row sub-serrate, edged above with red; the second row mostly sub-ovate, slightly edged above with black; the third row so edged; a round spot in cell, sometimes duplex, ringed black; three spots at base in the several interspaces; shoulder and inner margin well silvered.

Body above dark fulvous, beneath, the thorax gray-fulvous, the abdomen yellowish; legs red, yellowish on inner side; palpi yellow, ferruginous at tip and in front; antennæ black above, ferruginous below; club black, ferruginous at tip.

FEMALE. — Expands 2.7 to 3 inches.

Same color; the markings heavier; the marginal lines confluent on primaries; the sub-marginal lunules on same wings enclose paler, often nearly white spots.

Under side red-brown at base, the upper outer part of cell and extra-discal area to margin yellowish; silver as in male.

Secondaries buff, mottled with ferruginous-brown, the band narrow, buff, the spots large, well silvered.

This is the type of *Coronis*, Behr, but there is a great variation in the species in the coloration of under side. Examples from Gilroy, California, where *Coronis* seems to be abundant, are of the type form. From Mt. Shasta, the males are lighter, rather cinnamon color, the females a pale brown, or often fawn color over secondaries and apical area of primaries. Examples from Washington Territory, taken by Mr. Morrison, are nearly like those from Shasta; several from Mt. Judith, Montana, are almost same; so a male from the Northwest Territory, taken by Captain Gamble Geddes. A male from Nevada, taken by Morrison, has the under side decidedly yellow, the mottling pale gray, while a male from Utah, sent me by Mr. B. Neumoegen, has almost no mottling, but is nearly clear yellow over secondaries and all of primaries, except just at base, where the red is greatly diluted.

The species has a very extended distribution, ranging from Kern County, California, to Washington Territory; from Utah to Montana and the Northwest Territory (Belly River and Crow's Nest). I have not seen it from southern California, below Kern County, nor from Colorado.

Dr. Behr described *Coronis* in the paper before referred to as "No. 2," in a series of descriptions of the Californian Argynnides, not being then (1862) able to say whether or no the species had been described elsewhere. He says it is very similar to *Callippe* Boisduval, "but differs by the upper side being colored in the usual way of the genus, and not showing the pale lunulæ and spots of the disk like *Callippe*, which resembles in this respect more an Euptoieta than a true Argynnis;" and in his Latin description, he says of the under side of secondaries, "posticæ subtus fuscæ usque ad fasciam macularem intermediam partim dilutiores." Dr. Behr, about that date, sent me a sheet of colored figures of eight of the species described by him, and by this I am able to fix the type. In the paper in Proc. Ent. Soc., Phil., 1864, referred to, I gave an abstract of Dr. Behr's paper, and by his consent the name *Coronis* was applied to the "No. 2."

Dr. Boisduval described *Juba* in 1869; and added, "This species has so close a connection with *Callippe* that it may be but a local variety. The fore wings above are of a vivid fulvous in both sexes, while in the male *Callippe* they are of a pale blackish-fulvous. The under side does not offer notable differences. Mr. Lorquin, who has taken a number of examples of *Juba*, considers it a distinct species." In Boisduval's Latin description of *Juba*, he says, "posticæ subtus

flavescentes." Now in his description of *Callippe*, he says, "posticæ subtus cinereo-fuscæ." This does not agree with the color of *Juba* as given, nor with what Dr. Behr says of *Coronis* ("fusca"). But I have the type male of *Juba*, sent me by Dr. Boisduval, and named and marked "type" in his own hand, and this is not "flavescens," but the color of Behr's type. However, as I have said above, the species varies from red-brown to yellow on under side. *Callippe* is figured in Vol. I., But. N. A., and the differences between these species are really great, though they belong to the same sub-group, which also includes *Liliana* and *Semiramis*, both figured in the present Volume.

The female figured in Vol. I., Plate 33, as *A. Nevadensis* is *Coronis* of a pale-colored under-side variety. When that Plate was published, 1871, I followed the instructions of Mr. Henry Edwards, who had taken what he supposed to be the females of *Nevadensis*, at Virginia City. Later, 1878, Messrs. Mead and Morrison collected in Nevada, and brought back numbers of both *Nevadensis* and *Coronis*. The female of the former is always green. I concluded from the evidence laid before me at that time that *A. Meadii*, figured in Vol. II., Plate 24, must be an extreme variation of *Nevadensis*, in which the green is dark and lustrous.

ARGYNNIS CALLIPPE.

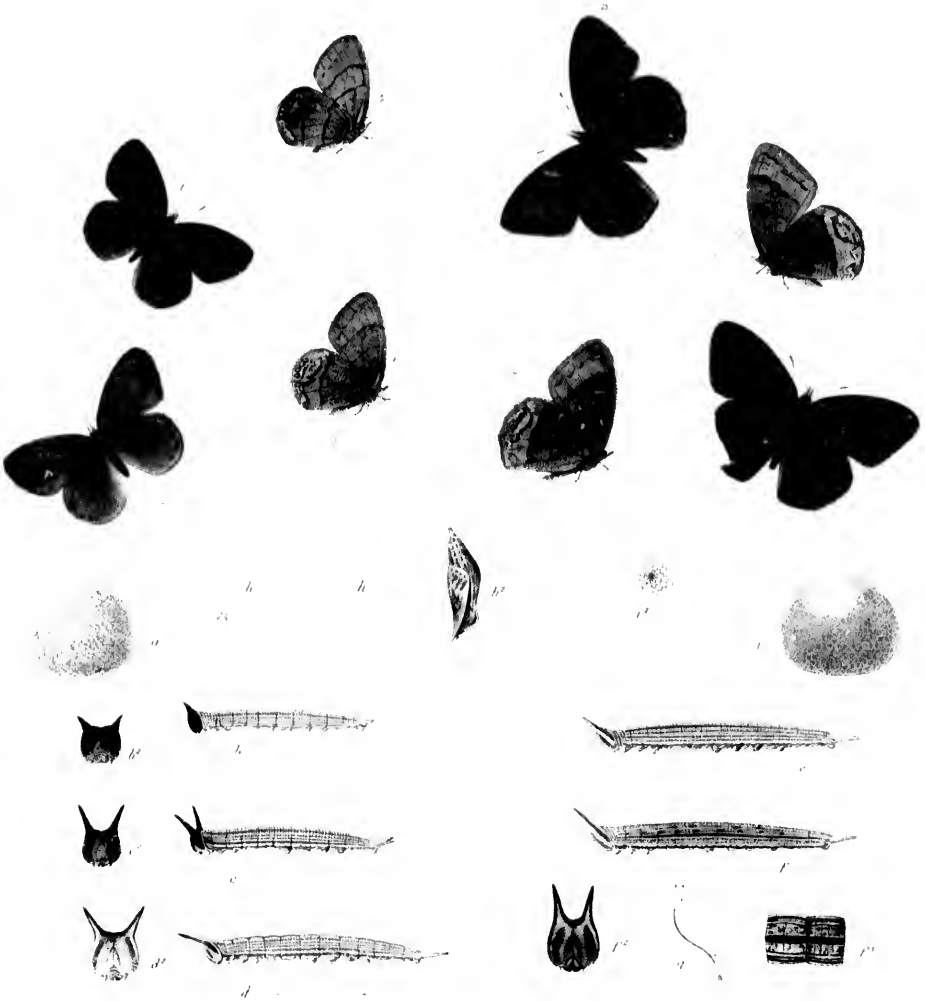
Argynnis Callippe, Boisduval ; Edwards, But. N. A.,Vol. I., p. 77, pl. 25.

Mr. W. G. Wright, at San Bernardino, says of this species: "Its range, in this region, is from near the sea level to the altitude of 2500 feet. It is found in the low valleys, where the hills shut off the winds, and the hot sunshine makes a torrid temperature. Its season is short, only about five weeks, and I have had no evidence of a second brood. When the males first appear, about 20th May, the bottom of the valley and adjoining hillsides are green with grass, and gay with flowers of various plants. These males are restless, alighting on the flowers but for a moment, and seem incessantly occupied in searching for their mates. Almost always I have had to take them on the wing. The females appear about 1st June, and should be searched for among the dead twigs and branches of the small bushes which dot the hillsides, such being the spots to which they resort to lay their eggs. Under these bushes, a few violets have grown in early spring, and by June, their dead leaves may be seen. The violets never grow at the bottom of the valley, and the female never approaches green violets, some bunches of which are to be found, in June, at a higher elevation. Her instinct leads her to the dead plants. Among the twigs about these, and upon the rubbish at the ground, she flutters and crawls, and having found a satisfactory place, pushes her abdomen down into the rubbish as far as possible and drops an egg. Perhaps puts another near the first, and then flies to another place. The young larvæ come from the eggs in about twelve days, and must be in lethargic state till the beginning of the next season. I have never been able to find the larvæ in spring, though I have searched diligently."

In the region about San Bernardino, there are but three species of Argynnis, namely, *Liliana*, *Callippe*, and *Semiramis*, and the last two have the same habits in disposing of their eggs. According to Dr. Behr, as stated in Volume I., *Callippe* is distributed throughout the State, and is the most common species about San Francisco, but it is everywhere one-brooded.

In the text concerning *Callippe*, in Vol. I., some doubt was expressed as to what form Dr. Boisduval applied that name, his description not being definite. But I afterwards received from him the type male (the *Callippe* of my Plate).

NEONYMPHA.
I.



GEMMA 1. 2 ♂. 3 4 ♀. HENSHAWI. 5. 6. ♂ 7. 8. ♀.

a Egg magnified *e f Larva mature magnified*
b Larva young . *g* . . *nat size*
c d . *1st 2nd moult* . *i Egg 1st micropyle mag.d*
k Chrysalis nat size. k² mag.d

NEONYMPHA I.

NEONYMPHA GEMMA, 1–4.

Neonympha Gemma, Hübner, Zutr. Exot. Schmett., I., figs. 7, 8, 1818; Boisduval and Leconte, Lepid. de l'Amer., pl. 62, 1833; Edwards, Can. Ent., XI., 31, 1879; French., But. of East. U. S., p. 235, 1886.

MALE. — Expands 1.25 inch.

Upper side uniform gray-brown; secondaries have four small black spots on middle of hind margin, in pairs on the interspaces, often more or less obsolete; fringes concolored with the wings.

Under side lighter, with a yellowish tint, through which the dark ground shows in fine streaks, particularly over basal areas; primaries crossed by three brown crenated lines, two of which limit the discal band, the other midway between this and margin, running towards apex; these discal lines are continued on secondaries, but are more widely separated, heavier, more irregular, the outer one projecting a sharp spur on second sub-costal nervule, reddish-brown; there is also a trace of a sub-marginal line next anal angle, the margin there reddish-brown; on middle of hind margin a large sub-oval patch of red-brown thickly dusted with yellowish scales, so as almost to conceal the ground, and within this, next margin, four velvet-black spots in pairs, each bearing an inverted T-shaped silver mark; the interspaces to outer angle each with two dashes of silver, and the second median interspace with an interrupted silver serration, the sub-median with a dash.

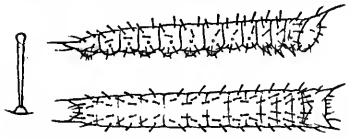
Body above color of wings, beneath, the thorax gray and brown, abdomen yellowish; legs gray-brown; palpi same with many black hairs; antennæ fuscous above, brown below, ringed with yellowish; club ferruginous, black on upper side.

FEMALE. — Expands 1.3 inch. Scarcely differing in any respect from the male.

EGG. — Sub-globular, as high as broad, the base flattened; surface under a low power smooth, but under a high one seen to be reticulated throughout in

irregular hexagons, the sides of which have broad flanks that occupy nearly all the interior, leaving but a light point in centre of each; color yellow-green. (Fig. *a.*) Duration of this stage from three to six days, according to the temperature.

Young Larva. — Length .12 inch; cylindrical, a little thickest in middle, tapering very gradually to 13, which ends in two conical tails, from the end of each of which proceeds a long bristle, the space between the tails concave; color yellowish-white; the upper surface presents six rows of low, conical tubercles, each giving out a short process; those on upper part club-shaped, slightly thickened at extremity; low on either side is another row, of same thickness throughout; on 2, 3, 4, the upper processes are nearly in cross line; on 4 to 12 they are differently arranged, each three being in triangle, the dorsal one lying on front of the segment, the sub-dorsal at the rear, the other a little before the middle; on 13 there are eight, in two rows of four, the front consisting of the pair of dorsals and pair of laterals, the hinder row of the dorsals and sub-dorsals, besides a pair of sub-dorsal long bristles in the rear, and a pair of short ones in the concavity between the tails; in the lower row, on each segment from 2 to 13, are two shorter processes, nearly in horizontal line, the hinder one always a little below the other; on 7 to 10 each, and on 13, over the pro-legs, is a pair of very short hairs, in horizontal line; head one half broader than 2, broad as high, flattened frontally, a slight angular depression at top; on each vertex, a conical, divergent horn, somewhat curved forward, in three sections, each smaller at the junction than the top of the next below; at the end a bristle, and another on the middle, on the inner side; a few shorter ones scattered over face; color of head and horns black-brown. In about two days from the egg the color gradually changes to pale green, and stripes appear, a white sub-dorsal, and two on mid-side. (Fig. *b*, *b*^{2}.) Duration of this stage, six days in April, August, and October.



After first moult: length .18 inch; nearly the same shape, somewhat thicker in middle, the dorsum more arched; the tails longer, more slender, and brown-tipped; each segment five times creased, and on the ridges so caused a row of white tubercles, irregular, conical, each with a short white hair; color dark green, marked longitudinally by white; on mid-dorsum a clear green stripe, and the ground on either side of it is whitish, owing to the numerous tubercles there; on the verge of dorsal area a white stripe, another along base of body, and between these, on side, are two contiguous white lines; under side bluish-green,

feet and legs green; head sub-pyriform, truncated, higher and narrower in proportion than before, the horns longer, more tapering, less divergent, slightly curved forward, about as long as the face; the space between them not angular, but concave; color of head and horns brown, pale on front face, and green-tinted; from base of each horn a dark stripe passes down the side of face, and there is a second such stripe in front. (Figs. *c*, c^2.) Duration of this stage, in August five days, in October ten, in May seven.

After second moult: length .34 inch; nearly the same shape, the tails longer; color pale green, the stripes as before; head nearly as at second stage, the horns more divergent; color of front face deep green, the back of head dull green, the stripes and horns reddish-brown. (Figs. *d*, d^2.) Duration of this stage, in August five days, in May eight.

After third moult, in autumn: length .55 inch; same shape; color soiled white, greenish on dorsum next head; the dorsal stripe dark, the sub-dorsal and basal brown.

At four days from the moult: length .72 inch; color now drab on dorsum, the median and sub-dorsal stripes darker; sides red-brown, the two lines buff; basal stripe yellow-buff; under this, a broad black-brown stripe the length of body; tails drab, reddened at tips.

MATURE LARVA. — Length .96 inch; slender, the dorsum slightly arched; ending in two long, conical, sharp-pointed tails, which meet at base; the whole surface finely and sharply tuberculated, most of the tubercles giving out a short white hair; color buff and reddish-gray in bands and stripes; a narrow gray mid-dorsal stripe, then a broad buff band to verge of dorsal area, and edged by a reddish line; next a broad gray lateral band, with a narrow buff stripe below; the basal stripe yellow-buff; beneath this a partly obsolete blackish band; tails drab, red at tips; feet and legs brown; head sub-pyriform, truncated, on each vertex a long, conical, pointed horn, but little divergent, the space between the two at base concave; color drab, both back and face; horns drab behind, black-brown in front and between; a broad black-brown stripe down the front face, and a narrow one on side from base of horn. (Figs. *g*, natural size, *f*, f^2, f^3, magnified.) In August, ten days from third moult to chrysalis.

MATURE LARVA, in May, from eggs laid in April: color light yellow-green, the dorsal stripe darker, the sub-dorsal and lateral lines and basal stripe yellow; tails pink-tipped; head sordid greenish-white front and back, the stripes brown, horns red-brown. From third moult to pupation five and six days. All the larvæ, ten in number, of this April and May brood were green. (Fig. *e*, magnified.)

CHRYSALIS. — Length .46 to .52 inch: greatest breadth, at abdomen, .14 inch; cylindrical, abdomen conical; head case scarcely produced beyond mesonotum, narrow, excavated at sides, ending in two sharp, divergent projections, the depression between angular; mesonotum prominent, carinated, angular, the summit rounded; followed by a shallow depression; wing cases flaring on dorsal side; color of abdomen and dorsum from buff larva sordid yellow-buff, the wing and antennæ cases and the projections all more yellow; the surface finely streaked brown, irregularly and mostly longitudinally; from posterior base of mesonotum to 13 a brown band; the wing case shows an irregular, wavy, brown stripe on disk, and a stripe on costal margin; each nervule ending in a blackish dot. (Figs. *h*, *h*, natural size, h^2, magnified.)

From green larvæ green chrysalids; blue-tinted, the dorsum and abdomen streaked with whitish; wing cases without stripe; the dorsal edges of wing cases carmine, and top of head case cream-color. Duration of this stage, in May, eight days.

The attitude of this larva in suspension is peculiar. From 13 to 5, the body hangs almost straight, the dorsum incurved; the anterior segments bent at right angle, the head turned down on 2. When at rest, in all the later stages, the larva holds the head bent under, so that the horns are nearly in the dorsal plane. (Fig. *d*.)

Gemma is quite a common species in certain localities near Coalburgh, W. Va., but altogether wanting in others which would seem equally favorable for it. It is abundant in the grassy streets of a small village, and there are stretches of road through the woods, or near the creeks, where one is sure to find it during its season. I have never seen it on the hillsides. It has a slow, tremulous flight, near the ground, rests frequently, and returns to its haunts.

There are here three annual broods: the butterflies appearing in April and May, in June and July, about 20th August and through September. The late larvæ hibernate. They feed on grasses, and eggs are easily obtained by confining the females over grass set in flower-pot. Eggs laid 21st April gave butterflies from 2d June. Eggs laid 7th August hatched 11th. The larvæ were mature 3d September, and pupated 5th. On 23d August, I got sixteen eggs. Several of the larvæ were placed in alcohol, but the remainder were mature, though in a lethargic condition, 20th November. I failed to carry these through the winter. Another female, 30th September, gave two eggs. From these, I raised one larva, which was lethargic and mature 24th November. This was kept in the house, and at intervals moved a little and fed; finally pupated 4th February. As described above, the larvæ of the spring brood have all been green, those of the later broods brown.

Gemma flies in southern West Virginia, and in the same latitude to Illinois; is common in the mountains of North Carolina and eastern Tennessee, and in the northern parts of Georgia, and Alabama. It does not seem to fly far from the streams. Rev. W. J. Holland writes that it was found in great numbers at the foot of Bald Mountains, Madison County, N. C., near the French Broad River. "The whole country here stands on end, and is a mass of piled up rocks and tilted strata. Here in the gullies and clefts *Gemma* abounded, in company with *N. Sosybius*. I never saw it in the lowlands of the State."

Mr. E. M. Aaron writes: "*N. Gemma* I took in swampy woods around Maryville, east Tennessee, and at several points in western North Carolina. In fact, through all the river and creek bottoms of east Tennessee and western North Carolina it is moderately common. I have received it from the northern parts of South Carolina, Georgia, and Alabama. My brother took quantities of it along the river bottoms of the Gulf coast of Texas, and one specimen at Monterey, Mexico. When taken on the mountains of Tennessee, it was never at any altitude, and when far from running water was always badly worn."

NEONYMPHA I.

NEONYMPHA HENSHAWI, 5–8.

Neonympha Henshawi, Edwards, Trans. Am. Ent. Soc., V., 205, 1876.

MALE. — Expands 1.5 inch.

Upper side dark brown, often with a russet tint over the extra-discal areas of both wings; some examples have an ill-defined patch of russet on the median interspaces of primaries, and there is usually a russet edging to hind margin of secondaries next anal angle; on middle of same margin two small black spots, not always present; fringes dark gray.

Under side either brown or russet, thickly dusted with yellow-white scales, more yellow beyond the discal band of secondaries; the whole surface finely streaked and dotted with red-brown; primaries crossed by three wavy red-brown lines, two of which enclose the discal band, the other lying nearly midway between the band and margin, often macular; some examples have a demi-line crossing cell to median; the discal lines are continued across secondaries, the outer one often projecting roundly on second sub-costal nervule; a short sinuous line at anal angle; on middle of hind margin a large sub-oval patch, the ground of which is dark brown, sprinkled with whitish scales; within this, in upper median and discoidal interspaces, a pair of velvet-black spots, each with an inverted T-shaped patch of silver; in the interspaces towards outer angle a pair of silver dashes each, and in lower median a silver serration, and a bar in sub-median.

Body above dark brown, beneath gray-brown; legs same; palpi gray with many black hairs; antennæ blackish, annulated with light; club black above, ferruginous at tip and beneath. (Figs. 5, 6.)

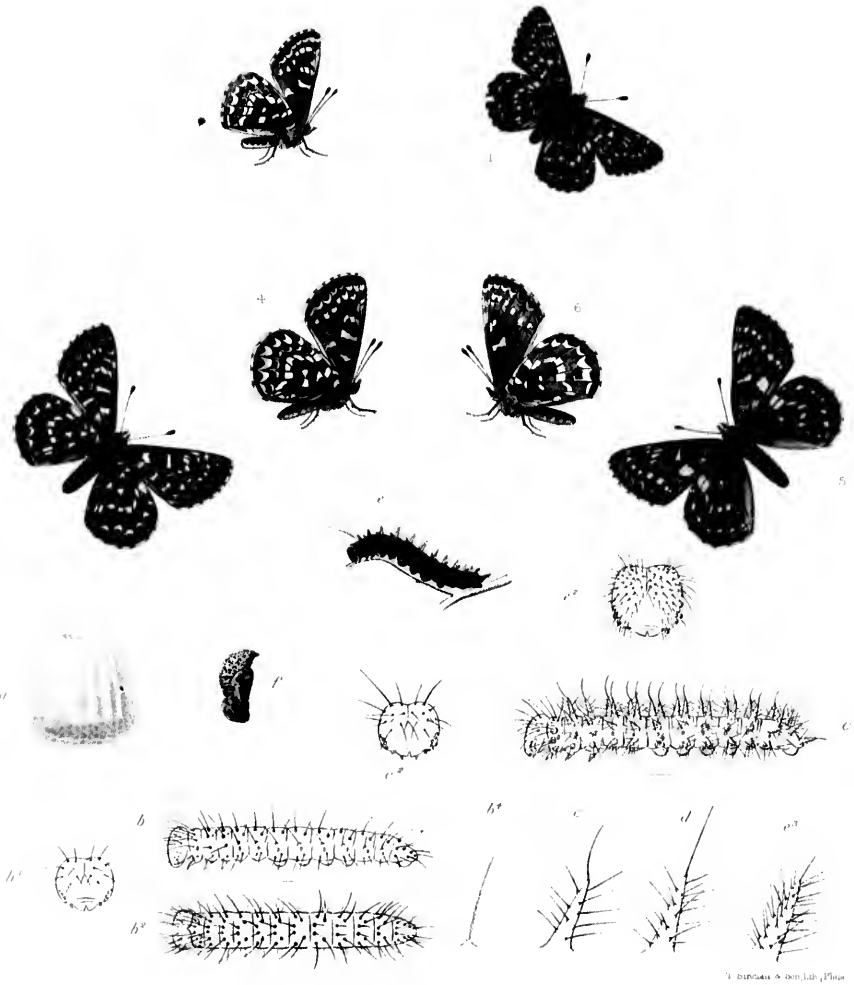
FEMALE. — Expands 1.7 inch; russet, brown about the margins; spots on secondaries as in male. Under side of primaries russet, of secondaries yellow-brown; marked like the male. (Figs. 7, 8.)

NEONYMPHA I.

Egg. — Sub-globular, broader than high, about as 7 to 6, the base flattened; wholly covered, when seen under a high power, with a flat network of irregular hexagons; a fine rosette about the micropyle. (Figs. *i*, *i*^{2}.)

This species seems to be common in parts of New Mexico, Arizona, and Colorado. It was first taken by Mr. H. W. Henshaw, of the Wheeler Exploring Expedition, 1874. Mr. Morrison afterwards brought examples from Arizona, and Mr. B. Neumoegen from Oak Creek Cañon, Colorado. In 1881, Mr. Doll sent me eggs from Arizona, by which I was enabled to get the drawing, but none of them hatched. The resemblance of *Henshawi* to *Gemma* is close so far as regards the markings.

MELITAEA.
1.



BARONI 1 2 ♂ 3 4 ♀ VAR. 5 6 ♀.

a Egg magnified *d Spurs at 2nd molt magnified*
b b¹ Larva Lyoung *e e² Mature larva, e³ natural size*
c c² " 1st moult *f Chrysalis*

MELITÆA I.

MELITÆA BARONI, 1–5.

Melitæa Baroni, Henry Edwards, Papilio, I., p. 52, 1882; W. H. Edwards, Can. Ent., XI., p. 129, 1879.

MALE. — Expands from 1.5 to 1.8 inch.

Upper side black, spotted with red and pale ochrey-yellow, mostly in common transverse rows; the spots of the marginal row red, well separated; of the second row yellow, often quite small on primaries, or mere lines; of the third row, yellow on primaries, red on secondaries; the fourth is bifid on median nervure of primaries, the two branches running to costa, the outer one partly red, partly yellow, the inner one yellow; from median to inner margin either yellow, or yellow and red, the outer half each spot being red; on secondaries the spots of this row are yellow and large; from outside arc of cell of primaries to base four bars, red and yellow alternately; a yellow patch below the origin of the lower median nervule; the basal area and costal margin much dusted yellow, the shoulder red; secondaries have a fifth, but demi-row, from costa to median, red, sometimes wholly wanting, and four yellow spots on basal area, two in cell, one below cell, one on costal margin; fringes of both wings yellow, black at the ends of the nervules.

Under side red, primaries dull, secondaries bright; both wings have broad marginal borders; the yellow spots of second and third rows of primaries repeated, the former much enlarged; a large yellow sub-triangular patch on the sub-costal interspaces; the yellow spots in and below cell repeated; secondaries have the yellow spots of second and fourth rows repeated, enlarged, forming two confluent bands, the outer one lightly edged black above and below, the other or discal always edged with black on the basal side, but not always on the marginal side; the third row is of red spots, each wholly but lightly edged with yellow, except on the marginal side; between the third and discal row is an intermediate narrow stripe of red from lower branch of sub-median to upper branch of sub-costal, and this is often confluent with the yellow discal band; but sometimes a black

line partly separates them; in some examples this red stripe is suppressed, or absorbed by the spots of the third row, and in this case there is a black edge on marginal side of the discal band; the basal area red, the four yellow spots repeated, all edged with black; a fifth spot on costal margin; shoulder and inner margin yellow.

Body black with long gray hairs on thorax, the collar red; beneath, thorax buff, abdomen buff, red laterally; legs red; palpi red, yellow at base; antennæ either annulated red and buff, alternately and equally, or red only; the under side black; club black, tip ferruginous. (Figs. 1, 2.)

FEMALE. — Expands 1.6 to 1.9 inch.

Upper side black, and nearly as in the male; or there is an excess of red, all the red spots being much enlarged. Beneath as in male. (Figs. 3, 4, 5.) Many females have scarcely any black edging to the spots of the second and third rows on secondaries, and contrast strikingly in this respect with *Rubicunda* and the other species of the group. (Fig. 5.)

EGG. — Conoidal, rounded at base and there marked by many shallow indentations; the sides ribbed vertically, the ribs about twenty in number, straight, low, the spaces between a little excavated; the top truncated, a little depressed; color yellow-green. (Fig. *a*.)

YOUNG LARVA. — Length .08 inch; cylindrical, of nearly even thickness from 2 to 10; the segments rounded; on each segment low conical tubercles, each of which gives a long tapering hair; under a high power these hairs are seen to be thickly set with barbs; (Fig. b^4;) the tubercles form six longitudinal rows, on either side one dorsal, one sub-dorsal, one lateral; on 2 the three are in straight line on the front, and on rear of same segment is another row of four, two on either side, and lying between those of front row; on 3 the row is straight, on the front; on 4 the two dorsal tubercles are on front, the others a little behind, so as to form a curved row; from 5 to 12 inclusive the two dorsals are in front, the 1st and 6th a little back, the 2d and 5th either on middle of the segment or more to the rear; on 13 are six in front, the 2d and 5th a little back, and behind these six in two longitudinal rows to extremity; in general the hairs of anterior segments are turned a little forward, those on posterior half back; below spiracles is a row of smaller tubercles, with shorter hairs, one each on 2, 3, 4, on the rest two, on 13 three, the hairs all bent down, the hindmost one of each pair placed a little higher than the other; color of body greenish-brown; head rounded, a little broader than high, a little depressed at suture, the vertices

rounded; color black; on the front are small tubercles and hairs, seven on either lobe. (Figs. *b*, b^2, b^3.)

After first moult: length .15 inch; color greenish and pale brown, mottled; body now furnished with seven rows of spines, which are present at each stage to maturity (as in all species of this genus), one row being dorsal, three lateral (two above, one below spiracles); these spines are long, tapering to a point, and thinly beset with long tapering black hairs, the one at extremity recurved somewhat; the dorsals run from 5 to 12, and are yellow; the first laterals from 3 to 13, black; the second laterals from 3 to 13, black; (there are four spines on 13, two on front, two on rear, and the front ones may be considered to belong to the first laterals, the other to second;) the lower row from 3 to 11, black; there are also low rounded yellow tubercles, two on 2, one just above the other, below the line of the spiracles, with two short hairs; on 3 and 4 one, in line with spiracles, with four hairs; and along base a row, one on 2, 3, 4, 5, 11, 12, 13, with four hairs; from 6 to 10 inclusive two with two hairs; on dorsum of 2 are three small tubercles on either side in front, and one behind, four in all, each with one long hair turned forward; head as at first stage, the tubercles and hairs disposed in same way, with an additional one on either lobe making eighteen. (Figs. c, c^2, c^3.)

After second moult: length .22 inch; color black; all spines black, except of dorsal row, which are yellow, as before; in shape as at second stage, but the hairs are more numerous and the one from apex is straight. (Fig. *d*.)

After third moult: length, in hibernation and therefore contracted, .3 inch; color as before; the spines more thickly beset with hairs, which are more divergent, and make a dense covering.

Mature Larva, probably after fifth moult. — Length 1 inch; cylindrical; color velvet-black, dotted on the rear of each segment with white tubercles; spines long, tapering, thickly beset with long, tapering, divergent hairs, a straight one from summit; the dorsal row and the row along base yellow, all others black; under side smoky-brown; feet black, pro-legs brown; head subcordate, the vertices rounded, thickly covered with low tubercles, each of which gives a short black curved hair; color black-brown. (Figs. *e*, e^2, e^3.)

Chrysalis. — Length .65 inch; cylindrical; head case short, narrow, excavated at sides; mesonotum moderately prominent, rounded, followed by a shal-

low depression; abdomen stout, furnished with several rows of sharp, conical, short tubercles (corresponding to the larval spines); the wing cases a little flaring at base, depressed in middle; color blue-gray, the whole surface much marked with black; wing cases buff, more or less tinted red; with a black patch from base almost to hind margin, the nervules within it being orange, a marginal row of serrated spots, and another submarginal; head case and mesonotum largely black; the tubercles more or less enclosed with black; behind the dorsals are four small spots each, forming with the tubercle a triangle; similar spots on sides. But there is much variation in extent of the black markings. (Fig. *f*.)

In 1876, Mr. Oscar T. Baron, then at Mendocino, California, sent me several mature (or nearly) larvæ of the present species by mail. They were twelve days out and but one was alive on arrival. From this the drawing given on the Plate, Fig. *e*, was made. Several larvæ had pupated, but were more or less eaten, and I suppose the single larva had kept itself alive in that way.

On 16th December, 1878, I received from Mr. Baron, then at Navarro, about twenty of the same larvæ, in hibernation. Mr. Baron wrote that the eggs were laid June 29th, in clusters, one large and several small, the former containing sixty or more eggs, the latter from five to twenty. The larvæ hatched 20th July, or after 21 days. Their first care was to spin a common web, and this was occupied (of course, with additions, as needed) until the time for hibernation approached. Then some larvæ left the common web and spun for themselves among the wilted leaves of the food plant. Mr. Baron thought this plant was a species of Castelleia, but it was not identified. These larvæ did not survive the winter. I was able to get a description of the stage after third moult, and had to depend on alcoholic specimens for the earlier stages and the egg.

On 18th May, 1879, I received from Mr. Baron several chrysalides which had come from the same lot of larvæ, and from them obtained six butterflies, between 22d and 31st May. One of these was the red variety, female, shown by Figs. 5, 6.

Not much is known of the early stages of the American species of the group of Melitæa to which *Baroni* belongs. It is a difficult group to separate, and this makes it the more important that the preparatory stages of the several species should be studied.

ARGYNNIS.

III.

LILIANA 1.2♂3 4.♀

ARGYNNIS III.

ARGYNNIS LILIANA, 1–4.

Argynnis Liliana, Henry Edwards, Proc. Cal. Acad. Nat. Sci., VI., 1876.
Aberr. Baroni, W. H. Edwards, Trans. Am. Ent. Soc., IX., 3, 1881.

Male. — Expands 2.2 inches.

Upper side either deep red-fulvous, or pale, varying; the black markings as in the allied species, but slight, the spots small; the mesial band on secondaries continuous; the fulvous spots on same wings, both marginal and discal, often paler than the ground color; fringes on both wings yellowish, black at the ends of the nervules.

Under side of primaries yellow-buff; the basal area, and to hind margin below median, brown, with buff in the median interspaces; some examples, however, are red-brown at base, and the nervules are edged red; the outer half of cell yellow-buff, the P-shaped spot as the base; the two or three spots on the subcostal brown patch and the five uppermost marginal spots well silvered, the sixth spot partially so.

Secondaries brown, very little mottled with buff; the band narrow, brown-ochre; the spots large and well silvered; the sub-marginal triangular, those of second row, except the small ones, fourth and seventh, oval or sub-oval, narrowly edged black on basal side; of third row, the three spots are oval, pyriform, and crescent, with intermediate dashes of silver in some examples, and a streak on inner margin, also edged black; a round spot in cell and three at base; shoulder and inner margin well silvered.

Body above covered with red-brown hairs; below, the thorax with hairs which are gray at base, yellow to reddish without; abdomen buff; legs red and buff; palpi yellow at base, red without and at tip; antennæ pale black above, red-brown below; club black, tip ferruginous. (Figs. 1, 2.)

FEMALE. — Expands 2.35 inches.

Upper side pale fulvous; the marginal spots of both wings lighter. Under side as in the male, the basal area and nervules of primaries red. (Figs. 3, 4.)

ABERR. BARONI. The two marginal lines very heavy, and in place of the submarginal lunules a broad band crossing the wing; the row of round black spots is represented by a band from costa to upper median nervule, with two round spots in the median interspaces, the two spots usually found in the next interspaces wanting; on the under side, the marginal silver spots of primaries are changed to a solid bar, and the corresponding lunules on secondaries are changed in same manner; so the three spots of second row next costa are confluent, making one great spot. This fine aberration is in the collection of B. Neumoegen, Esq.

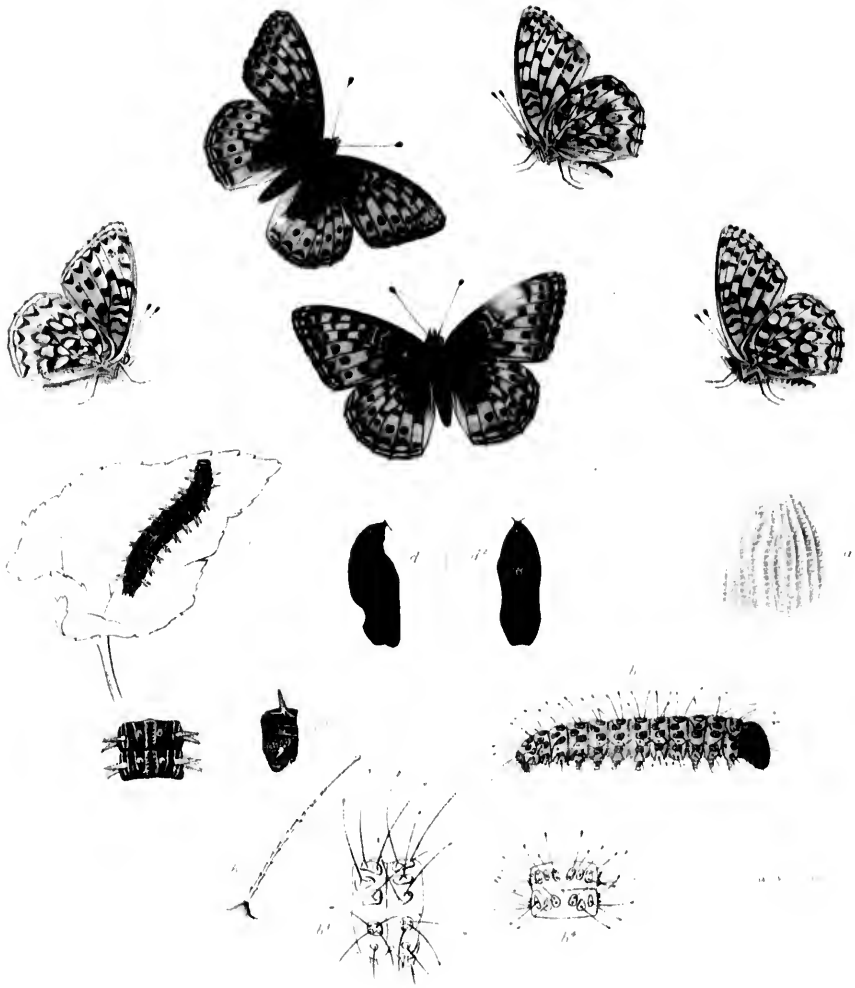
EGG. — Conoidal, truncated, depressed at summit, marked vertically by twenty-two or twenty-three ribs, which are as in the other species of the genus; the outline of this egg is much as in *Eurynome*, Vol. II, pl. 23, the base being broad, the top narrow, and the height not much more than the breadth; color yellow. (See Plate V of Argynnis, Fig. *a*.)

YOUNG LARVA. — Length .08 inch; cylindrical, marked as in the genus by tuberculous patches, with hairs the same in number, but somewhat different from some other species in the sub-dorsal rows; there are here two hairs from each tubercle, but instead of being nearly equal in length, the anterior one is much the shorter, and inclines toward the head, while the other stands up straight, or leans a little towards the tail; color of body light brown; head as broad as 2, subglobose, somewhat pilose; color black-brown. (Plate V, Fig. *b*.)

Liliana flies in northern California and Utah. The examples taken by Mr. Henry Edwards, from which the description was made, were from Napa County. Mr. O. T. Baron supplied collectors during the years 1878 to 1880 from Lake County and elsewhere, and on 12th July mailed me eggs just then laid by a female confined over violet. The eggs hatched 24th July, or at about 13 days from the laying, and the larvæ at once went into lethargy. Later in the season, I sent them to Maine for safe-keeping through the winter, but none survived. (By an oversight the egg and young larva were not figured on the present Plate, but will be given on Plate V of this series of Argynnis.)

ARGYNNIS.

LX.



EGLEIS 1 2 ♂ 3 4 ♀ 5 VAR. ♂.

a Ovi — magnitudo — c Matura Larva — nat. size
b, b* Larva equata — c*, c* — parts aucta
d Chrysalis

ARGYNNIS IX.

ARGYNNIS EGLEIS, 1–5.

Argynnis Egleis (Eg-le'-is), Boisduval, Lep. de la Californie, p. 59, 1869.
"No. 5," Behr, Proc. Cal. Acad. Nat. Sci., II., p. 174, 1862.
Monticaga, Edw., Syn., 1872 (not Behr).
♀ *Mormonia*, Bois., l. c., p. 58.

MALE. — Expands 1.8 to 2 inches.

Upper side bright fulvous, a little obscured at base; marked and spotted as in the allied species; double lines along hind margins, the mesial band on secondaries continuous and all the markings of both wings light; fringes of primaries alternately fulvous and black, or nearly all black, with a little fulvous in middle of each interspace, of secondaries, either wholly fulvous, or with black just at ends of nervules.

Under side of primaries yellow-buff apically, pale red at base and to hind margin below median, or just at base, and along the median nervules, in which last case the interspaces are buff; the black markings repeated; the sub-marginal spots either buff altogether, or the upper four and the two on the brown subcostal patch are imperfectly silvered.

Secondaries yellow-buff, the belt between the two outer rows of spots clear colored and immaculate; the remainder of wing to base washed with diluted brown, through which the yellow ground appears more or less clearly; the submarginal spots narrow, and sometimes well silvered; the other spots as in the allied species, but small, never, so far as observed, perfectly silvered, but varying much in this point; the spots of second and third rows rather heavily edged with black on the basal side.

But many examples are reddish-buff on under side, and the brown on secondaries is darker than in the type.

Body brown above, with long fulvous hairs, buff below; legs fulvous and buff; palpi fulvous; antennæ black above, fulvous beneath; club black, tip ferruginous. (Figs. 1, 2.)

FEMALE. — Expands from 1.8 to 2.1 inches.

Upper side less bright than in the male; the markings no heavier; but examples occur which are darker fulvous, and others which are much obscured over basal areas, and the fulvous is everywhere washed with brown; on the under side the base of primaries is more red than in the male; in the darker examples the disk and base of secondaries are more covered with brown or brown-ferruginous; and the spots of both wings are silvered, but not so perfectly as in many species. (Figs. 3, 4.)

There is much variation, and one of the common varieties is represented by Fig. 5. In this there is no trace of silver, and the spots are clear yellow-buff, color of the ground of the wing. I have seen no female of this type.

EGG. — Conoidal, truncated and depressed at top, rounded at bottom; the breadth to the height nearly as 8 to 9; marked by 18 thin, elevated, vertical ribs, slightly sinuous or bent, one half of them running from base to summit, the others but about two thirds the distance, then uniting with the first; the ends forming a serrated rim; between the ribs the rounded depressions are crossed by many very low horizontal ridges; color yellow. (Fig. *a*.)

YOUNG LARVA. — Length .06 inch, at 12 hours from egg; cylindrical, of even size from 2 to 10, each segment a little rounded; color greenish-white (changing in a few days to greenish-brown); marked by eight longitudinal rows of dark tuberculous spots, three being above the spiracles on either side, and one below; these spots are flat, oval or sub-triangular, and bear one or two small conical tubercles, from each of which springs a long tapering hair; under a high power these hairs are seen to be barbed, and knobbed at the ends; on dorsum of 2 is a bar, corresponding to the four dorsal and sub-dorsal spots of other segments, and on its front are six hairs, on the rear four shorter ones; the spots of the dorsal rows are sub-oval, each with two hairs; of the sub-dorsal rows triangular and smaller, each with but one hair; of the third or mid-lateral row sub-oval, on 2, 3, 4 with two hairs, on following segments but one; the spots of the fourth, or infra-stigmatal, row are rounded, and except on 2 and 13, each of which has two, have four divergent hairs; along base, on 3 to 6, and on 11 to 13, is a line of tubercles, one to each segment, with short hair, but on 2 in same line is a spot like those of upper rows, small, with two hairs; the hairs of the dorsal rows on the three anterior segments are bent forward, on the middle segments are nearly upright, on the last four are turned back; it is almost the same with the sub-dorsal row, but in the mid-lateral the two hairs on 2, 3, 4 are turned in opposite ways, and after 4 are bent down; in the fourth row, the upper two on each spot

from 3 to 9 or 10 are quite divergent and are turned up, and the lower pair, just as divergent, are beat down; after 10 all are turned down; feet and legs color of body; head obovoid, bi-lobed, dark brown, shining, much covered with short hairs. (Figs. b to b^4.)

After first moult: length .1 inch; color grayish, mottled and specked with black; body furnished with six rows of spines (as is the rule in this genus, from first moult to last); these spring from shining black tubercles and are black, stout at base, tapering to top, and beset by many short black hairs; head obovoid, black, with black hairs. The duration of this stage was seventeen days and upwards, in February and March.

After second moult: length .16 inch; the tubercles of the lower row dull orange; color of body dark gray, mottled with black; on either side the medio-dorsal line a gray stripe, and along base a gray band; head as before. Duration of this stage 11 days and upwards.

After third moult: length .22 inch; scarcely different; the spines of lower row now yellow nearly to tips. To next moult nine days.

After fourth moult: length .4 inch; the lower spines yellow as before, and the dorsals of 2 also yellow; color of body black-brown mottled with gray-white; the gray dorsal lines as before. To next moult 9 days.

After fifth moult: length .6 inch; in about twelve days reached maturity.

Mature Larva. — Length 1.2 inch; cylindrical, thickest in middle segments, tapering pretty evenly either way; color gray-brown, mottled and specked; running with the dorsal and sub-dorsal spines is a black stripe, edged on either side by a sordid white line; between the dorsals a yellowish band cut in middle by a black line, and specked with brown; the spines small at base, and rather short for the size of the body, the bristles very short; the dorsals dull white, the other rows dull yellow, and all with black tips; the dorsals on 2 turned forward, but not longer than others of the same rows; feet and legs pale brown; head sub-cordate, the vertices being rounded, the front flattened; color black on front, dull yellow behind, much covered with black hairs of irregular length. (Figs. c, c^2, c^1.)

Chrysalis. — Length .8 inch; shaped as in other members of the genus; head case square, transversely rounded, a little depressed at top; mesonotum

prominent, carinated, followed by a deep excavation; the tubercles on abdomen very small, scarcely visible; color dark brown, mottled in shades, and with more or less yellow-brown, particularly on the abdomen, on dorsal side of which the darker shade makes a serrated border to the front of each segment; the wing cases dark and glossy. The only chrysalis died before pupation. (Figs. *d*, *d*^{2}.)

This species was first described by Dr. H. Behr, without a name, but designated as "No. 5" in his paper on the Californian Argynnides, 1862; and it is compared and contrasted with his "No. 4," which later he called *Montivaga*. Dr. Behr says that No. 5 is much more common than the other, and "is easily recognized by the black bordering of the spots of the intermediate fasciæ (the second and third rows), their oval, not quadrangular, shape, and the rounded (lunular) form of the marginal spots." In 1869, Dr. Boisduval described the species as *Egleis*, Dr. Behr not having meanwhile applied a name to it, but included in it, I apprehend, the *Montivaga*, Behr, and certainly the distinct species *Irene*. He calls attention to this last as a variety which he had taken to be a species, but says that after having compared more than a hundred examples he finds that one runs into another in such a way that they cannot be separated. After eliminating *Montivaga* and *Irene*, there still remains a wide amount of variation between the forms which yet pass under the name *Egleis*. One of these is figured on the Plate (5). Examples from Mt. Bradley, California, are often very dark, not fulvous but brown, the females well silvered. *Mormonia* is not distinguishable in the original description from *Egleis*, and in the Latin synopsis of characters at the head of each description the same words are used for both, except that for *Egleis* the spots of the under side are said to be silvered or pale, whereas in *Mormonia* they are said to be silvered only. Dr. Boisduval sent me the male of *Egleis* and female of *Mormonia*, and there is no more difference between the two than would belong to different sexes.

The species is widespread, occupying northern California, and especially Nevada. It flies also in Utah, near Salt Lake, and in northern Colorado, though it seems nowhere to be common in this last-named State. Mr. Mead took large numbers in 1878, at Summit, Nevada, and the same year Mr. Morrison also collected in Nevada. I had the opportunity of examining all the variations in both collections. Besides the Nevada examples, I have at different times received many from Mts. Bradley and Shasta, from Mr. Behrens.

Mr. Mead (1878) sent me from Summit several eggs of *Egleis*, laid on violet by a female in confinement, and they hatched on or about the 18th August. The larvæ at once went into lethargy, as is the case with all the larger Argynnid larvæ of the later generation, or all larvæ where there is but one annual genera-

tion. I kept them in a cool room till last of January, 1879, when the survivors, three in number, were brought to a warm room and placed on violet. By 5th February they were seen to be feeding. On 18th February, one passed first moult, the second moult 5th March, the third 16th, and was that day accidentally killed. The second larva passed third moult 15th April, the third larva the same moult 17th April. This last died before another moult, but the second passed fourth moult 26th April, the fifth 7th May; suspended 20th and pupated 21st May; but died before imago. The general history is therefore similar to that of *Cybele*, *Atlantis*, and the other larger species, but unlike that of *Myrina* and the species of Group II.

COLIAS.
IV.

COLIAS IV.

COLIAS CHRYSOMELAS, 1–9.

Colias Chrysomelas (Chry-som'-e-las), Henry Edwards, Pacific Coast Lepidoptera, Feb., 1877.

Male. — Expands 2 to 2.4 inches.

Upper side greenish-yellow, not much obscured at base; the marginal border of primaries very broad, black, more or less dusted with yellow scales, cut nearly to the outer edge by the yellow nervules, usually even-edged within, or slightly erose, but sometimes roughly dentated, curving roundly at the apex, but little advanced on costal margin, and on inner margin projecting a rather long spur; discal spot small, sub-ovate, black.

Secondaries also have a broad border, cut to the outer edge by the two median nervules; not dusted yellow; the discal spot usually wanting, but sometimes orange, or indicated by a slight orange tint; fringes of both wings pink, yellow at inner angle of primaries.

Under side of primaries lemon-yellow, deeper colored along costal margin, and orange-tinted over apical area, often deeply; except on inner margin and to middle of cell, thickly dusted with fine brown scales; the discal spot repeated, a slight oval ring with yellow or sometimes pink-tinted interior; costal edge pink; submarginal patches are sometimes present in the median interspaces, a small cluster of black scales to each, but oftener there is no trace of these.

Secondaries entirely orange-yellow, thickly dusted; the discal spot pearl-white, or perhaps roseate throughout or about the edge, in a red-brown, broad ring; at base a small patch of pink; at outer angle a cluster of brown scales, never large, often a mere trace; some examples have submarginal patches in the median interspaces only. Body covered with greenish-yellow hairs, the collar dull pink; under side yellow; legs pink; palpi yellow, pink at tip; antennæ and club brown above, elsewhere pink, except that the end of the club is ferruginous. (Figs. 1, 2.) Very rarely examples are of a deep yellow, as Fig. 5, and the marginal borders narrow and as in Fig. 7.

FEMALE. — Expands 2.2 to 2.5 inches.

Either bright yellow, or of the tint of the male, or paler, a whitish yellow; the marginal border of primaries broad, of nearly even width except at apex, pale dusky black, completely inclosing a series of yellow patches that cross the wing; discal spot as in the male, occasionally orange.

Secondaries have the border much narrower and limited to upper half the wing; often represented by a few scales or patches; the discal spot either pale orange, solid, or an orange ring with pale centre. (Figs. 3, 4, 8.) Fig. 9 represents a curious variety, in which the border of primaries takes the form of a series of long triangles, one on each nervule.

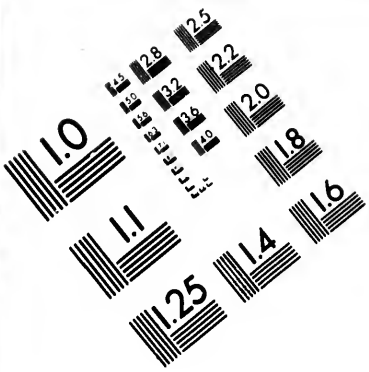
So far as at present known, *Chrysomelas* is limited to Northern California. Nevada has been thoroughly searched for butterflies, and this species has not been taken there. The original examples from which Mr. Edwards made his descriptions were from Napa County. Mr. James Behrens has for several seasons taken many at Shasta, Shasta County, and at Soda Springs, Siskiyou County.

There is no doubt that *Chrysomelas* is nearly allied to C. *Occidentalis*, Scudder, figured in Vol. I. pl. 18, described on page 57, a species found over N. W. Br. America, from Vancouver's Island to Lake Saskatchawan, but not in the Rocky Mountains or at high elevations. The two form a distinct sub-group, differing from any other in the character of the border of the fore wing in the female. I have thought *Chrysomelas* might be a southern form of *Occidentalis*, and so put it in my Catalogue, 1884. On the other hand, Mr. Henry Edwards has been familiar with both these forms in the field, and is positive that they are distinct species. At the end of his description he says: "I have no doubt whatever of the distinctness of this species. It is most nearly allied to C. *Occidentalis*, Scud., the original types of which are now before me. It differs in the extreme width of the marginal band, equally broad on primaries and secondaries, and always distinctly cut by the nervules on both wings; by its much larger size, and by the paler ground color of the female, with more pronounced marginal border. The usual absence of the discal spot of primaries is also a strongly marked character." This was in 1877. Ten years later, June, 1887, Mr. Edwards writes me: "I am fully of the opinion that *Chrysomelas* is quite distinct from *Occidentalis*. There is a difference between the two that cannot be expressed in words, but any one who has taken the two forms on the wing, as I have, must be of my opinion. *Chrysomelas* is from the Coast Range, a different region from the home of *Occidentalis*. My first specimens of the former were from the foothills of Napa County. I afterwards got it from Mendocino County, and Mr. Behrens takes it at Shasta. These localities are part of the same range of mountains, the Coast

Range. Now *Occidentalis* is found on Vancouver's near the sea-level, and thence across the continent at low elevations to western Canada."

I have thought it best, therefore, to give *Chrysomelas* as a species, for the judgment of an experienced lepidopterist, familiar with both these butterflies in life, is of weight. Whether there are two species or two forms of one species must hereafter be determined by breeding from the egg.

Mr. Scudder described the female of *Occidentalis*, Proc. Bost. Soc. Nat. Hist., IX., 109, 1862, as white, with a greenish tint, with margins like those of C. *Eurytheme*, Boisd. It is said that three females were under view. This description does not cover the yellow female, an example of which is figured on the Plate in Vol. I., but applies to the albino Fig. 5, which I now believe to be *Eurytheme*, and quite out of place on that Plate. Dr. Hagen called attention to this some years ago, and on examination I allow that he was right. Striking out this albino, the true type of the female is represented by Figure 3. I have never seen an albino female *Occidentalis* or of *Chrysomelas*.



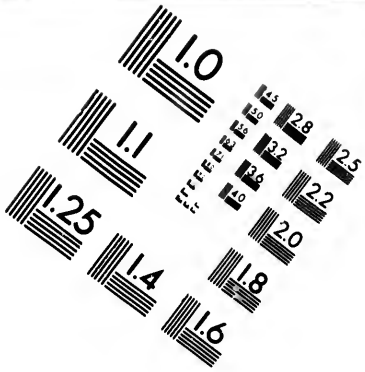
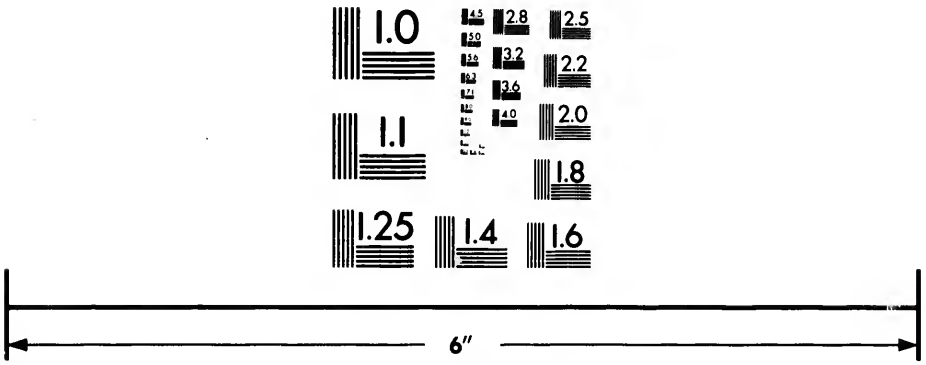
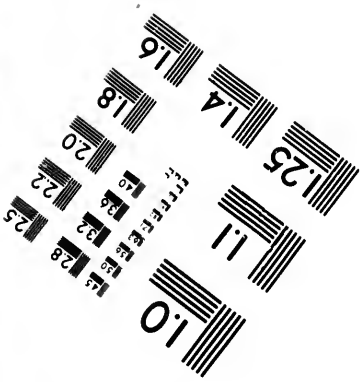
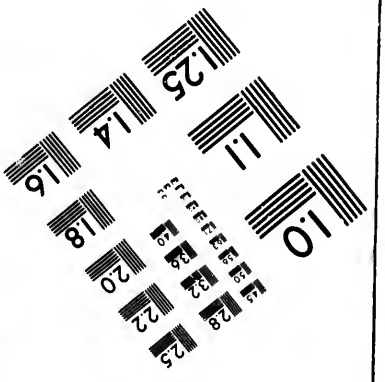


IMAGE EVALUATION TEST TARGET (MT-3)







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ARGYNNIS.

X.

NAUSICAA. 1 2 ♂. 3 4 ♀.

ARGYNNIS X.

ARGYNNIS NAUSICAA, 1-4.

Argynnis Nausicaa (Nau-sic'-a-a), Edwards, Trans. Am. Ent. Soc., V., 104, 1874; id., Papilio, II., 6, 1882; Mead, Report, Wheeler Exped'n, V., 752, 1875.

MALE. — Expands 2.5 inches.

Upper side deep red-fulvous, the bases much obscured; hind margins edged by two lines almost confluent; the submarginal spots lunular, separated, the other markings as in the allied species, light; the mesial band of secondaries broken, not continuous; fringes yellowish in the interspaces, black at the ends of the nervules.

Under side of primaries almost wholly bright red-brown, less red next apex; a little buff in the middle of the sub-costal interspaces; the submarginal spots lanceolate, the lower ones black, those next apex brown, the upper six imperfectly silvered; one or two sub-apical silver patches.

Secondaries dark brown, often ferruginous, mottled with buff; the band between the two outer rows of spots narrow, much encroached on by the ground color, sometimes clear buff, sometimes more or less dusted with brown scales; all the spots small and well silvered; those of the submarginal row narrow, broader next outer angle, all edged above with brown or ferruginous; those of the second row narrow, heavily edged above with black; the third row consists of three sub-lunate spots, also edged black; in the cell one or two often minute spots in black rings, and three patches at base; the shoulder and inner margin silvered. Body dark fulvous, beneath, gray-brown on thorax, the abdomen buff; legs buff; palpi buff at sides, brown in front and at tip; antennæ fuscous above, brown below; club back, the tip ferruginous. (Figs. 1, 2.)

FEMALE. — Same size.

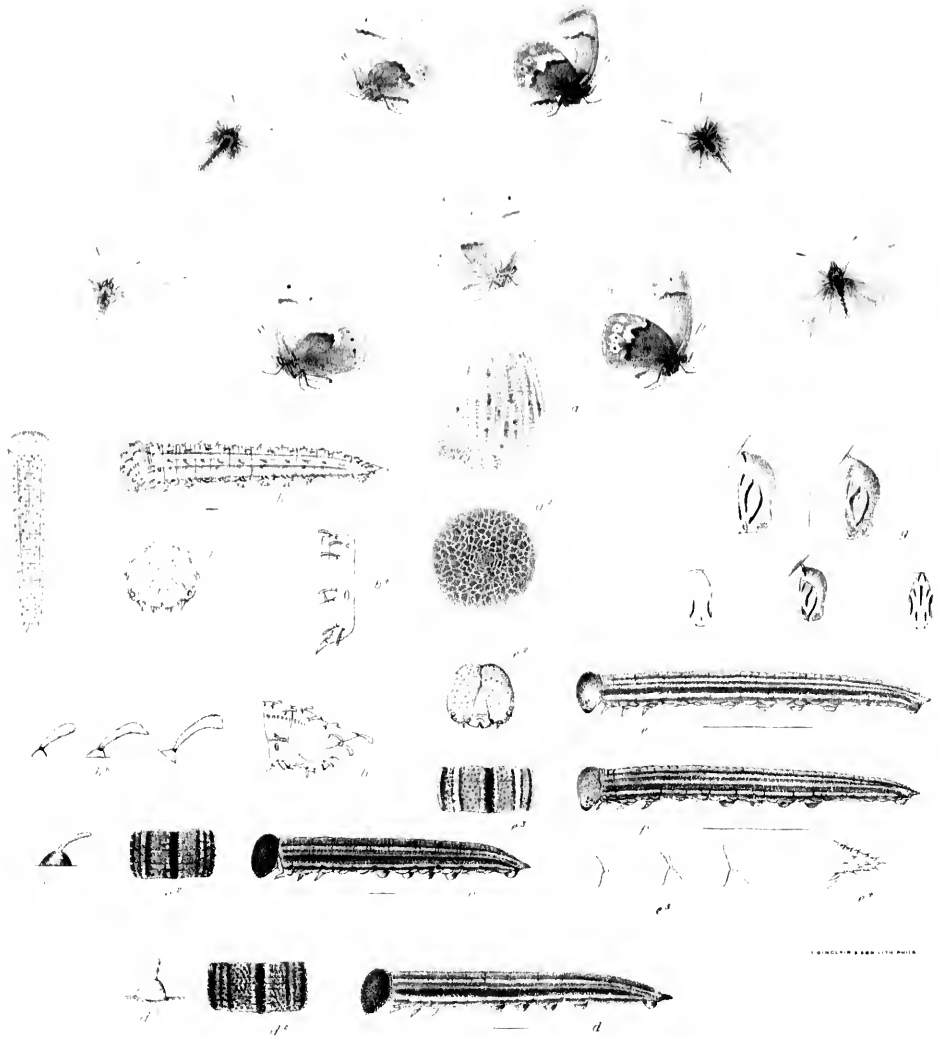
On the upper side the marginal lines are confluent on primaries, and the lunules are joined to them, these latter inclosing pale fulvous spots inclining to white next apex; the spots of the mesial band small, mostly lunular. Under side of primaries deeper red, the buff spaces more extended, and covering the upper

outer corner of the cell; secondaries darker, more mottled, the band more restricted; the silver spots a little larger. (Figs. 3, 4.)

This species was described from 1 ♂ 2 ♀ taken by Mr. Henshaw, member of Lieut. Wheeler's Expedition, 1874, at Rocky Cañon, Arizona. The late Mr. Morrison brought a few examples, all males I believe, from Arizona in 1882, but I know not the exact locality. Up to the present year, 1887, these were the only ones to be found in collections. It was reserved for Rev. George D. Hulst, of Brooklyn, New York, to make us better acquainted with the species, and I have to thank him for the examples figured on the Plate, and for the interesting account I am able to give of locality and habits. Mr. Hulst writes: "About the middle of last June (1887), I started on a summer vacation to California and Arizona, going first to California. On the way home I stopped at Prescott, Ariz., and thence went twelve miles south to Maple Gulch, in the mountains, at the head-waters of the Hassayampa River. I reached this place July 1st, and had eleven days' collecting. It was in the rainy season, and, with one exception, it rained every day, more or less, while I was there. I took specimens of Argynnis *Nausicaa* each day of my stay, mostly males, the first females appearing only the day before I left.

"The country there is extremely broken and mountainous, with the little brooks at the head of the river running through rocky cañons, up the steep sides of which the mountains rise from 1,000 to 2,000 feet. Along the beds of these brooks, where the dampness is constant, are found white-stemmed violets, the same or very nearly related to the eastern Viola Canadensis. Where these were found, and never at any great distance from them, this butterfly was found; so that, probably, the violet is its food-plant. The species was very local, only found in the bottoms of the cañons, at 6,000 to 7,000 feet altitude, and within an area of not more than one by three miles. And with a single exception all that I saw were on the north side of the divide. That one was on the south, but the conditions were the same, though I did not see the violets. The butterflies were very quick on the wing, and rarely alighted. The few taken on flowers were on Asclepias tuberosa. Some were taken on the ground, sipping moisture where the bright sunlight reached the beds of the streams. Except when alighted they were very difficult to catch, as there are neither roads nor paths in that wild country; heavily thorned shrubs were plentiful, and not a square rod of level surface was to be found."

Mr. Hulst thinks it probable that this species is to be found in central and southern Arizona, in the mountains where violets grow, but it must be local and much restricted. It is the most southern species of its genus, and its affinities are with the *Aphrodite* sub-group.



GALACTINUS 1 2 ♂, 3 4 ♀. FORM CALIFORNIUS 5 6 ♂, 7 8 ♀,
VAR. ERYNGII 9 ♀.

a *a*¹ *Egg* *magnified*
b, *b*¹, *b*² *Larval stages* ,,
c *Chrysalis* ,,

Cœnonymph
Edwards, Can
FORM CALI
X., 309, 1852
VAR. ERYN

FORM G
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CŒNONYMPHA I.

CŒNONYMPHA GALACTINUS, 1–9.

Cœnonympha Galactinus, Boisduval, Annales de la Soc. Ent. de France, 2d Series, X., 309, 1852; W. H. Edwards, Can. Ent., XVIII., 201, 1886.

Form California, Westwood-Hewitson, Gen. Diurnal Lep., 398, pl. 67, 1851. *Californius*, Boisd., l. c., X., 309, 1852.

Var. Eryngii, Henry Edwards, Pacific Coast Lepidoptera No. 24, Feb'y, 1877.

Form Galactinus.

Male. – Expands 1.2 to 1.4 inch.

Upper side sordid yellow-white, with a dusky shade over secondaries caused by the dark under surface; immaculate; the base more or less obscured by black scales, but some examples have nothing of this; fringes long, color of wings.

Under side gray-brown, darkest over basal half of secondaries, the hind margins of both wings lighter, a yellowish-gray; the inner margin of primaries either whitish or tinted brown; a pale ray crosses the disk beyond cell to lower median nervule, and on the basal side of this the dark scales are dense and make a sinuous or crenated edge; secondaries have a similar ray, angular, interrupted on upper median interspace, broadest between this and costa; primaries have near apex a small black ocellus, in pale ring, with white centre, but often there is merely a black dot, and sometimes this is wanting; secondaries have from one to four submarginal ocelli in the median and disco-cellular interspaces, differing in individuals as to distinctness.

Body above, color of wings, beneath, the thorax is covered with long dark gray hairs; legs and palpi dark gray; antennæ same above, yellowish below; club gray, tip ferruginous. (Figs. 1, 2.)

Female. — Expands 1.45 inch.

As in the male, the under surface rather darker; the ocelli more pronounced, sometimes a second one in the second median interspace of primaries. (Figs. 3, 4.)

Form California.

Both sexes are lighter colored than *Galactinus*, nearly white, there being no dark shade over upper surface, and no black at base; beneath, the general color is yellowish, the extra-discal areas being nearly or quite free from black scales; the basal half of secondaries pale brown, slightly dusted black; the ocelli same. (Figs. 5–8.)

VAR. ERYNGII.

This variety differs from *California* simply in being of a more yellowish hue on both surfaces, the basal areas on under side scarcely darker than the rest; and in the absence of ocelli, which is usually total; some examples, however, have traces of ocelli, as seen in Figure 9.

EGG. — Conical, truncated, the flat top covered with a low network of irregular meshes, very fine about the micropyle; the lower part well rounded, with a netted and indented surface; the sides ribbed vertically, the ribs low, narrow, in number about forty, of which several end at from one third to four fifths the distance from base; color yellow-green, with ferruginous specks here and there. (Fig. *a*, micropyle a^2.) Duration of this stage about thirteen days.

YOUNG LARVA. — Length .1 inch; from 2 both dorsum and sides slope regularly to 13, which ends in two short, conical tails, at the end of each of which is a process like those on dorsum; color pale yellow-green, the under side less green, more yellow; on mid-dorsum a brown line, and on either side three such, one sub-dorsal, one on middle, less distinct, and a third running with the spiracles; on each segment are six white processes, each process from the summit of a conical brown tubercle, forming six longitudinal rows, three on either side; those of the dorsal rows are club-shaped, much thickened at end, of the sub-dorsal rows are more slender, of lower row, which is just above the spiracles, of equal thickness throughout; on 2, 3, 4, the processes are nearly in cross line, but on 4 to 12, they form a triangle on each segment, the dorsal one being on the front, the sub-dorsal on the rear, the other on second ridge; on 2 the processes of the two upper rows are on front, and between them on the rear is a third; in front of the spiracle are two, the upper one short, and like the others of the lower row, but the second one is long and tapers like a hair; on 13 are fourteen processes, six being dorsal, three to each row, and four lateral, two to either side; two at the ends of the tails, and two in the hollow between the tails; (in Fig *b* one process on 13 is by oversight omitted; its place is near front of the segment in the lateral row;) along the base is a row of very short processes, two on 2, one on 3 and

4, two each from 5 to 12, one on 13; also over the pro-legs, 7 to 10, are two hairs each, but on 13 there are three, besides two clubs; the processes of the upper rows are recurved, except on 2, where they turn forward, those of the basal row bend down and back; feet and pro-legs yellow-green; head broader than 2, rounded, narrowing toward the top, a little depressed; color carnation; over the face a few short clubbed processes, thick like the dorsals. (Figs. *b* to b^6.) Duration of this stage twelve to eighteen days.

After first moult: length .19 inch; stouter; the dorsum less sloping, curving rapidly from 11 to end; color yellow-green; the mid-dorsal stripe dark green, the three side lines paler, and not very distinct, the upper one edged on its lower side by whitish-green: the basal ridge yellowish; tails red at end; surface covered thickly with low rounded tubercles, each with its short, bent, slightly clubbed white process; feet and legs green; head sub-globose, broader than 2; color dark green; the face much covered with fine white tubercles with short processes. (Figs. *c*–c^3.) Duration of this stage about seven days.

After second moult: length .32 inch; scarcely differing from last previous stage; the tubercles finer, much more numerous, rounded, the processes short, straight, and of uniform thickness. (Figs. *d*–d^3.) To next moult ten days.

After third (and last) moult: length .56 inch; shape as before; color yellow-green. But soon after the moult some of the larvæ began to change color, and within four days had become red and buff.

Mature Larva. — Length .84 inch; slender, scarcely arched dorsally, of even height and width from 3 to 7 or 8, then tapering gradually to 13; ending in two short conical tails, which meet at base and are rough with tuberculations; color yellow-green, striped longitudinally with yellow, there being two narrow stripes near together on mid-side, and a heavier and deeper colored basal stripe; on mid-dorsum a dark green stripe, edged by pale green; the tails red at tip; under side, feet and legs bluish-green; whole upper surface thickly covered with fine sub-conical white tubercles, each of which gives a fine short white process; these are either tapering, or slightly clubbed, or cylindrical, the effect being to give a downy coat; head broader than 2, sub-globose, narrowing toward top, depressed at suture; much covered with fine tubercles and short processes. (Figs. *e*–e^3.)

Or the body was reddish with a buff tint, the stripes yellow; the under side

red-brown; head greenish-yellow, with a tint of brown over face. (Fig. *f*.) From third moult to pupation about twelve days. (The larval measurements were taken at from 12 to 24 hours from the egg or moult.)

CHRYSALIS. — Length .36 inch; breadth at mesonotum .14, at abdomen .16 inch; very much as in Satyrus *Alope*, the ventral side straighter, the abdomen more swollen, less tapering; cylindrical, stout, the upper end truncated, the abdomen conical; head-case narrow, ending in a sharp cross ridge which is a little arched at top, the sides roundly excavated; mesonotum prominent, arched, the carina rounded transversely, the sides slightly convex, followed by a shallow depression; color — from green larva — yellow-green, over dorsum and abdomen finely specked with white; marked by nine black stripes of irregular length; of these, there is one on dorsal edge of each wing-case from base to inner angle; a curved stripe on middle of same reaching the hind margin; a short one on hind margin on ventral side, two parallel short ones on the antennæ cases, and a larger on ventral side between the wings; there is also an imperfectly colored black stripe on either side of 13 (in the figures this is too black and distinct); top of head case whitish with a dash of black below on dorsal side.

From buff larva; color pinkish brown, no decided marks, but the curved wing stripes appear in a deeper shade of brown. One chrysalis from a buff larva was green, but the wing cases were buff; and it was fully striped black. Another, also from buff larva, was pinkish at first, with three darker stripes on dorsum in addition to the nine before described, which last were faint brown; the three were, one on mid-dorsum below the excavation, and one on either side this; in a day or two the chrysalis had changed to full green, with the nine distinct stripes as usual, but the three additional ones had disappeared. Another was wholly green, with no stripes or traces of them. (Fig. 9.) Duration of this stage eleven and twelve days.

The two forms *Galactinus* and *California*, or *Californius*, are of one species, as has been proven by breeding from the egg, *Galactinus* being the winter, the other the summer form. And although *California*, Westwood-Hewitson, has the precedence of one year, yet I call the species GALACTINUS, because the winter form of a dimorphic species is regarded as the primary form, the only form when the species was single-brooded, and the summer form as secondary and derived from the other.

On 1st May, 1885, I received thirteen eggs laid by *Galactinus* in confinement, from Professor J. J. Rivers, at Berkeley, California, and which had been mailed 23d April. They began to hatch 5th May. On 7th May, I received a second

lot of eggs from Professor Rivers. By 11th inst., all had hatched. On 17th May, the first moult was passed by some of the larvæ, the second on 24th May, the third on 3d June. The first pupation took place 15th June, and the first butterfly came out 26th June. From laying of eggs to imago, 65 days, the egg stage having been 13, the larval 41, the chrysalis 11. The butterflies were all of the form *California*. The larvæ fed on any species of lawn grass. The egg much resembles that of the genus Satyrus in shape, but there are twice as many ribs as in S. *Alope*, and the network on summit is much finer. The egg differs in all respects from any species of the genus Neonympha with which I am acquainted. The larva and chrysalis are very like *Alope*, but the processes at the first larval stage are widely different from *Alope*, or other true Satyrus. The arrangement of the tubercles and processes on the young larva are almost exactly as in Neonympha *Gemma*, except that in the latter the processes are more of the nature of hairs. As in *Gemma* also, there were but three moults, which is exceptional with butterflies.

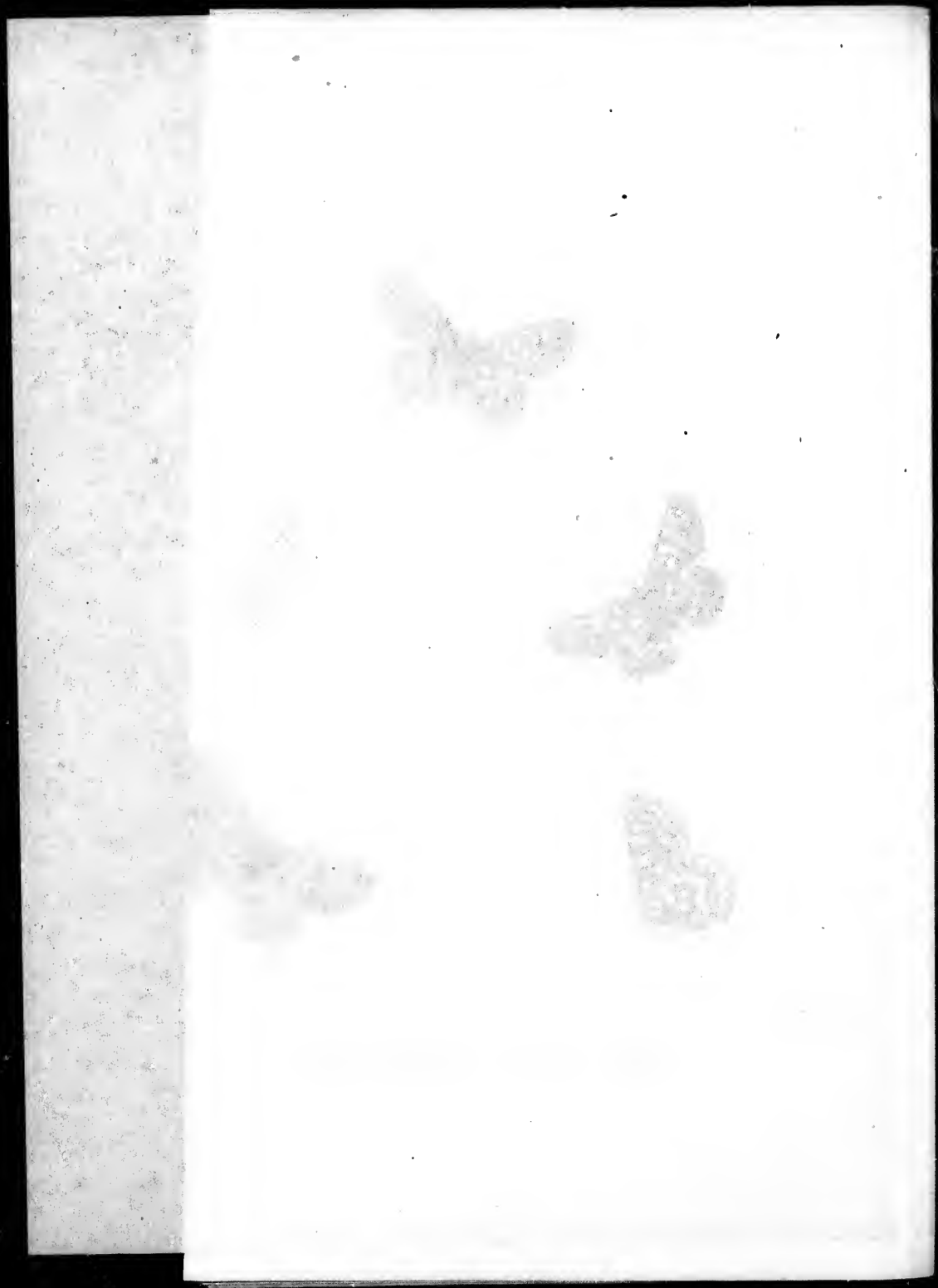
Mr. Henry Edwards writes of *Galactinus*: "It is almost the earliest butterfly of the year in California, making its appearance on warm days even in March, and becomes abundant in April, continuing so throughout May. It is always found upon grassy plains and meadows, and in the open; has a slow and rather irregular flight, alights very often, and is fond of settling upon flowers. If a storm comes on, or the sky becomes much obscured by clouds, it at once clings to the stems of grasses or other plants, and folds its wings to rest. It is remarkably common about the Bay of San Francisco, and I have taken it in the mountains up to 5000 and 6000 feet. It is certainly found in Nevada, though I never saw it in that State. I took it in Oregon and Washington Territory, but not on Vancouver's Island. It seemed there to be replaced by C. *Ampelos*." Professor Rivers says: "*Galactinus* affects open places in the vicinity of woods or in the cañons, or on the slopes of the foothills of the Coast Range. It is common at Berkeley at from two to four hundred feet above the sea-level; also in Napa and Sonoma Counties, and is found both in the valleys and on elevated hillsides where there are open places associated with trees and bushes. Its mode of flight is a short and low up and down movement, sometimes drifting with the wind, but always making short stoppages on the lowest herbage. It remains with us here till the latter part of October." The habits as described are similar to those of the Neonymphæ.

Kirby catalogues some two dozen species of this genus, and they are found throughout the north temperate zone in Europe, Asia, and even in Northern Africa. In North America there are seven or eight species. The mature larvæ and chrysalids of two species are figured in Buckler's "Larvæ of British Butterflies," (London, 1886,) and in both cases these stages are closely like those of *Galactinus*.

MELITAEA.

III.

RUBICUNDA. 1 2. ♂, 3 4 ♀, 5. VAR. ♂



MELITÆA II.

MELITÆA RUBICUNDA, 1–5.

Melitæa Rubicunda, Henry Edwards, Papilio, I., p. 52. 1882.

MALE. — Expands 1.7 to 2 inches.

Upper side black, spotted with deep red and ochrey-yellow, pale or deep, mostly in common transverse bands; the spots of the marginal rows small, well-separated, red; of the second row, either red or yellow, or the red is partly replaced by yellow, always small, often altogether wanting, in which case there is a broad, black, common band, as shown in Fig. 5; of the third row, yellow on primaries, red on secondaries, the latter large; the fourth row, on primaries, is bifid from median nervule to costa, the outer branch and main row usually wholly red, but sometimes the spots are more or less edged yellow on basal side, the inner branch yellow; in cell four transverse bars, red and yellow alternately from arc to base; also a yellow bar below cell; secondaries have a red stripe from costa to median across end of cell, red, sometimes macular or wanting, though usually a small spot is left at outer end of cell; four yellow spots near base, three in straight row from costa to sub-median, the fourth outside in cell; fringes of primaries mostly black, white or pale yellow in the median interspaces, of secondaries, a little black at the ends of the nervules, the rest light.

Under side red, of nearly the same shade as above; the yellow spots repeated on primaries enlarged and distinct; on secondaries all spots are repeated, enlarged; the red ones of third row each lightly edged yellow, except on marginal side; above this is a bit of the black ground, and next a narrow red stripe from costa to sub-median, separated by a black line from the fourth or discal band of yellow; (in many of the allied species this stripe is yellow and is in part confluent with the discal band;) on the basal area a fifth spot on costa; shoulder and inner margin yellow.

Body black, brown above, the collar red; beneath, the thorax covered with long yellow hairs, which within are gray, the abdomen red ventrally, on the sides red; legs red; palpi red, yellow at base; antennæ red on upper side, with fine rings of black, black below; club black, tip ferruginous. (Figs. 1, 2, 5.)

FEMALE. — Expands 2 inches.

Upper side as in the male; often there is an excess of red, the yellow spots being mostly replaced by red. On the under side the red spots of third row are more decidedly edged yellow. (Figs. 3, 4.) Of the preparatory stages of *Rubicunda* nothing is yet known. What I described as the larva and chrysalis of *Rubicunda*, Can. Ent., xv. 119, 1885, were of another species, M. *Taylori*, of Vancouver's Island.

RUBICUNDA was originally described by Mr. Henry Edwards as possibly but a variety or form of M. *Quino*, Behr. Curiously enough, no one, not even Dr. Behr himself, to-day, knows what M. *Quino* is or was intended to be. The types were lost, and the published description fits no known species or variety. It certainly was not what Mr. Edwards understood it to be when he compared both *Baroni* and *Rubicunda* with it. He says of the latter, that "red is the prevailing tint, and the sub-marginal bands of secondaries are simply bands of red," etc. Since this was written, *Rubicunda* has been taken in great numbers by Mr. James Behrens, at Mendocino, California, and I have received from him many more than a hundred examples. There is much variation among these; one type, and that the most common, having nearly all the upper side spots small, so that a large part of the black surface is exposed. (Fig. 1.) Another, having the second common row obsolescent, or wanting altogether, so as to present a conspicuous black band there. (Fig. 5.) In another, the red spots of third row are very large; and in another still, red prevails over the marginal half of each wing, and it was this which Mr. Edwards had in view in making his description.

Respecting this species, Mr. Behrens says: "My catch of 1884 and 1887 was in the Comptche District of Mendocino (Comptche, name of old Indian chief). This district is the highest ridge of the County, all deepest redwood forest, Sequoia sempervirens, 1600 to 2000 feet above ocean-level, and twenty-five miles inland from the coast. I caught all the males in the timber flying with Chionobas *Iduna*, and they have the same habits as that species, flying high and settling on the sandy road in the sunshine. It also alights on the leaves of a tan-bark oak, a small species, growing not much over twenty feet high. There are no visible flowers in these dense forests, and I am totally at a loss to mention the food-plant of the larvæ. I was all the time on the lookout for it. It must have surprised you that during six weeks so few females were taken by me, in all less than a dozen, while I took hundreds of the males. But I did capture three of the females in an open uncultivated field a few miles away. If you could form an idea of this mountainous and rough region you would hold me excused for not

diving down the precipices on one side the county road, or climbing the heights on the other, with all the impediments of bramble and underbrush, and that at a temperature never under 80° Far., all June 100°, and now again in August, 100° every day. Both *Iduna* and *Rubicunda* females seem to avoid the flight up from the deep gulch." Mr. Behrens notices that the males adhere tenaciously to the net, by reason of the strength of the claws or feet, more so than other Melitæas he was accustomed to take.

No doubt the food-plants of *Rubicunda* are same as those of the allied species, Scrophularia, Penstemon, Castelleia, etc., which grow either in the gulches or the open fields, and there is where the females would congregate.

Mr. Henry Edwards writes: "The home of *Rubicunda* is Mendocino County. This is in the coast range of mountains, about one hundred miles from San Francisco, north. It is mostly pine forest, and it would appear that it is not a rich butterfly country, as this species and Chionobas *Iduna* are the only things of importance found there."

On looking over old letters of Mr. O. T. Baron, I find several mentions of *Rubicunda*. On 11th May, 1880, he writes from Mendocino: "For the first time I have the caterpillars of *Rubicunda* and *Baroni* side by side for comparison. They resemble each other much, but still if they were mixed up I would pick either kind out without a single mistake." On November 20th: "*Rubicunda* I caught in Eden Valley, Mendocino County; also fifteen miles north of Ukiah, the county-seat, and on the head waters of the Big River, eighteen miles west of Ukiah. Eden Valley is about 3000 feet above the level of the sea; the other places mentioned have about 1500 feet elevation. I have also raised two or three specimens of the same insect from caterpillars found on two different plants, the one, I think, a species of Castelleia, the other I do not know. The caterpillar is certainly distinct from that of *Baroni* and feeds on different plants. I shall be able to give you the whole history in the coming spring, and also send the larva, pupa, and probably eggs." Unfortunately, I never received any of these stages, Mr. Baron soon after having left that region.

Mr. Morrison took *Rubicunda* on Mt. Hood, Oregon.

EREBIA.

I.

MAGDALENA 1 2 ♂, 3 4 ♀, HAYDENII. 5 6 ♂.

a Egg a² micropyle *magnified*
b b² Larva (young)
c - - *processes*

T. E. SINCLAIR & SON, LITH. PHILA.

before the middle of the segment; on 13 are six in two rows made up of the dorsal and sub-dorsal, which fall nearly into line, a lateral on either side in front, and six around the end, these last smaller and with shorter processes; the processes on 2 are decidedly club-shaped (Fig. *c*); on the other segments to 12 scarcely clubbed (Fig. c^3); on the sides of all moderately clubbed, and short (Fig. c^2); on 13 the four uppermost are cylindrical and long (Fig. c^4); along base a row of minute tubercles with short hairs, two to each on 2, 7 to 13, one on each of the rest; color at first pink-white, with a brown mid-dorsal stripe, and three brown lines on the side; a few days later the dorsum had a green tint; later the anterior half became greenish, the rest pink-white; under side, feet, and legs paler; head a little broader than 2, ob-ovoid, the top a little depressed; color black-brown, surface granulated; marked by a few low tubercles, each giving a white process. (Figs. *b*–b^2.) This larva died before a moult.

Very few examples of this Erebia are to be found in collections, and all, so far as I know, have been taken by that indefatigable lepidopterist, Mr. David Bruce, of Brockport, New York. Mr. Bruce wrote me, July 15, 1887: "I have just got in from the mountains after a hard struggle. The rainy season has commenced a month earlier than usual, and consequently there is no depending on anything. I have been on Bullion Mountain, 14,000 feet, for nearly two weeks, have taken five *Magdalena*, a good series of C. *Bore*, also of *Semidea*. I send you two eggs of *Magdalena*." These were laid 10th July, and one hatched on 22d. The other was put in alcohol, that its likeness might be drawn. The larva at first seemed lethargic, and I thought it would sleep as the larvæ of the genus Satyrus do, and so pass the winter. But on 26th I noticed that it had eaten of the grass on which it rested, and had changed color, as small larvæ usually do after feeding. On 28th I sent it to Mrs. Peart, at Philadelphia, and learned that it died there a few days later, and before a moult, attacked by mould.

Later, Mr. Bruce kindly wrote out his observations on this species, thus: "E. *Magdalena* is found in the most uninviting-looking spots it is possible for a naturalist to explore. Black, barren, detached rocks, that look as if an immense peak had fallen and split into fragments; hardly a blade of grass or a patch of lichen to relieve the utter desolation. Yet even here, animal life is found in plenty, and fitted for such a dwelling-place. All day long can be heard the singular 'keek' of the 'Little Chief' Hare, Lagomys princeps, and until the animal is seen, the stranger is puzzled to know if it is the voice of a bird or an insect, on the earth or in the air; yet the little ventriloquist is sitting on a rock probably within a yard of his feet. A loud shrill whistle announces the

presence of the large Mountain Marmot, who may be seen on the topmost rock, keeping a good lookout. A few pairs of the Mountain Linnet or Gray-crowned Finch are sure to fly from the rocks, where they are breeding, to the nearest snowbank, and are soon busily engaged searching for seeds that have blown from below or washed from above. The sun gleams out, and, awakened into activity by its beams, comes Erebia *Magdalena*, flitting leisurely, like the rest of its family, then suddenly taking an upward flight, it soars around, more like a Limenitis than an Erebia. Another of same species springs up from the rocks, the usual skirmishing chase ensues for a few minutes, the sun is again obscured, and the insects disappear as if by magic, and will not be seen until it is bright again. I have never found this species but among such broken rocks, varying from 12,000 to nearly 14,000 feet elevation. The females fly to the nearest grasses to deposit their eggs. They alight on the ground, and crawl into the tuft of grass quite to the root, and it is difficult to find them, while no amount of beating or brushing will make them fly out. I saw one drop into a tuft which I could cover with my hat, and searched for her for ten minutes in vain. It was only by pulling the tuft entirely in pieces that at last I found her. It was this female that laid the two eggs in confinement which I sent you. I have never seen the males fly beyond the rocks at all. *Magdalena* when fresh has a beautiful satiny gloss, which in the males has a purple tint, but they soon become worn and brown and lose this tint. As far as my experience goes, this is the most difficult to capture of all our native butterflies, not because of its rapid flight, but from the nature of its habitat. The collector cannot follow it, and when it is at rest on the black rocks it is almost invisible. Owing to its habits the species will always be rare in collections. I have met with it from June 28th to July 18th, on the front range of the Rocky Mountains, Park County, Colorado."

Magdalena on upper side is exactly like the Arctic-American species, E. *Fasciata*, Butler, the same size, shape, and color even to the club of antenna. But *Fasciata* is conspicuously banded beneath across both wings. Our Coloradan must have descended from the same stock with *Fasciata*, if it be not an offshoot of that species. Usually Erebia *Epipsodea* is distinctly banded beneath, but individuals are found in Colorado with no more of a band than *Magdalena* shows. So far as known by Mr. Bruce this absence of a band in the present species is constant.

It may be a very long time before more is known of the early stages of *Magdalena* than what I have related. I find it almost impossible to rear larvæ of these high alpine species, and in cases where larvæ have reached maturity they fail to pupate.

I asked Mr. Bruce, if, considering the great elevation at which this species

lives, and the frosty nights even during the short period of its alpine summer, it would require three seasons for the larva from egg to reach imago, the first winter being spent by the larva in its first stage, the second either when mature or in pupa. He replies: "As to the three year theory, I do not think it is so at all. You have no idea of the forcing and invigorating influence of the air, and the effect on everything that has life, both animal and vegetable. You may leave the barren-looking cold hills for a week and return to find them carpeted with flowers, in many cases actually pushing through the snow. Where the sun catches, in early spring, the snow soon melts, and the hibernating larvæ feed and grow rapidly. I can only form my ideas from hibernating Arctian (Heterocera) larvæ; these hibernate when very small indeed, come out very early, will freeze and thaw as the cold or heat predominates, yet keep growing all the time. I have no reason to think the diurnals do very differently. I think there is plenty of time for Erebias to feed up and be out on the wing by the middle of June. The mountain larvæ are all very partial to basking on the stones in the sunshine, feeding little till the afternoon and evening, but then they feed voraciously. The temperature gets down to 30° Fahr., or lower, every night during the summer months; a thin ice frequently forms on the small lakes in July even. Yet I believe the grass feeders *do not get into a torpid state* after vegetation once starts, for the soil and stones retain heat where the sun has struck for any length of time. Yet the air is so cold that moths do not fly by night at all, the Noctuids and Bombyces, at these elevations, being day-fliers."

EREBIA I.

EREBIA HAYDENII, 5–6.

Erebia Haydenii, Edwards, ♂, Hayden's Report, Survey of Montana, 1872, p. 467; id., Trans. Amer. Ent. Soc., V. p. 19. 1874.

MALE. — Expands 1.6 inch.

Upper side blackish-brown, immaculate; under side paler, dusted with gray scales; secondaries have a complete series of black-brown ocelli along hind margin, each ringed with rust-red, and having a small white pupil; on primaries two or three black points, the margins edged by a narrow rust-red stripe.

Body, color of wings; legs yellow-brown; palpi black-brown; antennæ yellow-brown, annulated white; club ferruginous. (Figs. 5, 6.)

FEMALE, at present unknown.

This species was described fifteen years ago from two much worn and badly damaged males, brought in from Yellowstone Lake by Dr. Hayden's Expedition, and until recently I had not known of another example in any collection. Nothing whatever was known of the species except what the dried insects discovered. To call attention to the species I concluded to figure the male only. After the Plate was done, I accidentally learned that Prof. S. A. Peabody, of the University of Illinois, had taken *Haydenii* in 1887, and he kindly sent me two pretty fresh males, and gave the following account of their capture: "I send you two males *Haydenii*, I have no females. These were taken in the immediate vicinity of the Falls of the Yellowstone, on the grassy slopes west of the cañon, and at an altitude of about 8,000 feet, or, say, between 7,700 and 8,000. I see that in the Trans. Ent. Soc., V. 19, this species is reported at Yellowstone Lake, which is about 15 miles from the Falls. I did not go there. The altitude of the lake is not materially different from that of the upper fall. I did not see any females. I was at the Falls, Aug. 3d and 4th. On 5th, I passed over Washburn Mountain

to Yancey's, on horseback. I went to the mountain with a company and a guide, and could not stop to take insects. From the summit I was alone, and on a pretty good trail, but as I had yet twenty miles to go before nightfall, you may understand that I did not delay very much. The next day's travel was over an arid and parched country, and mostly under cold and rainy sky, where nothing flew. These Erebias were on sunny slopes, covered with the wild flowers of the country, few of which were known to me. Every other butterfly seemed to be Argynnis."

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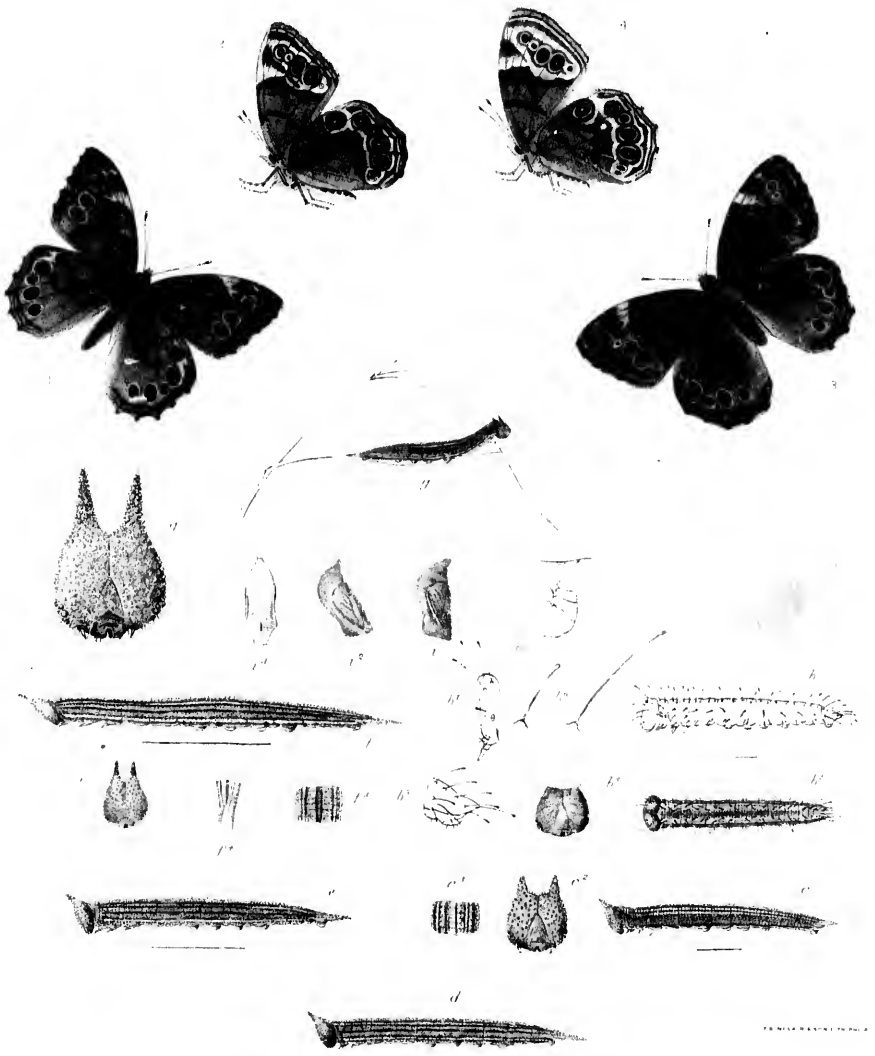
DEBIS.
I.



PORTLANDIA 1 2 ♂, 3 4 ♀.

a Egg magnified *e* 1st to 4th mlt magnified
b Larva (young) " *g* 5th moult nat size
i Chrysalis

DEBIS I.

DEBIS PORTLANDIA, 1–4.

Debis Portlandia, Fabricius, Spec. Ins., II, p. 82, 1781; Boisduval and Leconte, Lepid. de l'Amer., p. 226, pl. 58, 1833; Morris, Lepid. N. Am., p. 79, 1862; Edwards, Can. Ent., XIV, p. 84, 1882; Fernald, But. of Maine, p. 70, 1884; French, But. of East. U. S., p. 29, 1886.

Andromacha, Hübner, Samml. Ex. Schmett., I, 1806–1818; Say, Amer. Ent. II, pl. 36, 1825; Morris, l. c., p. 78, 1862.

MALE. — Expands from 1.9 to 2.2 inches.

Upper side yellow-brown, or wood-brown, individuals varying in depth of color; the extra-discal area paler, more yellow, variable; on this a row of four oval or rounded blind ocelli, sometimes unequal throughout, sometimes the posterior pair very large, equal; often the spot on lower discoidal interspace wanting, or reduced to a point; these ocelli are of a soft brown hue, and each lies within a pale yellowish ring which fades into the ground; on primaries, owing to the transparency of the wing, the outer edge of the basal area is dark, particularly next costa, and projects in an angle, often double-toothed, on upper median nervule; a similar dark edging is sometimes to be seen on secondaries, but usually there is nothing of this; secondaries have also a series of five ocelli, unequal, the middle one often very small, sometimes altogether wanting; sometimes the upper pair are very large, equal; both wings bordered by two fine parallel dark lines; fringes brown at the ends of the nervules, gray or whitish in the interspaces.

Under side paler brown, with a slight violet reflection; the basal areas edged without by a common dark stripe, sinuous, projecting considerably against both cells and on inner margin of primaries; halfway between this and base a similar stripe, nearly straight, bending upwards on lower median interspace of secondaries and joining the outer stripe on sub-median nervule; on the arc of each cell a dark stripe; the extra-discal area of primaries lighter, of secondaries same as the basal, with a dull yellow or whitish diffuse band passing entirely round each series of ocelli; these have now small white pupils, and each is within a definite

yellow ring, pale or bright; on secondaries there is a duplex sixth ocellus next inner angle, each part very small, elongated.

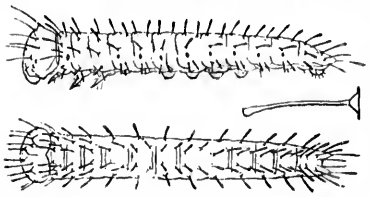
Body above yellow-brown, beneath yellow-white, the abdomen lightest; legs brown-yellow, the tibiæ whitish; palpi white within, with long black hairs in front; eyes brown-black; antennæ blackish above, ringed with white, red-brown below; club black, the tip red-brown. (Figs. 1, 2.)

FEMALE. — Expands from 2 to 2.25 inches.

Very much as the male; the ocelli varying in same manner, perhaps, however, never so small as in some males. (Figs. 3, 4.)

EGG. — Semi-ovoid, a little higher than broad, the base slightly rounded and arched at the middle; surface smooth; color greenish-white. (Fig. *a*.) Duration of this stage from four to six days.

YOUNG LARVA. — Length .13 inch, cylindrical; tapering slightly on both dorsum and sides from 2 to 13; ending in two short conical tails; color at first yellow, somewhat tinted brown, after two days changing to yellow-green, more green on dorsum; on each segment from 3 to 12, above spiracles are six conical tubercles forming as many longitudinal rows, three on either side, a dorsal, sub-dorsal, and lateral; on 3 and 4 they are nearly in cross line, but from 5 to 12 are in triangle, the dorsal one standing on the front ridge, the sub-dorsal on the rear, the lateral on the second ridge or a little before the middle of the segment; from each of these a long, slender, tapering hair, the end thickened (Fig. b^6); on 2 are three tubercles and hairs corresponding to the three rows, though not all in line with them, and behind and between the upper two an additional one; against spiracle, to the front, is a fine hair, and just over it a shorter, coarser one; (see cut; on the Plate, figs. *b* and b^4 fail to show the sub-dorsal tubercle on 2;) on 13 are twelve tubercles, three on each side in the upper two rows, two in the lateral row, two at the ends of the tails, and two short hairs in the concavity between the tails; below the line of spiracles is a row of short, coarse hairs, not thickened at ends, two to each segment, except on 3, 4, 13, which have but one; head at first nearly twice as broad as 2, at two days from the egg one-fourth broader only; ob-ovoid, truncated, slightly depressed at the suture; on each vertex is a small sub-conical protuberance, from the top of



which comes a long, tapering hair; a few hairs over the front. (Figs. *b* to b^6.) Duration of this stage, six to eight days.

After first moult: length .26 inch; the dorsum arched, on 3 and 4 depressed; 13 ending in two long, tapering tails; color bright green; densely covered with low, sharp, whitish tubercles, which are disposed in longitudinal rows, one of which edges either side the dark green mid-dorsal stripe, and another lies between this and the sub-dorsal narrow yellowish stripe, which itself is crowded with tubercles; below this stripe there are four somewhat irregular rows, and then the yellowish basal stripe; each tubercle gives a very short white hair; under side, feet, and pro-legs paler green, head higher than before, the sides less curved, depressed somewhat more; on each vertex a high, conical process, which, as well as the whole face and back, is thickly covered with whitish sub-conical tubercles, each with its short white hair; color green, the ends of the processes red. (Figs. *c* to c^3.) Duration of this stage, seven to eight days.

After second moult: length .44 inch; shape as at second stage; tuberculated in same way; the sub-dorsal and basal stripes as before; head same, the processes more red. (Fig. *d*.) To next moult about nine days, but, like all stages, the duration depends on the weather.

After third moult: length .52 inch, scarcely different. (Fig. *e*.) To next moult, in a single instance, six days; all other larvæ hibernated at this stage.

After fourth moult, in spring: length .6 inch; shape nearly as before, the abdominal segments arched, the others level; tails long; color yellow-green; a darker mid-dorsal band, a green line next above the yellow sub-dorsal stripe, and another on mid-side; the basal stripe yellow; head narrower at top, the bases of the processes meeting at the suture; color green, the ends red. (Figs. *f* to f^4.) To last moult eleven days; in one instance sixteen, in another twenty days, owing to cold weather.

After fifth moult: length 1 inch; in about ten days the larva was full-grown.

Mature Larva. — Length, ♂, 1.2 inch, greatest breadth, on middle segments, .16 inch; ♀, 1.4 inch, breadth .17 inch; cylindrical, slender, the dorsum arched, and sloping about equally either way from the middle; 13 ending in two long, slender, tapering tails; color yellow-green; on mid-dorsum a dark green band, on the edge of dorsal area a narrow yellow stripe to the tail, and on upper side of it a dark green line, another such line on mid-side, and a yellow stripe along

base; all the cross-ridges thickly set with fine whitish tubercles, each giving a very short fine hair; tails red-tipped; under side, feet, and legs pale green; head ob-ovoid, broad on lower front, narrowing rapidly upwards, well rounded on front and sides; on each vertex a long, tapering process, their bases meeting at the suture; these processes, as well as the rest of the head, are rough, with large rounded equal tuberculations, each with its short, stiff white hair; color yellow-green, the processes red, all tubercles white; the ocelli brown, the largest green with brown rim. (Figs. g–g^2.) From fifth moult to pupation about fifteen days. The position when suspended is shown by Fig. h.

Chrysalis. — Length .6 inch, greatest breadth across both mesonotum and abdomen .22 inch; cylindrical, the abdomen conical; head case short, bevelled on both sides equally to a rather broad, sharp ridge, with sharp, triangular corners, at top a little excavated, the sides roundly excavated; mesonotum prominent, angular, the apex rounded, followed by a shallow depression; wing cases flaring at base, very little constricted in middle; color delicate green, sometimes with a bluish tint; the ventral side of abdomen paler; the top of head and dorsal edges of wing cases cream-white; surface smooth, glossy. (Figs. i to i^3.) Duration of this stage in May, thirteen to fourteen days.

Portlandia flies throughout the Atlantic States and Mississippi Valley. It is abundant in the South and West, but how far to the West it flies I am unable to say. I have received it, however, from Fort Niobrara, Nebraska. It is believed to be nowhere a common species in New York or New England, and is occasionally taken as far east as Halifax, Nova Scotia. Prof. C. H. Fernald informs me that at Orono, Maine, the late Mr. Anson Allen used to find it in some numbers through the summer on a road through a growth of spruce trees. I learn from Mr. H. H. Lyman, of Montreal, that Mr. E. C. Trenholme, of that city, has found this species tolerably common on the Western and Little Mountains, above Montreal, on one occasion having "come upon a flock of a dozen, flitting about near the ground." Mr. Lyman writes that he has received two specimens taken at East Selkirk, Manitoba, lat. 50° 10′, the most northern locality probably so far noted.

In Say's time, about 1825, *Portlandia* was known only as southern, and that author states that it had never been taken so far north as Pennsylvania. Very likely the species has spread to the north and east during the last sixty years, as many species of birds are known to have done. Mr. Philip H. Gosse, in his "Canadian Naturalist," London, 1840, p. 246, speaks of seeing a single

example in Canada. The same author, in "Letters from Alabama," London, 1859, page 122, gives an interesting account of the habits of the species, under the name of Hipparchia *Andromacha*, which I copy here. "It is interesting from its social and gamesome habits. A particular individual will frequent the foot of a particular tree for many successive days, contrary to the roaming habit of butterflies in general. Hence he will sally out on any other passing butterfly, either of his own or of another species, and after performing sundry circumvolutions, retire to his chosen post of observation again. Occasionally I have seen another butterfly of the same species, after having had his amicable tussle, take likewise a stand on a neighboring spot, and after a few minutes' rest, both would simultaneously rush to the conflict, like knights at a tournament, and wheel and roll about in the air as before. Then each would return to his own place with the utmost precision, and presently renew the 'passage of arms,' with the same result, for very many times in succession." I have myself never had an opportunity of observing the habits so well described, nor can I hear of others having done so. But a butterfly restricted to forests in which was no undergrowth, like the pine forests of the South, would of necessity have the habit of resting on trees. The late Mr. James Ridings collected butterflies in Georgia, a few years ago, and informed me on his return that Satyrus *Pegala* alighted on the bark of trees in the pine forests, and returned persistently to the same spot, and as he compared the habit with that of *Portlandia*, probably he had noticed the latter species in the same district. I know of no other of the North American Satyrinæ which do this, unless it be the Chionobas of the *Gigas* group.

The species is not a common one in the region in which I live, but every year I see a few individuals flying near the ground about the edge of the wood, or among the trees and shrubs near my house. They are also to be seen in the depth of the forest. On one occasion, in June, I visited an unopened coal seam at least a mile from any clearing, and at five hundred feet elevation above the creek, where the coal was exposed to view, owing to its being between two ledges of rock, a little sulphur-tinctured water trickled upon the base rock, and here were several *Portlandia* and that rare butterfly, Eudamus *Cellus*, in a cluster, eagerly sucking. On the way down the creek, the wheel of the wagon struck a small, decayed, moss-covered stump at the foot of the hill, and quite a flock of *Portlandia*, which had been resting on the stump, were flushed. I caught eight, four of them with one sweep of the net, all males fresh from chrysalis. Near the same place, several summers ago, Mr. Ridings took a number of specimens. He told me that this butterfly was infallibly attracted by any excrementitious matter, and he had only to wait near a spot where such was to be found to get all the individuals he wanted.

Mr. Lewis Ullrich, of Tiffin, Ohio, wrote in August, 1881, that shortly before, he had taken some hundred and fifty good examples of *Portlandia*, and rejected many more as imperfect, in a certain piece of woods near by, and remarked that the species seemed to be confined to this particular spot, and, so far as he knew, was not to be found elsewhere in the County. Two or three years later I applied to Mr. Ullrich for specimens, and learned that the old hunting-ground had been cleared of undergrowth and cattle turned in, to the utter destruction of these butterflies.

The larvæ, like all the family, eat grasses. I first obtained one egg of *Portlandia* by confining a female on grass under a net, August 22, 1873, but it failed to hatch. Several other experiments were unsuccessful, until August 15, 1877, when I got seven eggs. These hatched on 21st, and on 27th, the larvæ began to pass the first moult; on 3d September, the second moult, on 12th, the third, and soon after, all became lethargic, and were left in a cool room for the winter. On February 17, 1878, they were brought into a warm room, and the same day were seen to be moving. On 26th February, one passed the fourth moult, and died soon after from injuries received on the way to Philadelphia, for its portrait. Meanwhile all the rest had died. That is a sample of the bad fortune which often happens in rearing butterfly larvæ, and it has not unfrequently taken me several years to get at a complete life-history of a species.

On September 5, 1881, I received twelve eggs from Mr. Ullrich. These began to hatch on 8th; on 15th the larvæ were passing first moult, on 23d, the second. On 8th October, one passed the third. The moults were irregular, several days intervening between the passage by the first and last larva of same stage. On 24th October, one passed the fourth, but died soon after; the others were in lethargy by 1st November. Early in February, 1882, these larvæ were brought into the house, and on 24th, were observed to be in motion; by 1st March all were feeding. The fourth moult was passed from 16th to 23d March; on 31st, one passed the fifth, and the last passed same on 4th April. The first chrysalis formed 13th April, and this gave imago 29th. Two that passed fifth, 5th April, pupated 20th, and the butterflies came out 4th May.

The hibernating larvæ, therefore, pass three moults in the fall, and two in spring; but it is probable that the number of moults of a summer brood is but four, as with some of the allied species.

While the larva is at rest the head is bent under so that the horns are turned forward, and the back part is in line with dorsum, as seen in Fig. *g*. When a moult takes place, as the old face is cast off, the new horns are seen folded down over the face and flattened, and it is several minutes before they begin to rise and fill out, and fully ten before they are erect. These organs are not solid, but

hollow shells merely. I noticed one larva as it was passing the second moult, and another at the fourth, and the behavior was the same in both cases. As the tails were disengaged from the old skin, they stood apart at a right angle for some time, and in about ten minutes began slowly to approach each other and get in line with the body The first movement of the larva was to turn around so as to get at and devour the cast skin. In suspension the figure is very different from N. *Gemma*, but is like N. *Sosybius*, and nearly same as in Satyrus *Alope*. (Fig. *h*.)

I have taken *Portlandia* at Coalburgh, W. Va., as early as 18th May, and fresh examples in June, July, and August. There must here be at least two annual generations, possibly three. If three, the first in May, the second middle of July, the third late in August.

This is the only species of its genus accredited to the Americas, but under the supposed synonymical name of Lethe, Marshall and De Niceville, in "The Butterflies of India," describe thirty-four species, which they divide into four groups, principally inhabiting the Eastern Himalayas and Assam. Nothing is said of the early stages of these species, and it remains to be seen from comparison of egg, larva, and pupa, whether either of the groups or any one of the species is really congeneric with Debis *Portlandia* or not. It is highly probable that they are not, and that *Portlandia* properly forms a genus by itself.

Say describes the caterpillar briefly as "downy and mucronate behind," — mucronate, in his glossary, meaning "terminating in a sharp point." Of the chrysalis he says, "It is angulated, bi-mucronate on the front," which is not a correct description, as the head case is without points or processes. Boisduval and Leconte give a fair representation of the chrysalis after Abbot, but the caterpillar is bad as can well be. The description in the text is drawn from the figure and not from nature, and it is said that the two points which surmount the head spring up in the form of ears (s'elevent en form d'oreilles), as indeed they do in the figure. The same authors copy from Abbot's unpublished figures [illegible] perhaps is the Georgia type of the butterfly, large, with very large and [illegible]ual ocelli over both wings.

Note. — Since this paper was printed I have received a letter from Mr. L. Ullrich, before mentioned, and to whom I had written to ask if he had observed the gamesome habit described by Mr. Gosse. Mr. Ullrich is an experienced collector of lepidoptera; he is also Clerk of Seneca County, Ohio, and was so engrossed by his official duties that he could find no time for an earlier reply. Hence this note. The letter says: "I do not recollect of ever seeing *Portlandia* flying antagonistically at other species, but to see them sitting on the side of a tree or stump head downward, the wings closed over the back, was a common occurrence. The many butterflies I found in 1881 — and I took hundreds of them — were all from an area of about one acre in extent, within a small piece of woods. Here was an open patch on which grew a certain kind of grass, the food of the caterpillars, and joining it was a half acre of open second-growth of hazel, maple, and other trees, from fifteen to twenty feet high. When the sun shone clear it was usual to find a score or more of *Portlandia*

about one tree, sitting on the trunk, flying up and away a few feet, and returning to same tree, apparently playing with each other. At the same time the great body of the butterflies seemed content with resting in the full sunlight on the tops of the leaves.

"Some trees seemed to have more attraction than others. I remember a certain hickory where I could always find some of the butterflies sitting on the trunk.

"Plenty as *Portlandia* was there, not one did I ever find outside this acre, not even in the piece of wood in which it was enclosed, or in any other part of Seneca County."

I also have had a few lines from Mr. Behrens, in which he asserts that the larger Chionobas of the Pacific coast have no such habit of settling on the trunks of trees, as I had conjectured might be the case from an expression in one of his old letters.

DEBIS I.

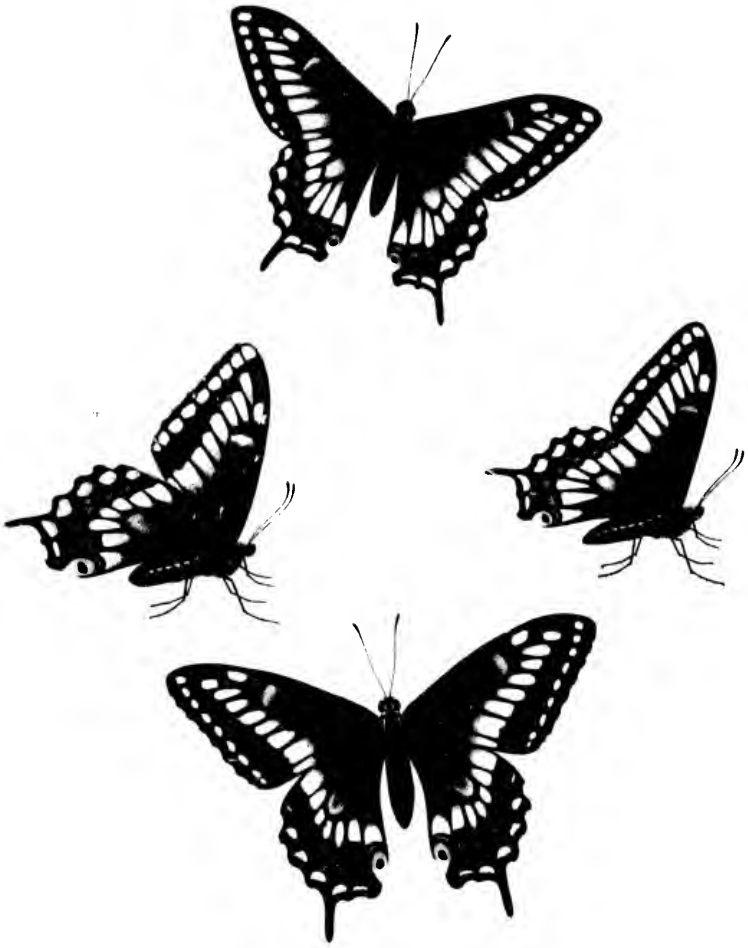
EXPLANATION OF THE PLATE.

PORTLANDIA, Figs. 1, 2 ♂, 3, 4 ♀.

a EGG, magnified.
b YOUNG LARVA, side view; b^2 back, magnified.
b^3 head; b^4 segment 2; b^5 last segment; b^6 hairs, magnified.
c Larva after 1st moult; c^2 head; c^3 dorsal view of one of the middle segments, magnified.
d Larva after 2d moult.
e Larva after 3d moult.
f Larva after 4th moult; f^2 head; f^3 middle segment; f^4 end of 13, magnified.
g MATURE LARVA after 5th moult, nat. size.
g^2 head of same, magnified.
h Larva suspended for pupation.
i i^2 i^3 CHRYSALIS.

PAPILIO.

L.



NITRA. 1 2 ♂. 3 4 ♀.

PAPILIO I.

PAPILIO NITRA, 1-4.

Papilio Nitra (Ni'-tra), Edwards, Papilio, III., p. 162. 1883.

The sexes alike in color and markings.

MALE. — Expands 3 inches.

Upper side black, spotted and banded with yellow after the manner of the *Asterias* group; the sub-marginal spots of primaries rounded next apex, the rest ovate, of secondaries semicircular, the one next inner margin sub-crescent; the common discal band composed of long separated spots, the anterior ones on primaries lanceolate, the others truncated and not definite on the basal side; an oval spot in the subcostal interspace and a crescent bar inside the arc of cell; on secondaries the band covers about one fourth the cell; the spot at anal angle yellow, on which is an orange ring about a round black spot; on the extra-discal black area loose clusters of black scales entirely across the wing.

Under side pale black, the markings repeated, pale; the extra-discal area on secondaries dusted lightly with yellow scales, and above these blue scales about a rather dense nucleus of same, particularly in the median interspaces; the anal ring deep orange-fulvous.

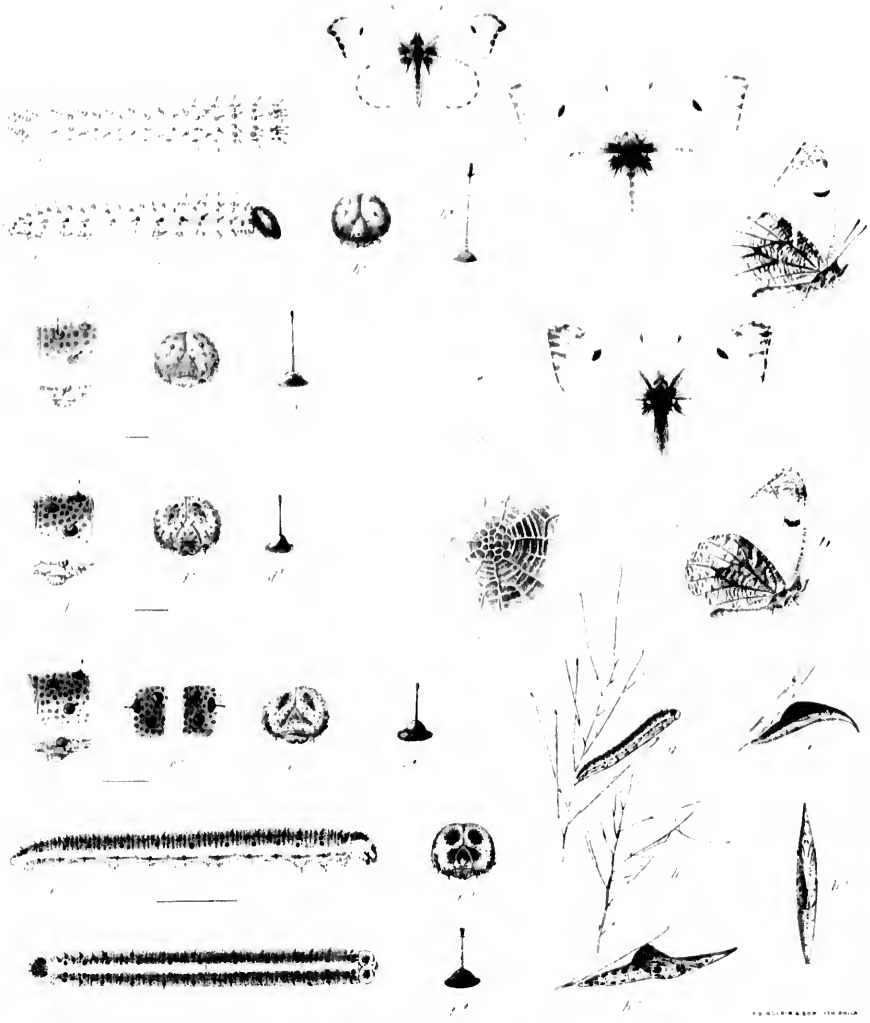
Body black, the wing-covers yellow, the abdomen showing a slight lateral stripe from base of wing to last segment; legs and palpi black; the frontal hairs black, yellow at the sides; antennæ and club black. (Figs. 1, 2.)

FEMALE. — Expands 3.3 inches.

Spotted and banded as in the male, the upper spots of discal band sub-ovate; the yellow paler; under side without orange in the interspaces except the median. (Figs. 3, 4.)

NITRA was described from a single pair taken by Wm. M. Courtis, M. E., in Judith Mountains, Montana, July, 1883. Mr. Courtis wrote me that he saw

several other examples, but took only the two, not supposing the species to be new or rare. I ventured the conjecture that *Nitra* would be found in British America, and this has happened. At different times three examples have been sent me for examination by Mr. James Fletcher, two of them taken in the Rocky Mountains, at Canmore, 26th June, 1885, on the summit, in company with P. *Zolicaon;* and the third, at Regina, N. W. Terr., by Mr. N. H. Cowdry. And Mr. Fletcher states that a fourth is in the Geddes collection, at the National Museum, Ottawa.



LANCEOLATA 1 2 ♂ 3 4 ♀. *a Chrysalis*
GENUTIA 5 ♂.

a a' Egg magnified a' 1st Larva moulting mag^d
b Larva expanding q " out size
c c' c'' 1st 2nd 3rd skin b Chrysalis "
b' Chrysalis mag^d

ANTHOCHARIS I.

ANTHOCHARIS GENUTIA, 5.

Anthocharis Genutia, Fabricius; Edwards, But. N. A., II., p. 83, pl. 17. 1878.

Egg. — Long, narrow, thickest in middle, curving moderately towards the base, which is broad and flattened, towards summit more rapidly, so that the upper half is cone-shaped; the top depressed, the micropyle surrounded by minute irregularly hexagonal cells; ribbed vertically, the number of ribs about sixteen, half of which reach the summit and curve to the depression, the others ending not much short of summit, the spaces between crossed by numerous fine ridges; color yellow-green. (Figs. *a* to a^3.) Duration of this stage about four days.

Young Larva. — Length .05 inch; cylindrical, tapering very gradually from 2 to 12, curving roundly on dorsum of 13, ending squarely; color greenish-yellow; running longitudinally are three rows of rounded tubercules on either side, from each of which proceeds a short straight hair, which tapers from the base, and is thickened at the end, the end usually covered by a globule of fluid (Fig. b^4); the tubercles are concolored with body, the hairs light; on 3 and 4 stand in cross row, sometimes with a little irregularity; after 4 to 12 in triangle, the dorsal tubercle being on the front of the segment, the sub-dorsal on the rear, and the lateral a little before the middle; on 2 the upper two are near together on the front, and corresponding with the lateral row below is a very small one, and a hair without tubercle close to and under it; there is also a third one behind and between the upper two equal to either in size; on the front of 13, the three tubercles are in triangle as with the preceding segments and at the rear is a cross row of four, the two middle ones being dorsal, the others smaller and apparently of the lateral rows; at the extreme end, on either side a small tubercle; along base a row of short hairs, two on 2, and from 5 to 12; one on 13, and on 3 and 4 one each, from a tubercle; head a little broader than 2, sub-globose, depressed at top; on each lobe three tubercles like those on body

in triangle, so placed that the bases make a cross row of four on forehead; a few smaller ones scattered about; color pale brown. (Figs. *b* to b^3.) Duration of this stage two to three days.

After first moult: length .14 inch; same shape; color light-green, or green-yellow, glossy; no dorsal or basal stripe; the tubercles present, but conical with broader bases, and disposed as before, the hairs similar but shorter; the surface is now thickly covered with little round very pale brown spots, from the centre of each a minute and very short black hair; head much as before but broader in proportion to the height, light brown, a little greenish, tuberculated as before, but more thickly, one on the front of each lobe much larger than any other; color green with a tint of brown. (Figs. *c* to c^3.) Duration of this stage two days.

After second moult: length .27 inch; color yellow-green, glossy; a yellowish mid-dorsal band begins to appear indistinctly, and a more distinct band of white along base; the tubercles present, with same arrangement, each broader at base and flattened there, a little more brown than before, the hairs similar but still shorter; the rounded spots much as at second stage, not so pale brown; head as last described, but much more tuberculated, two on each lobe being now conspicuous; color pale green with two brownish discolorations on front. (Figs. *d* to d^3.) To next moult two days.

After third moult: length .38 inch; color dull yellow-green, glossy; a yellow dorsal band not always clear, except on anterior segments, and a whitish, or yellowish-white basal band; the tubercles about as at next preceding stage, but darker, as are the spots; head still more tuberculated, all being small except the two mentioned before, and a third one over the ocelli; color of face pale green, the sides whitish, a cloudy brown patch on each lobe. (Figs. *e* to e^4.) To next moult two days.

After fourth moult: length .6 inch; in three days was full-grown.

Mature Larva. — Length .92 to .95 inch; cylindrical, slender, the head broad as 2; color dark yellow-green, glossy; under side, feet and legs lighter; a yellow mid-dorsal band from 2 to 13, a broader white band along base; upper surface furnished with six longitudinal rows of shining black tubercles, low, conical, the bases broad and flattened, each giving a short black hair or process, which tapers slightly and is thickened at end; on 3 and 4 these tubercles are arranged in straight cross row, on 2 in cross row, but the middle one on each side is a little

in advance, and an additional one behind makes a triangle with the upper pair; from 5 to front of 13 in triangle, the dorsal tubercle being on front of the segment, the sub-dorsal on rear, the lateral a little before the middle; the shield on 13 is black and on it is a large dorsal tubercle on either edge of the band, with a lesser one behind, besides two minute ones across the band at the end, in all twelve black tubercles on this segment; below shield are several white tubercles with white processes; from 3 to 13, on the lower edge of the white band, is a small black tubercle to each segment; all the cross ridges are thickly set with very fine, short black hairs, some of which, especially on the anterior segments, come from minute black tubercles, but most rise from a pale black rounded spot, without tubercle; the under side whitish, outside feet and legs yellow-green, above to the band less yellow, more green; head sub-globose, broad as high, narrowing at top, and a little depressed at suture, broad at base; color white and pale green, with a pale black patch on the forehead on either lobe, and one below, crossing the triangle; on each upper patch is a triangle of large black tubercles and on lower one two on either side the suture; many small white tubercles cover the face. (Figs. *f* to *f*⁴.) From fourth moult to pupation about five days; from laying of egg to pupation about nineteen days.

Chrysalis. — Length .72 to .78 inch; slender, the abdomen long, round, tapering to a point, the head case surmounted by a long tapering process, so that altogether the shape of the two ends is much the same; in some examples the dorsal outline is regularly arcuated as in Fig. *h;* in others the mesonotum is slightly prominent, and the outline is less regular, as at *h*²; on ventral side the thoracic segments form a prominent sub-triangular projection compressed laterally, and covered by the wing cases; color generally of a pale yellow-brown, with a reddish tint, mottled with white and darker brown about mesonotum, the process at head brown; the wing cases more or less dotted and streaked black, on abdomen a dorsal row of black dots, two to four on a segment, varying; and a sub-dorsal row of dots or points. (Figs. *h*², *h*³, much enlarged, *h* showing the natural size in outline.) The chrysalis passes the winter, and the butterfly comes forth the following spring.

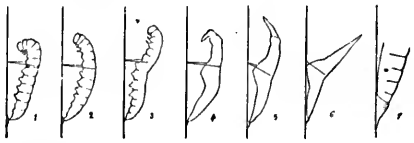
In Volume II. 1878, I gave all the particulars I had been able to learn of this species. No one was known to have bred it, and nothing was reported of its preparatory stages, except that Mr. Boll, in Texas, had seen the female laying eggs on Cardamine. Of late years, however, some of the Washington lepidopterists had become acquainted with the full history, and Mr. Henry F. Schönborn, of that city, kindly undertook, in 1886, to supply Mrs. Peart with eggs, larvæ, and food

plants, and did so, until the full set of drawings was made, sending day after day one stage or other or the plants. I myself saw none of those larvæ, but received three pupæ from Mrs. Peart which had formed about 22d May. From one of them came a male butterfly 7th March, 1887. The periods of the earlier stages of one example were thus: larva hatched 27th April; 1st moult 30th April; 2d, 4th May; 3d, 9th; 4th, 12th; pupated 22d; at Philadelphia. The plant was Sisymbrium Thaliana, described in Wood as growing among rocks and in sandy fields from Vermont to Georgia, and westward to Kentucky, with a stem 4′–12′ high.

The present year, 1888, Mr. Schönborn supplied me with eggs and plants, and I immediately found the same plant abundant close by my house. I believe, at one time or other, I had confined females *Genutia* upon every cruciferous plant in the neighborhood but the right one, and had never obtained an egg. This butterfly is rare here, however. The eggs are laid on the flower-stalks, and Mr. Schönborn writes that he has never found more than one egg on a plant, nor more than one larva. He says: "I never found a larva in open fields, although the plant grows there in abundance in large patches. I always found them on isolated plants growing in places sparingly covered by large oaks, hickories, cedars, and other trees." The young larva feeds on the flowers and buds, and as these pass away, on the seed pods, usually beginning at the end of the long, slender pod and eating towards the stem. (See Fig. *g*.) After the plant has gone to seed, Mr. Schönborn says it utterly disappears, and the larvæ never pupate on the plants, but go to the trunks of the nearest trees and there change in the cracks of the bark, or other protected places. The color of the pupa is such that on an oak it would be almost undistinguishable.

I kept my larvæ on growing plants set in a flower-pot and covered by a muslin bag kept upright by sticks, and one morning chanced on a larva in the act of pupating, almost done, while another was just about to begin. Both were attached by buttons of white silk and by girdles to the same stick. The second one at this time was curved from end to end, the head almost touching the stick. (See cut, 2.) Presently it straightened itself and a creeping movement passed from tail to head in a way to loosen the skin from the body, the larva convulsively throwing itself against the girdle, then to the support (3). These throes soon burst the skin at top, exposing the head over which the process was bent down, flattened and small (4). When the cast reached the last segment it was thrown to the ground by a rapid twisting movement of the pupa, and afterwards the same continued for nearly a minute, accompanied by a vigorous pushing downward. This double motion fixed the hooks securely in the button, which was forced into a cup shape, so that it quite sheathed the end of the segment

and afforded a firm support (7 magnified). I have not noticed this peculiarity in the shape of the button in any other species. It would be useful, considering that nearly a year must pass before the butterfly will issue. Immediately after



the skin dropped the thorax was a little prominent (4) — no indication of this had been given by the larva — and it enlarged almost imperceptibly, while the dorsum remained arched. This was the attitude up to fifteen minutes. At twenty the depth of thorax was .14 inch ; the process .1 inch long, .03 wide at base, partly raised, semi-translucent (being hollow, a thin shell), not yet rounded (5); the abdomen and all the dorsum still retained the larval colors, even to the yellow band, every tubercle and spot having its corresponding pale black spot or point; the wing cases and under side of head and the process dark brown. As the depth of the thorax increased the girdle was tightened, and the dorsum bent in; and when at thirty minutes the projection touched the stick the dorsum was bent in at an angle which fell a segment below the girdle. The pupa had thus assumed its final shape (6), the process meanwhile having straightened, and rounded, becoming .18 inch long and .06 broad at base. The depth of thorax was now .17 inch. At about twenty-four hours the pupa had assumed its final colors, losing the resemblance to the larva. Fig. 1 represents the attitude of the larva for a time before pupation began.

ANTHOCHARIS I.

ANTHOCHARIS LANCEOLATA, 1–4.

Anthocharis Lanceolata, Boisduval, Annales de la Soc. Ent. de France, 2me Ser., X. p. 284, 1852; Mead, Psyche, II. p. 183, 1878. *Edwardsii*, Behr, Trans. Am. Ent. Soc., II. p. 304, 1869.

MALE. — Expands 1.4 to 1.8 inch.

Upper side white, the apical and upper marginal nervules of primaries edged with brown scales; on the arc of cell a sub-oval or crescent black spot; the bases of wings dusted black; fringes white, on primaries brown at ends of nervules.

Under side white, the apical area finely streaked across the interspaces with brown; the discal spot crescent. Secondaries streaked over whole surface with gray-brown, green-tinted, most densely on costal area, lightly over the outer third of wing; near outer angle an oblique pure white band from costal edge to cell.

Body covered with gray hairs beneath, the thorax white, abdomen yellowish; palpi white, the front hairs brown at end; antennæ whitish, club gray-black, yellow at tip. (Figs. 1, 2.)

FEMALE. — Expands 1.7 to 1.9 inch.

Similar to the male; the nervules more widely edged brown, forming long serrations from the margin; across the sub-costal interspaces a loose band of same color. (Figs. 3, 4.)

MATURE LARVA. — "Length 1.25 inch; body rather elongated, tapering somewhat posteriorly from the sixth segment; upper side apple-green, shading off laterally into pale blue, which is bounded by a distinct bright yellow line just above the spiracles; next this line is a slightly broader one of pure white; under side and legs apple-green, the former bluish along middle; each segment is covered with fine black points arranged in transverse rows" (that is, on the cross ridges of the segments); "on each also are six minute black tubercles, each with fine black bristle, arranged in triangle; head rounded, pale green,

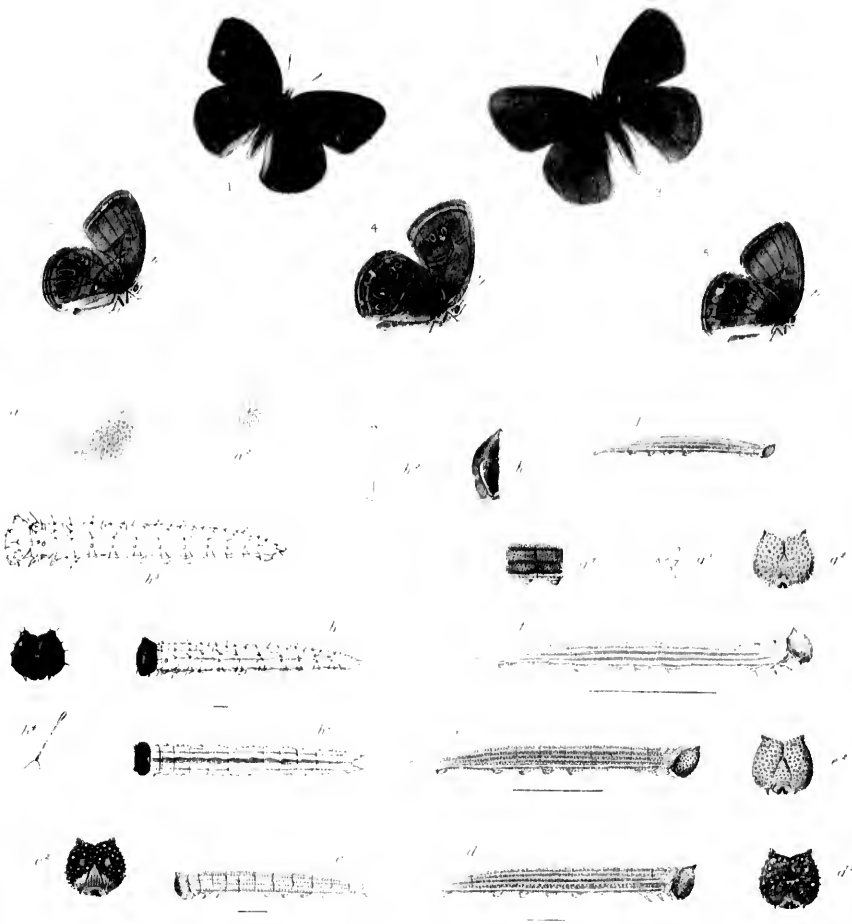
thickly dotted with black." (Mead, Psyche, II. 183, 1878.) The tubercles without doubt are disposed in same way as in *Genutia*, in straight cross rows on 2–4, in triangle after. Mr. Mead was of the opinion, when the above was written, that this larva was *Lanceolata*. He says: "At different times during June, I found, in the Yo Semite Valley, a few caterpillars which I feel certain are those of A. *Lanceolata*." He describes their chrysalids as having "the long palpi case bent around backward into a sickle shape," and this identifies the species. No other Californian Anthocharis has that shape of the chrysalis, and I believe the chrysalids of all except one very rare species are now known. Those bred by Mr. Mead died during the winter, he informs me.

CHRYSALIS. — Length about one inch; slender, the abdomen tapering to a point, the head case surmounted by a long tapering process, which in all examples observed is much recurved; on ventral side the thoracic segments form a prominent rounded projection, compressed laterally and covered by the wing cases; color brownish-yellow, immaculate. (Fig. *x*.)

LANCEOLATA flies in the hills of Marin, Sonoma, and other Counties in northern California. Mr. O. T. Baron found it most abundant in Shasta County. He also took examples near Summit, July 6, 1888, the elevation being 8000 feet. At Bear Valley, altitude 4000 feet, he took a female while ovipositing on Arabis perfoliata. Mr. Baron tells me that ten years ago he took this species in Mendocino County early in April, and in Shasta County, at elevation of only 3000 feet, at the end of June, and he believes it to be double-brooded. That is the more probable, as several other of the Pacific species of this genus are known to be double-brooded, as *Hyantis*, *Ausonides*, and *Reakirtii*, *Sara* being the second brood of the latter. The late Mr. H. K. Morrison brought examples of *Lanceolata* from Nevada, and it has appeared in collections from Arizona, but I am unable to give the localities in either region.

NEONYMPHA.

II.



AREOLATUS ♂ 1 2 ♂ 3 4 ♀ 5 VAR. ♀.

a Egg *magnified* *c 1st Larva 1st to 4th moults mag^d*
b Larva *young* *d Larva mature nat size*
b Chrysalis

NEONYMPHA II.

NEONYMPHA AREOLATUS, 1-5.

Neonympha Areolatus, Abbot and Smith, Insects of Georgia, I. pl. 13, 1797; Boisduval and Leconte, Lepid. de l'Amer., pl. 63, 1833; Edwards, Can. Ent., XIV. p. 163, 1882.

MALE. — Upper side brown, immaculate; fringes concolored. Under side paler, with a gray tint; hind margins edged by a common ferruginous stripe, a little before which is a second, narrower on primaries, often broader on secondaries; on the basal areas two such stripes, not always reaching costa of primaries, nearly parallel, the outer one somewhat sinuous; this outer stripe on secondaries unites at the angles with the second marginal one, and forms an irregular oval ring, within which, in each interspace from the upper discoidal to submedian inclusive, is a sub-oval, mostly long and narrow, dark brown spot in yellow ring, and dotted with metallic bluish points or minute clusters of scales; there is much variation in these spots; the upper one is small and sometimes wanting, and the lower one, or fifth, is much smaller than either of the other three. Occasionally there is a sub-oval ring on primaries also, enclosing one or two small ocelli in the middle interspaces.

Body above, color of wings; beneath, the thorax gray-yellow, abdomen gray-brown; legs brown; palpi buff, with dark brown hairs in front and at tips; antennæ dark above, buff below, club ferruginous. (Figs. 1, 2.) Fig. 5 represents a variety of the male on which the bands of secondaries are diffused.

FEMALE. — Expands 1.7 inch.

Both sides colored and in general banded and spotted as the male, but often the oval ring on primaries and the small spots are present. (Figs. 3, 4.)

EGG. — Sub-globular, as high as broad, the base flattened; surface under a low power smooth, but under a high one seen to be reticulated in irregular shallowly excavated hexagons; the micropyle in centre of a rosette of minute cells, five-sided; color pale yellow-green. (Figs. *a*, a^2.) Duration of this stage about six days.

YOUNG LARVA. — Length .12 inch; cylindrical, the thoracic segments equal, then tapering on dorsum and sides to 13, which ends in two short conical tails, from the end of each of which proceeds a long bristle, the space between the tails angular; color delicate green; the upper surface presents six rows of low, conical black tubercles (Fig. b^1), each giving out a short black bristle or process, thickened at the end; on 2, 3, 4, these are nearly in cross line, on 4 to 12 in triangle, the dorsal one on front of the segment, the sub-dorsal at the rear, the lateral a little before the middle; on 13 there are eight, in two rows of four on front and rear, besides the pair at ends of tails; on 2 the cross line is to the front, and behind and between the upper pair is an additional one; also in front of spiracle is a small tubercle, and just below it a fine hair; along base of body is a row of fine short hairs, two on each segment from 2 to 13; feet and pro-legs green; head about twice as broad as 2, sub-globose, flattened frontally, a slight angular depression at top; on each vertex a low semi-ovoid process, at the top giving two divergent black hairs; just below vertex is a similar smaller process, and two others in vertical line at side face, each of these with a single hair; color black. (Figs. b to b^5.) Towards the end of the stage the color changes to decided green and several longitudinal stripes appear; on either side of the green mid-dorsal one is a whitish stripe, and others on middle of side, and along base. (Figs. b, b^2.) Duration of this stage about eight days, but depending on the weather.

After first moult: length .22 inch; slender, the dorsum slightly arched, the tails longer, tapering; color of body green, the tails tinted red; surface thickly covered with fine yellow tubercular points, partly arranged in longitudinal rows, ten in all, one on either side being next the mid-dorsal green stripe, one sub-dorsal, two on side, one along base, each point giving a fine short whitish hair; under side, feet and legs green; head rather ovoidal, truncated, and depressed at top; on each vertex a low compound process, made of a central cone, and others about its base, each with its bristle; surface of face rough with sharp tubercles of varying size, each with short bristle; color of back of head and the front triangle deep green; the rest of the front and the processes on vertices red-brown, with two green patches one on either side the suture; ocelli emerald-green. (Figs. c, c^2.) But some larvæ have the head wholly green, the vertex processes reddish; one had a brown band across forehead, the rest green; another had the front face except the triangle brown, the cheeks green. To next moult about nine days.

After second moult: length .3 inch; shape as before; color yellow-green; stripes as before; head as at last previous stage, sometimes wholly green, some-

times partly brown; one example had one cheek brown, the other green. (Figs. *d*, d^2.) To next moult about seven days.

After third moult: length .7 inch; color yellow-green. (Figs. *e*, e^2.) In all examples bred by myself this was the closing stage. But Mrs. Peart carried one larva to fourth moult, the length then .96 inch. (Fig. *f*.)

Mature Larva (whether after third or fourth moult). — Length 1.1 to 1.3 inch; slender, the dorsum well arched, the slope either way from middle equal; tails slender, conical, divergent; color yellow-green; the surface covered with fine sharp tubercles, most dense in certain longitudinal rows, one of which is on either side of the mid-dorsal dark green stripe, one sub-dorsal running from head to end of tail, two on the side, and a broad one along base; tails reddish; under side, feet and legs green; head obovoidal, truncated, the top depressed angularly; on each vertex a small conical process about the slope of which are several minute tubercles, each giving a short bristle; surface rough with fine green tubercles among which are scattered a few white; ocelli emerald-green. (Figs. *g* to g^4.) The attitude in suspension is that of figure 6, quite unlike that of N. *Gemma*, before described.

Chrysalis. — Length ♂ .48 inch, breadth at both mesonotum and abdomen .18 inch; ♀ (probably) .54 inch, breadth .2 inch; cylindrical, abdomen conical; the wing cases a little raised on dorsal side; head case very short, scarcely projecting beyond mesonotum, bevelled transversely to a sharp edge, roundly excavated at the sides, the top very little incurved; mesonotum rounded, carinated, the sides flat or a little excavated; color green, the edges of carina, wing cases and top of head cream color; surface much covered with dots and small patches of whitish, not distinct enough to affect the general green hue. Duration of this stage about ten days, in summer. The late larvæ doubtless hibernate when half grown.

Areolatus, so far as at present known, is restricted to the Gulf States, and part of Tennessee, and to the southern Atlantic States. A few examples have been taken as far north as Atlantic City, New Jersey. Mr. E. M. Aaron has found the species among the mountains of east Tennessee, and probably it would fly in west North Carolina also. It is difficult to get information about the localities of butterflies from the southern States, so few persons are interested in such matters. Its habits are similar to those of its near ally, *Gemma*. I have never seen it on the wing.

I have had greater difficulty in bringing larvæ of *Areolatus* to pupation than almost any species of the genus I have experimented with. For several years I

fed them on lawn grass, which nearly every Satyrid larva in my hands has eaten readily. The eggs of this species in nature are laid on coarse grasses, and at last I found that by selecting one such — Dactyloctenium Ægyptiacum — I did better. The first eggs received came 17th August, 1877, from south Georgia, some twenty, and were hatching on arrival. Part of the larvæ got through two moults, but by 30th September all had died.

In 1881, I received three young larvæ from Dr. Wittfeld, Indian River, Florida, but all died before first moult.

In 1882, 30 to 40 eggs came, 12th May, from Mr. J. Elwyn Bates, Florida. On 29th May, two passed first moult; on 30th, of four which endeavored to pass second but one got through, the others dying during the process. By 4th June, there remained eight larvæ in second stage. On 15th, the sole survivor passed second moult, and I sent it to Mrs. Peart, at Philadelphia. This larva passed third moult July 3d, the fourth July 15th, and pupated 28th. This chrysalis died, but was probably female, measuring .54 inch in length against .48, one which produced a male.

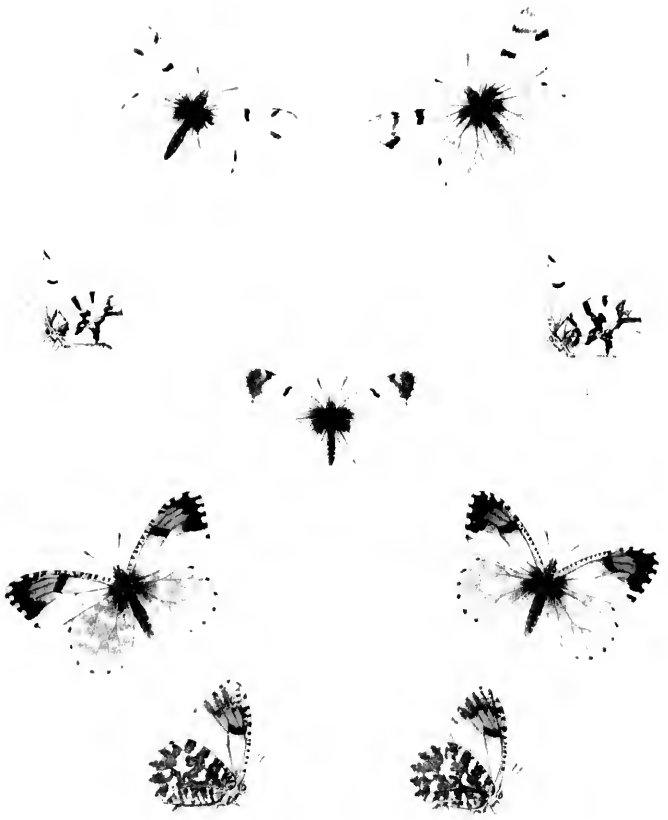
The same year I received from Dr. Wittfeld a dozen larvæ in first stage. These I fed on the coarse grass as before said. The first moult was passed 20th July, the second 29th, the third 5th August, and two larvæ pupated 17th August, another 20th. The last of these gave a male butterfly 30th August. Dr. Wittfeld has written me that this species moulted but three times.

Kirby's Catalogue, 1871, calls *Areolatus* a variety of *Phocion*, Fabricius. In the same way N. *Gemma* is there put as a synonym of *Cornelius*, Fabr. The descriptions in both cases are insufficient of themselves to determine what species were meant, and may be applicable to a dozen as well as to those under view, and there are no figures to serve as guide. As regards *Gemma*, I believe it is generally agreed among lepidopterists to begin the history with Hübner's figures and name. As to *Phocion*, as described, it is quite another thing from *Areolatus*. In Sp. Ins. II. p. 138, 1781, the text translated from the Latin reads: "Wings above fuscous, immaculate; hind wings beneath with yellow (flavis) stripes and three oblong ocelli. Habitat ————————" (that is, unknown); "fore wings beneath fuscous, immaculate; hind wings with four yellow (flavis) stripes, whereof the second and third unite at either end, and between them are three much elongated black spots in yellow (flava) rings, and with many silver (argenteis) points."

The bands of *Phocion* are yellow, and the same word is used as for the yellow rings of the spots; the spots or ocelli are three in number; the points on the spots

are silver; and the under side of fore wings is immaculate. Whereas in *Areolatus* the bands are ferruginous, while the rings are yellow, the ocelli are five, the points are metallic blue, and the fore wings are not immaculate, but crossed by the pair of common ferruginous bands, and ocelli are often present. In the female there is an increase in the number of bands on fore wing, and ocelli are present. And whether *Phocion* came from Asia, Africa, or America, was unknown. Abbot figured *Areolatus* ninety-one years ago (1797), and Boisduval and Leconte again in 1833. As *Areolatus* the species has been known to this day. In any case, very much less than ninety years of possession, especially when the title begins with an undoubted description or reliable figure, is sufficient against all claimants. To surrender in favor of a doubtful or forgotten name, accompanied by an inapplicable description, and with no locality, is not to be thought of. I reject *Phocion*, therefore, and have no idea that *Areolatus* is a variety of what Fabricius had in view, or that one name is a synonym of the other.

ANTHOCHARIS.
II.



ROSA 1 2 ♂ 3 4 ♀. OLYMPIA 5 ♂
PIMA 6 7 ♂ 8 9 ♀

ANTHOCHARIS II.

ANTHOCHARIS ROSA, 1–4.

Anthocharis Rosa, Edwards, Papilio, II, p. 45. 1882.

MALE. — Expands 1.2 inch.

Upper side of both wings pure white, the bases pale black; costal margin of primaries sometimes immaculate, sometimes much streaked with black; near apex a short straight black bar, turned back obliquely, another bar at the end of upper median nervule; the apical area between these almost immaculate, a few scattered black scales only lying near costa; on the arc a narrow black bar, bent or a little sinuous.

Secondaries of thinner texture, discovering the markings of under side; fringes black at the ends of the two sub-costal nervules, otherwise white, as also on primaries.

Under side white, with a pink tint over costa of primaries and all of secondaries anterior to the sub-costal nervure, deepest next base; the bar on costa repeated, much reduced, the black scales largely replaced by yellow; the bar on hind margin suppressed, but indicated by a patch of yellow; the upper sub-costal nervules yellow, and at the end of each a black streak running with the edge of costa; the discal bar much reduced, paler, and cut by the yellow arc.

Secondaries have three cross bands of luteous-yellow, densely covered with black scales, with some open spaces or patches showing clearly the yellow ground; the anterior band narrow, making a circle about base not always complete; the second, or discal, sends a short stout branch along median to the third, and is attenuated on inner margin; the third has a triple fork on hind margin, is very narrow in middle, and broad on inner margin; at outer angle a wedge-shaped bar; the nervures and branches on middle of the wing yellow.

Body covered with long light-gray hairs, the abdomen gray-white, beneath, the thorax with white hairs, at the sides yellow, abdomen white, faintly tinted yellow; legs pinkish, the femora clothed with long white hairs; palpi white, with

pale gray hairs at top and sides; antennæ white above, yellowish below; club white above, yellow below and at tip. (Figs. 1, 2.)

FEMALE. — Expands 1.4 inches.

Color of male on both surfaces, and similarly marked; between the ends of the apical bars are black scales in considerable number, suggesting a cross band, and next apex are more such scales than in male. (Figs. 3, 4.)

ROSA was described from 3 ♂ 3 ♀, sent me by the late Jacob Boll, and taken by him on one of his expeditions to the extreme west of Texas, in 1878. He informed me, in answer to inquiry, that he took several more, and all were of the same type, particularly having reference to the markings about the apices of fore wings. The species is very near to *Olympia*, figured in Vol. II of this work. In *Rosa* the apical area is immaculate in the male, except for a few loose scales next costal margin, a little distance from the apex. In the female there are somewhat more of these scales, and a nebulous connection of the two marginal bars. (In the Plate, Fig. 3, this last feature is a little too pronounced, the flecking in the insect being no heavier in this than next the apex.)

The first known examples of *Olympia*, 1 ♂ 1 ♀, were taken at Coalburgh, W. Va., April, 1871. The description soon after published in Transactions of the American Entomological Society, III, p. 266, mentions "a large gray patch at apex, partly replaced by white," — that is, a gray patch with one or more interior spots or patches of white. Nothing is said of a definite bar on either margin. In the insects, which are now before me, the inner edges of the gray patch are somewhat blacker than the rest, especially next the margins, but there is nothing of a definite bar. The description in Volume II was rewritten, and gives the apex as covered by a gray sub-triangular patch, "terminating on either margin in a small spot of darker color;" and the figure of the male accompanying shows a pale patch filling the apical area limited on the margins by spots or clusters of scales of darker color.

Since 1871, *Olympia* has been taken in all the States lying west of West Virginia, to Nebraska, and in Colorado. The species seems particularly abundant at Whiting's, Lake County, Indiana, and I have seen many from that locality. One of these is represented in Fig. 5, and all the Indiana examples which I have seen have been near to this, showing a patch of solid pale black with a small white interior patch next costa in the direction of the base.

In both the descriptions of *Olympia* spoken of, I mentioned a single male as being in the Museum of Comparative Anatomy, at Cambridge, Mass., also from Texas, and by Mr. Boll. This was taken at Dallas, and I considered it to be the

same as *Olympia*. I have recently asked Mr. S. H. Scudder to look at this insect and compare with the figure of *Rosa*. He replies: "It is almost precisely like your Fig. 1, with the sole exception of the position of the dusky flecks at the extreme tip of the wing, those in Figs. 1 and 3 showing a little bar parallel to the one within, while these were at the very apex itself." From which the Dallas example would seem to be *Rosa*.

It may be that these are properly but forms of one species, *Olympia* the northern, *Rosa* the southern form. As yet not much is known about either, and of *Rosa* nothing but what I have given above. Doubtless they are common in many localities, but flying at the same time with the white Pierids, they are unobserved.

ANTHOCHARIS II.

ANTHOCHARIS PIMA, 6–9.

Anthocharis Pima (pee'ma), Edwards, Canadian Entomologist, XX, p. 158. 1888.

MALE. — Expands 1.75 inch.

Upper side of both wings yellow, the bases pale black; primaries have the basal half of costa white, crossed by irregular black streaks; the apex edged white on both margins, and within this is a series of five large, elongated black spots, almost confluent, filling the interspaces to second median nervule, each projecting a spur to the margin; on the arc a broad, rectangular bar, the area between this and the spots and costal edge intense orange.

Secondaries of thinner texture, discovering the markings of under surface; fringes whitish, a few black hairs at the end of each nervule on secondaries, and many on primaries.

Under side of primaries yellow, the costal margin as above, the apex white, green-tinted, the lower three black spots of upper side indicated by yellow-green, and finely dusted black, the bar repeated, the orange also, but paler and diffused over cell and second median interspace.

Secondaries yellow-white, largely covered by broad patches of yellow-green, which form four irregular, connected, transverse bands between hind margin and base above median nervure; below median to inner margin crossed by stripes of similar color, unequal, mostly wedge-shaped.

Body covered with long gray hairs, which are yellowish at extremity, the abdomen yellow-gray; beneath, the thorax white, abdomen yellow-white; the femora white, other joints buff; palpi white, black at tip, and with black hairs at sides; antennæ imperfectly annulated white and black above, white below; club black above, orange beneath and at tip. (Figs. 6, 7.)

FEMALE. — Expands 1.7 inch.

Same yellow as male; the apical spots larger and completely confluent, the

orange narrower, paler, the bar less rectangular, broadest on sub-costal; under side as in the male. (Figs. 8, 9.)

Four examples of this species, 2 ♂, 2 ♀, were taken early in April, 1888, by Oscar T. Baron, in Arizona, Pima County, on the barren plains between Pontano and Tucson. It is the only known American Anthocharis in which both sexes are yellow.

EREBIA II.

EREBIA FASCIATA, 1–3.

Erebia Fasciata, Butler, Catalogue of Satyridæ in British Museum, p. 92, pl. 2, Fig. 8. 1868. Edwards, in Report on the Diurn. Lepˢ. collected in Alaska, by E. W. Nelson. Washington, 1887.

Male. — Expands 2.2 inches.

Upper side black, immaculate; fringes concolored. Under side of primaries brown, with a tint of ferruginous over cell; on the extra-discal area a broad ferruginous transverse band from costa to middle of sub-median interspace, both edges crenated; on the costal margin the color of this band is less distinct, rather passing into brown; the discal area, lying between the band and the pale base, takes the shape of a band common with that of secondaries, but very pale; apical area dusted gray.

Secondaries have at base from costa to middle of cell an obscure gray space, the rest of basal area blackish-brown and confluent with a broad discal band of same color which crosses the entire wing, its outer edge irregularly crenated; beyond this a dark gray narrower band, gray scales on brown ground, the outer edge also irregularly crenated; the margin bordered by brown, slightly dusted gray.

Body black-brown throughout; legs brown; palpi black-brown; antennæ black above, gray below; club black above and (apparently so) on under side. (Figs. 1, 2.)

Female. — Expands from 1.9 to 2.2 inches

Upper side paler brown; the discal area of primaries dull ferruginous over the median and half of sub-median interspaces and lower outer part of cell, nearly as in *Discoidalis*. Under side of primaries very pale ferruginous, the discal band distinct, the apical and costal area to cell hoary. Secondaries have the whole basal area dark cinereous, the discal band blackish, the band beyond whitish-

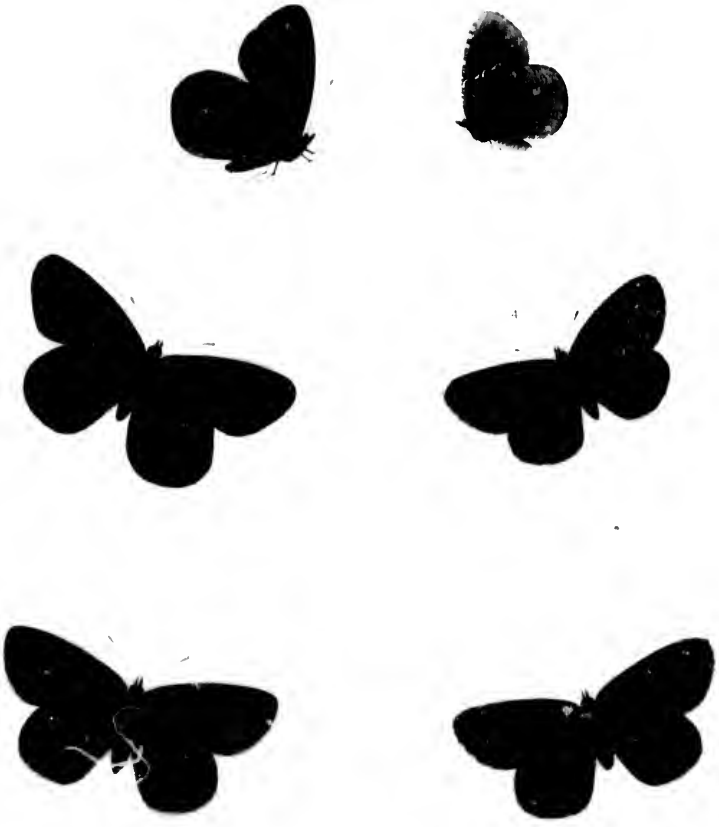
cinereous, the border brown, the exterior part hoary. Antennæ whitish above, ferruginous below, club black above, ferruginous below. (Fig. 3.)

Another female, from Kotzebue Sound, shows a narrow dull ferruginous band above, corresponding to the extra-discal band beneath; on the under side the red is nearly lost, a mere tint; on secondaries the similar band is much narrower than in the male, and the marginal border is proportionately broader, dark gray except a black stripe along its anterior edge; antennæ as in the other female.

Mr. Butler described this species from nine examples, giving "Arctic America" as the locality. He speaks of the antennæ as varying, "black, rarely ferruginous." As I have said above, the antennæ of the single male examined are black, of the two females gray and ferruginous. Mr. Butler sent me two of the Museum examples, by authority of the Trustees, many years ago, and from those the figures on the Plate have been drawn.

The second female is smaller, and shows some variation from the type. Was taken by Mr. E. W. Nelson, at Kotzebue Sound, 14 July, 1881, caught, as he says, in his hat. As Mr. Nelson reports butterflies to have been numerous in that region, *Fasciata* is probably a common species there. I have never seen it in other collections. The resemblance of the upper side of the male *Fasciata* to *Magdalena* is evident.

EREBIA.



FASCIATA 1 2 ♂ 3 ♀

DISCOIDALIS 4 5 ♂ 6 ♀

EREBIA II.

EREBIA DISCOIDALIS, 4–6.

Erebia Discoidalis, Kirby, ♂, Fauna Boreali-Americana, IV, p. 298, pl. 3, figs. 2, 3. 1837.

Male. — Expands 1.8 inch.

Upper side dark brown; primaries have a large castaneous patch, which covers half the sub-median and all the median interspaces, as well as lower outer part of cell; costa next base freckled gray and brown, towards apex two or three small gray patches; secondaries immaculate; fringes gray, on primaries brown at ends of nervules.

Under side of primaries brown, the castaneous patch repeated; some examples have this patch diffused so that nearly the whole wing is red; over the hind margin a gray bloom, which becomes strong next apex; the whole costa mottled brown and gray-white; secondaries brown over basal half, mottled and streaked in light and dark, beyond to margin gray, with many transverse brown streaks interiorly; at outer angle a gray-white patch, a smaller one a little nearer base, another on the inner edge of the gray area in discoidal interspace.

Body brown, the abdomen underneath gray; the fore legs brown, the femora of the middle and hinder pair brown, other joints yellow-brown; palpi brown; antennæ imperfectly annulated red and gray, gray beneath; club brown, ferruginous below. (Figs. 4, 5.)

Female. — Expands 2 inches.

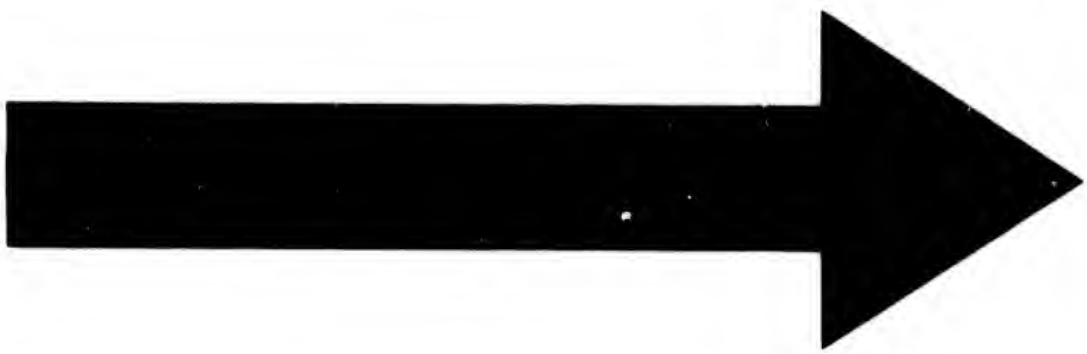
Similar to the male. (Fig. 6.)

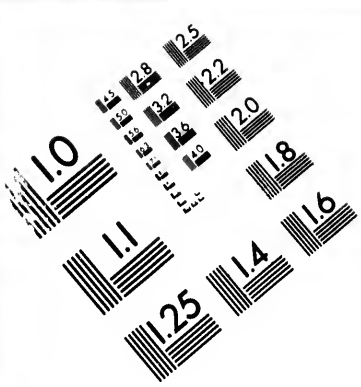
Discoidalis was described by Kirby from Cumberland House, lat. 54°, several specimens having been taken. In 1863, I received perhaps twenty examples from Mrs. Christina Ross, wife of Bernard C. Ross, Hudson Bay Company agent at Fort Simpson, Mackenzies River, and I do not remember having seen the species since, though many collections on both the west and east coast of America have been submitted to me. Mr. James Fletcher tells me that but a single example has been brought in by the late Canadian Government Expeditions, and that was from Fort Simpson.

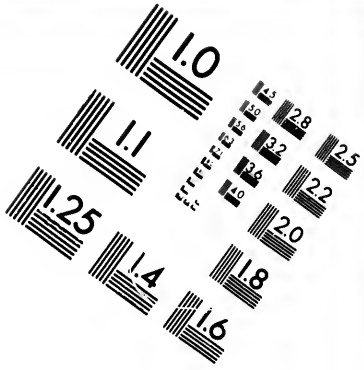
CHEIROCHELUS.

L.

TRITONIA 1 2 ♂ 3 4 ♀.







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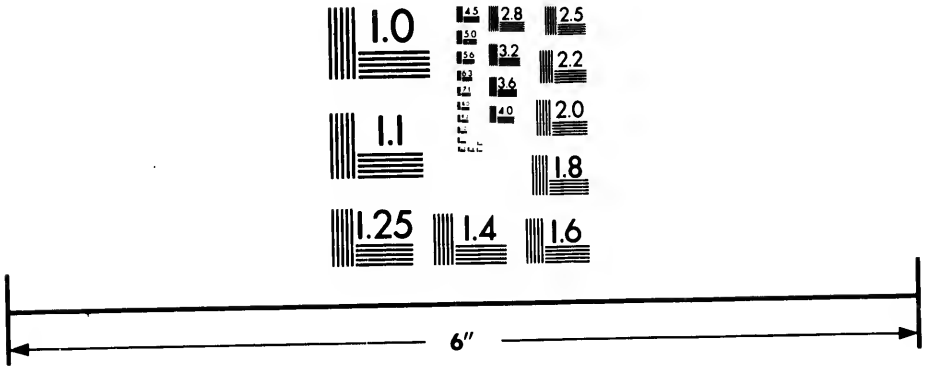

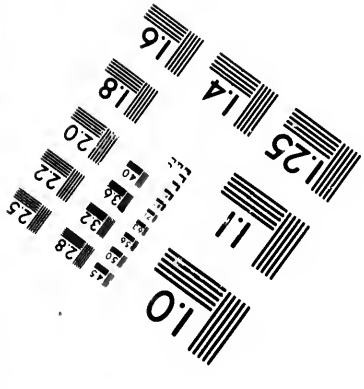

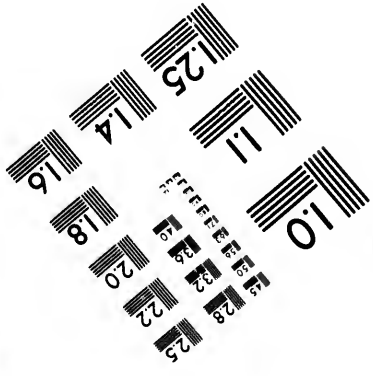

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GEIROCHEILUS I.

GEIROCHEILUS TRITONIA, 1-4.

Geirocheilus Tritonia, Edwards, ♂, Trans. Am. Ent. Soc., V, p. 18. 1874.

MALE. — Expands 2 to 2.3 inches.

Upper side velvety blackish-brown, changing to brown on hind margin of primaries, with an olivaceous tint at apex; costal edge of primaries near apex yellow-white; beyond disk a transverse row of four small white spots set in the middle of the discoidal and median interspaces, the lower one smallest and sometimes wanting; secondaries have a broad dull ferruginous marginal band, running from outer to inner angle, sometimes ending abruptly at lower sub-costal nervule; this band encloses next the margin a series of broad crenations of darker color, the interior of each paler than the edges; on the basal side of the band, and a little within, some examples show two or three white points in the middle interspaces, one to each; fringes of primaries black at the tips of the nervules, yellow-white in the interspaces, of secondaries nearly all black, or brown-black, there being but a few light hairs in each interspace.

Under side smoky-brown; the white spots repeated, enlarged, each forming the pupil of a large rounded black ocellus; secondaries have the band repeated, but the red is brighter and variegated with lilac in nebulous clusters in and next the nervules mostly, and over the posterior half are scattered yellow scales; in the sub-costal interspaces the red is mostly suppressed, and ground is nearly brown; on the basal edge of the band, upon clear red spaces, is a row of yellow points and spots, commencing with a point on the lower sub-costal interspace, and ending at sub-median nervure, just before which are two points. The three spots in the median interspaces are crescent or V-shaped, varying in individuals; the crenations repeated, edged on the basal side by brown, ferruginous elsewhere, and more or less dusted yellow.

Body black-brown, beneath same, abdomen gray-brown; legs brown on upper side, all the joints whitish beneath, the last joint of the front pair entirely white,

a little dusky on upper side; palpi whitish, the long hairs in front and at tip brown; antennæ brown, grayish towards end, gray below, club yellow. (Figs. 1, 2.)

FEMALE. — Expands from 2 to 2.3 inch.
Similar in color and markings to the male. (Figs. 3, 4.)

TRITONIA was first made known by Mr. H. W. Henshaw, of the Wheeler Expedition, 1873, a few examples having been taken among the White Mountains of Arizona. Later, I received others from near Prescott, Arizona. Neither Mr. Morrison nor Mr. Doll, in their collecting trips to that region, fell in with this species, nor was it seen by Mr. Wright or Mr. Baron. It probably is confined to special localities. Of its habits I know nothing, but Mr. Baron writes me of the allied species, G. *Patrobas*, which he took in Mexico, that it flies at an elevation of 6,000 feet, among pine and oak timber, and a thick growth of coarse grass. Its habits may be similar to those of Satyrus *Pegala*, in south Georgia.

These two species constitute the genus. I have a pair of *Patrobas*, sent by Mr. Baron. It is a considerably larger insect than the other, in general similarly marked. The white spots are smaller, the crenated marginal band much wider, occupying fully one half the whole ferruginous area, the ocelli below and their pupils are larger; on the fore wings there is a lilaceous sub-apical nebula, not found in the other; on hind wings the variegated area is narrower, more red, less lilac, and becomes obsolescent on the upper half or third to costa; and the spots of the yellow series are smaller and more regular.

PAPILIONIDAE, 1.♂ 3.4♀

PAPILIO II.

PAPILIO PILUMNUS, 1–4.

Papilio Pilumnus, Boisduval, Spec. Gen., I, p. 340. 1836; Ménétriés, Cat. Mus. Petr., II, p. 110, pl. 7, fig. 2. 1857; Mead, Report on Diur. Lep. of Wheeler Expedns., p. 741. 1875; Strecker, Lep., p. 13. pl. 2, figs. 3, 4, ♂. 1873.

Size and general form of *Daunus;* secondaries with three tails.

MALE. — Expands from 3.8 to 4.25 inches.

Upper side either bright yellow or dark yellow, banded with black much after the pattern of *Daunus*, but there is one band less on primaries; the bands, except the marginal, are also much heavier; costa of primaries black, the space between the nerves mostly yellow; a narrow band covers the bases of wings and the inner margin of secondaries, widening gradually from the median nervure, and ending squarely a little above the marginal band; a second proceeds from costa against the middle of the cell, is broad at first, tapers very gradually on primaries, rapidly on secondaries, and ends evenly with the inner band, the two being connected by a narrow stripe; the third lies on arc of cell, and has a more or less macular extension to the lower median nervule; the fourth is short, and lies across the subcostal nervules to the discoidal; hind margins bordered by a broad band as in *Daunus*, within which, on primaries, is a narrow stripe of yellow, divided into spots by the nervules, and near the inner edge a macular line of yellow scales; on secondaries are five lunate submarginal yellow spots, the two posterior ones washed with red-brown; above the angle the margin is excised and edged with red-brown; above this, and also in the next interspace, is a cluster of metallic blue scales, under which, in the outer interspace, are separated scales both blue and yellow; in the second median interspace is a large loose cluster of yellow, with a few blue at top, and some individuals have small clusters of blue to the costal margin; some also have a yellow streak or small spot in the uppermost interspace in this same line; the exterior tail is long and narrow, the tip pointed, somewhat convex on the outer side, edged yellow on that side near tip and on all the inner side, the yellow more or less washed red-

brown; the other tails are entirely black, rounded at end; the lengths of the three are about as 63; 30; 22; fringes of primaries yellow, of secondaries same in the emarginations, the rest black.

Under side yellow, the black markings repeated, paler; the submarginal yellow stripe broader, and now a continuous band; the line of scales more definite; the interior of the second band yellowish-black through its length; the spots on secondaries much enlarged, all washed red-brown; above each the ground is dusted yellow, with increasing density towards the top, and the series ends in an elongated narrow metallic blue spot, above which the clear black ground shows in a small lunation; the yellow on disk next the marginal band in the median and submedian interspaces washed red-brown.

Body above black, a yellow stripe passing along thorax from head to insertion of wings; beneath, thorax yellow; abdomen yellow, with a ventral black band and lateral line; legs black; palpi yellow; antennæ and club black. (Figs. 1, 2.)

Female. — Expands 4 to 4.5 inches.

Like the male, the red-brown on upper side darker. (Figs. 3, 4.)

Nothing is known of the early stages of this species, nor of the food plant, but probably the larvæ feed on plum, cherry, and, in general, the same plants as *Daunus*.

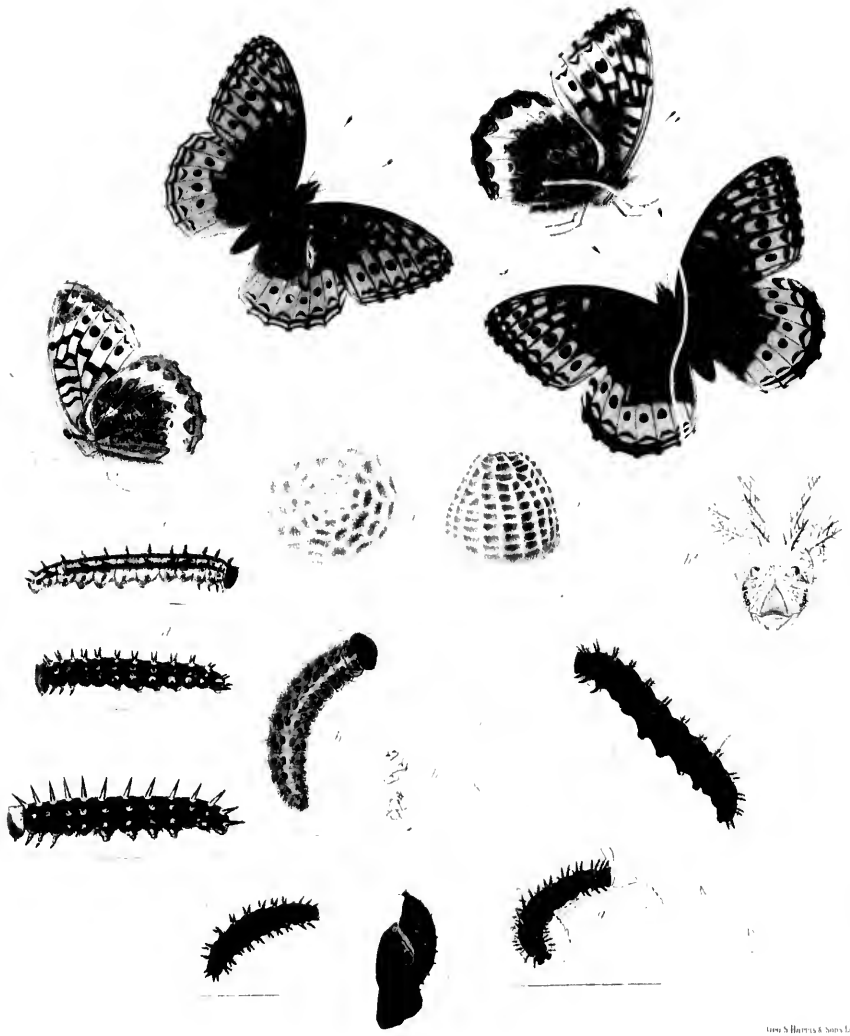
One or two examples of Pilumnus were brought from New Mexico by the Wheeler Expedition of 1871, as Mr. Mead relates. But what the locality was is forgotten. And the late Mr. H. K. Morrison took one male in Arizona, in 1882, on Graham Mountain, as is believed. I know of no other instance in which the species has been taken within the United States. Its home is in Mexico and Central America. Hearing that Professor Edward T. Owen of Madison, Wisconsin, had seen *Pilumnus* in Mexico and captured many examples, I wrote him for what information he could give me, and his reply was as follows: "My experience with Papilio Pilumnus is limited to the region about Jalapa, in the state of Vera Cruz. Some years ago, I took several, mainly at the summit of a sharp hill of two or three hundred feet elevation above the surrounding country. This summit, during the months of February and March, was a trysting place for quite a number of species of butterflies. They seemed possessed with an instinct for mounting, and on reaching this hill would rise along its slope to the summit. Once there, they circled about till the end of the entomological day. Most species showed

such fondness for the place that they might be relied on to return even if frightened off by an unsuccessful stroke of the net; *Pilumnus*, however, showed more discretion, and once missed by the net, took permanent leave. While watching a beautiful male, as he flitted round the regular course which each species under such circumstances quickly adopts, it occurred to me to utilize the habit of salutation which prevails throughout the butterfly tribe. Accordingly, I took from my box a battered specimen recently caught, and pinned it through the thorax to a switch about five feet long, trimmed to the greatest possible inconspicuousness. With this wand I danced my butterfly up and down, so as to imitate, though feebly, natural flight, and to prevent too easy discovery of its condition. With left hand thus occupied, the right grasping the handle of the net, jealously kept behind me, I watched for a moment when the new-comer's back was turned, and took position on his beat. As he swung down upon me, the thump of my pulse apparently furnished enough appearance of vitality to my decoy; for he started rapidly toward it, settling on it before I was ready with the net. The few seconds, however, necessary to demonstrate the sex of the decoy, enabled me to bag my prize with ease, and without injury to his perfect tails. In this way I caught seven males that day. After this, I kept a damaged specimen on hand, during the rest of my trip, and I rarely missed a butterfly of that species.

"Later, at Queretaro, I tried the same plan successfully with P. *Daunus;* and later still, in Colorado, I caught *Daunus* with a *Turnus* decoy. I intend in future to carry pasteboard and water colors, with a view to imitating, even if clumsily, any rare species which I may find especially difficult to catch. Only males were taken in this way. The females of all these species are more easy of capture on account of their heavier flight and mental preoccupations." I spoke of this mode of taking Papilios to Mr. David Bruce, and he told me he had used paper decoys with success.

In Papilio IV. p. 100, is a description of what purports to be the mature larva and chrysalis of *Pilumnus*, but there is some mistake in the matter, the stages as described belonging to the *Palamedes* group, and probably to *Palamedes* itself. I have seen the identical pupa which was so described, in the collection of Mr. Henry Edwards, and it is of the form and peculiar character of *Troilus*. Certainly the pupa of *Pilumnus* would be of same character as that of *Daunus*, *Rutulus*, and *Turnus*.

ARGYNNIS.
XI.



CYBELE VAR CARPENTERII 1 2 ♂ 3 4 ♀.

a Egg (×6ᵈᵉˢ) magnified c Larva 1ˢᵗ to 5ᵗʰ moult
b Larva (natural) d Larva mature
e Chrysalis

Geo. S. Harvey & Sons Lith. Bath

ood S Harris & Sons Lith Phila

ARGYNNIS XI.

ARGYNNIS CYBELE, 1-4.

Argynnis Cybele, Fabricius; Edw., But. N. Am., I, p. 67, pl. 21. 1868; id., Can. Ent., VI, p. 121. 1874; xii, p. 141. 1880; Scudder, But. N. E., p. 589, pl. 4. 1889. CARPENTERII, Edw., Tr. Am. Ent. Soc., V, p. 204. 1876.

Var. CARPENTERII.

In Volume I, I gave what information was at that date attainable respecting the distribution and habits of CYBELE. Examples of the species have since come from Montana, locality unknown, but supposed to be Helena, and from Fort Niobrara, Nebraska. These are the extreme western limits recorded. Mr. Scudder states that it has been taken, at the north, in Alberta; at the east, at Cape Breton. His map, Plate 21, showing distribution, draws the western line through middle of Dakota, Nebraska, and Kansas; and the southern line with the south line of Virginia and Kentucky. But I have seen examples from the collection of Mr. E. M. Aaron, which were taken at Maryville, east Tennessee. Mr. Aaron reports *Cybele* also from Highlands, Macon County, North Carolina, the extreme southwest of the State; also that he has taken it in considerable numbers at Elizabeth City, at the lower end of the Dismal Swamp. The species is so far unknown in the Gulf States and Texas.

Mr. Scudder says, p. 559, that in New England *Cybele* is scarcely larger than *Aphrodite*. Examples from Maine which I have seen are often very small, dark above, and the under side of hind wings is usually quite dark brown, the females especially so. Those taken in West Virginia, on the contrary, are large, with heavy black lines on upper side, and the hind wings beneath are red-brown. In Nebraska and Montana, the size is about same as at the east, but the fulvous color is brighter, more red, and the under side is very light, near to cinnamon-red, — so far as the examples seen by me show.

I described *Carpenterii* as a distinct species, near to *Cybele*, and was influenced in the determination by the fact that *Cybele* was not known to fly within hun-

dreds of miles of New Mexico. The examples, two males, one female, were taken by Lieut. (now Captain) W. L. Carpenter, U. S. A., in New Mexico, above timber line. I wrote, in 1887, for further information, and Captain Carpenter replied: "The Argynnis *Carpenterii* were collected on Taos Peak, about 12,000 to 13,000 feet elevation. I saw several others at same time. I had collected the preceding year, in Colorado, above timber line, without seeing it." On reading this, I wrote Prof. F. H. Snow, who has collected butterflies extensively and during several seasons in New Mexico, Colorado, and Arizona, to ask if he had ever seen this butterfly, or *Cybele*, in those regions. To which he replied that he had not, but had never been on Taos Peak. I have also inquired of every person I knew of as having collected among the high peaks of Colorado, Messrs. Bruce, Snow, Mead, Nash, particularly, but no one had seen the species in that State. Just so as to Arizona. The case therefore is peculiar. A colony of a strictly northern butterfly is evidently imprisoned on the summit of a lofty mountain far to the southwest. In New England and New York, as well as in Virginia, *Cybele* does not fly at even moderate elevations, but in the lowlands; on the higher ground it is replaced by *Aphrodite*. If this colony on Taos Peak could descend, we may be sure they would do so. That they do not shows that either the climate forbids or their food plant is wanting. Violets are common plants among the mountains of Colorado and Arizona, and both States are remarkably rich in species and individuals of Argynnis. The conditions are plainly unfavorable to the spread of *Cybele* to the south and southwest, and that it has not done so is the more singular, inasmuch as the largest and handsomest examples are those found near the southern limit. Probably it cannot live or perpetuate its kind on the hot sandy soil of the extreme south, or the burning plains of Texas. We may infer that this colony in New Mexico was cut off from the main body when the climate was changing, and the species was retreating to the north, after the manner so graphically described by Messrs. Grote and Scudder in the case of Chionobas *Semidea*, a species which was left stranded on the summit of the White Mountains of New Hampshire.

These specimens of *Carpenterii* in coloration as well as size most nearly resemble their congeners from the extreme east of New England, and differ widely from western examples.

DESCRIPTION OF THE PREPARATORY STAGES OF CYBELE.

Egg. — Conoidal, truncated, and depressed at top, broad at base, the breadth equal to the height; marked by about eighteen prominent, vertical, slightly wavy ribs, half of which extend from base to summit, and form around the latter a serrated rim; the others end irregularly at two thirds to three quarters the

distance from base; the broad, rounded spaces between crossed by nearly equidistant low ridges; micropyle in the middle of three rows of small rounded cells, outside of which are rings of cells of irregular sizes, mostly five-sided; color yellow. (Figs. *a*, a^2.)

Young Larva. — Length at 12 hours from egg .07 inch; cylindrical, stoutest in middle, the last segments tapering rapidly; color dull green, translucent; marked by eight longitudinal rows of dark subtriangular tuberculous spots, three being above the spiracles on either side, and one below; these spots are flat and bear small conical tubercles, those of the upper, or dorsal, row two, of the next two rows, one, of the infrastigmatal row four, and each tubercle gives out a long tapering clubbed hair; on 2, on either side, is a large spot, corresponding to the spots of the upper two rows of other segments, and bearing three tubercles and hairs; the dorsal spots are near the front of the segment, the subdorsal beyond the middle to the rear, the lateral a little in front of the middle, and the lowest row on the middle; under side, feet and legs green; head a little broader than 2, rounded, slightly bi-lobed, with a few hairs from fine tubercles; color black-brown. (Figs. *b* to b^3.)

After 1st moult: Length .13 inch; stoutest in middle; color dull green mottled with brown, the latter taking the form of macular longitudinal stripes; spines disposed as in the genus, tapering, black, rising from black tubercles, except those of the lateral row, which have yellow tubercles; each spine ending in a short black spinule and beset by several others about the sides; feet black, pro-legs greenish-brown; head sub-cordate, the vertices rounded, at top of each, on the front side, a little conical black process, the front flattened, and showing many black hairs; color shining black-brown. (Fig. *c*.) To next moult eight to twelve days.

After 2d moult: Length .24 inch; color chocolate-brown, the lateral spines pale yellow at base and for one third up; the upper rows have the bases more indistinctly yellow and then mostly on the outer sides, the inner being nearly or quite black; spines otherwise shining black, the bristles black; head as before; color shining black. (Fig. *d*.) The next moult four to nine days, according to the state of the weather.

After 3d moult: Length .4 inch; color dark velvety brown; the spines black; all of the laterals yellow at base and for about one third up; the subdorsals distinctly yellow at base on the anterior segments, the yellow gradually fading to

the last segments; the dorsals also distinctly yellow on anterior segments, the last wholly black; the dorsal spines on 2 are directed forward, but are no longer than others; head as at next previous stage, black in front, but yellow behind; all yellow is reddish, or honey-colored.

At this stage there was some variation in individuals in the color of the spines. One had all yellow at base except the dorsals on 2 and 12, which were black. (Fig. *e*.) To next moult five to eight days.

After 4th moult: Length .6 inch; color velvet-black; laterals wholly bright yolk-yellow; subdorsals same on anterior half, the remainder duller yellow; dorsals bright yellow on anterior half, but after 6 less so, and on 9 to 12 black; in line with the dorsal spines on segments from 3 to 11 two gray dots; head as before.

Another larva had all three rows of spines largely reddish-yellow fully halfway up from base; the last two pairs of dorsals shading into brown. (Fig. *f*.) To next moult four to eight days.

After 5th moult: Length 1.1 and 1.2 inch. (Fig. *g*.) Reached maturity in six to eight days.

Mature Larva. — Length 1.8 inch at rest, 2 inches in motion; greatest breadth at rest .35 inch; color velvety black, under side chocolate-brown; between each pair of dorsal spines from 3 to 11 two gray dots transverse; the spines throughout slender, beset with short black bristles; the bases of all spines reddish-yellow, and for about two thirds up, the rest shining black; the spines of 2 wholly black, a little recurved, directed forward, but no longer than other dorsals; the longest dorsals .14 inch; feet and pro-legs black; head small, .14 inch wide, and equally high, subcordate, the front flattened, finely tuberculated, the back much rounded, the vertices sub-conic, and each on its anterior side giving a small black conic process; the face much covered with black hairs of irregular length; color of front dull dark brown, of back reddish-yellow. Several larvæ were as described, others showed much less yellow on the spines; the laterals always largely yellow, the subdorsals much less so, the dorsals a little yellow at base from 3 to 6, after that less and less, changing gradually to brown, and on 11 to 13 black. In from two to three days after maturity the larvæ suspended, and in about twenty-four hours pupated. (Fig. *h*.)

Chrysalis. — Length 1.1 inch; breadth at wing-cases .4, of abdomen .36 inch; cylindrical, a little compressed laterally; head case prominent, nearly square at top, the vertices being but very slightly elevated, transversely rounded

to the ridge at summit, the sides bevelled; mesonotum moderately prominent, rounded, carinated; followed by a deep rounded depression; the wing cases with prominent conical processes at base, much elevated above surface of body, the outer edges flaring, the middle part depressed; on the abdomen two rows of small tubercles corresponding to the dorsal spines of the larva, and which extend to the head case; one row of minute tubercles on each side; the whole surface finely corrugated; color variable, being sometimes glossy dark brown, with a fine mottling of reddish-orange, not distinct, over wing cases and anterior parts; or dark brown mottled with drab, this last prevailing on the wing cases; or dark brown mottled with lighter brown, most distinctly light at margins of wing cases, where they pass down to surface; or almost wholly dead-leaf brown, a little obscure on wing cases; the anterior abdominal tubercles usually black in front, yellow behind, the posterior tubercles wholly black. (Fig. *i.*) Duration of this stage sixteen to twenty days.

In the text to Argynnis *Diana*, page 147, Volume II, 1876, I gave a general account of raising larvæ of *Cybele* from egg. In the Canadian Entomologist, XII, p. 143, 1880, I gave farther observations, and related that up to the preceding winter I had always lost most of the larvæ of this species, as well as *Diana* and *Aphrodite*. They died off during the winter, or during the stages in spring, or in chrysalis, and I had been unable to contrive any successful mode of carrying the larvæ through. But, in fall of 1879, it occurred to me that freezing them solid might be the proper thing, and I sent several larvæ of *Cybele* to Professor Fernald, then at Orono, Maine, to be placed in his ice-house. They were in small paper pill-boxes, the unglazed sides of which afforded foothold. These were put in a flat tin box and deposited in frozen sawdust under the ice, as Professor Fernald informed me. Five months later, on 5th March, 1880, I received the boxes by mail. The larvæ were nearly all alive, and when first seen, several showed some movement, though only three days from the ice. Others were lethargic some hours longer, but next day all had left the boxes and betaken themselves to the plants of violet among which I had laid them. They crawled to the stems and down to the bases in the hollows, and there rested when not feeding. On 10th March, one was found to have passed the first moult, several days in advance of any other, and this one continued in advance to maturity, passing second moult 18th, third 27th, fourth 4th April, fifth 12th, suspended 23d, pupated 24th April, and gave a female imago 14th May. The whole period from ice to imago was seventy-three days. The other larvæ passed first moult 19th March, second 29th March to 2d April, third from 4th to 6th

April, fourth 11th to 12th, fifth from 16th to 19th April, and the butterflies came out from 12th to 27th May. After the first moult I lost no larvæ. Before that there had been some loss, mostly, I thought, from their having been brought to a warm room too soon after I received them. These imagos were all of large size, equalling any ever seen here in the field. Comparing the stages of these frozen larvæ with others which in previous year I had carried through winter in a cool room: —

Iced Larvæ.	Brought from Cool Room.
Time from removal to 1st moult, 8 to 18 days	44 days and upwards.
" " 1st moult to 2d, 8 to 12 days	17 " " "
" " 2d " to 3d, 4 to 9 days	11 " " "
" " 3d " to 4th, 5 to 8 days	12 " " "
" " 4th " to 5th, 4 to 8 days	14 " " "
" " 5th " to chrysalis, 9 to 12 days . . .	12 " " "
" " chrysalis to imago, 16 to 20 days	24 " " "
Total period, 73 to 86 days	134 " " "

Evidently the freezing served as a tonic, and the larvæ subjected to it were in a healthy condition. Since 1880, I have been in the habit of freezing hibernating larvæ of all species, and have been very successful in rearing them to imago.

The early brood of *Cybele* appears here about the first of June. In some seasons they are quite abundant, but in others rare. For twenty years I have recorded the first appearance. The earliest date for the male has been 19th May, the latest, 17th June; the females always a few days later than the male. Soon after 1st July they are all gone. About 15th August, fresh males appear again, and then the females, and both are exceedingly plenty in September, the males disappearing about middle of the month, the females, some of them, living till frosts come in October. Eggs can always be got during September, by confining the females over violet. In one instance, 219 eggs were laid by a single female. When several are confined together, the bag and plant and earth are sprinkled with eggs. It would seem as if there must be two broods of the imago, one in June, the other in August, but two months do not give sufficient time for eggs to be laid and larvæ to mature and for the pupa stage. The shortest period for the egg has been twelve days, for the larval stages and pupa seventy to eighty. Of course, the hot weather between June and September might accelerate all stages, if eggs were laid in June. I never saw a mature egg in any female dissected in June, nor could eggs be obtained in confinement. In June, 1887, the species was plenty, and I shut up nine females on 29th; but failed to get an egg,

and dissection showed no formed eggs, nothing but fatty masses. In 1874, I endeavored to find out how long after the females of the fall brood appeared, mature eggs were formed. The first one was seen 16th August. On 20th, I dissected three, and in all, the eggs were soft and unformed; on 26th, they were soft, but had form; on 3d September, were firmer; on 17th, were fully mature, and a day or two after, many were laid. So that nearly a month seemed to be required for eggs to mature. At Coalburgh, all the larvæ have gone into lethargy at once on leaving the egg. But the late Mr. C. G. Siewers, of Newport, Kentucky, a first-rate observer, with whom I corresponded about the peculiarities of *Cybele*, wrote me, 30th October, 1877, that two eggs gave two larvæ, one of which fed up to and past second moult, and had gone to the base of the plant to hibernate. In 1881, 28th October, he wrote that he found a larva, ten days before, under rotten wood; that it was one half inch long (which would make it past third moult). To see if it would feed, he trimmed a violet stock and laid it by the larva. On 26th, he went again to the woods and found the larva, which had eaten holes in two leaves and then hidden itself in a crevice so that only its spines protruded. It may be, therefore, that some larvæ in West Virginia, from eggs first laid, pass three or four stages in the fall, and so begin the next year a month in advance of the main body of the species. This will account for the early butterflies. But why June females have not laid eggs is not easy to conjecture. Mr. Siewers wrote in 1876, that, on 24th June, he took a pair in copulation; they separated in the net; he kept the female five days, and till she died, got no eggs, and found none in the abdomen. On 25th June he caught another pair, which separated after three hours, and the result was the same.

As I have said, females are often to be seen flying late in the fall, and until frosts destroy them. This is long after all males have disappeared. I believe these females to be barren, or who have not had an opportunity to mate, and so live much longer than the rest of their sex, for the females of all species of butterfly die very soon after their eggs are exhausted.

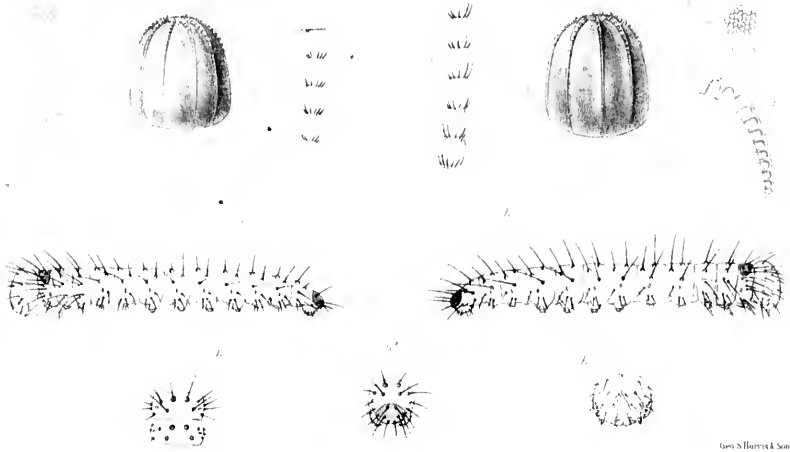
I have rarely seen a larva of *Cybele* in natural state, but on two occasions found one hibernating at the top of the root of a violet plant which I had dug up to set in pot for my larvæ. Once, in March, I found one on under side a grass leaf in a bit of sod I had taken up, and it must have spent the winter there. On 16th May, 1888, a mature larva was found on the under side of a lath which was lying on the ground. This larva died, but had it pupated, the imago would have come out about 10th June.

The caterpillars feed on every kind of wild or cultivated violet or pansy, and the flowers are eaten with avidity. In moulting, the skin bursts below the head, along 2 to 4, and the three pairs of legs are extricated first, the head being bent

back by the tension of the skin on dorsum, so that the legs are lifted up in the air, with much struggling to free the head and to burst the skin along dorsum. The spines lie flat and back and rise slowly as the skin slips off them, and the bristles, which are in pencil, separate slowly as they dry. At first every spine is yellow to base and the head also dull yellow, but all become dark in a few hours. The June butterflies are particularly fond of asclepias flowers, and may often be picked off by the finger, seeming besotted with the liquid they feed on, in the same way as *Turnus* and other Papilios.

Mr. Scudder says, But. N. E. p. 561, that *Cybele* is single-brooded in New England, appearing the last of June; that the eggs are laid about middle of August, and the insects are on the wing till middle of September, or occasionally later.

GRAPTA.
L.



INTERROGATIONIS. 1 ♂. 2 ♀.

CHANGED BY COLD. 3 4 ♂. 5 ♀.

a. Ova *magnified*

b. Larva Æstivalis

c. Pupa Crispata

d. Larva Hyemalis

Geo S Harvey & Sons Lith Phila

Geo S Harvey & Sons Lith Phila

♀

GRAPTA I.

GRAPTA INTERROGATIONIS, 1–5.

Grapta Interrogationis, Fabricius.
Form Fabricii, Edw., But. N. A., I, pl. 39, p. 115. 1872; Scudder, But. N. E., I, p. 319. 1889.
Form Umbrosa, Lintner; Edw. l. c., I, pl. 38, p. 111. 1872; Scudder, l. c. 1889.

The preparatory stages of this species were but imperfectly described in Vol. I, and therefore I now give them fully.

Egg. — Conoidal, the base flattened and rounded; marked by from eight to eleven thin vertical ribs, which near the base are low, but from about the middle begin to rise, increasing gradually, and terminate around the rim of the summit with an incurved slope; these ribs have their sides scooped in grooves perpendicular to the surface, the grooves enlarging as the rib deepens; micropyle in centre of a rosette of six minute pentagonal cells, outside of which are two and partly three rings of larger cells, irregularly five-sided; color pale green. Duration of this stage three to four days in summer, in April and May about ten days, depending on the weather. (Figs. *a* to *a'*.) (The egg of *Umbrosa*, Fig. *b*, pl. 38, Vol. I, is not good, nor even of proper shape, though drawn by so excellent an artist as Mr. Konopicky.)

Young Larva. — Length, at 24 hours from egg, .1 inch; cylindrical, even from 2 to middle, then tapering slightly to end, the dorsum falling rapidly on the last segments; on 2 is an oval chitinous patch on which are eight tubercles, four on either side the mid-dorsal line, three in front, and one behind and between the upper pair, each with long, tapering black hair, turned forward over the head; on each segment from 3 to 13 are six conical tubercles, forming as many longitudinal rows, three on either side, a dorsal, sub-dorsal, and lateral; on 3 and 4 they are nearly in cross line, the lower one on each and the corresponding one on 2 replaced by a pair of minute ones close together, on 2 a little above the line; but from 5 to 13 in triangle, the dorsal one standing on the front ridge, the sub-dorsal on the rear, the lateral a little before the middle

of the segment, all these except the laterals on 2 to 4 with long tapering hairs, those on front segments turned a little forward, on the middle upright, after 6 more or less recurved; the hairs on 2 to 4 are short, turned down and forward; on 2 to 13 is a row of minute tubercles running with and behind the spiracles except on 2, two to the segment on 2 to 4 and on 13; on 2 the pair stand before and a little above the spiracle, oblique to the line, and the hairs of these are unequal, the upper one being one third as long as the other, turned down and forward; the other hairs of this row are turned down and back; along base from 2 to 12 is a row, also minute, two to the segment, the middle ones nearly in horizontal line, on other segments the hinder one a little elevated, the hairs short, depressed; at base of each pro-leg a fine depressed hair, on 13 four such in line; on 3 and 4 similar hairs, but from minute tubercles; on 13 a chitinous sub-oval shield on which are eight tubercles and hairs, two dorsals in front, two on rear, two at each side, corresponding with the sub-dorsal and lateral rows; color of body at first whitish-yellow, semi-translucent; feet and legs same; some examples have the dorsum crossed by brownish patches alternating with the yellow of the intermediate segments; as the stage proceeds the color changes to red-brown with white on dorsum of 4, 6, 8, and 10, individuals varying, however; head rounded, very little broader than high, the top depressed slightly; color shining black; furnished with several small black tubercles, in four pretty regular cross rows; one row near top of four, of which the largest is in front on the middle of the lobe, the other round the side; one across middle of eight, one below this of six, all these minute; and one over mandibles of four, still small; each tubercle with its short black depressed hair. Duration of this stage three days in May, two in summer. (Figs. b–b^4.)

After 1st moult: Length .14 inch soon after the moult, in 24 hours .20 inch; slender, even; color red-brown, with indistinct whitish lines; of these, a wavy line runs with second laterals; from base of each first lateral is an oblique line outward to the front of the segment, and from each dorsal are two such lines, one on either side; armed with seven rows of spines, one dorsal, and three on either side, as in the genus; these are short, stout, black, beset near top with short branches, with some spinules on the sides; on dorsum of 2 is a transverse row of four short, simple spines; as the larva approaches second moult, the bases of the dorsal and first lateral spines become white or yellow, or reddish-yellow, while the color becomes more red, and the lines become more distinct; legs and feet dark brown; head rounded, depressed at top, the vertices a little produced, each bearing a stout, thick, black process, with conical spine at top, and shorter ones around the base of this; color black, with many black hairs. Duration of this stage from two to three days.

After 2d moult: Length .24 inch; color black, the lines as before, with the addition of one running with lower laterals, more distinct, often macular; spines as before, but variable in color; in some examples, all are black except the dorsals and first laterals on 4, 6, 8, 10, where they are reddish-yellow; some have the spines on these rows light, except on 9, 11, and 12; usually the second laterals are black and the lower row is pale yellow; in all cases the tips are black; as the stage proceeds the color of body changes to olive-brown, and the lines become more conspicuous; head as before, much covered with white simple spines. Duration of this stage from two to three days.

After 3d moult: Length .5 inch; color black, with cream-white lines, quite macular; spines very variable; some examples have every spine of the upper five rows reddish to reddish-yellow, the lower laterals pale yellow; some have the dorsals and first laterals from 3 to 11 red, the rest and all of second laterals black; some have the body color vinous instead of black, with no black spines, the upper rows very red anteriorly, the lower laterals yellow; the lines yellow; head either deep brown red, or decided red in the vinous larvæ, the processes red, with spines both red and black; the spines on face yellow or white. Duration of this stage two to three days.

After 4th moult: Length .9 inch. In two to three days is fully grown.

Mature Larva. — Length 1.3 to 1.5 inch; cylindrical, stout; the color very variable; some are dull black with white, yellow, and red tubercles on the cross ridges, and longitudinal lines and bands of red and yellow; there being a band along the basal ridge, a stripe running with second laterals, an oblique line from base of each first lateral outwards to the front of the segment, and one from either side of each dorsal also to the front of the segment; some are very black, the tubercles yellow, no lines or stripes above the basal ridge; some are russet, the lines and stripes obliterated, the tubercles yellow and red; and there are intermediate variations; under side black-brown; spines long, slender, tapering, with several spinules at top, one being a continuation of the spine, the others arranged somewhat irregularly; these are of about equal length in the several rows; others, which are shorter, are found on the sides of the spines, and are particularly numerous on the upper rows of the anterior segments; the dorsals have five main spinules, the first laterals six, the second and lower laterals four and five; in most examples the dorsals and first laterals are red, except on 3, where they are red with black bases, and on 11 and 12, where they are usually black, the red being deepest on anterior segments; the second laterals are sometimes all red, and the lower row is always yellow (but in the varieties of this

larva there is great variation in the color of the spines from deep red to yellow); over the feet from 2 to 10 is a simple red spine; on 2 is a dorsal row of six simple black spines; spiracles conspicuous, black in white rings; head obovoid, rather flattened, deeply cleft, the vertices high, and each bearing a stout and black process, ending in a long spur, with five others about its base, each hair-tipped; the face covered with simple spines and tubercles, some minute; on each side below vertex are four long spines, black, the rest are mostly white, each with hair; color either deep red-brown or red, about the ocelli a large black patch. From 4th moult to pupation, five to six days.

CHRYSALIS. — Length 1 inch, greatest breadth .3 to .32 inch; cylindrical; head case prolonged, compressed transversely, at each vertex a long conical process; mesonotum elevated, the carina prominent, thin, nose-like, more rounded on the anterior side than in *Comma*, followed by a deep depression; wing cases raised, flaring at base, compressed in middle, with a prominent point on the margin on dorsal side; on the abdomen three rows of tubercles, those corresponding to the dorsal row of the larva minute, to the first laterals large and conical, the pair in the middle of the series particularly prominent; those in the excavation gilded; color variable, in shades of brown from light yellow to dark, often clouded with olivaceous or lilac; sometimes a dark green stripe on the side of abdomen beyond wings. Duration of this stage from seven to eleven days, according to the weather.

INTERROGATIONIS is both sexually and seasonally dimorphic. Mr. Scudder, But. N. E., I, 329, has thus spoken of this peculiarity: "The two forms differ so greatly and constantly from each other, not only in coloring but in the form of the wings, and even in the abdominal appendages, that they have been considered distinct species; in each form, too, the sexes differ considerably in the coloration of the under surface of the wings, so that the species includes four sets of individuals, which may be distinguished quite as readily as a great many acknowledged species of the best studied faunas." Also, page 317: "Here is an insect where there are two very distinct forms in each sex, and in each of which the sexes are readily distinguished by the coloration of the wings; they differ in the brightness and variegation of the lower surface of both wings, and the obscurity of the upper surface of the hind pair, . . . not only differ in the markings of the wings, but also in their form, and in the structure of the genitalia."

Part 9, Volume I, which contained the two Plates of this species, appeared early in 1872. I had established the fact of seasonal dimorphism the preceding summer by raising larvæ of the June and July broods from eggs laid by the form UMBROSA, in both cases finding the two forms among the resulting imagos. In the

Canadian Entomologist, X, p. 69, 1878, I gave a statement of farther observations to date, and said that, at Coalburgh, W. Va., there were three broods of the imago annually in descent from the hibernators, and an effort, more or less successful, towards a fourth, depending on the temperature in the fall months and the consequent length of the mild season. That some individuals hibernated, and the females surviving laid their eggs in the last days of April or early in May. From these eggs came butterflies the last of May or first of June. That the second laying occurred in June and the butterflies therefrom appeared early in July; that the third laying took place the last of July and the butterflies appeared in September, some as early as the first, others late in the month. That females of this brood, which is the third of the year, laid eggs about the middle of September, and the butterflies from them came out in October. But that the larvæ were now liable to be caught by cold weather and destroyed, or the food plant was cut off, and so they starved, the result being that few could reach chrysalis and imago. And that I was inclined to think that the butterflies of the third brood did not hibernate, and the continuance of the species here depended on the few individuals which survived from the earlier imagos of the fourth brood. In no other way could I account for the scarcity of this species in spring as compared with G. *Comma*. There then followed a statement of the several lots of eggs I had bred from up to end of 1877.

Four years later, in same magazine, XIV, p. 201, 1882, I brought the history to date, and stated that the hibernating form was *Fabricii*, but that I had seen one *Umbrosa* flying so early in the year that it also must have hibernated. That on the only occasion on which I had been able to get a hibernated female of *Fabricii* to lay eggs in confinement, the result was wholly the other form, *Umbrosa*. That eggs laid by the females of *Umbrosa* of the first brood in descent from the hibernators had produced either a mixed brood or all *Umbrosa*. That eggs laid by the females of *Umbrosa* of the second brood in descent from the hibernators had also produced a mixed brood, with a greater proportion of *Fabricii* than in the preceding brood; and that eggs laid by *Umbrosa* of the third brood, or larvæ found late in the year, had in all cases produced *Fabricii* only. Also that all the butterflies so far seen late in the year had been of the form *Fabricii*.

I now bring the observations spoken of together, and supplement them with others to end of 1888. As will be seen, the eggs, save in one instance, have been laid by *Umbrosa* females. That is because in all these years (since 1870) I have found no *Fabricii* females to breed from, while from July to September, in every year, *Umbrosa* is in abundance. Nearly all the *Fabricii* I have seen have been late in the fall, though the result of breeding in summer shows that there must be many *Fabricii* flying.

First Brood: Eggs laid by Fabricii.

1877, 28th April, obtained eggs from ♀ *Fabricii* in confinement. Result, about 4th June, 21 *Umbrosa*. This was the only ♀ *Fabricii* I have ever been able to take and breed from. (Where the word "about" is used, a few days before and after the given date is meant.)

Second Brood.

1871, 4th June, eggs laid by ♀ *Umbrosa* in confinement. Result, about 1st July, 11 *Umbrosa*, 6 *Fabricii*.

1869, 5th June, found larvæ. Result, about 25th June, 26 *Umbrosa*.

1873, June, found larvæ. Result, last of same month, 19 *Umbrosa*.

1870, 4th July, found eggs. Result, 10th August, 1 *Umbrosa*, 2 *Fabricii*.

1878, 27th May, obtained eggs from ♀ *Umbrosa* in confinement. Result, about 22d June, 54 chrysalids, from which came 38 *Umbrosa*, 11 ♂ 27 ♀, and 16 *Fabricii*, 14 ♂ 2 ♀.

1879, 3d June, eggs from ♀ *Umbrosa* in confinement. Result, about 21st June, 16 pupæ, which were placed on ice. From these came but 3 ♂ 4 ♀, all *Umbrosa*.

1879, 20th to 28th July, found eggs and larvæ. Result, 65 *Umbrosa*, 28 ♂ 37 ♀, 4 *Fabricii*, 3 ♂ 1 ♀.

1879, 20th July, eggs from ♀ *Umbrosa* in confinement. Result, 21 *Umbrosa*, 7 ♂ 14 ♀.

1881, 7th July, found larvæ. Result, 8 *Umbrosa*, 2 ♂ 6 ♀.

1887, 23d June, eggs from ♀ *Umbrosa* in confinement. Result, about 13th July, 41 pupæ, from which 22 *Umbrosa*, 12 ♂ 1 ♀, 9 *Fabricii*, 8 ♂ 1 ♀.

1888, 24th July, eggs of ♀ *Umbrosa* in confinement. Result, about 9th August, 10 *Umbrosa*, 9 ♂ 1 ♀.

That is,	11	Umbrosa	to	6	Fabricii.
	26	"			
	19	"			
	1	"	"	2	"
	38	"	"	16	"
	7	"			
	65	"	"	4	"
	21	"			
	8	"			
	22	"	"	9	"
	10	"			
Total,	228	Umbrosa	to	37	Fabricii;

or of the former 86 per cent., of *Fabricii* 14 per cent. Of the eleven broods six produced *Umbrosa* only, five both forms.

THIRD BROOD.

1870, 1st August, found larvæ. Result, about 13th September, 6 *Umbrosa*, 16 *Fabricii*.

1871, 29th July to 5th August, confined several ♀ ♀ *Umbrosa*. Result, about 1st September, 63 *Umbrosa*, 34 *Fabricii*.

1877, 15th August, found larvæ. Result, about 22d September, 2 *Umbrosa*. 9 *Fabricii*.

1878, 16th August, eggs from ♀ *Umbrosa* in confinement. Result, about 19th September, 1 ♀ *Umbrosa*, 20 *Fabricii*, 7 ♂ 13 ♀.

1881, 2d and 3d August, found eggs and larvæ. Result, about 1st September. 46 *Umbrosa*, 17 ♂ 28 ♀, 6 *Fabricii*, 5 ♂ 1 ♀.

1887, 10th to 15th August, found larvæ. Result, from 15th to 22d September, 6 *Umbrosa*, 9 *Fabricii*.

That is,	6	UMBROSA to	16	FABRICII.
	63	" "	34	"
	2	" "	9	"
	1	" "	20	"
	46	" "	6	"
	6	" "	9	"
Total,	124	UMBROSA to	94	FABRICII;

or *Umbrosa* 57 per cent., *Fabricii* 33 per cent. Every lot produced both forms.

FOURTH BROOD.

1872, 10th October, found larvæ past third moult. Result, 8th to 18th December, 4 *Fabricii*.

1879, 1st September, eggs from ♀ *Umbrosa* in confinement. Result, to 8th October, 25 *Fabricii*, 10 ♂ 15 ♀.

1879, on 19th and 26th September, 2 ♂ *Fabricii*.

1887, 8th October, from three found larvæ, 3 *Fabricii*, 2 ♂ 1 ♀.

1878, 8th September, found larvæ. Result, about 3d October, 10 *Fabricii*, 6 ♂ 4 ♀.

That is,	4	FABRICII.	
	25	"	
	2	"	
	3	"	
	10	"	
Total,	44	FABRICII, no UMBROSA.	

This goes to show, therefore, that in the first brood from the hibernators the form *Umbrosa* was produced to the total exclusion of *Fabricii*. Although this brood was raised but in one instance, we may conclude with much probability that the result in several instances would be the same, inasmuch as where the species is but two-brooded, the first in descent from the hibernator is *Umbrosa*, with very rarely an exception. In the second brood *Umbrosa* preponderated largely, as 86 to 14, and six lots produced that form only, five lots both forms. In the third brood there were fewer *Umbrosa*, the proportion being as 57 to 43, and every lot, whether raised from eggs or from found larvæ, was made up of both forms. In the fourth brood all were *Fabricii*.

I think it probable that some few of the later individuals of the third brood hibernate. This would account for an occasional *Umbrosa* seen late in the year or early in the spring, and which therefore would be a hibernator. Also it would preserve the species when the fall is cold and unpropitious for the production of a fourth brood, as it apparently sometimes is. The season of 1888, at Coalburgh, during all September, was cold and wet, and the leaves of Elm and Hackberry fell early in October, so that no larva of a fourth brood could have reached pupa on those plants — and in the fall there are no other food plants. If the species is not extinct the coming spring (1889), it would seem to be because some imagos of the third brood were able to hibernate.

In Florida there must be at least four full broods of *Interrogationis*, as the season is much longer at each end than in West Virginia. On 28th September, 1880, I received twenty-five half-grown larvæ from Indian River, sent by Dr. Wm. Wittfeld. These were passing the fourth moult on 8th October, and between the 12th and 17th November, 16 *Fabricii* came out, and no *Umbrosa*. (By an oversight, in Can. Ent., XIV, p. 206, this is stated as 25 instead of 16.)

Individuals sometimes occur which are intermediate between the two forms of this species. One such I have seen from the collection of Miss Morton, and another I am told is in the collection of Mr. Neumoegen. The shape is of *Fabricii*, and the color of under surface as well, but the hind wings on upper surface have the black of *Umbrosa*.

It is interesting to compare the history of a species like the present in several localities, especially with the more northern. In the lowlands of New York, *Interrogationis* seems to be three-brooded. Miss Morton says there are three broods at Newburgh. On June 11, 1886, 15 to 20 larvæ, one third grown, were found. All the butterflies from these, coming out from July 7th to 20th, were *Umbrosa*. This was the first brood. All butterflies seen on the wing the last half of August were *Umbrosa*, and Miss Morton considered them to be the second brood. All seen the last part of September and in October were *Fabricii*, the third brood.

Professor Lintner, in Trans. Am. Ent. Soc., II, p. 315, 1869, says of the species: "During the first week of July, 1861, there were brought to me, at Schoharie, N. Y., 14 larvæ and chrysalids. The larvæ were mature and in a day or two pupated. The imagines proved to be every one of the 'black variety' (*Umbrosa*), 3 ♂ 11 ♀." This of course was the first brood. "About the middle of July several other seemingly identical larvæ were taken by me, which, emerging the last of the month, gave the ordinary *Interrogationis* (*Fabricii*)." This would be the second brood. "I collected, on August 10th, two chrysalids and twenty larvæ from one half inch to nearly full size. During the ensuing two weeks many additional larvæ were taken by me," etc. As the result, about 110 *Interrogationis* (*Fabricii*) were obtained and not a single *Umbrosa*. These would be the third brood. In the same paper, Mr. Lintner speaks of the rarity of *Umbrosa*, and says "it seldom falls into the hands of a collector." This was at Schoharie, in the heart of the Hop region, and was written before the seasonal dimorphism of the species was known, and when the two forms were recognized as distinct species.

Mr. Scudder, But. N. E., I, p. 330. says there are but two broods in New England. "The eggs laid by the hibernating females produce nearly but not all *Umbrosa*, and the eggs of the last brood almost invariably only *Fabricii*." And he gives the experience of Professor Carl Braun, of Bangor, Maine, as decisive. But the experience of Mr. F. H. Sprague, in eastern Massachusetts, also given, seems to show that in that State there are three broods. "Mr. Sprague's experience tells the same story, excepting in 1887, when, he writes me, 'the August brood was mixed, about evenly divided between the two forms.' He adds that the later ones, which he looks on as a third brood, were *Fabricii*, though an *Umbrosa* was reared the last week of August; so, too, I bred, about the middle of October, a single male of the form *Umbrosa*." Mr. Sprague's observations go to show that the first brood is *Umbrosa*, the second mixed, the third *Fabricii*. Mr. Lintner's second brood came out all *Fabricii*, and Miss Morton's all *Umbrosa*. It is much to be wished that a series of careful observations of this species, with breeding from the egg, could be made in the region of three broods, as in New York, for satisfactory comparison with those to the north and the south, the two and four-brooded regions.

I wrote Professor Braun for the particulars of the broods raised by him at Bangor. On the 12th June, 1886, he shut up a female *Fabricii*, and by 19th (keeping the insect alive by feeding it molasses) there were 110 eggs. These hatched from 27th to 30th June, and the larval stages required 17 days, the pupal 5. This brings the emergence of the imagos to middle of July. The result was *Umbrosa*, except 2 ♂ *Fabricii*. This was the first brood in descent.

Professor Braun writes that the same year, by 10th August, he had 24 eggs laid by *Umbrosa*, and the butterflies from them came out between the 20th and 25th September, and were all *Fabricii*. He adds: "There are only two broods of this insect in Maine."

As stated, Mr. Scudder had an *Umbrosa* from pupa in October. Miss Morton saw a fresh *Umbrosa* in northeastern New Jersey, 14th October, 1888. I myself have seen an *Umbrosa*, at Coalburgh, which had hibernated. But these are exceptions to the rule that the last brood of the year from Maine to Florida, in regions where there are two, three, and four broods, is *Fabricii*.

According to Mr. Scudder, *Interrogationis* is very rare north of the boundary line of the United States, and then only in Ontario and Quebec, in the latitude of New England. So that nowhere in its territory is the species represented by a single form.

Where a species is already two-brooded and the length and warmth of the season permits a third brood, the original hibernating form would seem to be the one to lay eggs from which would come the hibernating imagos. In the present case, *Fabricii* being the hibernator where there are but two broods, the first in descent will be *Umbrosa*, the second *Fabricii*, this last hibernating. If there are to be three broods, the *Fabricii* would seem to be the form to lay eggs, and these might be expected to produce *Umbrosa* as the hibernators. If a fourth brood was reached, *Fabricii* would be the hibernator as it was at first, when the species was two-brooded. That is, we should expect the odd broods to be *Umbrosa*, the even *Fabricii*. But it is found that in all latitudes, in New England, in Virginia, in Florida, the original winter form remains the winter form, and the middle one of three broods, or the second and third of four broods, are made up of both forms. These interior broods seem to be interpolated between the original summer and winter broods. Apparently, the heat of summer disposes to *Umbrosa*, while the tendency to alternate produces *Fabricii*, and the result is a mixed brood. But late in the season, one tendency overcomes the other, and the last brood everywhere is *Fabricii*.

In Vol. I, I gave the food plants as Hop, Elm, Nettle, and Bœhmeria. To these I add Hackberry, Celtis, of any species, but the preference is for the two first-named, Hop early in the season, Elm in August and September. I have near my house a preserve of Elm sprouts which are cut down in July, to be soon replaced by a fresh growth. It is on the tender terminal leaves of these that the female prefers to lay her eggs, usually on the under side of the leaf, either singly or in strings of two to eight. I had supposed the number of ribs

in all eggs laid by one female was the same, but Mrs. Peart found that in a string I sent her the topmost egg had eleven ribs, while all the rest had but nine, as shown on the Plate, Fig. a^4. The young larvæ do not consume their egg shells, as many species do. They eat holes in the leaf, each for itself, and during the first two stages feed about the margins of these. During all stages they are unprotected, except as they lie beneath the leaf. They are not gregarious as a rule, though doubtless where the species is abundant, and the food plant local, their numbers may suggest gregariousness. But so many as are hatched on the leaf keep together for two or three stages, then scatter about the plant.

GRAPTA INTERROGATIONIS.

ON THE EFFECT OF COLD APPLIED TO THE CHRYSALIDS OF GRAPTA INTERROGATIONIS.

INTERROGATIONIS has proved susceptible to the influence of cold. In Psyche, Vol. III, p. 15, 1880, I related this at length. The same account was given in the Appendix to Weismann's "Studies in the Theory of Descent," Part I, p. 149, 1880, London. I have thought it well to publish Plates of the species affected, showing the changes brought about, and the present is the first of the series. Figs. 1, 2, show the upper sides of the normal male and female. Figs. 3, 4 ♂ 5 ♀, changed examples. Eggs of form *Umbrosa* were obtained from females in confinement, June, 1879. As the chrysalids formed, at intervals of from six to twenty hours after pupation, they were placed in the ice-box. At fourteen days, all but five were removed, these being left six days longer. Several were found to be dead at the end of the fourteen days. The temperature most of the time was about 35° Fahr. (1.7° C.), but a little higher each day, as the ice melted, reaching then 40° to 45° Fahr. (4° to 7° C.). From the first lot were obtained seven perfect butterflies, 3 ♂ 4 ♀, from the twenty-day lot five, 4 ♂ 1 ♀. All were form *Umbrosa*, and nearly all had been changed in one striking particular. In the normal *Umbrosa* of both sexes, the fore wings on upper side have, on the costal margin next inside the broad border of the hind margin, and separated from it by a considerable space of fulvous, a dark patch which ends a little below the discoidal nervule; inside the same border, at inner angle, is a similar patch, lying on the submedian interspace. Between these two patches, across all the median interspaces, the ground is fulvous, but very slightly clouded with black, often so slightly that it would not be noticed. Now, in all four of the females exposed to cold for fourteen days, there is present a broad black band which crosses the entire wing, continuous, of uniform shade, covering the two patches as well as the intervening clear space, and almost confluent with the marginal border from end to end, only a streak of obscure fulvous anywhere

separating band and border (Fig. 5). The other spots on same wing are not at all changed.

In the fifth female, the one from chrysalis exposed twenty days, the band is present, but while it is broad and crosses the space between the patches, it is not continuous, but includes on its outer side a series of obscure fulvous lunules. While it may have been changed, there is no certainty of it, because individuals are sometimes bred or taken having the same peculiarity. One such is figured in Vol. I (Fig. 3, Pl. 39).

In all the males, the patches are diffused, those at the apices almost coalescing with the borders. In the three from fourteen days' exposure the patches are connected by a narrow band (Fig. 3). In the four from twenty days this band is macular but decided (Fig. 4). As in the females, all the change is limited to the extra-discal area of fore wing. In the females no change was noticed on under sides. In the males, perhaps none also in the markings, but it was stated in the first account that the colors of all were intense, with more red than in a series of natural examples. But the delicate shades are evanescent, and to-day I do not see the peculiarities I noticed two years ago. For this reason no figure of the under side is given.

It appeared, therefore, that fourteen days was as effective in producing changes as a longer period. In fact, the most decided change was found to have taken place in the females which were exposed the shorter period. Also that cold, in case of this Grapta, changed certain markings only, and that the females were most susceptible to the influence.

In 1878, I had put chrysalids of Grapta *Comma* on ice at from ten minutes to six hours after pupation, some therefore being quite soft and none fully hardened, and lost every one of them. This led me to expose the *Interrogationis* in 1879, at from six to twenty hours from pupation, after hardening had taken place.

One object I had in view in these experiments was to learn whether exposing the summer chrysalids would result in producing the winter form of the butterfly (*Fabricii*). But all were *Umbrosa*.

I should have continued these experiments in subsequent years, but at Coalburgh we rarely have ice.

GRAPTA I.

GRAPTA COMMA.

Grapta Comma, Harris.

Form Harrisii, Edw., Can. Ent., V, p. 184. 1873; *Comma*, Edw., But. N. A., I, 101, pl. 36. 1871; id., Can. Ent., XIV, p. 189. 1882; Fernald, But. Maine, p. 52. 1884; French, But. Eastern U. S., p. 185. 1886; Scudder, But. N. E., I, p. 332. 1889.

Form Dryas, Edw., Trans. Am. Ent. Soc., III, p. 17. 1870; id., But. N. A., I, p. 109, pl. 37. 1871; Scudder, l. c. 1889.

The stages of this species also were imperfectly described in volume I.

Egg. — Conoidal, the base flattened and rounded; marked by from eight to eleven thin vertical ribs, which near the base are low, but from about the middle begin to rise, increasing gradually, and terminate about the rim of the summit with an incurved slope; these have their sides grooved as in *Interrogationis;* the micropyle in centre of a rosette of minute five-sided cells, about which are two or three rings of larger cells; color pale green. (Fig. *c.*) Duration of this stage, at Coalburgh, W. Va., five days in April, four in July.

Young Larva. — Length, 12 hours from egg, .08 inch; in shape and clothing in all respects like *Interrogationis,* as before described; color whitish-green; feet and legs green; head rounded, the top depressed slightly; color dark brown. (Fig. *d.*) Duration of this stage, four days in April, two days in July.

After 1st moult: Length .13 inch; color either brown-black or black with whitish lines at the junction of the segments; the spines short, stout, black, and set with short divergent bristles; in the individuals which have white lines, on segments 4, 6, 8, 10, the spines spring from whitish tubercles, on the other segments from black; in the black examples all tubercles are black; on 2 are four small spines in cross row on the chitinous band; a row of small spines over legs and feet; feet black, pro-legs olivaceous; head round, depressed at top, the vertices a little produced, each bearing a short, thick process with short spines at top; color of head and processes dark brown; many black hairs over face

springing from black tubercles. Duration of this stage, three days in April, two in August.

After 2d moult: Length .3 to .33 inch; same shape; color dark olive-brown or black-brown or reddish-brown, individuals varying; the spines longer, and at one third from the top give off branches; the posterior end of each segment after 2 crossed by two or three fine white lines; in front of the medio-dorsal row of spines are two oblique divergent whitish bars, and one such bar from base of each spine in first lateral row on outer side; the spines vary largely in color, some larvæ having all the spines black, some have the dorsal and first lateral rows on 5th, 7th, 9th segments white, the rest black; some have white from 4 to 11; some have white on 9 only; on 2 a collar of black simple spines; head broader than high, the top rather square, not much depressed, the processes larger, but similar to preceding stage, crowned with six points, one in middle, the rest about it; surface glossy black, with many simple spines, of different sizes, usually all black, but some examples show a few white among the black; each with long hair. To next moult, in May three days, in August two days or somewhat less.

After 3d moult: Length .38 to .4 inch; color black, crossed on the posterior end of each segment with two or three lines or stripes of white, sometimes more or less macular and varying much in width; the oblique marks on dorsum as before, more conspicuous; a yellow band runs along base in line with lower lateral spines, and the posterior part of each segment above this band shows an oblique bar, and some white spots and points; the spines as before; the medio-dorsal row always white; those of first lateral row usually white, but sometimes on 3 are black, or partly black; some examples have the second lateral row wholly black, others white, or some of the last spines are parti-colored; head as before, the white spines predominating largely. To next moult, in May three days, in August two days or somewhat less.

After 4th moult: Length .8 inch; in three days reaches maturity.

Mature Larva. — Length 1 inch; cylindrical, stout; the color varies much, some examples being cream-white, some greenish-white, with almost no markings, or the markings are obsolescent; others are velvet-black, the dorsum crossed by white stripes on the posterior edges of the segments, with two white divergent bars meeting at a small angle in front of each dorsal spine and running to the anterior edge of the segment, and with a similar oblique bar from each spine of the first lateral row on the lower side of it; along base is a raised

yellow ridge, and from this up to second laterals the ground is crossed by abbreviated white stripes or patches, particularly on the last half of the segments; above this the side is black; but individuals vary in the extent of this black area, and sometimes the same area is vinous-red; the spiracles black in broad white rings; at the bases of the second laterals, from 9 to 11 or 7 to 11, is usually a fulvous or orange patch, varying in extent; the spines long, tapering, each with from three to five spinules a little below the summit and one which is the prolongation of the spine itself; those of the dorsal and upper lateral row are largest and longest, each with five spinules, besides one or two lower down, and some very small ones nearer base; those of second lateral row are of medium length, with four branches; and those of the lower row are shortest and have three and four branches; in the green and white varieties all the spines and branches are whitish or yellow, in the black, the spines are yellow, mostly black-tipped, but those of first lateral row are sometimes black to their bases, those of second row sometimes wholly, sometimes but partly black; 2 has a collar of six simple spines, and two others are on each side; under side either greenish or brown-yellow; head rather square, higher than broad, with high vertices; in the light examples the color of head is dull pink, in the dark ones black, shining, sometimes with a forked whitish stripe down front; on each vertex a short, stout process, cylindrical, compressed in the middle, broad at the top, crowned by five equal, blunt-tipped spines around a sixth in the middle; each with hair; these processes are black in the black larvæ, and in the light ones either red or red with black tops; face and whole head thickly covered with simple white spines of variable length, all white, except that sometimes there are one or two of the longer ones on side face below the vertex which are black, or black and white; along back of head and down the sides is a row of these spines close set. From fourth moult to pupation five days.

Chrysalis. — Length .8 to .9 inch; greatest breadth .24 to .26 inch; cylindric[illegible] case high, compressed transversely; at each vertex a long, conical pro[illegible]e mesonotum elevated, the carina very prominent, thin, nose-like, followed by a deep excavation; wing cases raised, flaring at base, compressed in middle, with a point on the margin; on the abdomen three rows of tubercles, those corresponding to the dorsal row of the larva small, to the first laterals large and conical, the pair in the middle of the series particularly prominent, and those in the excavation silvered, gilded, or bronzed, varying; color variable, many examples being dark brown, with lighter or with yellow-brown, and much reticulated with dark lines; others are dead-leaf brown; others are light, up to dead-white, shaded slightly with yellow-brown, with a bronze lustre over the wing cases and anterior dorsal parts. Duration of this stage about seven days.

GRAPTA I.

The two forms of this species were figured and described in Volume I as distinct. In Canadian Entomologist, V, p. 184, 1873, I gave the result of breeding larvæ from eggs laid by a female *Dryas*, at Coalburgh, the same year. Among the imagos both *Comma* and *Dryas* appeared, and seasonal dimorphism was established. In Vol. VI, p. 157, 1874, I showed that eggs laid by *Comma*, later called form HARRISII, produced *Dryas*. So that either form produced both forms. In Vol. X, p. 69, 1878, I gave a statement of all observations to date, and said that at Coalburgh there were three broods of the butterfly annually, and the individuals of the third hibernated. That the hibernating females deposited their eggs last of April or early in May, and the first brood of the butterflies came from chrysalis about 1st June: but should the weather be cold during May, then from middle to last of June. That the second laying of eggs took place in July, between 15th and 30th, and butterflies from these appeared last of August or early in September. That the third laying of eggs occurred in September, and the butterflies from them came out in October. That, so far as appeared from breeding, or from observations in the field running through many years, the last laying of eggs produced *Harrisii* only, and that the series began in the spring with eggs laid by females of that form exclusively. That the result of the eggs laid by these hibernating *Harrisii* had in all cases been *Dryas*, with a single exception, when a male *Harrisii* appeared. That the next brood of the season, the eggs having been laid by *Dryas*, had sometimes consisted wholly of *Dryas*, but in others of both forms, *Harrisii* considerably outnumbering *Dryas*. That the third brood, eggs laid by *Dryas*, had given *Harrisii* only and closed the season.

In same magazine, XIV, p. 189, 1882, I brought the history down to date. It appeared that in different years there was variation of at least a month in the laying of eggs by the hibernating females, depending largely on the state of the weather, and consequently nearly or quite a month's difference in the appearance of the first brood of the butterflies of the year.

I now bring together all these observations, with others to end of 1887.

FIRST BROOD: Eggs laid by HARRISII.

1869, 18th June, from chrysalis came 1 ♂ *Harrisii*.

1871. Between 10th and 18th May, found larvæ. Result, from 20th May to 2d June, 7 *Dryas*.

1873, 20th May, found larvæ. Result, about 20th June, 4 *Dryas*.

1874, 10th May, obtained eggs from female in confinement. Result, about 27th June, 34 *Dryas*.

1875, 14th May, obtained eggs as last described. Result, about 18th June, 19 *Dryas*.

1882, 17th April, obtained eggs, etc. Result, about 22d May, 12 *Dryas*.

1886, 16th May, found larvæ. Result, 1st June, 2 *Dryas*.

That is, 78 DRYAS to 1 HARRISII.

SECOND BROOD: Eggs laid by DRYAS.

1870, July, found larvæ. Result, 2 *Dryas*.

1873, 30th July, obtained eggs from female in confinement. Result, about 1st September, 6 *Dryas*, about 50 *Harrisii*.

1876, 29th July, obtained eggs, etc. Result, about 14th August, 5 *Dryas*.

1886, 25th July, came from chrysalis, from found larvæ, 2 *Harrisii*, 1 *Dryas*.

That is, 14 DRYAS, 52 HARRISII.

THIRD BROOD: Eggs may have been laid by either form.

1870, last of September, found 70 larvæ. Result, in October, all *Harrisii*.

The butterflies of the first brood then have come from chrysalis from 20th May to 18th June, in different years. Of the second brood, from 25th July to 2d September; of the third, about middle of October.

The caterpillars vary much, as shown on the Plates in Volume I, some being very black at maturity, others greenish-white. But the color does not indicate the form of the imago. From one lot of larvæ in June came 19 *Dryas*, though eleven of the larvæ were black, eight white.

Comparing the behavior of the species with what is in New England; according to Mr. Scudder, the first brood comes from chrysalis at the end of June and to middle of July, the second from about 25th August to last of September. This may be regarded as the history in northern New England. In the Catskills of New York, at Hunter, elevation about 2000 feet, I have found two broods, from about 20th August, all the individuals seen being *Harrisii*, in midsummer *Dryas*. In the lowlands of New York, I think there are three broods, but no one seems to have carefully observed about this. Mr. Lintner, at Schoharie, took both forms 24th July, when, if there were but two annual broods, only *Dryas* should have been flying.

The winter form *Harrisii* is found as far to the north as Fort Simpson, Mackenzie River, whence I formerly received several examples (as stated in Vol. I), in a large collection of butterflies made during one or two seasons by Mrs. Ross. As no *Dryas* appeared, it is to be presumed that this form did not fly there, and that the species was one-brooded only. And, according to Mr. James Fletcher, the recent collections made under the auspices of the Canadian Government

give evidence in the same direction.[1] It appears also that in Maine, at least in the interior and beyond, only *Harrisii* is found. Professor Braun tells me that neither he nor any collector known to him in the vicinity of Bangor has ever taken or seen *Dryas*, though *Harrisii* is not uncommon. And he did not recognize examples of *Dryas* which I sent him. Professor Fernald, in his Butterflies of Maine, speaks of the species as two-brooded, but he writes that he is not now certain of that, and has himself never known a *Dryas* to have been taken in Maine.

In Vol. I, I gave the food plants as Hop, Nettle, and false Nettle (Bœhmeria). To this I add Elm and cultivated Gooseberry, on which last plant I saw a female lay an egg, 14th April, 1886. According to Mr. Scudder, Professor Packard also gives Currant and Basswood (Tilia). But at Coalburgh the eggs are almost always laid on Hop and Bœhmeria, and either singly or in small clusters, more or less of them in strings of from two to half a dozen or more (on one occasion, a female confined in a bag over Hop laid forty-eight eggs, nearly all in strings, one of nine, two of eight, one of seven, and others of less number), standing at right angles to the surface of the leaf. The under side of the terminal, tender leaves is selected, but on Hop, the stem also. The newly hatched larva eats a hole in the substance of the leaf, and during the first stage feeds about this. For the first two stages it is exposed just as the larva of *Interrogationis* is, but at the second moult behaves differently from that species, which makes no shelter for itself at any time. In August, 1882, I watched three larvæ of *Comma* to learn at exactly what stage they began to protect themselves, placing them as soon as hatched on a plant of Bœhmeria set in flower-pot and in my room. Very shortly after the second moult they had got to the bases of the third pair of leaves from the top, two on one leaf, one on the other, and were engaged in drawing the edges of the leaves, next base, down with silk spun. To effect this, they had bitten off the principal rib on either side the mid-rib, very near the edge of the leaf, and had also cut across to the edge. This leaf naturally curves the other way, so that the caterpillars were working at a disadvantage on the convex side. But notwithstanding this, they had, in course of an hour, bent down the edges and bound them together for one half inch from base. Next morning all

[1] Mr. Scudder, But. N. E. p. 338, makes this remark respecting the occurrence of *Comma* on Mackenzie River: "In the north, Edwards records it from Fort Simpson, Mackenzie River, which is too far in advance of its ordinary range to be probable; as he had butterflies from the fort of the same name on Albany River, and Jenner Weir reports it from Moose Factory near there, the more southern fort is the probable locality meant." To this I would say that I once received a few butterflies from Rupert House, three or four *Machaon-Aliaska*, and one Chionobas *Calais*, carried overland by Mr. Drexler in his note-book, and from no other quarter in northern British America. The *Comma* came from Mackenzie River. Mr. Bernard C. Ross afterwards told me, when in New York, that the summer at Fort Simpson was hot, even if short, and that melons had ripened within the walls of the fort.

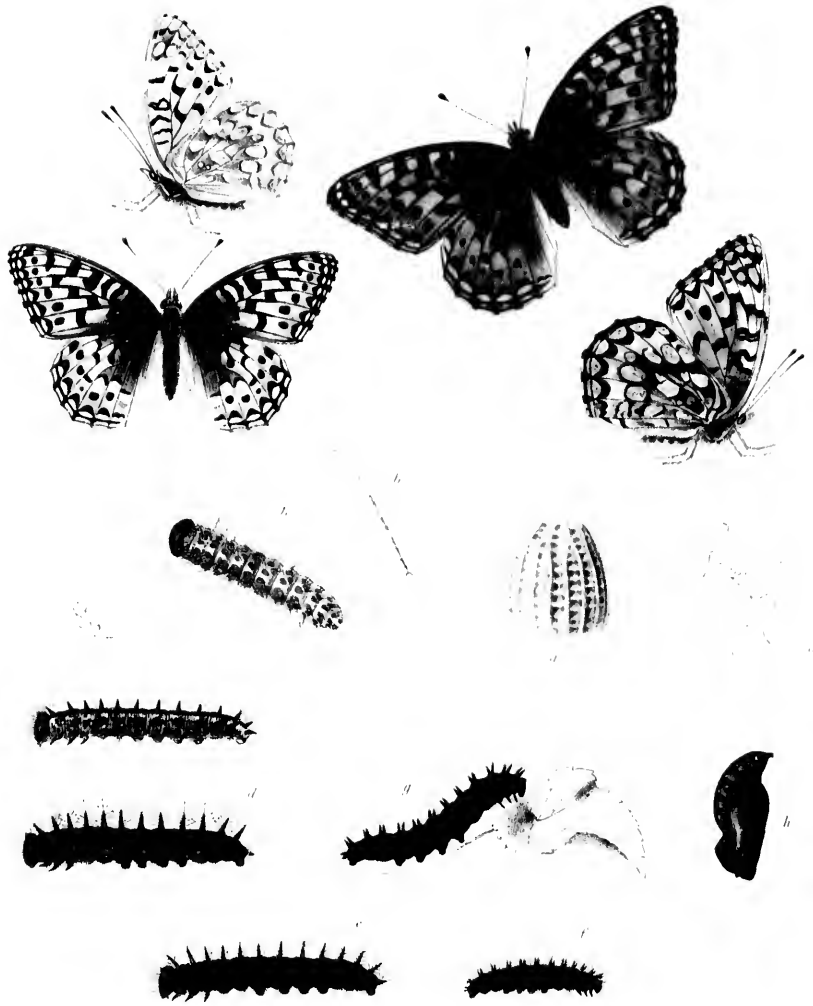
were resting under their completed awnings, two under one, as at first, and had fed off the tip end of the leaf. I had to transfer them to a larger plant, and the next day found two under one leaf, which had been brought together during the night. The third larva was on the upper side of its leaf and had closed that next base. Later, this larva had drawn down the top of the plant and was concealed very much after the manner of the larva of P. *Atalanta*, which uses this same plant. Here it passed the fourth moult. By which it appears that these larvæ can adapt themselves to circumstances. I noticed that at the older stages the ribs were not bitten, nor were the edges of the leaf cut, the larva being able to draw down the edges and sides without that aid. When lying under the shelter they are at the inmost part, and are curled up much like figure 6. I have occasionally found two larvæ under one tent on Hop. So far as I know, pupation does not take place under the tent, but the larva seeks a suitable and protected place at a distance.

The nearest ally of *Comma* is G. *Satyrus*, figured with its larva in Vol. I, pl. 40, a species common in the Pacific States to the Rocky Mountains, and which has occasionally been taken as far to the east as Montreal, Canada. An example has also been taken in the Adirondacks of New York, by Mr. W. W. Hill. I received a large number of chrysalids of *Satyrus*, perhaps fifty, from Mr. H. K. Morrison, sent from Olympia, W. T., and not one gave imago. Each was filled with multitudes of dipterous larvæ. If this pest is found elsewhere as at Olympia, it would seem that the Grapta has a severe struggle for existence. *Satyrus*, like *Comma*, is seasonally as well as sexually dimorphic, the second form being MARSYAS, figured in Vol. II, pl. 34. The larvæ much resemble those of *Comma* and protect themselves in precisely the same manner. These are the only American species of the genus known to have this peculiar habit.

I placed twenty-six chrysalids of *Comma*, at from ten minutes to six hours from pupation, on ice, and kept them at a low temperature for eighteen and twenty days. All were killed, and since then, for want of ice, I have been unable to repeat the experiment. Perhaps better results would have been obtained had the pupæ been from twelve to twenty-four hours old.

ARGYNNIS.

V.



NEVADENSIS 1 2 ♀ HALCYONE 3 4 ♀.

APHRODITE

a a Eggs magnified
b g Larvæ, the early stages "
h Chrysalis

ARGYNNIS V.

ARGYNNIS NEVADENSIS, 1, 2.

Argynnis Nevadensis, Edwards, ♂ (not ♀), But. N. A., Vol. I, p. 93, pl. 33. 1871; Geddes, Can. Ent., Vol. XIX, p. 232. 1887.

Female. — Expands from 2.2 to about 2.6 inches.

Upper side pale yellow-fulvous, often very light; the submarginal spots paler than the ground, as are often the spots on secondaries which correspond to the second silvered row beneath.

Under side of primaries as in the male, but often quite red at base and along inner margin; the apical area and hind margin, and all of secondaries, mottled with pale olive-green on yellow ground; the silver spots large. (Figs. 1, 2.)

At the time the Plate in Volume I was published, 1871, scarcely anything was known of this species, beyond the fact that Mr. Henry Edwards had taken a few examples in Nevada, about Virginia City and Lake Washoe. The female figured was sent by him as belonging to the male, but was afterwards found to be of A. *Coronis*, which is illustrated in both sexes in the present Volume.

Nevadensis proves to be a widespread species. Mr. H. K. Morrison brought great numbers of it from Nevada, Wyoming, and Montana; I received examples from the boundary line, Montana, by Dr. Coues; also from Douglass County, Washington, and from Utah; and Captain Gamble Geddes also reports it at Calgarry, N. W. Territory.

ARGYNNIS V.

ARGYNNIS HALCYONE, 3, 4.

Argynnis Halcyone, Edwards, ♂, But. N. A., Vol. I, p. 83, pl. 28. 1869.

FEMALE. — Expands from 3 to 3.25 inches.

Closely like the male in color and markings, as described; but some examples are of a deep brown-red. The silver spots are large. Those of the second row round or broad oval mostly. (Figs. 3, 4.)

HALCYONE was described twenty years ago from two examples of the male sent me by the late B. D. Walsh, which had been taken somewhere in Colorado by Dr. Velie. It was many years before I saw another, on Mr. Morrison's return from a collecting trip in southern Colorado. From him I had a few specimens, mostly females. Some years ago, Mr. E. A. Dodge sent me a male taken in the same State, but with no note of locality. And in 1886, Mr. David Bruce sent a male from Golden. The species is still a very rare one in collections, but I think somewhere in the south or southwest of Colorado and the adjacent parts of Utah and Arizona it will some day be found in abundance.

ARGYNNIS V.

ARGYNNIS APHRODITE, a–h.

Argynnis Aphrodite, Fabricius; Edwards, But. N. A., Vol. I, p. 71, pl. 22. 1868; id., Can. Ent., Vol. VI, p. 121. 1874: Fernald, But. Maine, p. 39. 1884; French, But. East. U. S., p. 157. 1886; Scudder, But. N. E., p. 563, pl. 4, figs. 1, 2. 1889.

Both sexes of APHRODITE are figured in Volume I. The preparatory stages have never been described or figured, with the exception of the egg, young larva and chrysalis, in But. N. E. I now give the complete history.

EGG. — Conoidal, truncated and depressed at top; in general like *Cybele*, but narrower at base, or higher in proportion to the width; marked by about eighteen prominent, vertical, slightly wavy ribs, part of which extend from base to summit and form about the latter a serrated rim, the others ending irregularly at three fourths or more the distance from base; the rounded spaces between the ribs crossed by nearly equi-distant fine ridges; micropyle in the centre of seven minute five-sided cells, about which are two or three rows of larger cells, irregular, but mostly five-sided. (Figs. *a*, a^2.) [illegible]ration of this stage 15 to 22 days.

YOUNG LARVA. — Length, at twelve hours from the egg, .06 inch, cylindrical, somewhat stoutest in middle; color dull green, semi-translucent; marked by eight longitudinal rows of dark, sub-triangular, flat, tuberculous spots, three of which are above the spiracles on either side and one below; these bear small tubercles, in the upper or dorsal row two, in the next two rows one, in the lowest row four, each giving out a long, tapering, clubbed hair; on front of 2 is a large dorsal spot, sometimes divided into two, bearing three tubercles on either side the mid-dorsal line; on the two following segments the three spots are nearly in vertical row; on 5 to 13 those of upper row are near the fronts of the segments, of the next row to the rear, of the third row a little in front of the middle; color yellow-green; under side, feet and legs, more green; head a little broader than 2, rounded, flattened frontally, a little bilobed, with many long

hairs; color black-brown. (Figs. *b*, b^2.) The larva hibernates at this stage, direct from the egg.

After first moult: length, at twelve hours, .14 inch; shape of *Cybele;* color gray-green, mottled with olive-green and brown; spines as in the genus, black from greenish bases, each ending in a short black spinule, and with several others about the sides; under side more green; feet black, pro-legs brown-green; head sub-cordate, the vertices rounded at top of each, to the front, a little conical process; furnished with many black hairs; color shining black-brown. (Fig. *c.*) To next moult seven to ten days.

After second moult: length, at twelve hours, .2 inch, color dark greenish-brown, mottled in shades; the spines black, and also the bases, except that the upper row have a little yellow on the outer side, the lower row, and those of middle row on 3 and 4, a little yellow all round; under side brown-green; head shaped as before, shining black. (Fig. *d.*) Duration of this stage five to eight days.

After third moult: length, .36 inch; color dark brown, the spines black; those of lower row and the anterior two of middle row, dull reddish-yellow at base, the rest of both rows very slightly tinted same; head as at previous stage, black, with many long hairs. (Fig. *e.*) To next moult six or seven days.

After fourth moult: length, .55 inch; color dull black; all spines black, the lower row dull yellow at base; head as before, but dull black over front, reddish-yellow behind. (Fig. *f.*) To next moult about six days.

After fifth moult: length one inch. Reached maturity in about seven days.

Mature Larva. — Length, at rest, 1.6 inch, in motion, 1.9 inch; cylindrical, slenderer than *Cybele*, somewhat thickest in middle segments, each segment well rounded; color blackish-brown, with a velvet black patch about base of each spine, making six longitudinal macular velvety bands; the spines of dorsal rows on 2 no longer than others, a little turned forward; all spines slender, beset with black bristles; the bases of lower row dull reddish-yellow, the others black, but those on anterior segments greenish; under side dark brown; feet black, pro-legs brown; head small, as broad as high; sub-cordate, the front flattened, the back much rounded, the vertices sub-conic, each on its anterior side bearing a small conical process; the face much covered with black hairs of irregular lengths;

color of front dull black, of back reddish-yellow. (Fig. *g*.) In five or six days from maturity the larva suspends, and in from thirty-six to sixty hours pupates. Time from fifth moult to pupation twelve to fourteen days.

CHRYSALIS. — Length one inch, breadth at wing cases .35, at abdomen .32 inch; greatest depth .4 inch; cylindrical, a little compressed laterally; shape of *Cybele*, rather more slender, the head case a little narrower; head case, and antennæ and tongue cases, shining brown-black, the first of these a little mottled with brown-yellow; the wing cases light yellow-brown, crossed by very many fine dark brown streaks, and with a patch of same color near shoulder, another on disk, and a large, broad patch near to and along hind margin; abdomen gray and brown in transverse bands; on dorsum the gray area is serrated, the points reaching the front of each segment; on sides and beneath the brown and gray areas are about equal, the gray in rear. (Fig. *h*.) Duration of this stage seventeen to twenty days.

Another chrysalis was olive-brown, the anterior parts much covered with dark brown dashes; the wing cases pink-tinted, and dark next hind margin, the whole finely reticulated with dark brown streaks; the anterior part of each abdominal segment black, in a cross band, the posterior edges irregular, rather erose than serrated.

In the text to Argynnis *Diana*, Vol. II, p. 147, 1876, I gave a general account of raising larvæ of APHRODITE. I have since then several times bred the species from eggs obtained at Coalburgh, W. Va., carrying the larvæ through the winter in a refrigerating house. In all cases they went into lethargy direct from the egg.

In 1888, I obtained eggs from a female confined over violet, on 23d September. These hatched 15th October, and the larvæ were sent to Clifton Springs, New York, whence I received two survivors, 16th April, 1889. These were placed at once on a plant, set in flower-pot, and covered by a muslin bag. One was seen no more, but the other fed and passed its first moult 24th April; the second, 1st May; the third on 6th, the fourth on 12th, the fifth on 18th; suspended 30th, and pupated 2d June. The imago came forth 19th June, a female, after seventeen days in pupa. The only peculiarity I noticed in this larva was, that when about to pupate, it made for itself a tent of the leaves of the plant by weaving them loosely together, so low down that when in suspension it would nearly touch the ground. Not knowing what was going on, I pulled one leaf off and the larva fell. The same afternoon it had fixed itself under another leaf,

five inches above ground, and with no attempt to bring other leaves about it. There it pupated. It may be that the making of a tent for pupation is the usual habit of the species in natural state, and it may also be a habit of the genus. But in confinement I have not before observed it in any species. Usually my Argynnis larvæ have suspended from the sides or top of the bag.

Since the Plate of this species was given in Vol. I, 1868, much has been learned of its distribution. It is not common in the Kanawha Valley, West Virginia, where *Cybele* is abundant. I never have seen it in June, when many *Cybele* are flying, but every year I see a few examples in September. To the eastward of my home, some fifty miles, among the mountains, elevation 2000 feet and more, I have reason to think it is common enough, and perhaps replaces *Cybele;* for some years ago, Professor Julius E. Meyer brought several *Aphrodite* and no *Cybele* from a day's collecting in Fayette County. Probably it is found in the mountains all the way to southern North Carolina. Mr. E. M. Aaron has taken it at Asheville, and has received it from Macon County, in same State. He has taken it, he tells me, in various parts of middle and eastern Tennessee, and knows of its having been taken in northern Alabama. How far to the westward it flies is uncertain, because it has been confounded by myself, Mr. T. L. Mead, and others, with Arg. *Cipris*, Edw., a nearly allied species that abounds in the Rocky Mountains from New Mexico and Arizona, through Colorado and Montana into British America; and with another, A. *Alcestis*, Edw., which inhabits Illinois and beyond, to Nebraska. It therefore happens, from the confusing three species together, that the western limits of *Aphrodite* are as yet undetermined. In Papilio, Vol. III, p. 161, 1883, I gave Judith Mountains, Montana, as a locality, but I had *Cipris* in view. So I think it possible that *Cipris* was the species taken by Captain Geddes, at Edmonton, Alberta, and by Professor Dawson, at Woody Mount, Assiniboia. *Aphrodite* is stated by Mr. Scudder to be common in parts of Ontario, and in Quebec, along the lower St. Lawrence; also in Nova Scotia; but is wholly absent from the White Mountain region of New Hampshire, being replaced there by Argynnis *Atlantis*.

SATYRUS.

I.

PEGALA 1 2 ♂ 3 4 ♀. 5 ♀. VAR.:
ALOPE VAR 6 7 ♂ 8 ♀.

SATYRUS I.

SATYRUS PEGALA, 1–5 : 8.

Satyrus Pegala (pe-ga'la), Fabricius, Syst. Ent., p. 491. 1775. Edwards, Proc. Ent. Soc., Phil., Vol. VI, p. 195. 1866; id., Can. Ent., Vol. XII, p. 5. 1880.
Alope? var., Boisduval and Leconte, Lep. de l'Amer., pl. 228, p. 59. 1833.
Form Pegale, J. B. Smith, Bull. Brooklyn Ent. Soc., Vol. VI, p. 128. 1884.

Male. — Expands from 2.4 to nearly 3 inches.

Upper side dark brown; hind margins bordered by two fine darker parallel lines, a little within which is a stripe of same color; primaries have an extradiscal deep ochre-yellow transverse band, broadest anteriorly, incised on basal side at the upper median nervule; on this is a single black ocellus, lying across the discoidal interspaces, with a small central cluster of blue scales, a few of which are often replaced by white; occasionally there is a black dot, or even a small blind spot, suggesting a second ocellus, in middle of second median interspace.

Secondaries have a black ocellus on second median interspace, in yellow ring, with small white, or blue and white, pupil; fringes of both wings concolored.

Under side yellow-brown, with a gray tint, most decided on apical area of primaries and beyond disk of secondaries; the band repeated, paler; the ocellus repeated, a little enlarged, the cluster of scales enlarged, often elongated into a blue nebulous streak, having, in the end toward base, a solid nucleus of white; the marginal lines and stripe conspicuous; the brown area covered densely with abbreviated dark streaks, which over bases and disks form somewhat concentric broken rings, limited without by a common dark stripe; this on primaries edges the band, on secondaries is irregularly sinuous, throwing out a rounded projection against cell, followed by a rounded sinus on second median interspace; the ocelli are six, in two groups of three, each on a patch of clear dark brown, one across the lower subcostal and discoidal interspaces, the other across the median; these are either round or oval, individuals varying, the middle one of each group

largest; each in yellow ring, and with blue or blue and white pupils, the clusters varying sometimes as described on primaries.

Body concolored with wings; legs and palpi dark brown; antennæ brown, finely annulated with white; club ferruginous. (Figs. 1, 2.)

Female. — Expands about three inches.

Upper side color of male; the band broader; the ocellus sometimes large, with large central cluster; some examples have an additional spot, like some males, and occasionally there is a second ocellus quite as large as the first, and as conspicuously pupilled. Under side more gray, sometimes very light on secondaries; there is also a trace of a brown stripe on same wings near base, particularly across cell. (Figs. 3, 4, vars. 5, 8.[1])

This species varies in respect to the ocelli of both surfaces. In my paper referred to, in the Canadian Entomologist, I stated that I had before me twenty-nine examples, being all I had in my own collection, or could borrow from correspondents. Of these, twenty-one were males, eight females. Of the males, fourteen had one ocellus on fore wing, two had an ocellus and a small black spot, six had the ocellus and a mere point. Beneath, seventeen had six ocelli on hind wing, three had five, and one had five on one wing and six on the other. All had the ocellus on upper side of hind wing.

Of the females, five had one ocellus only; one had one and a small spot, while two, one of which is figured on the Plate (5), had two large, equal, and conspicuously pupilled ocelli. On under side, six had six ocelli, one had five, and one had five on one wing and six on the other. "The uniformity of these characters — the ocellus at inner angle always present, and the number of small ocelli, which are scarcely ever less than six and never less than five — in so many examples brought from various quarters, contrasts strikingly with the great variability of *Alope* and *Nephele* in the same points" (p. 54).

One of the two-eyed examples seems to have been figured by Boisduval and Leconte, after Abbot, for *Alope*. Dr. Boisduval says in the text that he regards *Pegala* as a one-eyed variety of *Alope*. In my copy of the work, the larva is represented as having the dorsum green, the side white, divided longitudinally by a narrow gray band. This white may have originally been colored yellow, as Mr. Smith says his copy of the book shows yellow, with green over the gray band. But all this is quite unlike *Alope*, and its co-form *Nephele*, as may be

[1] Fig. 8, on the Plate, represents a fore wing of *Pegala*, variety, from Florida, and the reading at bottom is incorrect.

seen on referring to Volume II, Plate 41, Fig. *h*. The whole surface here is green, except a narrow stripe of yellow along base, and a subdorsal faint yellow line. The larva of *Alope*, form *Olympus*, Plate 42, Fig. *a*, is green, but has the subdorsal line developed into a stripe as conspicuous as the basal. The chrysalis of Boisduval's plate has two ocellar prominences, much as in Neonympha *Gemma*, while the head case of *Alope* is truncated and rounded, with no projections.

I have tried in vain for years to obtain eggs of *Pegala*, in order to become acquainted with all the preparatory stages. Until we know to the contrary, I suppose the coloring of the larva and the shape of the chrysalis, as given by Abbot, must be regarded as correct. Though I only know of these by Boisduval's figures spoken of.

I was informed by that veteran lepidopterist, the late Mr. James Ridings of Philadelphia, who collected one season in Georgia, after I became acquainted with him, that, in its habits, *Pegala* differed considerably from *Alope*, flying in the pine forests and alighting on the bark of trees. When disturbed, it would fly about for a while, and eventually return to the same spot. It seemed to him to resemble Debis *Portlandia* in habits rather than *Alope*.

Mr William H. Ashmead, when a resident of Jacksonville, Florida, wrote me: "*Pegala* is quite common in hummocks, along fences, and in the outskirts of forest, from about the middle of July to October. When chased they fly high and alight on the side of a tree, and are seldom seen in open fields." (*Alope* and *Nephele* fly slowly and low, and I have never heard of their alighting on trees.) Dr. A. W. Chapman wrote from Appalachicola: "*Pegala* is or was common in the open pine woods back of this city. It seemed to like a hot, sandy exposure, but I never saw one in my garden or in the fields. They always alight on the naked bodies of the pines, with head up, down, or sideways."

This species seems to be very nearly restricted to the southern part of the Gulf States. It has been taken in a single instance by Mr. T. L. Mead, in middle Florida, at Oviedo, Orange County. He sent me a male caught in his peach orchard, the present year (1889); and writes as follows: "The only examples seen were the one sent you and one other. I saw them in the orchard on the fallen fruit. When disturbed, and at other times, they hid in the dense foliage of the orange trees. In company with them were some Limenitis *Eros* and an Apatura." So far as I know, *Pegala* has not before been taken much to the south of Jacksonville. How far to the northward, along the coast, it flies, I am not advised. I formerly received examples from St. Simon's Island, Georgia.

What I spoke of as "a diminutive *Pegala* (as if from a starved caterpillar)" in Can. Ent. XII, 52, sent me by Professor Lewis R. Gibbes, of Charleston, S.

Carolina, I now believe to have been a variety of *Alope*. Rev. Dr. John G. Morris told me, in 1880, that he had never known *Pegala* to have been taken along the coast of Virginia or Maryland. At the same time, Professor C. V. Riley made inquiries of lepidopterists in Washington, and all agreed that the species was unknown there. A similar inquiry made the present season received a similar reply. I could not hear that it was found in middle and northern Georgia or in north Mississippi, on corresponding with collectors. And the late Messrs. Boll and Belfrage, long resident in Texas, and professional collectors, could give me no information about *Pegala*, though Mr. Belfrage said that *Alope* was common where he lived, in Bosque County. Mr. Heiligbrodt, at Bastrop, said that, at times, *Alope* had been common, but he did not know *Pegala*. But, on the other hand, Mr. Otto Meske, of Albany, N. Y., wrote that, in 1876, he received a single *Pegala* from Bastrop, the only one he ever saw from Texas. This may have been a one-eyed *Alope*, for occasionally an *Alope* with but one ocellus is taken in the Northern States.

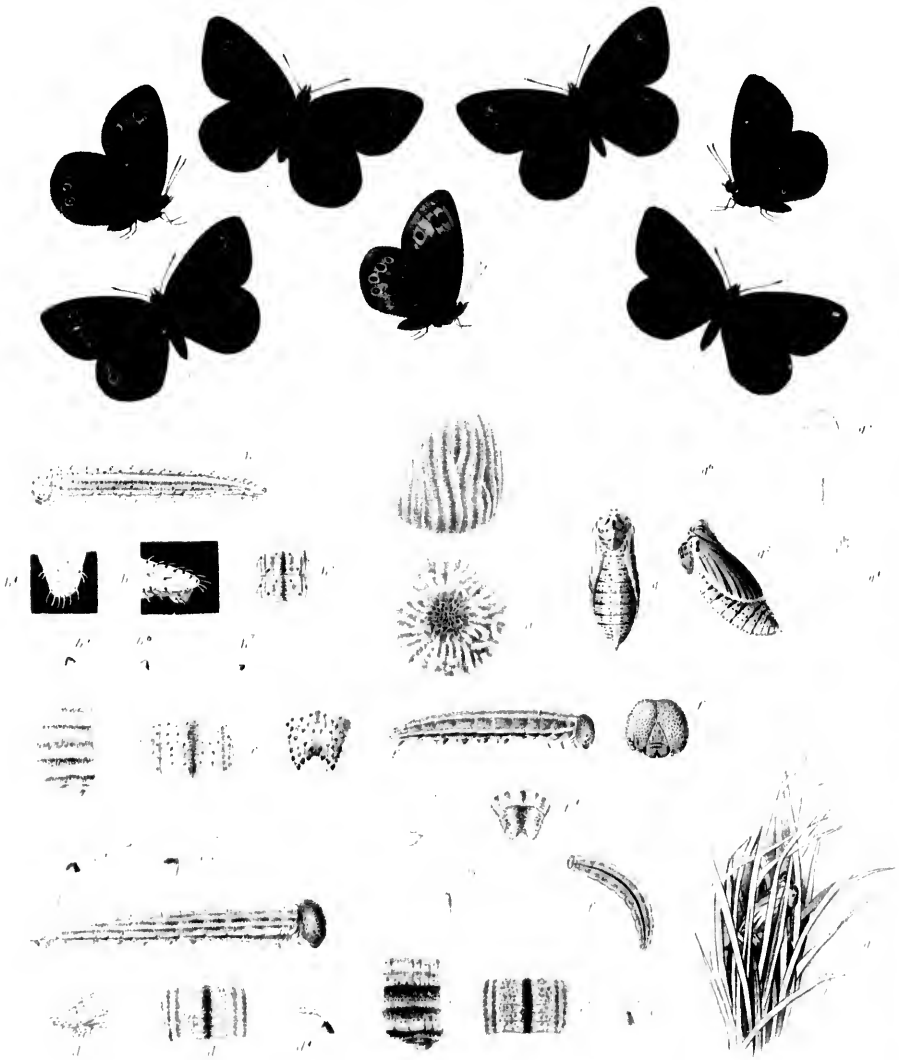
But, on the other hand, Mr. William H. Ashmead writes me that he saw two examples of *Pegala*, the present season, at Alum Springs, Rockbridge County, Virginia, "one of which alighted on the side of an oak tree not four feet from me, and I had a most excellent opportunity for seeing it. It astonished me to see this species so far north, and I pointed it out to my little daughter, who was walking with me at the time, and said: 'See, there is a beautiful butterfly, like what we have in Florida.'" The locality is about 150 miles southwest of Washington, among the mountains. It is almost impossible to get information about buttertlies, at the present day, in any of the Southern States, except Florida and Texas. Fifteen and even ten years ago, there were several persons, in different States, to whom I could apply for information. Now I do not know of one. The late H. K. Morrison lived among the mountains of North Carolina, and year after year made collections of butterflies for sale, but I have never heard that he took *Pegala* anywhere, certainly, in his own State. I have no idea that this species is found from Alum Springs southward, or that its presence in the locality mentioned is other than accidental.

What, then, is the form which has been taken somewhat abundantly in certain parts of New Jersey; by Mr. E. M. Aaron, at Mt. Holly, in 1882, by Mr. J. B. Smith, "in the pine barrens," 1883, and by Dr. Henry Skinner, at Cape May, 1889? It is small (Figs. 6, 7), the size of *Alope-Maritima*, and looks like that form. But many examples have but one ocellus; others have one and a point in place of the second. Dr. Skinner writes that there are all sorts of intergrades up to undoubted *Alope*, and they fly together. He has sent me a male, on which the band is yellow, not ochraceous. On fore wing there is a single ocellus, and on

under side of hind wing there is also but a single ocellus. The absence of more or less of these ocelli on hind wing is a peculiarity of *Alope*, but not of *Pegala*. In the former, a large percentage of individuals have but one, two, and three ocelli, and many indeed none at all. I regard these New Jersey examples as strictly variations of *Alope*. If the whole group, in North America, has sprung from *Pegala*, as I consider probable, these cases of single ocellus appearing at the east, in the territory of *Alope*, or, at the west, in that of *Ariane*, are owing to reversion. But I have spoken of this matter at length in Volume II, and need say no more here.

EREBIA.

III.



EPIPSODEA 1 2♂ 3 4 ♀ 5♂ 6 7♂ VAR BRUCEI

1 Egg 2 Larva 3 Pupa 4 Imago 5 Female 6 Chrysalis

EREBIA III.

EREBIA EPIPSODEA, 1–7.

Erebia Epipsodea, Butler, Catalogue of Satyridæ of British Museum, p. 80, pl. 2, fig. 9. 1868; Mead, Report Wheeler Expedition, Vol. V, p. 776. 1871.
Rhodia, Edwards, Trans. Am. Ent. Soc., Vol. III, p. 273. 1871.
Var. Brucei, Elwes, Trans. Ent. Soc., London, 1889, Part II, p. 326.

Male. — Expands 1.6 to 1.9 inch.

Upper side dark velvety-brown; primaries have a submarginal patch of bright red-fulvous, broad on the lower subcostal and discoidal, narrow on the median, interspaces, containing from two to four black ocelli, one being in each of the discoidal interspaces, one in the second median, and if there be a fourth, it is in the upper median; the third and fourth, one or both, are usually mere dots; sometimes the larger of these ocelli are pupilled with white, but often all are blind.

Secondaries have a submarginal row of fulvous patches, four or less, sometimes immaculate, at others with a central black dot in one or more of them; but sometimes with pupilled ocelli as large as the lower one on primaries. Fringes concolored.

Under side of primaries dark brown, often with a faint tint of fulvous over the disk; the patch repeated, the spots also, the upper pair, one or both, usually enlarged.

Secondaries brown, with broad discal band of darker hue, the inner edge of same irregularly sinuous, the outer sinuous, partly crenate; the basal and marginal areas paler, with a sprinkling of gray-white scales, as shown in the figure of the female, 4; in many examples the entire wing is nearly of one shade, and the markings are obsolescent as in Fig. 2; the spots of upper side repeated, each within a slight ring of fulvous.

Body brown-black; palpi same; fore legs same, the others gray-buff; antennæ brown above, gray-white below; club brown above and below, the sides and tip fulvous. (Figs. 1, 2, 5.)

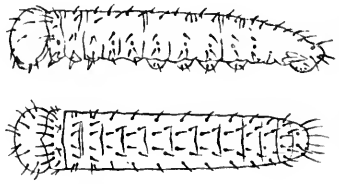
FEMALE. — Expands 1.8 to 2 inches.

Similar to the male in color and markings, except that the ocelli are enlarged, and are often very conspicuous (Fig. 5); the tint of fulvous of under side is often a decided color; occasional examples show five ocelli on primaries, the fifth being in submedian interspace; in one under view, the upper pair and the fourth spot are large, the third is small, and the fifth is of half the diameter of the third, and all five have white pupils. (Figs. 3, 4.)

Var. BRUCEI. This differs from the type in having no ocelli on either wing; and the under side of secondaries of nearly uniform shade, with little or no trace of a band. But in some examples which show no ocelli on upper side of primaries, there are black points on one or both surfaces, in the discoidal interspaces. (Figs. 6, 7.)

EGG. — Sub-ovoidal, a little flattened at base, the top depressed and a little convex; broadest just above base, narrowing towards summit; about one fifth higher than broad; marked by about thirty-five vertical, somewhat sinuous, ridges, most of which extend from base to the rim of summit, but a few from base one third to one half up, or from summit as far down, and join the main ridges; these are high, narrow at top and flattened or rounded, the sides sloping, a little incurved, the bottom of the depression rounded; the micropyle is in the centre of a rosette of several concentric rings of minute cells; color chalk-white. (Figs. *a*, a^2.) Duration of this stage about twelve days. The egg resembles that of *Magdalena* in sculpture, but is less regularly ovoidal, and the base is flattened.

YOUNG LARVA. —Length, at twenty-four hours from the egg, .11 inch; thickest anteriorly, tapering very gradually on back and sides to 7 or 8, then more rapidly, the dorsum arching to 13, which ends bluntly, without tails; furnished with three rows of blackish, sub-conical tubercles, each of which gives a white process; these rows are dorsal, sub-dorsal, and lateral; on 2 there is an additional tubercle back of and between those of two upper rows, and another a little below and behind the lateral; and there are two in front, in vertical line, a little above the spiracle; on 3 and 4 the three tubercles are nearly in vertical line, but from 5 to 12 they are in triangle, the dorsal one in front, the sub-dorsal at rear, the lateral a little before



the middle of the segment; on 13 are two rows with six tubercles, made from the dorsal and sub-dorsal, which here come nearly into line, a lateral on either side, in front, and six around the end, projecting horizontally (Figs. b^3, b^4); the interior four small, with somewhat shorter processes; the processes on 2 are thickly clubbed (Fig. b^5), on the following segments to 12 are longer and scarcely clubbed (Fig. b^6), on 13 cylindrical, and still longer (Fig. b^7); along base a row of minute tubercles with short hairs, two to each segment on 2 and 5 to 13, one on each of the rest; color greenish-white, with a mid-dorsal brown line, and three similar equidistant lateral lines, the space between the second and third specked with black or dark brown; under side, feet and legs paler; head a little broader than 2, subglobular; covered with shallow pits, marked by a few low subconical tubercles, blackish, each with light hair. (Fig. *b*; cross section, middle segments, b^2.) Duration of this stage six to seven days.

After first moult: length, at twelve hours, .2 inch; nearly same shape, thickest at 2, tapering gradually to 11, then rapidly, curving roundly to extremity, 13 ending in two short conical tails (Fig. c^3); the tubercles similar to those at first stage, but much more numerous, bent, arranged irregularly in both horizontal and cross lines, those on 2 decidedly, on segments to 12 slightly, club-shaped (Fig. c^4), on 13 nearly cylindrical, gradually thickening towards end (c^5); color greenish-yellow, as are also the under side, feet and legs; a mid-dorsal blackish-brown stripe, on the side three narrow, equidistant, brown stripes; the basal ridge yellowish, and under it a brown line; head as before, subglobular, pitted, with many fine tubercles, and short processes and hairs; color green-yellow. (Figs. *c*, c^2, section of side and dorsum, segment 7.) To next moult about ten days.

After second moult: length, at twenty-four hours, .28 inch; shape as before, tails as before; the tubercles and processes much more numerous; color greenish-yellow; a mid-dorsal heavy brown stripe, three light ones on side, equidistant; the basal ridge more yellow, and beneath it another brown stripe; under side, feet and legs pale green; head as before, yellow-green. (Fig. *d*; d^2, cross section.)

After third moult: length, at twenty-four hours, .38 inch; scarcely differs from the last preceding stage, the tubercles still more numerous, bent close to the body. (Fig. *e*, section of side of segment 7; e^2, across dorsum of same.)

Some weeks after the moult, one of the larvæ having reached the length of .6 and two of about .5 inch, they became lethargic, and were taken to Clifton Springs, New York, and placed in the refrigerating house there, the temperature

of which is supposed to be about 40° Far., the year round. I received them again 5th April following, two alive and healthy. During the night of 14th–15th April, one passed a moult.

At fourth moult: length, twelve hours after, .65 inch; color over dorsal area brownish-green, the sides pale brown-yellow; the mid-dorsal band intense black; a pale black, almost faded out, sub-dorsal line, a stripe of pale black on middle of side; the basal ridge more yellow, and under it a macular black line; gradually, as the stage progressed, the brown passed away, and by the sixth day from the moult, the body was decidedly green, as shown in Fig. f^2. At about twelve days from fourth moult, the larva was fully grown.

Mature Larva. — Length one inch; body stout, thickest in middle, arched dorsally, the last segments curving rapidly; 13 ends in two short bluntly rounded sub-conical tails (Fig. f^1), the space between nearly a right angle; whole surface densely covered with fine, sharp, conical tubercles, each giving a short tapering process (Fig. f^6) or hair; color a delicate yellow-green, the under side more green, as are also the pro-legs; the legs brown-yellow; the mid-dorsal band narrow, widest on middle segments; high on the side, a rather indistinct yellowish stripe; the basal ridge greenish; head sub-globose, covered with shallow brown pits (the lithographic artist has represented the face in f^3 as if covered with raised tubercles, and the mistake was not noticed in time to correct it); color pale yellow-brown, the ocelli black. (Fig. f, side view as in f^2). From fourth moult to pupation about seventeen days.

Chrysalis. — Length .48 inch; breadth across mesonotum .16, across abdomen, .18 inch; cylindrical, abdomen stout, conical, the ventral outline nearly as much curved as the dorsal, ending in a short spur, which is furnished at and near the bluntly rounded tip with a few very short, straight bristles (Figs. g^4, g^5, g^6); head case short, projecting little beyond base of mesonotum, but produced on ventral side considerably, so that the ventral outline from summit to middle of wing cases is much excavated (the entire ventral outline, from summit to cremaster forms a double curve); the top narrow, a little convex, the sides notched; mesonotum low, scarcely at all carinated, rounded both ways, followed by a shallow excavation; color whitey-brown, much specked with brown-yellow, especially on dorsal side; the head case and mesonotum marked by abbreviated brown streaks, the most conspicuous of which are three converging on the carina and sides of mesonotum; the antennæ and tongue cases also indicated by black lines; the wing cases have eleven or twelve black longitudinal streaks,

reaching the hind margins; the abdomen crossed by brown lines at the junctions of the segments, and dotted longitudinally with black in dorsal and lateral lines, two dots to the segment. (Figs. g, g^2, g^3, enlarged.) Duration of this stage ten days.

EPIPSODEA was first known to me by examples taken by Mr. T. L. Mead, in Colorado, 1871. He says, in Report of the Wheeler Expedition: "This species inhabits the mountains of Colorado below timber line. Specimens were brought from Fairplay by the Expedition. It begins to appear about the first week in June, is common by the middle of that month, and remains until the last of July."

Several examples were received in 1883, by Mr. William M. Courtis, from Judith Mountains, Montana, at about 4,000 feet elevation, in July. From Mr. Ernest Stevenson, at Walla-Walla, southeast Washington, came some unusually large specimens, late in June, 1885; others from Spokane Falls, in east Washington, by Dr. W. J. Holland. I have also received this species from St. Michaels and Nushagak, Alaska; and have received eggs from Mr. Thomas E. Bean, at Laggan, Alberta. On the other hand, I have not seen *Epipsodea* from south Colorado, or New Mexico, or Arizona, or Utah, nor from the Sierra Nevada range anywhere. So far as appears, it is confined to the Rocky Mountains from middle Colorado northward to the Arctic sea, but flies over the lowlands in its northernmost range, and may there have a wide distribution. Many examples from Colorado are small, the wings expanding less than any seen from Alaska; and the largest have come from Washington. Throughout its territory the two principal varieties seem to be found, the banded and not banded.

Mr. Butler described the species from two individuals "from Rocky Mountains," but the locality was not stated.

Mr. Bruce writes: "I first met with *Epipsodea* in Platte Cañon, Colorado, at about 9,000 feet elevation. It frequents damp and boggy places where the grass grows rank and coarse. In such situations, up to nearly 12,500 feet, I found it rather common. In one place, at the highest altitude named, a small stream of muddy water from a mine had been conveyed in wooden troughs which emptied into a basin-like depression; in this place, being always moist, the grass and flowers grew luxuriantly, and many species of butterflies were in profusion. *Epipsodea* was plenty, and in almost all the examples I captured here, the ocelli on upper wings were absent. Many had none on lower wings, others showed black points more or less minute.

"This variety, which Mr. Elwes has called E. BRUCEI, I see, is probably peculiar to these high stations, where I have found it during three seasons, for, in the

valley below, there was a narrow, boggy tract, more than a mile long, where *Epipsodea* was plentiful; but I found none of the variety spoken of. The only variation there was marked by the absence of the band on under side hind wings, and this was confined to few individuals.

"*Epipsodea* has a rather quick, jerky flight. It is not very readily captured, for, although it never appears to be in a great hurry, it flies close to the ground, and is always just ahead, dodging under every bush, and around every grassy hummock, as if in earnest search of something. It takes long flights without going far away, and seldom alights on flowers. Directly the sun is obscured, it dives in the grass, like almost all the mountain diurnals. All the Erebias, as well as the alpine species of Chionobas, 'play possum,' and pretend to be lifeless when captured, and will lie in or under the net, or on one's hand, some moments in that condition. I have found *Epipsodea* from June 9th to the end of August, in the front Range, in Colorado; at the latter date it was badly worn."

Mr. Elwes says, Tr. Ent. Soc., Lond., 1889, Part II, p. 334: "I have a single specimen, and Mr. Godman has a similar one, collected by Bruce in Cashier Valley, Summit County, Colorado, at 12,000 feet, which are considered by Bruce and W. H. Edwards to be a variety of *Epipsodea*, though it is so different from it that, had I more specimens, I should be inclined to consider it a different species, more especially as *Epipsodea* does not appear to extend to such great elevations, or to vary much; though its range of altitude is very great. I have taken it in Idaho at about 2,000 feet elevation, and in the Yellowstone Park at 5,000 to 6,000 feet, and have it from Colorado, taken by Bruce, as high as 9,500 feet. The specimens above mentioned are somewhat smaller, and with rounder wings, than the average of *Epipsodea*, but are best marked by the entire absence of ocelli on either wing or on either surface, and the partial disappearance of the red band." In the Synopsis of same paper, page 326, Mr. Elwes puts this under the species name as "? Var. BRUCEI."

Mr. Bean writes: "At Laggan, *Epipsodea* is moderately common in June and early July, frequenting open, grassy flats of the Bow River valley, at an altitude of about 5,000 feet. It is, in my experience, rarely found on the mountains, but I took a single male, the past season, on a mountain ridge, at 7,800 feet, or about 500 feet above the tree line. This specimen does not differ from those of the valley, 3,000 feet below. The form you mention (*Brucei*), which partly lacks the eye spots, I do not find.

"*Epipsodea* occurred at McLean, altitude 1,900 feet, in 1884, though not so common as it is at Laggan, and the localities were open grassy flats."

The eggs sent me by Mr. Bruce, in 1888, were laid by a female of this var. BRUCEI, not wholly destitute of spots, there being two or three black points on

fore wings, as in Fig. 6. The outcome was a single male, true type *Epipsodea*, scarcely banded beneath, out of chrysalis 12th May, 1888. This is shown on the Plate, Fig. 1. The eggs were laid 8th July and hatched 20th. On 25th, there were seven young larvæ. The first one passed first moult 27th July, the second moult 4th August, the third moult 28th August. The others lingered in their stages, but by 15th September, five had passed third moult. They were at all times kept out of doors, and cool weather now coming on they ceased feeding gradually. On 29th October, I found but three larvæ, all in lethargy, two of the five having disappeared. In November, I took them to Clifton Springs, as before stated. On 5th April, 1888, I received them again, two alive and wide awake as I opened the box. These were at once placed on grass, and in five minutes thereafter were feeding. On 15th April, one passed its fourth moult, the other on 17th. On 30th April, I noticed that one was bringing together leaves of the grass and forming a sort of loose cylinder. It was in the middle of a pretty dense tuft, the leaves of which were three to four inches long. On one of these the larva rested, holding by its prolegs, and was spinning a few threads and drawing the leaves down and about it. Before night the inclosure was complete. Nearly a score of leaves were held, mainly by threads at top and bottom, that is, above and below the larva, making a pretty close covering, but open by spaces so that most of the side, and the head, were exposed to view. The larva rested head up, back arched. Mr. Scudder, in But. N. E., has well characterized this structure as "an imperfect cocoon." Pupation took place on the night of 1st–2d May. Some hours after, when the chrysalis had hardened, I cut away the leaves one by one. There were fifteen of them, and the pupa rested upright, its lower end one and a half inch above ground, in an angle formed by three leaves. As I cut one of these, it turned over and fell, showing itself to be unattached. In fact, the cremaster was found to be furnished with but straight bristles, very short (Fig. g^5), and there were no hooks by which attachment could be had. As before stated, a male of the typical form came from this chrysalis on 12th May.

I had received young larvæ of this species from Mr. Bean, at Laggan, 25th July, 1886, they having hatched *en route*. I lost all but one of these. It passed first moult 2d August, the second moult 10th August, and soon after became lethargic. I kept it at Coalburgh, and brought it into the house middle of January, 1887, apparently healthy. But a month later it unaccountably disappeared.

Mr. Bruce had also sent eggs from Colorado which reached me 28th July, 1886. From these, five larvæ reached second moult, and went into hibernation, and died during the winter. From the behavior of the different lots of larvæ, it appears that hibernation may take place at either second or third moult.

This, therefore, is the complete history of an Erebia from egg to imago, and, so far as I know, the first such that has ever been published of one of the genus. To get drawings of the several stages, it was necessary to send them to Mrs. Peart, at Philadelphia, through the mails, some five hundred miles, with risk of loss or damage. Indeed, the second larva was in Philadelphia in its last stage, and being returned to me, imperfectly pupated on the way, and died.

The genus Erebia comprises many species, nearly all of which are European and Asiatic. Dr. Staudinger, in 1871, enumerated forty-eight, many of them boreal, others alpine, the latter found as far to the south as the Pyrenees, Alps, Caucasus, and Himalayas. Great Britain is credited with three species, and, in Buckler's Larvæ of British Butterflies, Vol. I, on Plate VI. are figured the mature larva and pupa of one of these, E. *Blandina*, and the young larva of another, E. *Cassiope*. In the text, Mr. Buckler relates that he raised the larva of *Blandina* from the egg, obtaining pupa and imago; and a brief description of the several stages is given, that of the larval being imperfect, as nothing is said of the several moults. Nor is it told how the larva pupated. Nevertheless, the plate represents the pupa resting nearly upright on a tuft of grass, but not at all inclosed. It looks very much like the pupa of *Epipsodea*. So an incomplete description is given of the stages of *Cassiope*, but how pupation took place is not told, nor is there a figure to show. The young larva as figured has forked tails, and therefore, I apprehend, it must have been drawn after the first moult.

In North America are eight or nine species, three at least of which are said to be old world, namely, *Tyndarus*, *Dis'oidalis*, and *Disa*. One species heretofore erroneously credited to North America, on the authority of Doubleday, E. *Vesagus*, belongs to the Andes, in South America.

The group is a very interesting one, and together with Chionobas, and some others, embraces those members of the Rhopalocera, or Diurnals, which are nearest the Heterocera, or Moths, allied to them in important characters in each of the four stages. The resemblances of the larvæ and pupæ are particularly striking. The latter are destitute of cremastral hooks in Erebia, in Chionobas, even of bristles, and pupation takes place, sometimes on the bare ground, sometimes in or on the sod, in one case, as we have seen, in an imperfect cocoon; sometimes in a real cocoon beneath the surface of the ground; or the larva goes into the ground and pupates naked, in a cavity made by the movements of its body, after the manner of nearly all the Sphingidæ. Before this Volume closes, I propose to illustrate these phases, in several species, and to make it plain that in the arrangement of the Diurnals the Satyrinæ are naturally at the bottom of the series, instead of at the top, where some recent systematists have, without sufficient ground, placed them.

EXPLANATION OF THE PLATE.

EPIPSODEA, 1, 2 ♂, 3, 4 ♀, 5 ♂; var. BRUCEI, 6, 7 ♂.

a EGG; a^2 micropyle, magnified.

b YOUNG LARVA; b^2 dorsum of two segments, magnified.

b^3 12th and 13th segment, side view; b^4 dorsum of 13.

b^5 process of 2d segment, b^6 same of middle segment.

b^7 same of 13.

c section of segment 7, after 1st moult, side; c^2 dorsum.

c^3 dorsal view of 13; c^4 process of dorsum, middle segment; c^5 of 13.

d Larva at 2d moult, magnified; d^2 section of middle segment across dorsum; d^3 side view of 13; d^4 process on dorsum, middle segment.

e section of segment 7 after 3d moult, side; e^2 dorsum; e^3 process on dorsum, middle segment.

f^2 Larva at six days after 4th moult, magnified.

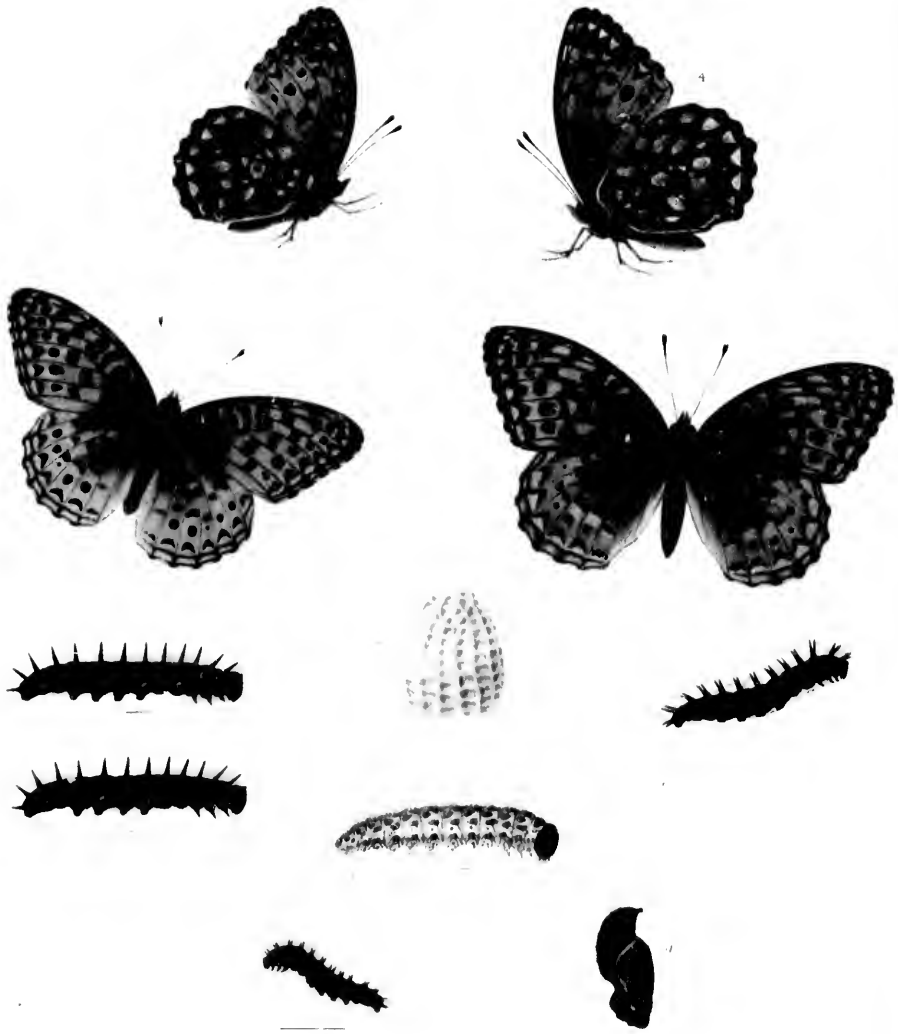
f MATURE LARVA, natural size; f^3 head; f^4 dorsal view of 13; f^5 side view same; f^6 tubercle and process of dorsum.

g CHRYSALIS, as formed in tuft of grass, a little enlarged; g^2, g^3 same, considerably enlarged; g^4 cremaster, side view; g^5 same, under side; g^6 processes on cremaster.

NOTE. — Since the foregoing paper was printed, I have seen the Canadian Entomologist for December, 1889, and learn therefrom (Vol. XXI, p. 238) that Dr. Henry Skinner has received examples of EPIPSODEA caught in Assiniboa, about 325 miles west of Winnipeg; and with them one of the var. BRUCEI, mentioned as var. SINE-OCELLATA.

ARGYNNIS.

VI.



ALCESTIS. 1 2 3 4 5.

ARGYNNIS VI.

ARGYNNIS ALCESTIS, 1–4.

Argynnis Alcestis, Edw., Tr. Am. Ent. Soc., V., p. 289. 1876. Ed., Can. Ent., Vol. XII., p. 69. 1879. Worthington, Can. Ent., Vol. X., p. 37. 1878. French, Butt. East. U. S., p. 158. 1886. Scudder, Butt. N. E., Vol. III., p. 1802. 1889.

MALE. — Expands about 2.8 inches.

Upper side bright fulvous, but slightly obscured at base; hind margins bordered by two parallel lines, the spots on inner side of which, on primaries, are lunate next apex, elsewhere serrate, on secondaries lunate, small; other markings as in *Aphrodite;* the mesial band, on both wings, broken into separated spots, which on secondaries are very small; fringes of primaries alternately fuscous and yellowish, in equal parts, of secondaries yellowish, with fuscous at the tips of the nervules.

Under side of primaries bright cinnamon-red from base to margin, the apical area of same hue as the hind wing, varying as that varies; the black markings repeated; the upper five, and often the sixth, submarginal spots silvered, and two or three silver spots subapical.

Secondaries of one color from base to margin, either dark chocolate-brown, as in *Idalia*, or deep ferruginous-brown, with no mottling on the disk, and therefore in contrast with the allied species *Aphrodite* and *Cipris;* occasionally, in the middle of the space between the two outer rows of silver spots is a narrow strip or a streak which shows a pale subcolor, but washed by the prevailing color of the wing; the spots well silvered; the seven of the outer row sub-triangular, edged on basal side with darker ferruginous; the second row has the first three and fifth and sixth nearly equal, sub-ovate, the fourth small, sub-triangular, the seventh and eighth sub-lunate, the eighth sometimes wanting, or obsolescent; in the third row are five spots, the first sub-rotund, the second and fifth small, long oval, the third sub-pyriform, large, divided, with a black edging on the basal side of the outer segment, the fourth rather small, lunate; all these, as well as the spots of the second row, heavily edged with black on basal side; in the cell are either one or two round spots, and below cell an oval, all ringed black; a spot without black at base of cell, and another at base of subcostal interspace; also at the origin of costal interspace is an elongated silver spot edged with black, and frequently the costal margin next base has very little or no silver; inner margin lightly silvered.

Body above red-fulvous, brown tinted; beneath, the thorax buff with fulvous

hairs; legs reddish buff; palpi buff, fulvous in front and at tip; antennæ black, fulvous beneath; club black tipped with ferruginous. (Figs. 1, 2.)

Female. — Expands about 3 inches.

Upper side darker, more red, much more obscured at base; the marginal lines heavy and on primaries more or less confluent; on same wings the submarginal spots are heavy and rest on the lines; all the markings and inscriptions heavy, the mesial band connected; on secondaries this band is either made of separated spots, or the posterior half is connected, the rest separated.

Under side of primaries fiery red, the apical area as on the hind wing, the silver spots large; the sixth spot more or less silvered, and sometimes the seventh partly; often there is a dash of silver on the basal side of the rounded spots in the lower three interspaces, and narrow, lanceolate spots of silver are in the lower subcostal and both discoidal interspaces between the marginal and discal rows (this excess of silver is very unusual in the genus); secondaries, as described for the male, of either olive or dark red-brown, solid color; the silver spots as in male in number and shape, enlarged; the costal and inner margins more extensively silvered. (Figs. 3, 4.)

Egg. — Conoidal, truncated, and depressed at top; in general like *Aphrodite*, but taller than broad, and taller in proportion to the width at base, the sides less convex (comparing some of the allied species, in *Alcestis* the breadth is to the height as 80 to 96, in *Aphrodite* as 80 to 90, in *Cybele* as 80 to 80); marked by eighteen prominent, vertical, slightly wavy ribs, about half of which extend from base to summit, and form around the latter a serrated rim; the remainder end irregularly at three fourths and upwards distance from base to summit, sometimes squarely at one of the cross ridges, but usually curve towards and unite with the long ribs; the rounded interspaces separated by nearly equidistant fine cross ridges; color when first laid greenish yellow (Fig. *a*). Duration of this stage twenty-five to thirty days.

Young Larva. — Length at twelve hours from the egg .08 inch; cylindrical, stoutest anteriorly, tapering backward, the dorsum sloping considerably; color brownish green, semitranslucent; marked by eight longitudinal rows of dark, sub-triangular, flat, tuberculous spots, three of which are above the spiracles on either side, and one below; these bear small tubercles; in the upper, or dorsal, row two, in the next two rows one, in the lowest row four, each giving out a long, tapering, clubbed hair; on front of 2 is a large blackish dorsal spot bearing three tubercles on either side of the mid-dorsal line, and below it, in line with the third row, is a small spot with two short hairs; and near the front, against the spiracle are two points, each with very short hair; on 3 and 4 the spots of

the three upper rows are in vertical line, but from 5 to 13 they are in triangle, those of the dorsal row near the fronts of the segments, the next row to the rear, the third a little in front of the middle; at the end of 13 is a large spot, or double spot, with several hairs; the spots of the infra-stigmatal row are placed on the middle of the segments, and still lower, in a line along the base of the legs, are single points, with a fine hair each, but two on 2; under side, feet and legs less brown, more green; head a little broader than 2, rounded, slightly bi-lobed, with many hairs; color dark brown (Fig. *b*). Most of the larvæ became lethargic direct from the egg, but about ten per cent proceeded to first moult and farther. The first moult was reached at eighteen days from hatching.

After first moult: length .15 inch; shape of *Aphrodite;* color yellow-green, the dorsum mottled with brown, especially about the bases of the spines; spines as in the genus, long, tapering, black, beset with short and fine black bristles, those of the second row rise from either pale yellow or greenish tubercles, all others from black ones; head sub-cordate, the vertices rounded; at top of each, to the front, a little conical process; color black, the hairs black. To next moult, in the Fall, five to seven days, in the Spring, fourteen to twenty-three.

After second moult: length .22 inch; shape as before, color black-brown, the sides paler than dorsum; the spines black; the bases of the dorsal rows pale buff on outer side, but black on the dorsal side, those of second row black, of third buff; the intermediate ones on 3 and 4 yellow; head shaped as before, black (Fig. *c*). To next moult, in the Fall, six days, in the Spring, seven to twelve.

After third moult; length .3 inch; color velvety black, with a tint of brown; the outer side of bases of dorsal spines now dull yellow; those of second row have very little yellow, and of third have yellow at base and a little way up the stem; color of front head shining black, but the back is yellow (Fig. *d*). To next moult, in the Spring, eleven to fourteen days.

After fourth moult: length .5 inch; color as at last previous stage; spines black, both dorsals and those of the second row very slightly reddish yellow at base; those of the third row and the intermediate spines of 3 and 4 are all orange at base and nearly halfway up; head as before, black in front, orange at back. At ten days after the moult: length .9 inch; not changed in color, the spines now deep red (Fig. *e*). (The length mark on the plate represents the length at the moult, not at ten days after, when the drawing was made, and should not have been present). To next and the last moult fourteen and fifteen days.

After fifth moult: length 1 inch; at from fourteen to twenty days from the moult was fully grown.

Mature Larva. — Length 1.4 inch at rest; greatest breadth across middle segment, .3 inch; cylindrical, of even thickness from 5 to 11, each segment rounded; color velvety black; the spines disposed as in the genus, long, slender, tapering; the dorsals on 2 directed forward, but are not longer than the others; all are beset with many short black bristles; those of dorsal rows are greenish brown at base, except on 3 and 4, where they are dull yellow; those of second and third, as well as the intermediate row, are dull yellow at base and halfway up, the tops black; under side and prolegs brown, the feet black; head sub-cordate, flattened frontally, the back rounded, the vertices conical, each at top bearing a little process or sharp tuberculation which is turned forward; on the face, many fine, short, black hairs; color black, the back either reddish yellow or dull yellow, individuals varying (Fig. *f*). From fifth moult to pupation from twenty-two to thirty-three days. The length of the several stages depends somewhat on the state of the weather.

Chrysalis. — Length 1 inch, breadth across mesonotum .33 inch, across abdomen .3; greatest depth .36 inch; cylindrical, somewhat compressed laterally; general shape of *Aphrodite*, but more slender; head case nearly flat at top, rounded, the curve being almost equal on dorsal and ventral side, a minute sharp tuberculation at each corner, the sides incurved; mesonotum prominent (as in the sub-group), carinated, the sides convex, followed by a deep rounded excavation; the wing cases flaring at base, compressed in middle dorsally, elevated ventrally, curving to the abdomen; this is conical, and shows two rows of tubercles which correspond to the dorsal tubercles of the larva, and extend to mesonotum and head case; a row of small ones on side, and another, more or less complete, below the spiracles; the whole surface finely corrugated; color red-brown, irregularly mottled black, the wing cases black along the nervules, and with a black patch on disk (Fig. *g*). Duration of this stage about twenty days.

Alcestis flies in southern Michigan, northern Indiana, and Illinois, in Iowa and Nebraska. It seems to be limited to a narrow belt of latitude, and is therefore vastly more restricted in its range than the allied species *Cybele* and *Aphrodite*, with which it associates. Mr. Worthington, in the paper above cited, says it is abundant on the prairie west and north of Chicago, in July and August, but seems to be local, "as examples taken a few miles north, in a timbered region, are almost uniformly *Aphrodite*." He adds, "I have been greatly surprised at

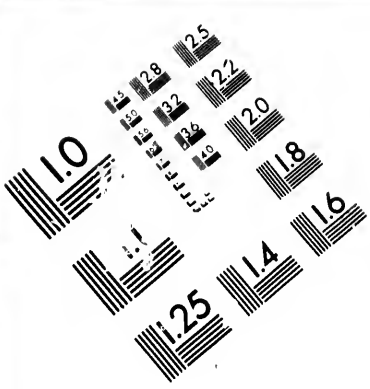
the readiness with which a strong *Aphrodite* upon the prairie can be distinguished, while on the wing, from the surrounding *Alcestis*, owing mainly to a slight difference in its manner of flight, which resembles that of *Cybele*." It may be distinguished also from the western *Aphrodite* by its intense red color, and by the hue of its under surface. This is often olivaceous like *Idalia*, and unlike any other North American Argynnis, of whatever sub-group, and the color is solid on secondaries from base to margin, with no submarginal band or any mottling of yellow on the disk, such as seen in *Aphrodite* and *Cipris*; at times the ground color is blackish ferruginous, also solid. In all the earlier stages, from egg to chrysalis, there are distinct differences from *Aphrodite*.

I have twice bred the larvæ of *Alcestis* to imago, the eggs having been obtained by confining the females over violet. The first eggs were received 26th September, 1876, from Mr. Thomas E. Bean, then at Galena, Illinois. The larvæ hatched 14th October, and at once went into lethargy. I carried them through the winter, at Coalburgh, but with much loss, not yet having discovered the advantage of a snowbank for hibernating larvæ. During January, 1877, they began to feed, and by 1st February, some had passed their first moult; on 15th, the second; on 27th, the third; on 10th March, the fourth; 25th March, the fifth; and pupation took place 16th April, the imago appearing 7th May.

In 1877, I received another lot of eggs from Mr. Worthington, at Chicago, which began to hatch 23d September. A second lot received later hatched 1st October. All the larvæ at once went into lethargy, and were kept in as cool a room as I could give them. Several were alive during January, and some were feeding in February, but one after the other died, and none reached the first moult.

In 1878, Mr. Worthington sent more eggs, and these were hatching 6th September. Several of the larvæ fed at once, and some were passing their first moult on 25th September. I never saw that happen with any larvæ of the larger Argynnis in my possession except in this one instance. But as I have related under *Cybele*, in this Volume, Mr. Siewers had known a larva of that species to feed and pass its second moult, and had found one wild that was deemed to have passed its third. On 1st October, some were passing the second moult, on the 7th of same month, the third moult. I was absent from home two weeks just after this, and on returning, 5th November, I found but one of these large larvæ living, and it seemed in lethargy. But ten days later it had died.

Of the larvæ that hibernated from the egg, two were found to be alive on 5th February, 1879, and one passed first moult on 11th February, the other 18th. The oldest passed second moult 4th March; the third, 11th March; the fourth, on 25th; the fifth, 9th April, and pupated 12th May. The other larva I had sent to Mrs. Peart, and had no record of its changes.



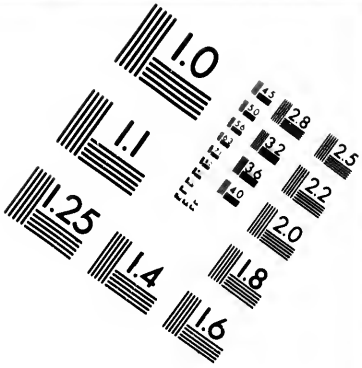
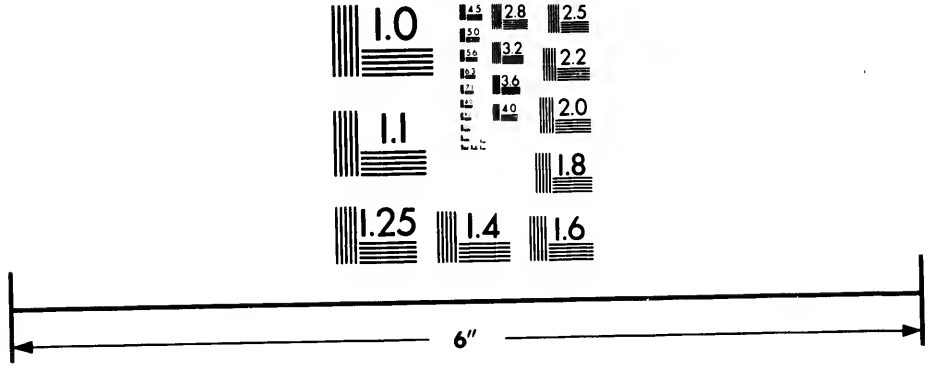
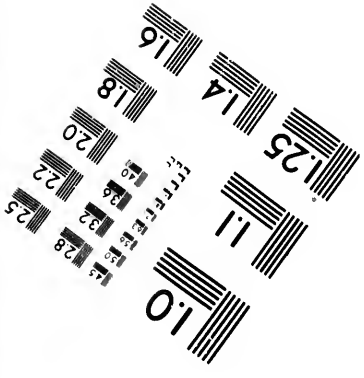
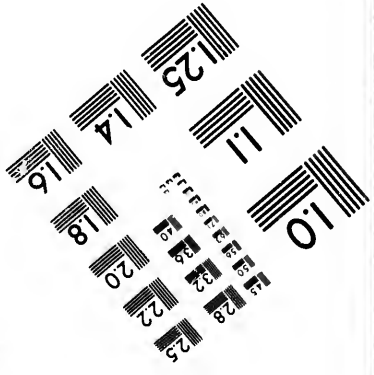


IMAGE EVALUATION TEST TARGET (MT-3)







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ARGYNNIS VIII.

ARGYNNIS ADIANTE, 1–3.

Argynnis Adiante, Boisduval, Lep. de la Cal., p. 61. 1869.

Male. — Expands from 2.3 to 2.4 inches.

Upper side red-fulvous, lightly dusted with brown at base; marked and spotted with black after the usual manner of the group; hind margins bordered by two parallel lines, resting on which, on primaries, are small serrated spots; on secondaries the corresponding spots are lunate, and most or all fail to reach the lines; the rounded spots very small on both wings; the other markings as in the group, but slight, and on secondaries extremely so, the mesial band being reduced to little more than a line, often macular; fringes yellowish, fuscous at the ends of the nervules on both wings.

Under side of primaries pale fulvous over basal area, and along inner margin, taking in the basal half of the cell, and half the remainder along and next the median nervure: on this part of the wing the black markings are repeated, reduced; the rest of cell, and a space beyond cell on the subcostal and upper median interspaces yellow-buff, the apical area pale brown-buff; the markings obliterated.

Secondaries have the basal area to the inner side of the second row of spots pale brown-buff, limited without by a faint brown stripe, corresponding to the mesial stripe of upper side, the hind margin bordered by same color; the rest of the wing — the extra-discal area — pale yellow-buff; the spots, which in most species are silvered, are here entirely without silver, yellow-buff in color, faintly edged with brown on the basal side.

Body above and below concolored with the basal part of the wings; legs reddish; palpi yellow, with red hairs in front; antennæ fuscous above, ferruginous below; club black, tip ferruginous (Figs. 1, 2).

Female. — Expands 2.3 to 2.6 inches.

Both sides as in the male, and the markings similar; in some examples the

basal area of primaries beneath is fiery red, in others it is paler, and as in the male (Fig. 3).

The male figured on our Plate is the original type of Dr. Boisduval, sent me by himself, and bearing his label as "type" ADIANTE. In his description of this male he says: "The four wings on upper side are of a vivid fulvous with the black spots disposed nearly as in the neighboring species. . . . The female resembles the male. This beautiful Argynnis was taken in some numbers by M. Lorquin, on the edges of woods, in the eastern part of California."

Of late years *Adiante* has not been a very common species in collections, owing to its local habits, apparently. Professor J. J. Rivers writes me that "it is found above Los Gatos in the Santa Cruz Mountains. It also occurs at several localities in the same range, and in Santa Clara and San Mateo counties; but it does not appear to be found farther south than about nine miles north of Santa Cruz city." Apparently Dr. Boisduval was mistaken in the locality.

Dr. Behr writes, March 15, 1890: "*Adiante* is found in the Santa Cruz Mountains, near Searsville, extending to Los Gatos Creek and farther south. I do not know its southern limit. If you strike the right time, it is common near the sawmill on the upper Los Gatos Creek, and in an hour you may catch several dozens. It is very constant, and unlike many of the California Argynnides, develops neither variations, nor aberrations, nor races."

ARGYNNIS.

VIII.

ADIANTE
ATOSSA

ARGYNNIS VIII.

ARGYNNIS ATOSSA, 4-6.

Argynnis Atossa, new species.

MALE. — Expands 2.5 inches.

Upper side bright yellow-fulvous, the base very lightly dusted brown; hind margins of both wings bordered by a single line, and that is the inner one of the two usually seen in the group, there being no trace of the outer line; no black submarginal spots on either wing, except on primaries, in the lower three interspaces, in each of which is a small spot representing the apex of the usual seration; nor are there the usual rounded black extra-discal spots, except on the lower four interspaces of primaries, and of these, the middle pair only are decided black; the black subapical patch is also wanting; the discal and cellular markings on primaries are light, and very much as in *Adiante;* on secondaries the mesial band is reduced to a series of abbreviated narrow bars, widely separated; the S-shaped spot at end of cell is slight; fringes pale yellow throughout.

Under side of primaries very pale fulvous at base to middle of cell, and in the P-shaped spot, and the basal part of the median interspaces; on this area the black markings are repeated, reduced; all the rest of the wing, in the cell and to apex and hind margin, pale yellow-buff, the markings obliterated.

Secondaries wholly pale yellow-buff, the basal area to the inner side of the second row of spots scarcely darker than the rest; all the spots faint, and with no trace of silver, their inner edges slightly dusky.

Body above concolored with the basal part of the wings; beneath, the thorax yellow-buff, the abdomen reddish-buff; legs reddish on the fronts, yellow behind; palpi yellow, the long hairs in front red; antennæ fuscous above, ferruginous beneath; club black, ferruginous at tip (Figs. 4, 5).

FEMALE. — Expands 2.6 inches.

Upper side of same hue as the male, a little paler next apex of primaries, with

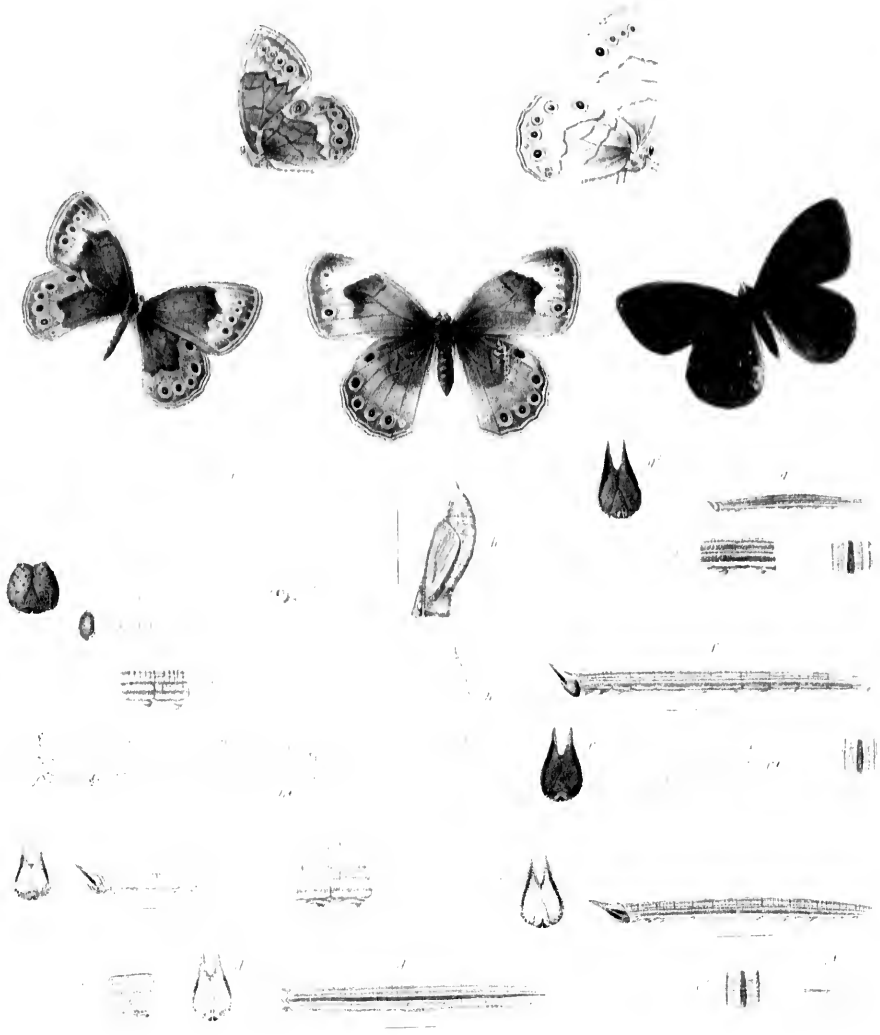
a gray edge to the costa and around the apex; the hind margins bordered by a single line, as in the male, with no diffusion at the nervures; the markings of both wings as in the male.

Under side of primaries deeper fulvous about base; otherwise as in the male (Fig. 6).

Something more than twenty years ago I came into possession of a strange Argynnis, which I was told was North American, but beyond that could get no information whatever. No one knew where it came from, but it was said to be surely American. I had never seen anything like it, and believed it must be a foreign species, but kept it in my collection, hoping one day to learn more about it. This was the male figured on the Plate. In January last (1890), Mr. H. K. Burrison, of Boston, Mass., sent me a few Argynnides for name, taken by him, in 1889, in south California and Arizona, and among them was a female exactly corresponding to the male spoken of. On asking where it came from, Mr. Burrison replied as follows: "It was taken at Tehachipe, south California. I stopped there only a few days, from July 4th to 8th, and this and another female were found in a little valley about four miles from town, by a small stream. I saw others, but caught only the two. If I remember rightly, the elevation was about 4,800 feet. I was in haste to reach Arizona to meet by appointment the friend with whom I traveled there, and did not have time to examine the tops of the mountains about Tehachipe, so can say nothing as to the height at which the species may be found."

I myself have seen but the pair figured, but Mr. Burrison reported to me the points of the second female, which agree with those of the one sent me, and now figured. All three examples are characterized by the peculiar yellow color on upper side, by the absence of the outer marginal line, and of the usual marginal and discal black spots.

That so striking a species could have been unnoticed in a region supposed to be thoroughly explored by lepidopterists, gives reason for the belief that many species of Argynnis yet undiscovered exist within the United States and Canada.



CANTHUS 1 2 ♂. 3 4 ♀. 5 ♂ VAR.

a Egg magnified *g* Larva 5th moult mature nat size
b f Larva young to 4th moult *g* 2 4 head and segts magnified
h chrysalis.

SATYRODES I.

SATYRODES CANTHUS, 1–5.

Satyrodes Canthus, Boisduval and Leconte (not Linn.), Lep. de l'Amer., pl. 60. 1833. Westwood-Hewitson, Gen. Di. Lep., II., p. 375. 1851. Edwards, Can. Ent., XV., p. 61. 1883. Id., XVII., p. 112. 1885. Fernald, Butt. Maine, p. 70. 1884. French, Butt. East. U. S., p. 232. 1886.
Boisduvallii, Harris, Ins., p. 305, fig. 128. 1862.
Eurydice, Scudder (not Linn.), Butt. N. E., I., p. 193, pl. 1, fig. 10, pl. 11, fig. 5. 1889.

Male. — Expands from 1.6 to 2.2 inches.

Upper side gray-brown, the outer third of both wings light, but varying much in individuals; the darker portion of primaries limited without by a fuscous diffuse stripe from subcostal to second or third median nervule, bending outward on the upper median nervule at nearly a right angle; on secondaries there are traces, more or less distinct, of a similar stripe, but narrowed; primaries have an extra-discal, nearly straight, transverse row of small, round, fuscous spots, usually four in number, standing on the two discoidal and the median interspaces; sometimes a fifth spot is present on the lower subcostal interspace, out of line with the rest, turned towards the base; these spots vary in size, usually the lower two being largest and equal, the upper two a little smaller and equal; the fifth spot minute; all surrounded by a narrow ring, paler than the ground color; but often there is nothing of this; sometimes the lower spot has a white central dot; secondaries have a corresponding row of six spots, sometimes all large, at others small as the spots of primaries, either without rings, or with decided rings of brown-yellow, the uppermost spot, which is usually the largest of the series, always without ring, and the spot next angle always minute; fringes gray-brown.

Under side yellow-brown, the outer third of each wing paler; the two areas separated by a dark brown stripe, which in some examples is sharply serrate throughout most of its course, sometimes sinuous; each wing has a similar stripe covering the arc of cell, and there is a common stripe crossing both cells and the interspaces; the spots repeated, enlarged, each in a brown-yellow ring, which

itself is surrounded by a dark ring and a pale halo, and each has a white pupil; the anal spot duplex, with double pupil.

Body above color of wings, beneath, the thorax and abdomen yellow-white, or in the darkest winged examples, brown-yellow; legs yellow-brown above, whitish below; palpi yellow-white with brown hairs in front; antennæ fuscous above, narrowly ringed yellow or whitish, beneath red-brown; club fuscous, the top red-brown. (Figs. 1, 2, var. 5.)

Female. — Expands from 1.7 to 2.4 inches.

In general like the male, but of paler hue; the spots larger; on the under side the inner rings are more yellow, and each series of spots is inclosed by a pale elongated ring; but the uppermost spot on secondaries is separated from the rest and has its own set of rings. (Figs. 3, 4.) Examples from Colorado are larger than any from New England, and somewhat larger than from Michigan or Illinois. There is everywhere great variation in the color and markings of this species, but I have never seen an example, nor is there one recorded, that is without the rounded spots on upper side.

Egg. — Subglobular, much flattened at base, as broad there as high; surface slightly rough, but without definite markings even under a pretty high power; but increasing this, there are to be seen small shallow cells, and a resemblance to eggs of the Neonymphæ; color greenish-white. (Fig. *a*). Duration of this stage about seven days.

Young Larva. — Length .09 inch; cylindrical; segment 2 rounded and somewhat prominent; from 3 to 11 tapering very gradually, 12 and 13 abruptly, and ending in two short pointed tails; color at first yellow-white, in a few hours changing to pale green; the upper surface shows six longitudinal rows of low, conical, black tubercles, each of which gives a short, thick, black bristle, thickened at the end; on 3 and 4 these are in cross line, on middle of the segment; on 2, the tubercles of the upper rows are advanced to front, and behind and between is an additional tubercle; that of the lateral row is above the line and in middle of the segment, and is without bristle, and below, in front of the spiracle, is a smaller tubercle and hair, and under it a hair without tubercle; on 4 to 12 the tubercles are in triangle, as in Neonymphæ; on 13 is a triangle at the front, two at base of tail corresponding to the upper rows, and longer than elsewhere; at the end of the tail a still longer bristle; along the base of the body is a row of short hairs, two on 2 and from 4 to 12, one on 3, 4, springing from tubercles and longer and tapering, one on 13; still another row of very short, tapering hairs

over feet and legs, three on 2, one on 3 to 6; two on 7 to 10, one on 11, 12, one on front of 13, and three over the anal legs; feet and pro-legs green; head considerably broader than 2, obovoid, truncated, the top depressed, the vertices low, conical, excavated at summit, and in the cavity a small tubercle and tapering hair (Fig. b^3); other tubercles arranged in cross rows, the upper row of two and largest, the next of six, the next of four, and the lower row of two, those of the second and third rows next suture without hairs; other short hairs over mandibles; the surface shallowly indented; color light brown; ocelli reddish-brown. (Figs. b, b^2.)

At three days from the egg, length .18 inch; color pale green, showing three whitish longitudinal lines, one near middle of dorsum, one on the verge of dorsum, one on middle of side. As the first moult approaches, the body becomes broad as the head, vitreous-green, the white lines distinct. (Fig. b^5.) Duration of this stage about eight days.

After first moult: length .26 inch; slender, slightly thickest in middle segments; the tails longer in proportion than at first stage, slender, sub-conical, pink-tinted, rough with white pointed tubercles and short bristles; on the transverse ridges of all segments are fine, sharp, white tubercles, each with its short white hair, or process; color at first greenish-yellow (Fig. c), later changing to pale green (Fig. c^3); on middle of dorsum a dark green stripe free from tubercles, on either edge of this a line of white tubercles; another line of tubercles, sub-dorsal, a third along base; between the last two are two other fine white lines, and one such between the dorsal and sub-dorsal; feet and legs green; head a little broader than 2, obovoid, the sides more sloping, less rounded, than in the first stage; on each vertex a long, tapering process or horn, tuberculated, brown-tipped, and marked in front by a reddish stripe which is extended down the side of the face to the ocelli; surface finely tuberculated; color of face and head yellow-green. (Fig. c^2.) To next moult six to nine days.

After second moult: length from .34 to .4 inch; same shape; color yellow-green; the same tuberculated lines; head as before, but narrower and higher, the horns longer and nearer together, striped as before, but the upper part pink; color of face pale green. (Figs. d to d^3.) To next moult fourteen to eighteen days.

After third moult: length .55 inch; shape and color, at first, as at preceding stage; but a few hours after the moult, in nearly all the examples, the color changed to brown and buff; at twenty-four hours from the moult, length

.57 inch; on middle of dorsum a broad brown stripe, on either side of which is a band of reddish-buff, passing into greenish-buff on the outer side; on the side another buff band, through the middle of which runs a brown line; the basal ridge buff; head and horns as at preceding stage (Figs. *e* to *e* [4]). A few days later the buff larvæ became lethargic.

But one of the green larvæ proceeded to fourth moult without change of color. From third to fourth moult, in the Fall, twenty-six days.

After fourth moult, in Fall: length .6 inch; color green; but twenty-four hours after the moult had changed; color now yellow-buff and red-brown; the mid-dorsal stripe pale brown, the bands on either side of it greenish-yellow; the side brown, with a dull green line running through it; head shaped as before, the face green, stripes reddish-brown. This larva became lethargic a few days later, but died during the winter.

After hibernation, in Spring: the color gradually changed from buff to green; wholly dull green, with a darker mid-dorsal stripe; a yellow sub-dorsal line from horn to tip of tail; two obscure yellow side lines; along base yellow; tails green to tips; head pale yellow, the stripes brown. Twenty-two days after the end of hibernation passed fourth moult.

After fourth moult in Spring: length .62 inch; color pale green, the mid-dorsal stripe dark green; the dorsal bands yellow-white; the two lines on side and the basal stripe same hue; head emerald-green, the horns reddish, the stripe dark brown. (Figs. *f* to *f* [3]; *f* [1] is the natural size a few days after the moult.) Duration of this stage thirty days.

After fifth moult: length one inch; color green, striped with whitish; in about twelve days was fully grown.

Mature Larva. — Length 1.2 inch; long, slender, segments 2 and 12 of equal diameter, the dorsum arched on middle segments, sloping evenly both ways, ending in two long tapering tails, which are roughly tuberculated; each segment creased transversely so as to make six ridges, the front one, from 3 back, twice as broad as any other and flattened, the rest a little rounded; whole surface covered with fine sharp tubercles, each of which gives a fine short hair; color of body green; a darker mid-dorsal stripe, and on each side of this a pale green dorsal band, on the outer edge a yellow-green stripe; the side covered by a pale green band through which runs a yellow line; along base a yellow stripe; feet

and legs pale green; head obovoid, high, the top narrow, on each vertex a long, tapering, conical process or horn, the two meeting at base; whole surface rough with fine tubercles, each with fine, short hair; color yellow-green, the horns red; down the front of each horn from near the top, a brown stripe, which passes along side of face to the ocelli, tapering to a line. (Figs. g natural size, g^2 to g^4 magnified.) The length of the period from last moult to pupation I am unable to give, but it is probably about ten days.

CHRYSALIS. — Length .62 inch; breadth across mesonotum .16, across abdomen .17 inch; cylindrical, slender; the edges of wing cases prominent; head case a little produced, beveled transversely to a sharp edge, excavated very little at the sides, the top incurved, the corners sharp; mesonotum prominent, the anterior side forming almost a right angle with the dorsal side, carinated, the sides flat and sloping; color green; the top of head case and dorsal edges of wing cases buff, a buff mid-dorsal stripe, and on either side of this another; also a faint lateral stripe on abdomen of same color. (Figs. h, h^2, magnified.)

CANTHUS flies in the northern States from Maine to Wisconsin, at least, and from New Jersey and northern Pennsylvania to Iowa, Nebraska, and Colorado. In the latter State it has been observed only in the northeastern part. Mr. David Bruce writes: "It occurs near Estes Park. This region is of about 5,000 feet elevation, and is well watered by the Big Thompson and Cache la Poudre rivers, and is full of small lakes and reedy flats where many of the small waterfowl breed in numbers. In this locality *Canthus* flies in abundance. The Colorado examples are of large size, exceeding any eastern ones, the males reaching 2.2 inches in expanse of wing, the females 2.4 inches, but they do not differ in other respects from their congeners.

Until recently, this species has not been reported in the southern States, or south of the Ohio River. But, in Psyche, Vol. V., p. 348, May, 1890, Mr. Ellison A. Smythe, Jr., of Columbia, South Carolina, relates as follows: "While collecting Catocalæ, in September, 1889, in a thick swamp, in Clarendon Co., S. C., near the Santee River, I came to a spot where a ray of sunlight penetrated the thick foliage far overhead, and there, in the glow, were a great number of Debis *Portlandia*, having a game of 'hide and seek' with one another. I stood watching their gambols for some time, until I thought that one of their number seemed smaller and otherwise different from the rest; in a moment he lit close to me, and I saw to my surprise that it was something entirely different, and at the moment I could not place it. That was enough, however, and I started to capture

it. But the game was not in my own hands. At the first movement, off he went, jerking in and out among the cypress knees and live oak buttresses, for some distance, becoming invisible when he lit. Capture on the wing seemed the only possible means of securing him, and so off I dashed, into tree trunks, splashing through water, occasionally falling flat in the mud over a concealed root; but the last time I fell, my net was over my prize, which proved to be *Canthus*. After considerable beating about, I started another, whose final capture was effected after a repetition of my first chase. These were the only two seen, though I hunted the same swamp for the next day. This capture seemed strange, for that especial swamp has been a favorite of mine for over eight years, and has been searched thoroughly by me. It is the only instance, to my knowledge, of the occurrence of the species anywhere in the southeastern States."

On reading this, I wrote Mr. C. Troxler, Senr., of Louisville, Kentucky, a collector of experience, but the reply came that he had never known *Canthus* to have been taken in Kentucky. Nevertheless, from the secluded habits of the species, it may perhaps haunt many a spot in the South.

In British America, the species ranges from Nova Scotia to Hudson's Bay, and westward nearly to longitude 85°, perhaps farther. Mr. Scudder speaks of a colony far to the north, at Great Slave Lake. It is said to be not uncommon in the Adirondacks of New York, but I have never seen it in the Catskills, in the same State. Mr. Scudder tells us that, in New England, it lives in elevated, moist meadows, and "is so restricted to them that one may sometimes find it in a spot but a few acres in extent, and search in vain beyond." Dr. Holland writes: "I found it very abundant at Saratoga, New York, in the grassy meadows near the lake. It seemed to hide among the tall drooping tufts of marsh grass, and by beating these, I succeeded in startling forth a large number of fresh specimens, male and female."

Mr. Bruce, at Brockport, western New York, says: "*Canthus* is common near here, in a genuine bog by the side of the Erie Canal. Another station in this State is near Syracuse. I never met with it on open, dry places."

Mr. James Fletcher, Ottawa, Canada, says "It is a common species here, found in many places. I have never taken it before 28th June, nor after August 2d, that I remember. It flies with a slow, drooping flight, very much like that of Satyrus *Nephele*. Notwithstanding this, however, it is very difficult to catch, being quicksighted and wary. It has, when settled, the same habit as Debis *Portlandia*, of facing round and watching as you approach. It always flies in wet meadows, or swamps, and nearly always over water. I got the larvæ by beating beds of Scirpus eriophorum in the beginning of June. They will feed on any of the coarse Cyperaceæ. I have also found the larvæ on Carex bromoides.

It seems to be an early feeder; I have never found larvæ feeding in a state of nature after five o'clock in the morning."

Superintendent I. N. Mitchell, of Fond du Lac, Wisconsin, writes: "*Canthus* occurs here, but my knowledge of its habits is entirely from meeting it in southern Michigan. I have taken many specimens there in two neighboring spots, in Cass County. One of these is a large meadow on the border of a lake, the meadow being covered with high grass. In some parts also thickly covered with trees and shrubs, but in others only partially with clumps of willow and shrubs, leaving open spaces of grass. It is in this last part that *Canthus* is most common, though it flies in all parts, and among the trees. It usually starts out of the grass near a clump of willow, flies among the bushes, in and out, dodges around them, where *Eurytris* flies through them. *Canthus* is much more easily taken than the other species. The second spot referred to is a small marsh, bordered by an abrupt hill which is wooded with beech and maple. In the marsh are grasses three or four feet high, willows, tamarack, sumac, and shrubs scattered about. I often started *Canthus* from the leaves of the beeches on the edges of the marsh, but never very far from the marsh. They usually made toward it when disturbed, and often settled near the upper ends of the grass stems, but low enough below the tops to be well hidden. They often alight on the trunks, limbs, or leaves of trees or bushes growing in the marsh, and I have started them out by throwing clods. Occasionally I took them on the stump of a recently felled maple, attracted by the sweet sap, and then in company with Graptas and Vanessans."

Professor Edward T. Owen, at Madison, Wisconsin, says: "I take *Canthus* in large numbers in and about our swamps. It is quite rare even a quarter of a mile from them. The tall swamp grass is its favorite haunt."

Mr. Edward A. Dodge, of Louisiana, western Missouri, writes: "*Canthus* was a not uncommon insect in both Illinois and Nebraska. So far as I know from eighteen years' experience, it was to be found only in grassy and weedy sloughs, flying weakly, close to the ground, and alighting on the grass stems."

Mr. Worthington writes from Chicago: "*Canthus* is equally abundant in open dry woods, dense ridges, or swamps. About the Calumet Lakes, on the wooded ridges, in swamp land, it is abundant. It also flies in the open oak woods on the high sand hills further north and east. North of the city, in the wooded lands, thirty to fifty feet above the lake, it is quite common. I remember the species distinctly as taken near and north of Milwaukee, Wisconsin, where all the land is high and rolling. From its habit of visiting the prairie morning and evening, I judge it may breed there; but a flight in the open in broad day is certain death, as they are an easy prey to the dragon-flies."

Mr. Fletcher says he received an example of *Canthus* from Rev. W. A. Burman, at Griswold, Manitoba, taken "in a shady ravine."

Professor French writes: "My observations are that this species flies in dry grass lands, and in the edge of low brushy places. I did not find it in swamps at all. But I never saw it flying except in one locality, in northern Indiana, where I was staying a few days."

I see no reason why the species should not frequent upland and dry places, or dry, open woods, as well as wet meadows, though from the testimony it is most often found near water. But in confinement, the larvæ eat lawn grass, and, of course, could eat any grass in a state of nature, though they seem to have a preference for coarser sorts, and such as grow in wet places.

Mr. Worthington sent me the first eggs I obtained, laid 11th to 13th July, 1879, by females tied in a bag over grass. When they reached me, on 20th, some were still unhatched. The first moult was passed 27th July, the second, 2d August, the third, 16th August; but at each stage some larvæ lagged, so that the third moult came on at various dates up to 2d September. The color of all the larvæ was green till after the third moult, when the first which had passed that moult, in course of twenty-four hours after same, changed to buff and brown, and on 31st August, these were evidently beginning their hibernation. But two, which passed third moult latest, went to fourth, one of them having changed to buff and brown, and passed that moult on 19th September, the other retaining its original color. This last passed fourth moult, 17th September, and during the day after, had also changed color. I lost all the larvæ of this brood.

On 25th July, 1881, I again received eggs, this time from Mr. W. C. Gallagher, then at Whitings, Lake County, Indiana, and another lot on 1st August. From one cause or other, the most efficient being minute spiders in the sod, I had but three larvæ left on 30th August, all past the third moult. All changed from green to buff and brown shortly after that moult. One was sent to Mrs. Peart, in Philadelphia. By 10th September, the other two were in lethargy, but it was observed that they had moved several times up to 4th December. One died during the winter, the other I brought into a warm room, 13th February, and placed in the sun. In about fifteen minutes it moved, and soon after, was feeding. When brought in, it was much smaller than when it went into lethargy; then measuring .6 inch, now less than .4 inch. By 25th February, it had reached .5 inch, and by 2d March, its former length, .6 inch. Early in March it began to change color, and by 6th inst., had become green again. It reached .66 before the fourth moult occurred, 24th March. I sent it to Mrs. Peart, for drawing, and there it passed 5th moult, 25th April; and continued to feed, by 7th May becoming full grown. After this, it seemed to be at rest all

the time, and finally died, 2d July, before pupating. So that the egg which had been laid in middle of July produced a larva which had not pupated 2d of July the year after.

The larva which was sent Mrs. Peart in the Fall behaved differently, going on to fourth moult, which it passed 17th October. This lived in lethargy through the winter, but escaped before its fifth moult.

The chrysalis figured I received from Mr. Fletcher, 22d August, 1884. Mr. Fletcher writes, 4th February, 1890: "I generally feed and get the pupæ of a dozen or so *Canthus* every spring. All my larvæ have been green, not drab. When the larva is at rest, it lies extended along the leaf, generally beneath the blade, and also alongside the midrib, the horns of the head and tails in a line with the body, and it is very hard to detect it when at rest." My observations are to the same effect, that when at rest, these larvæ have their heads turned down and under, so that the horns are nearly in same plane with the body, after the manner of larvæ of Apatura, also of Neonympha. But when feeding, the tails are elevated. Mrs. Peart has well shown this in figure f^4. When in this position, one extremity in profile is almost the same as the other, and the dorsum, being elevated in middle segments and sloping equally either way, makes the beholder uncertain at first view which is the head and which is the other extremity.

The species *Canthus*, *Portlandia*, *Gemma*, and *Areolatus*, placed in three genera, have some points, in the early stages, in common, and in others a curious interrelationship. The shape of the egg is the same in all; in *Portlandia*, the surface is smooth, even under a high power; in *Canthus*, it is smooth, but a high power brings out reticulations similar to those of the remaining two species, which are nearly alike. The heads of the young larvæ of *Portlandia* and *Canthus* are ovoidal, truncated, of *Areolatus*, ovoidal, but approaching a circle in outline, in *Gemma* more decidedly circular; *Canthus* has on each vertex a depression, out of the middle of which rises a low cone; *Portlandia* has the cone without the depression; *Areolatus* has an ovoid knob; while *Gemma* begins with a pair of high, divergent, conical horns. At first moult, *Portlandia* shows a pair of widely separated, high, conical processes or horns on head; *Canthus* a pair much resembling, but coming near together at base; *Gemma* long, tapering, divergent horns; *Areolatus* has a low cone on each vertex; and in each species the peculiar style of process runs through all the larval stages. As to the appendages on the bodies of the young larvæ, *Canthus*, *Gemma*, and *Areolatus* are very nearly alike, in *Portlandia* they are everywhere longer. In maturity, *Portlandia* and *Areolatus* are rather stout, *Gemma* and *Canthus* quite slender; and all four have long, slender, tapering tails. As to the chrysalids, *Portlandia* and *Areolatus* are very much the same shape, while *Gemma* and *Canthus* differ from them consider-

ably, but less between themselves. In the imagos, *Canthus* is midway between *Portlandia* and the other two. It has the habit of alighting on trees, like *Portlandia*, and according to Mr. Fletcher, of facing about, and watching an approaching entomologist, also like that other species, but in the others there is nothing of this. Both *Portlandia* and *Canthus* are attracted by sweet fluids, but I have never observed this in the other two. *Canthus* has drifted about from one genus to another in the Catalogues, being of late years classed with Neonympha. Mr. Scudder has done well to separate it, and give it a distinct genus, which I have adopted, as it is largely based on the preparatory stages.

Note. — Eurydice is not a North American butterfly, as I will show. A species of that name was published by Linnæus, 1764, and its name was changed by him, in 1767, to *Canthus*, Syst. Nat., 13th edition, p. 768, No. 129. "Alis integerrimus fuscis: subtus primoribus ocellis quatuor, posticis senis. Papilio Eurydice, Hab. in Amer. Sept."

Fabricius, Syst. Ent., p. 486, No. 191, says: "*Canthus*; alis integris, supra fuscis, immaculatæ. P. Eurydice, Linn., Hab. in Amer. Boreali. Alæ omnes supra fuscæ, immaculatæ," etc. In Ent. Syst., III., p. 157, he again describes *Canthus*, "omnes immaculatæ," etc., in same words as before, but gives as synonym, Arganthe, Cramer, pl. 204, fig. C. D., besides Eurydice, Linn. *Arganthe* is a South American species, without spots on upper side. The mistake in the habitat was a common occurrence in the earlier days. The insect perhaps was received from New York or Philadelphia and credited accordingly.

Godart follows Linnæus and Fabricius, translating their descriptions. The distinguishing character of *Canthus*, Linn. and Fab., is that the upper side bears no spots; it is immaculate.

We first come on our *Canthus* in Boisduval's Lep. Amer., where it is well figured. My copy has no text to this and half a dozen other plates, and how this happened I never knew. But it is to be supposed that the text had been duly printed when the plate appeared. Dr. Harris first called attention to the fact that *Canthus*, Linn., was not our species. He says: "This butterfly is figured in Dr. Boisduval's Hist. des. Lep. de l'Amer., under the name of *Canthus*, Linn. and Fab., but as it does not agree with the description of *Canthus*, of Linn. or Fab., I have thought it entitled to a new name," and he accordingly calls it *Boisduvallii*. I myself prefer to call it *Canthus*, Bois., the more, as since Boisduval's publication, 1833, the species has usually been known, and most often treated of, by that name. However, if *Eurydice*, Linn., had been the same species, I would not at this late day substitute that name for *Canthus*. A name in use should never be changed for an obsolete name, and the neglect to observe this common-sense rule has worked a great deal of mischief.

EXPLANATION OF THE PLATE.

CANTHUS, 1, 2, ♂, 3, 4 ♀, 5 var. ♂.

a EGG.

b YOUNG LARVA; b^2 head; b^3 process on vertex; b^5 section of side, segments 7 and 8; all magnified.

b^4 showing the tubercles and processes.

c Larva at 1st moult; c^2 head; c^3 side of 7 and 8; all magnified.

d Larva at 2d moult; d^2 head; d^3 side of 7.

e Larva at 3d moult; e^2 head; *e* dorsal view of 7; e^4 last segment; all magnified.

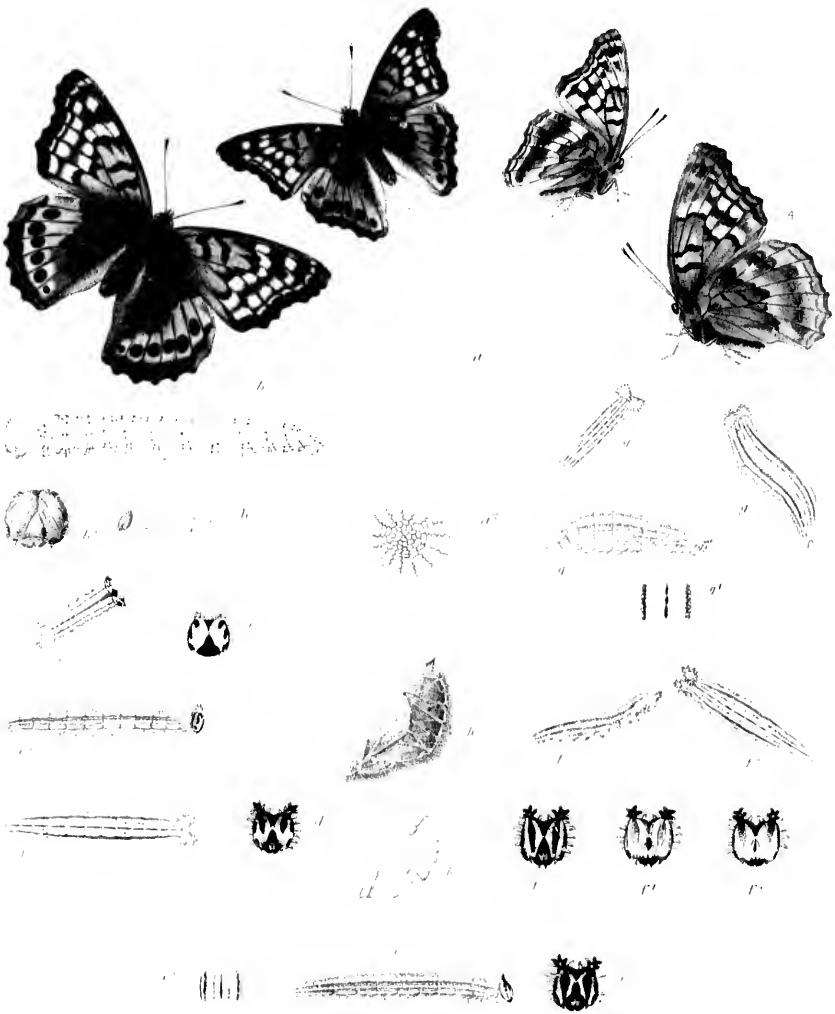
f Larva at 4th moult; f^2 head; f^3 dorsal view of 7; all magnified; f^4 larva natural size, near the end of the stage.

g MATURE LARVA, natural size; g^2 head; g^3 side of 7 and 8; g^4 dorsal view of 7; the last three figures magnified.

h, h^2 CHRYSALIS, somewhat enlarged.

APATURA.

I.



FLORA 1 2 ♂ 3 4 ♀

a Egg magnified
b Larva young
c " 1st to 3rd moults
f Larva 4th moult nat size
g " 5th "
h h^{1} *Chrysalis*

APATURA I.

APATURA FLORA, 1-4.

Apatura Flora, Edwards, Canadian Entomologist, Vol. XIII., p. 81. 1881; ? var. *Clyton*, Edw., Butt. N. A., Vol. II., p. 247. 1876.

MALE. — Expands 1.9 to 2.1 inches.

Upper side of primaries, over basal half, and all of secondaries, ferruginous, either bright or dull, the base and inner margin of secondaries covered thickly with long brown hairs; the apical area of primaries deeper colored, blackish in the interspaces; the hind margins dark brown, with a common submarginal black stripe; on the disk of primaries a transverse sinuous series of seven large, rounded, yellow-ferruginous spots, two of them in the submedian interspace, and sometimes confluent; outside these is a second series of five spots, besides a macular stripe next inside the black stripe from upper median nervule to the angle; in the cell, two black sinuous bars, often joined at upper end so as to give a horseshoe-shaped spot; secondaries have an extra-discal row of six rounded black spots, disposed as in *Clyton*, with sometimes a seventh paler one on costa; these are without rings and stand on the clear ferruginous ground; the basal area is separated from the discal, on the anterior half of the wing, by a macular blackish stripe; fringes of both wings white, at the tips of the nervules fuscous.

Under side of primaries yellow-brown next base, limited on the disk by a sinuous fuscous stripe; beyond this a large gray-brown patch covers the subcostal interspaces, the median interspaces ferruginous; the spots are repeated, pale yellow; the marginal edge brown, the stripe repeated, narrower, the apical part of it replaced by brown, and the rest edged on either side narrowly by pale yellow-brown; secondaries brownish buff over basal area, limited without by a wavy and irregular fuscous stripe from margin to margin; beyond this is a narrow space of yellow-buff, followed by a broader one of brown-buff, a shade darker than the basal area, the outer edge of it parallel with the margin, the inner edge irregular, and running nearly with the black stripe before mentioned; on this

the spots are repeated in deep red-brown, with traces of light ferruginous rings, more or less complete, always very narrow, often almost made up of separated scales; in the centre of each a little elongated black bar, on which are scales of metallic green or blue; the margin as in primaries, the stripe reduced to a line, fuscous; in some examples there is a series of narrow ferruginous crescents on the basal side of this line.

Body both above and beneath concolored with bases of wings; legs yellow-buff; palpi same; antennæ fuscous above, ferruginous below; club black, the tip greenish yellow. (Figs. 1, 2.)

FEMALE. — Expands from 2.25 to 2.75 inches.

Upper side rather lighter colored, no examples under view being so dark as some of the males; the markings similar. On the under side there is a slight gloss of purple over the basal half of primaries and all of secondaries; the yellow area on secondaries either washed with or replaced by brown; in the last case, the whole outer limb is brown, with a darker cloudy area running with the ocelli; these are nearly lost, represented usually by a sordid yellow central bar, without metallic scales. (Figs. 3, 4.)

EGG. — Nearly spherical, very little higher than broad, somewhat flattened at base, the top flattened and a little depressed; marked by sixteen slightly prominent vertical ribs, and by many fine, horizontal, equidistant cross ridges; the micropyle is in the centre of a rosette of irregularly five-sided cells, outside which are two or three rings of cells quite similar; color yellow-green. (Figs. *a*, a^3.) Duration of this stage six to seven days.

YOUNG LARVA. — Length .08 inch; cylindrical, segment 2 a little broader than 3, then tapering gradually to 13, the end of which is rounded; furnished with small conical tubercles in three longitudinal rows above the spiracles, dorsal, subdorsal, and lateral, as is common in the family, each tubercle giving out a rather long tapering hair; on 2, 3, 4, the tubercles are in vertical row, but on 2 are a pair of smaller ones to the front, making with the dorsal tubercle a triangle, and a third is in front of the spiracle; also in front of the lowest tubercle on 3 and 4 is a second in same row; on succeeding segments the three tubercles are in triangle, as in the family; on the rear of 13 is an additional triangle, and a fourth tubercle back of same; along the base, below the spiracles, are two fine tubercles with short hairs on each segment except 13, which has but one, in nearly horizontal line; and over the feet and prolegs is a fine hair to each, on 13 two [illegible]lor pale green; under side, feet and legs green (Figs. *b*, b^3); head sub-

conic, broad at the ocelli, narrowing rapidly upwards, the sides rounded, rounded frontally, most so on lower half, depressed at top, the vertices rounded; the surface thickly and shallowly indented; on either lobe eight minute tubercles, or sixteen in all, each with its tapering hair; of these, four are in cross row near the top, six in a second row in line with the apex of the frontal triangle, four in a third row half way between the second and the ocelli, and one behind the ocelli; color yellow-brown. (Fig. b^2.) Towards the last of the stage, a dark green mid-dorsal line appears, and another high on the side, almost sub-dorsal, the area between being whitish green. To first moult six days.

After first moult: length .14 inch; a little broadest at 2, then slightly compressed, thickening again at 7 and 8, and tapering beyond; ending in two short conical tails, which meet at base; the surface closely covered with yellow and yellow-white tubercles, arranged in longitudinal and also regular cross rows, stout at base, sub-conic, irregular in size, and from top of each is a short white hair; on mid-dorsum a dark green stripe free from tubercles, another on upper part of side; the area over dorsum occupied by two bands, one on either side the dorsal stripe, each band composed of two rows of tubercles, the outer one whitish, the inner one yellow; on the side is another similar band, and as the stage progresses, these separate, and a dull green line, or narrow stripe, lies between them; the tails are rough with tubercles, and each tail has a straight short bristle from the end; under side, feet and legs yellow-green (Figs. c, c^2); head large; broader than 2, sub-quadrate, the sides well rounded, the front but little, the top incurved; the whole surface shallowly indented and covered with a short yellow down; color greenish white, with dark brown spots and patches; a large brown triangle over mandibles, a small one at top, the two sometimes meeting on mid-face; a crescent patch at the base of each vertex and another on middle of the side; the ocelli black on brown ground; on each vertex, a short, compound, whitish, fleshy process, and single white spurs along the back and down the sides of the head, all much covered by long fine white hairs. (Fig. c^3.) To next moult about four days.

After second moult: length .26 inch; stouter, thickest in the middle, both sides and dorsum tapering in either direction; the tubercles as before, but broader, and flattened somewhat; colored as at second stage; the two rows of each dorsal band a little separated, showing a green imperfect line, the side stripe widened and darker; under side, feet and legs yellow-green (Fig. d); head nearly as before, rather more square, broader at top, the sides less rounded, the depression more angular; color behind pale green; the front darker green, the middle

brown patches much as before, the one at base of vertex extended down the front, the one on the side broadened; the principal processes lengthened, cylindrical next vertices, evenly forked at top, each fork tapering, rounded bluntly; at the base is a spur turned forward, and along the back and sides are spurs; so, along the back of the head at top and sides are spurs in line, the upper ones longest, the rest diminishing as they descend, the upper ones bent down; all, as well as the processes, pilose. (Fig. d^2.) To next moult about three days.

After third moult: length .38 to .4 inch; scarcely differs from third stage; head a little higher in proportion to the breadth; the stripe from vertex reaches the end of mandibles and the side patch is confluent with the ocellar patch. (Figs. e, e^3, e^2.) To next moult about five days.

After fourth moult: length .6 inch, greatest breadth .14 inch; same shape as at close of last preceding stage, and banded in the same way; six days after the moult the larva was fully grown.

Mature Larva. — Length, ♂, 1.2 inch, ♀, 1.4 inch; greatest breadth, ♂ .18 inch, ♀ .2 inch; body sub-cylindrical, broadest at base, the under side flattened, the sides sloping to dorsum; stout, in some cases almost of the same thickness from 2 to 8, then tapering rapidly to end, in others the middle segments are larger and the slope is regular either way, 2 being of even diameter with 12; ending in a pair of short, sub-conical tails, which are divergent from their bases and are rough with tuberculations; surface covered with irregular sub-conical, separated tubercles, some minute, others conspicuous, each with its short, stiff white bristle; general color bright yellow, or gamboge-yellow, a little whitened along the edges of the dorsal area; the mid-dorsal stripe scarcely more than a line, indigo-blue or black, greenish on the anterior segments; on the side two broad green stripes, the upper one darker, separated by a narrow stripe of yellow; under side, feet and prolegs dull green (Figs. f, f^2); head sub-quadrate, higher than broad, about as 7 to 6, the sides rounded, the front moderately so, the top depressed at a slight angle; the surface thickly and shallowly indented, and covered with a yellow down; color pale green, with black markings; there is much variation in the pattern, as partly illustrated by Figs. f^3 to f^5; in the darkest examples a large triangle of black meets another from the mandibles, and a broad stripe from base of vertex reaches the end of mandibles, while another passes down the cheek and coalesces with the ocellar patch; in some cases the black is partly or wholly replaced by gray-green, or blue-green, as shown in the figures; on each vertex, a short, stout process, black in front, bearing at top two equal, short, tapering, bluntly rounded, black prongs, at the base in front a

third, and on the inner side near front, a fourth; the back is green, and on it at top and sides are four other similar prongs, but green; along the back of the head at top and down the sides are greenish spurs, slender, the upper ones long, the others diminishing in length gradually and bent down; all these spurs and prongs much covered by long fine white hairs. From fourth moult to pupation about eight days.

Chrysalis, after fourth moult. — Length, ♂ .7 inch, ♀ .85 inch; greatest breadth, across mesonotum .26, across abdomen .22 inch; greatest depth, same, .3 inch; compressed laterally, the outline of ventral side convex, a regular curve from top of head case to end of wing cases; the abdomen prominent dorsally, much arched, sharply carinated, the sides very little convex, and near the keel slightly incurved, the anterior edge of each segment on the keel a little produced and thickened, and marked on either side by a shining black dot; the thoracic segments depressed at an angle of about 45° from the end of the keel, and their sides excavated; mesonotum low, rounded at summit, with a slight carina, the sides convex; the head case sub-conic, the ocellar projections prominent, three-sided, bluntly pointed, the space between their bases concave; from the end of each a low ridge runs back, the two meeting at base of mesonotum, the intervening space being almost flat; color green, finely streaked and specked with light buff over head case, mesonotum, and wings, the abdomen only specked; the neuration of the wings distinct in yellow or buff; a buff line passes along the keel and mesonotum, forking to the ocellar projections; another passes along the posterior edge of wing case, and is joined by a wavy line down the side of abdomen; on the middle of each abdominal segment, on the dorsal side, is an oblique faint buff line pointing down and forward, ending in a little buff spot. (Fig. *h*, ♂, outline, natural size, color as h^2.) Duration of this stage seven and eight days.

Some of the larvæ passed another moult.

After fifth moult: length .84 to .9 inch; greatest breadth, at segment 8, .18 inch, 2 and 3 being each .16; essentially same as at fourth moult in coloration. (Fig. *g*.)

Mature Larva. — Length 1.7 inch, greatest breadth .28 inch; broadest in middle segments, highest on 8 and 9, with a long slope to head, and a rapid one to 13; very stout, the bands and stripes all stretched in width, and the tubercles reduced and scattered; in coloration similar to mature larva after fourth moult. (Figs. g^2, g^3, section of 7 and 8, g^4.) From fifth moult to pupation, in August, eight days, in May, ten days.

CHRYSALIS, after fifth moult. — Length 1.06, ♀, depth .46 inch; breadth across mesonotum .31, across abdomen .26 inch; in coloration as before described. (Fig. h^2.) Duration of this stage eleven and twelve days, at Coalburgh; at Indian River, Florida, sixteen days, in February and March.

FLORA flies in middle and north Florida, but how far to the south is to me unknown. Also in parts of Texas, and it is stated by Mr. Aaron, Papilio, iv. 179, to have been found "moderately common" near Corpus Christi. Therefore it is probably an inhabitant of the Gulf States, one and all. Mr. Aaron speaks of *Clyton* as rare in the same district. It flies in north Florida, but Dr. Wittfeld, in many years' collecting at Indian River, has not taken *Clyton*. *Flora* is not a common species, but every year, and throughout their season, a few are to be found in the neighborhood of Dr. Wittfeld's residence. It is nothing like so abundant as *Alicia*. The presence of both is determined by their common food-plant, Celtis integerifolia, a tree nowhere in that region abundant, and confined to a few localities.

I described *Flora*, in 1876, as a possible variety of *Clyton*, but expressed the opinion that it would eventually be found by breeding to be a good species. And this has been the case. I have several times raised the larvæ from egg to imago, and the differences between them and the larvæ of *Clyton* are conspicuous and persistent. Through all the larval stages after the first, the processes on the head are of another type from those of *Clyton*, being short, stout, with equal branches, those of the other long, tapering, with unequal branches. The markings and coloration of the body also are of a different pattern. In the Northern States, *Clyton* is a one-brooded species; what it may be in the Gulf States, I am unable to state. But *Flora* has three annual broods of the imago at Indian River, the larvæ from the last brood hibernating after the second or third moult. The early butterflies from these hibernating larvæ emerge from chrysalis in March; the second flight takes place early in June, the third in August and September. Dr. Wittfeld writes: "There are certainly three broods. I have seen the butterflies first in March, and as late as October, on one occasion, in November."

Both *Clyton* and *Celtis*, as related in Volume II., pass the winter in large compact clusters on the under sides of leaves, entirely unprotected except as the leaf shelters them. On 21st September, 1880, I found 165 larvæ of *Clyton* on one leaf, at Coalburgh. As to *Flora*, I received the following account from the late Miss Annie M. Wittfeld, written 30th August, 1884. "This morning, while cutting leaves for my *Alicia* larvæ, I discovered two leaves sticking together. I picked and opened them, and what should I find but a larva of *Flora!* I

looked again and found what I took to be a spider's nest, but it contained three more *Flora*. I continued the search, and found eighteen, all in little houses of leaves fastened tightly together, one leaf lying across another obliquely. I found in none more than three, mostly but one."

The eggs are laid in clusters, after the habit of the genus. Dr. Wittfeld says: "*Flora* has a peculiarity in common with *Alicia*, that is, it often deposits its eggs yards away from any foliage. I have seen them do this on the trunk of the tree, ten feet from the nearest leaf; also on the Spanish moss which was suspended from the branches of their tree. Many young larvæ out of eggs fail to find the leaves, and so perish." From this habit of the female in depositing her eggs, and from the falling of the larvæ to the ground with their leaves, it is a wonder that not only *Flora*, but the allied species, all of which in larvæ fall to the ground in large part, are not exterminated. I have stated in Volume II., under *Celtis*, that I believed that species must survive mainly through larvæ hidden among the corky ridges of the bark of the tree, in my own neighborhood, at least.

Dr. Wittfeld obtained eggs of *Flora* by confining a female in bag over a branch of Celtis, and some of them were sent me by mail, 11th July, 1880. They were eight days on the road, and had hatched before I received the package. I was told that about 225 eggs, in one cluster, had been laid. The larvæ fed readily on leaves of Celtis occidentalis. The first moult was passed 24th July, the second 28th, the third on 3d August, the fourth 5–6th August; suspension took place 14th, pupation twelve hours later. On 22d August, two males came out, on 24th two females, on 26th and 28th, each, two females. So that but four moults were passed, and both sexes were represented in the imagos.

But, in 1881, I received another lot of larvæ, from same hand, also hatched on the road; and all that reached maturity, namely four, passed five moults. The first took place on 3d August, the second 7–8th, the third 12th, the fourth 18th, the fifth 24–25th August; the first suspension was on 1st September, pupation the evening of the same day. Another larva passed fifth moult 29th August, and pupated September 6th. Mrs. Peart, who was feeding two of same lot, and making drawings at each stage, wrote me 25th August that both had passed fifth moult. Both sexes here also were present in the resulting imagos, and the difference in the number of moults, in the two years, was therefore not sexual.

Miss Wittfeld sent me 9th January, 1884, some of the hibernating larvæ which she had found in August, as before related. She wrote: "I send six of the sleeping *Flora*. Three of ours are out, and are trying to eat old dry leaves, for we have nothing else for them. It surprised us to see them come out in this

cold weather, the mercury falling to 34°." Dr. Wittfeld had spoken of the same thing a few days before: "To-day the mercury stood at 36°, and two *Flora* came out of their hibernation and crawled on the glass, without sun or stove heat." I placed the six larvæ in the ice-house. They were pink colored, like *Clyton*, shortly after awaking from hibernation. On 22d April I brought them into the house. On 29th they were observed moving, and left their cases. By 1st May were changing to green, which, as in the northern allied species, is done without a moult. The first moult was passed 1st May; the second, on 11th. By 20th, all had passed three moults. These larvæ were of great size, .9 at fifth moult, some of them reaching 1.7 inch. The first pupated 30th May. After eleven and twelve days 1♂ 2♀♀ appeared, the latter very large, measuring 2.75 inches in expanse of wing, and one fourth inch more than any female after five moults in the fall.

Miss Wittfeld gave me the times of the last brood of larvæ of the year at Indian River, thus: eggs laid 10th October; hatched 16th; first moult 19th, second moult 24th, third moult 30th; by November 10th all were in hibernation; all were out by 14th January; the fourth moult took place 25th January, the fifth 4th February; were full-grown by 10th February, pupated 18th, and the imagos had come out by 6th March. As stated, the larvæ which I had passed three moults after hibernation.

The process of moulting, not only of *Flora*, but of the group, is as follows: the second segment swells enormously, and the mask of the old face is pushed forward. When the skin begins to pass off, owing to its extreme tenuity, and the resemblance of the new coat to the old, it is difficult to see that it is moving. Only by watching the gathering of the folds at the end of the body could I make sure of what was going on. As the mask is dropped, the new head is seen to be square at the top without projections or processes of any sort. But in about eighty seconds the vertex process parts from the side of the head, where it has lain folded down, and thin as paper. At three minutes it is half up, a mere membrane and covered by a mass of long hairs, the points brought together in penent. Then the spurs along the back of the head, which also have been folded close down, begin to lift. At five minutes the points had separated, at eight were filled out, and at ten they, as well as the spurs, had assumed their final shape. Up to this time, the whole head, processes, and spurs have been greenish white, the ocelli and mandibles black; but at twelve minutes there is a darkening of all the parts which finally are to be black, at first becoming darker green; at fifteen minutes gray-green. At twenty-five the white portions of the face are pure color, the gray is blackish; at forty-five, all the dark parts are pale black; at seventy the black is deep, and the change is complete.

DESCRIPTION OF THE PLATE.

FLORA, 1, 2, ♂, 3, 4, ♀.

a EGG ; a^2 micropyle.

b YOUNG LARVA; b^2 head.

b^3 YOUNG LARVA, showing the tubercles and processes.

c Larva at 1st moult ; c^2 side view ; c^3 head.

d Larva at 2d moult ; d^2 head.

e Larva at 3d moult ; *e* segment 8, dorsal view ; e^2 head.

f, f^2 Larva at 4th moult ; f^3, ^{4}, ^{5} heads in var.

g Larva at 5th moult ; natural size.

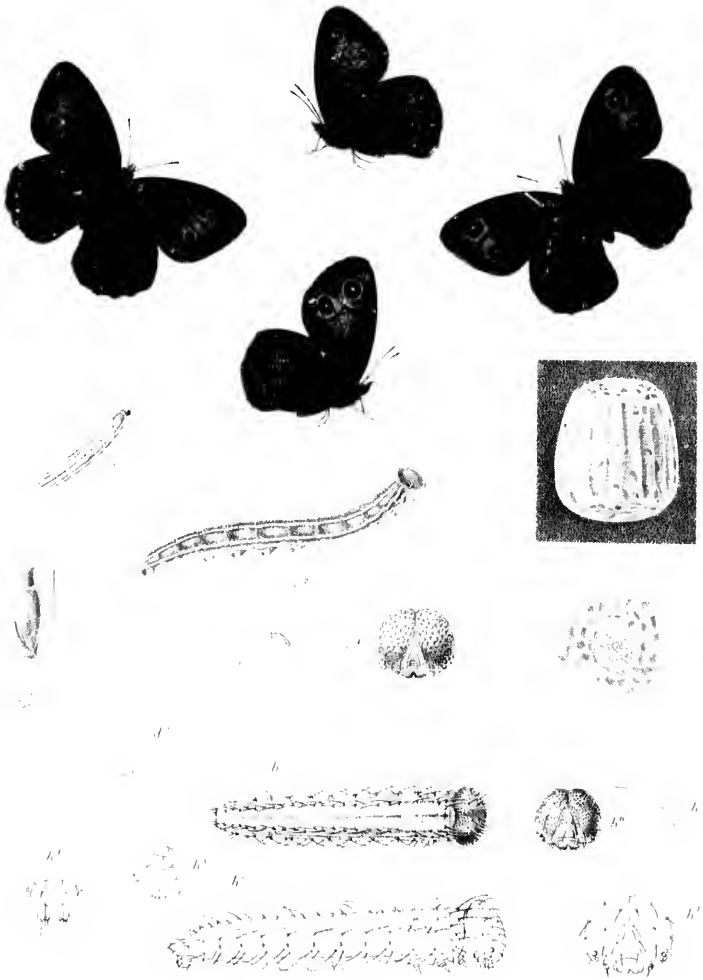
g^2, g^3 ADULT LARVA, after five moults, natural size ; g^4 section of segments 7, 8.

h CHRYSALIS, after 4th moult, natural size, ♂.

h^2 CHRYSALIS, after 5th moult, natural size, ♀.

SATYRUS.

II.



MEADII. 1 2 ♂. 3 4 ♀.

a Egg magnified *c* Larva mature nat. size.
b Larva young *c'* magnified

d Chrysalis

SATYRUS II.

SATYRUS MEADII, 1-4.

Satyrus Meadii, Edwards, Trans. Am. Ent. Soc., Vol. IV., p. 70. 1872; id. Can. Ent., Vol. XII., p. 94. 1880; Mead. Report Wheeler Exped., Vol. V., p. 774. 1875.

MALE. — Expands from 1.5 to 1.7 inch.

Upper side blackish-brown; primaries have an obscure submarginal stripe; two large black ocelli, placed as is usual in the group, each with small white pupil; these are surrounded by a russet halo, more or less diffused, the two often meeting; also the interspaces between the ocelli to the arc of cell are russet, but of a deeper shade; secondaries have a similar stripe, and a small ocellus in russet ring on the lower median interspace; fringes of both wings fuscous at the tips of the nervules, gray in the interspaces.

Under side of primaries paler, the apical area gray, the russet paler, diffused, the basal area, and the cell, much crossed by abbreviated black streaks; this area is limited without by a blackish line which starts on subcostal nervure halfway between the arc of cell and the ocellus, runs obliquely back to the upper branch of median, then crosses the interspaces, curves around the lower ocellus, and on to costa, parallel with the margin; next outside this a submarginal gray band; the ocelli repeated, the russet hue diffused over the outer part of cell.

Secondaries dark brown, more or less gray next base and over the disk, beyond the belt decidedly gray, especially on the upper half of the wing; the whole surface streaked black; the belt limited on either side by a blackish stripe, on the basal side not always distinctly; it is narrow on costal margin, projects in a broad double tooth opposite cell, after which is a narrow sinus; on the basal side the course is nearly straight to median, a little sinuous, then bends at a right angle on median, and at the origin of the lower median nervule turns obliquely to the submedian nervule; the ocellus repeated; sometimes a second one in the submedian interspace.

Body fuscous beneath, the abdomen gray-brown; legs gray-brown; palpi

yellow-brown, the long hairs on the front black; antennæ fuscous, annulated with whitish above, whitish below; club black above, ferruginous below. (Figs. 1, 2.)

FEMALE. — Expands from 1.55 to 1.8 inch.

Closely like the male, but the russet area is more extended. The ocelli are larger, and the encircling rings broader. (Figs. 3, 4.)

EGG. — Conoidal, truncated, the summit a little rounded, depressed in middle, the sides convex, the bottom rounded; marked by about twenty low, rounded, vertical ribs, which are slightly sinuous, and most of them considerably curved next base; the spaces between the ribs shallow, and crossed by many equidistant fine, raised threads, which are often lost in the middle part; the micropyle in the centre of a flat rosette of five-sided cells, outside of which are three rows of similar cells, gradually increasing in size; the remainder of the summit occupied by large, irregularly five and six sided cells, deeply but irregularly excavated, and having thin, sharp edges; color lemon-yellow. (Figs. *a*, a^2.) Similar to the egg of *Alope*, but with a greater number of ribs, and more convex sides.

YOUNG LARVA. — Length .08 inch; similar to *Alope;* tapering on both dorsum and sides from 2 to 13, the last three segments curving roundly on dorsum to the extremity; this is nearly square, a little incurved, and bears a conical tubercle at either side; on each side of the body are three rows of low, conical tubercles, one sub-dorsal, one to the segment, on 2 to 4 placed on the middle of the segment, after 4 on the front; one high on the side and near the sub-dorsal row, except on 2 to 4, where the distance is greater, one tubercle to the segment, those on 2 to 4 in the middle, after 4 on the rear; the third row a little above the spiracles, one to the segment, on the middle; on 3 and 4, behind the tubercles of the third row, is a minute one in same line, bearing a very short, clubbed process; on 2, behind and between the upper two tubercles, and also between the second and third, is an additional one, and there is a smaller tubercle in front of the spiracle; every tubercle bears a white, appressed process, nearly of even thickness, tapering from the base but very little, ending bluntly (Fig. b^5); those of the upper row longest, of the second row a little shorter, of the third a little shorter than of the second; all these processes from 2 to 4 are bent forward; after 4, all in the upper two rows are turned back; those of the third row to 13 are bent forward, on 13 back; at the rear of 13 are two tubercles and processes on the side, belonging to the two lower rows, and

the tubercles at extremity also have similar processes; between these last are two smaller ones with short processes; along the base of the body are minute tubercles, with short and fine, tapering hairs, two on 2, one each on 3, 4, two on each from 5 to 13; and there is one still finer and shorter hair over each of the legs; color pale pink with a red-brown mid-dorsal line and three others on each side, the lower one running with the tops of the spiracles; under side, feet and legs, a shade paler; head sub-globose, one half broader than 2, about as high as broad, narrowing upwards, a little depressed at suture, the front well rounded; surface thickly and shallowly indented; on either lobe ten fine tubercles, each with its short process, bent down; of these, four are in cross row near the top, six are in line with the apex of the frontal triangle, six are in line a little above the top of the ocelli, and two are behind the ocelli; color pale yellow-brown, the ocelli green. (Figs. *b*, *b*^{2} to *b*^{6}.) Hibernation began at once from the egg.

As soon as the larvæ began to feed in the spring, the color changed to green. From the awakening to first moult, in April, at Coalburgh, about twenty days.

After first moult: length, at twelve hours from the moult, .18 inch; the anterior segments thickest, the dorsum arched; ending in two conical tails which meet at base, and are rough with tuberculations; each segment several times creased, and on the ridges so caused are yellow tubercular points, each of which gives out a short, whitish clubbed process bent back close to the surface, except on 2, where all are bent forward; color pale green; a mid-dorsal darker green stripe, and two similar ones on mid-side, close together; the basal ridge yellow; tails red; under side, feet and legs bluish-green; head nearly the same shape as before, thickly covered with fine whitish tuberculations, with short hairs; color bright green. Duration of this stage about fifteen days.

After second moult: length, at twelve hours, .28 inch; same shape; color dark yellow-green, the tails red; armed as before; the mid-dorsal stripe dark green; high on the side a line of yellow tubercles; the basal ridge yellow; head as before, emerald green. To next moult about fifteen days.

After third moult: length, at twelve hours, .44 inch; very closely as at last previous stage; the upper line pale-yellow, and heavier, a narrow stripe rather; head as before, same color. To next moult about nine days.

After fourth moult: length, at twenty-four hours, .64 inch; in about five days was full grown.

MATURE LARVA.—Length, ♂, .85 inch, ♀, 1 inch; cylindrical, thickest in middle, the dorsum arched and tapering evenly either way; ending in two short conical tails, which meet at base; color yellow-green, the surface thickly covered with fine yellowish tubercles, each of which gives a short whitish tapering process bent back (Fig. c^3); on mid-dorsum a dark green stripe, next which the ground is rather more yellow than elsewhere; high on the side a narrow, yellow-white stripe; the basal ridge bright yellow; the tails red from base to tips; under side, feet and legs less yellow, more green; head sub-globose, rounded frontally, as high as broad, broader towards the top than in the earlier stages, narrowing upward but very little, slightly depressed at the suture; thickly covered with fine whitish tuberculations, each of which bears a very short, whitish tapering process; color emerald green. (Figs. c natural size, ♀, c^2 side view, greatly enlarged, c^4 head.) From fourth moult to pupation, eighteen days in May and June; again, thirteen days in June, at Coalburgh. The attitude of the larva in suspension is that of Fig. 6, as in the genus.

CHRYSALIS.—Length ♂, .49 inch, ♀, .54 inch; breadth at mesonotum, .17 to .18 inch, at abdomen .18 to .19 inch (in several examples the breadth at both points was equal, .18 inch); cylindrical, the abdomen conical; the ventral outline from top of head case to end of wing cases strongly arched, about as much so as is the dorsal below the depression; the wing cases elevated, beveled down to the abdomen; head case short, the top narrow, square or very little concave, the sides excavated; mesonotum rather prominent, rounded lengthwise, carinated, the sides a little convex; followed by a shallow depression; cremaster long, tapering, compressed transversely, rounded at extremity, and armed with stout hooks, varying in length and in form (Figs. d^2, d^3); color throughout light yellow-green, everywhere finely granulated with dull white, the dorsal region and the abdomen in dots and minute patches; the top of head case and the dorsal edges of wing cases cream-white. (Fig. *d*, a little enlarged, ♀.) Duration of this stage about eleven days.

SATYRUS MEADII was named from Mr. Theodore L. Mead, who first introduced it to notice, in 1871. He himself says, in his Report upon the Collections of Diurnal Lepidoptera, made (by the Wheeler Expeditions) in Colorado and other Territories: "While riding along the South Park road, this species was discovered near Bailey's ranch, about forty-five miles from Denver, and two specimens were taken on the 26th of August. None were to be found a few miles on either side of this point, so I returned and spent a week in observing the species and noting its habits. It must be very local, since, though not at all uncommon

where first met with, none were seen elsewhere during the season. It evidently first appears about the last of July, since nearly all the specimens were dilapidated, the males especially so. The species in mode of flight much resembles S. *Charon*, often alighting on dry bare spots in the grass and walking a few steps, then, after resting a few moments, flying off to some flower or other bare spot." The original description was made from these somewhat dilapidated examples, and the general color was given as light brown, whereas fresh examples are very dark.

Mr. Bruce has written for me the results of his observations on this species during the last few years: "S. *Meadii* is quite common at Buffalo Creek, in Platte Cañon, Colorado, from the middle of July until the beginning of September. It is a gentle, unobtrusive species, seldom flying more than a few inches from the ground. It is extremely partial to flowers, especially the Compositæ. A tall species of Senecio grows abundantly by the side of the Platte that is very attractive to butterflies, and during August the bright yellow flowers of this plant are literally swarming with S. *Meadii*, accompanied by several species of Argynnis and Chrysophani. But the *Meadii* always outnumber them all, and they are generally so engaged with the sweets that I have frequently filled my collecting bottle with selected examples without using the net. They are fond of places where the timber has been burned, and individuals will attach themselves to a fallen charred tree, and flit leisurely around it, and backward and forward through the limbs for some minutes, then alight on the trunk and promenade with wings half extended for several minutes more. The species seems very local. I have met with it nowhere else in Colorado but in this district, which is about forty miles from Denver, and between 6,000 and 7,000 feet in altitude. It does not ascend the mountains, but keeps to the gullies and water courses where grasses and flowers abound. It has a more direct flight than S. *Charon*, that species continually flying in a series of circles, but *Meadii* goes straight from flower to flower a long distance, and will then return and repeat the performance over almost the same track. The first year I visited Colorado, I lived at Buffalo Creek from July 15th to August 15th. I saw *Meadii* daily, and took a large number of examples. One fine female had the bright russet on fore wings entirely replaced by white. Except in this case, I have seen very little variation in color. Eggs are easily obtained in confinement, the females laying on any sort of grass."

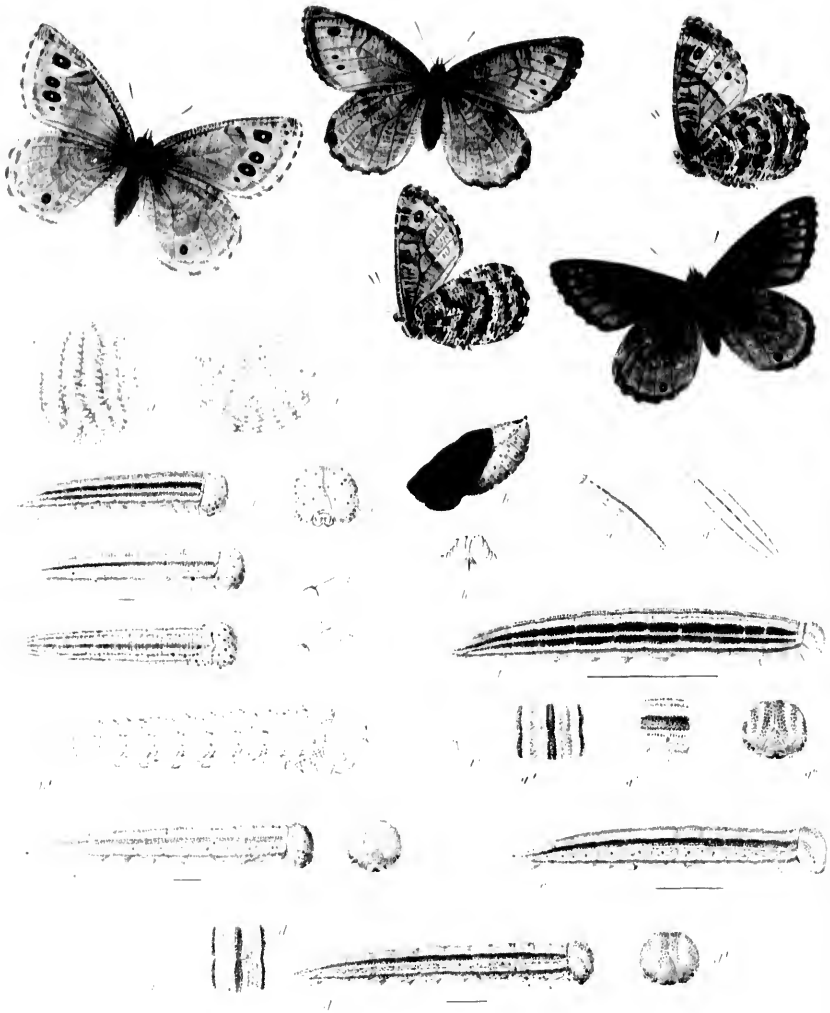
This species, as Mr. Bruce says, seems to be very local, and few collectors have met with it. Somewhere in Montana, Mr. H. K. Morrison took it, but the exact locality is not known. I can hear of it in Colorado, after corresponding with several persons who have collected butterflies in that State, only in the

region mentioned by Mr. Bruce. Prof. F. H. Snow writes: "I first took the species in July, 1878, near Dome Rocks, in the South Platte Cañon, about twenty-five miles from Denver; and subsequently in New Mexico, in the Water Cañon, west from Socorro, August, 1881. It was represented in both these places by comparatively few individuals." S. *Meadii* may be common in some parts of Arizona, but the only locality known to me is in the vicinity of Prescott. Mr. Fletcher says that it has never been reported as taken in Canada. Apparently it is a southern species, ranging from Montana perhaps into Mexico. Examples from Arizona are larger than those from Colorado. This is in contrast with Satyrus *Charon*, which swarms from Colorado to Alberta Terr. all through the mountains, and the most northern examples are largest.

I first received eggs of Satyrus *Meadii* from Mr. Jacob Doll, at Prescott, Arizona, 12th August, 1881. The larvæ were hatching on arrival, the package having been twelve days in the mail, and they speedily died.

In 1886, Mr. Bruce sent me several eggs from Denver, laid 2d and 3d August. These began to hatch 17th, and the larvæ at once became lethargic, and were soon sent to New York, to go into a refrigerating house. I received them again 31st March, 1887, nearly all alive, and two or three days thereafter they were observed to be feeding. On 12th April they began to pass the first moult, on 27th the second, by 6th May eight had passed that moult, on 12th May one passed the third, and on 24th the same larva passed the fourth moult. All had passed the fourth by 27th May. On June 10th the first pupation took place, on 11th and 12th others. The first imago came forth on 21st June, after eleven days in pupa.

On 18th August, 1889, I again received eggs from the late William S. Foster, at Buffalo Creek, Colorado. These hatched, and the larvæ went at once into hibernation, as before. On 2d April they came back from New York; on 4th some were feeding. On 21st one passed the first moult, on 16th May the second, on 24th the third, on 1st June the fourth, on 13th June pupated, and the imago came forth June 14th, at a little less than eleven days. They were fed on Poa pratensis, Blue grass, growing in pots, and, like all the genus, were easy to rear.



CHRYXUS 1 2 ♂, 3 4 ♀, 5 VAR ♀

a Egg magnified *g g'* Larva mature nat size
b b' Larva young to 1st moult *h* Chrysalis mag^{d}

CHIONOBAS I.

CHIONOBAS CHRYXUS, 1–5.

Chionoba Chryxus, Doubleday, Westwood and Hewitson, Genera of Diurnal Lepidoptera, Vol. II., p. 383, pl. 61, fig. 1. 1851. Edwards, Proc. Ent. Soc. Phil., Vol. III., p. 82. 1863. Scudder, id., Vol. V., p. 5. 1865. Mead, Report Wheeler Expedition, Vol. I., p. 777. 1875.
Var. CALAIS, Scudder, ♀, Proc. Ent. Soc. Phil., Vol. V., p. 7. 1865.

MALE. — Expands from 1.8 to 2.25 inches.

Upper side either red-brown or yellow-brown,[1] individuals varying much between these extremes; primaries have three fifths their surface from base either a dark or a pale brown, often with spurs along the nervules, an especially prominent one lying on the upper branch of median; often also the basal color is continued along all the nervules to the marginal border, which is either broad or very narrow, and colored as the base; across the nervules the red or yellow ground forms a narrow band, on which are black ocelli, either pupiled or blind, never large, sometimes minute, from one to three in number; if but one is present, it is on the upper discoidal interspace, if a second, it is usually on the second median interspace; these may be equal, or the upper one the larger; if a third is present, it is usually on the upper median interspace, and is always small; but sometimes the arrangement is quite different, as seen in Fig. 1, there being a minute ocellus on either side of the upper spot, the lower one wanting; the costal edge streaked transversely gray and brown; behind and encroaching a little on the cell is the dusky sexual band, scarcely to be discovered in the darker examples.

Secondaries of nearly uniform color, but sometimes, owing to the thinness of the membrane, the mesial band of under side appears indistinctly, darkening the disk; the marginal border either broad or narrow, brown; a small ocellus in lower median interspace, often a mere point; fringes of both wings yellow-white in the interspaces, fuscous at the tips of the nervules.

[1] Examples from Banff, Alberta Terr., have the red clear and bright; all, except one individual which I have seen from Colorado, have the red obscured — that one showing as bright as any from Canada.

Under side of primaries reddish or yellowish, the cell pale, the apical area more or less gray-white, and both cell and apex finely streaked with brown; the arc of cell covered by a dark brown stripe, and inside cell, near outer end, is an imperfect transverse bar of same hue; the disk is crossed by a brown stripe, corresponding to the outer limit of the dark area of upper side, nearly straight from costa to upper branch of median, on which it bends inward at a sharp angle, then runs to the submedian nervure, which it strikes at three fifths the distance from base; hind margin streaked brown, limited by a macular blackish stripe on inner side; the ocelli repeated. Secondaries gray-white, or a pale yellow-white, clouded with pale brown, much covered with dark brown abbreviated streaks; the mesial band varying in width, sometimes very broad, the edges almost black, the outer nearly parallel with the margin, irregularly crenated, with a projecting tooth that is either single or double on the discoidal nervule, and two prominent and equal rounded crenations in the median interspaces; but these last are often cut squarely off; the inner edge angular on median, and with a large rounded projection on sub-costal.

Body dark brown, beneath, the thorax black, the abdomen yellow-brown; legs gray, the long hairs of the femora dark brown; palpi yellow-brown, the front hairs black; antennæ reddish above, somewhat annulated with gray below; club black, on under side gray-yellow. (Figs. 1, 2.)

Var. CALAIS. This was originally described from a single female, which forms part of my collection. The color above is dull reddish brown, and the basal area as well as the discal is remarkably dusky, the outer limits of this portion blackened so as to form a rather diffuse stripe. There is an interior similar stripe across the cell of the fore wing, which is continued less definitely to the inner margin, and these two include a dusky band that corresponds with the mesial band on under side. The hind wing shows nothing of the interior stripe. On the under side, the ground of primaries is reddish, the markings not differing from the usual *Chryxus;* of secondaries is reddish from base to the outer limit of the band, beyond that sordid yellow; the basal area is well covered with heavy streaks of dark brown, and so is the interior of the band; the extra-discal area to margin is but finely streaked, and with paler brown; the band is very broad, in general as in *Chryxus;* the discoidal projection is double toothed, and the teeth are equal and sharp; the median crenations are cut off and show erose edges. I have seen no example of *Chryxus* female so conspicuously marked on upper side, but occasionally one approaches this *Calais*. The female hereafter spoken of, taken by Mr. Bruce in September, fresh from chrysalis, comes very near it. On the under side, some of the Banff males are closely like the *Calais*

female at all points. My conclusion, after seeing the new material lately sent me by Mr. H. K. Burrison, 3♂, 1♀, taken at Laggan and Banff, and by Professor E. T. Owen, 16♂, 17♀, taken at Banff, all in June, 1890, is that *Calais* and *Chryxus* are one species. There is a perceptible difference between a series of examples from Colorado and these from Canada, as, for example, the northern males have narrower fore wings, as a rule, and so far as at present observed, the larvæ at every stage have the light bands of deeper hue, and the stripes heavier and darker, and this strongly suggests a difference of species. But so far as I am able to determine from the examples of the butterfly under view, the species is *Chryxus*, and *Calais* is a variety, and perhaps the extreme northern form.

Female. — Expands from 2 to 2.25 inches.

The upper side never so dark as in some of the males, either reddish brown, or yellow-brown, individuals varying much in the shade; the disk and base much obscured or scarcely at all; in some, there is an absence of any stripes or definite markings, in others the outlines of the mesial band of under side of primaries are indicated by black stripes; the ocelli on primaries sometimes two, more often three, and occasionally four, varying much in size, as is shown in the figures on the Plate; under side as in the male; one example under view shows five ocelli, though but four on the upper side; some have the mesial band of primaries as distinctly outlined as that of secondaries, others show scarcely a trace of it; there is wide variation. (Figs. 3, 4, 5.)

Egg. — Similar to egg of C. *Ivallda* (Vol. II., pl. 45); sub-conic, the base flattened, but somewhat rounded; broadest at about two fifths the distance from base, the upper part narrowing slightly, the top flattened; marked by nineteen vertical ribs, somewhat sinuous, narrow at top and rounded, the sides a little convex, the interspaces not deep (a cross section would show the hollows to be equal to, and in outline very like, the elevations); the micropyle is in the centre of a rosette of five-sided cells, outside which are two or three rows of similar cells, gradually increasing in size; color dead-white. (Figs. *a*, a^2.) Duration of this stage fourteen and fifteen days.

(Note. — In the description of the egg of C. *Ivallda*, it is stated that the sides of the ridges are excavated, which is erroneous. They are slightly convex, and a cross section would give an outline similar to that of *Chryxus*, as above described.)

Young Larva. — Length, at twenty-four hours from the egg, .12 inch; thickest anteriorly, tapering from 2 slightly and regularly on dorsum and sides,

but after 8, rapidly on dorsum, the last segments curving to 13, which ends in two short, sub-conical tails, not quite meeting at base; furnished with three rows of blackish, conical tubercles, on either side, above the spiracles, a dorsal, sub-dorsal and lateral, one tubercle to the segment in each row from 3 to 12; on 2 there are four tubercles at the front, placed near together and equi-distant, not quite in vertical line, but obliquely back, the third and fourth falling a little below the sub-dorsal row; there is also a process in front of and above the spiracle, and below it a tapering hair; on 3 and 4, each, is a second one in front of the lateral; those of 3 and 4 in vertical row, on the middle of the segment, on the remaining segments in triangle; 13 has the three on front part, and a second three to the rear, one of them being at the tip of the tail; also between the tails, a little below the tip, on either side is a smaller tubercle and process; each tubercle from 3 to middle of 13 gives out a very short, thickly-clubbed, bent white process (Fig. b^5); those on 2 and at the rear of 13 are longer, slenderer near base, less heavily clubbed at top (Fig. b^6); under the spiracles is another row of smaller tubercles, 2 on 2, 1 on 3 and 4 each, 2 from 4 to 12, and one on 13; also over the feet is a short hair to each, over the prolegs two, and over the anal leg three (this arrangement of tubercles and style of process is characteristic of the genus, so far as observed); color, at first pinkish white, in a few hours changing to slate-blue, in about two days to gray-green; marked by longitudinal dull red lines, a mid-dorsal, and three on either side; in the more northern examples, the mid-lateral line is heavy and dark colored and the mid-dorsal broad (Figs. b, b^2); in the southern these are pale, and the upper one slight (Fig. b^3); in all, the sub-dorsal (upper lateral) is slight, and so is the lower lateral, but it is sometimes confluent in part of its course with the broad one above it; under side, feet and legs pale green; head broader than 2, sub-globose, the front well rounded, broadest below, narrowing upward, depressed at the suture; surface covered with shallow indentations, and showing a few tubercles like those on the body, those of the upper two rows brown, the others concolored with the face, each with an exceedingly short, slightly clubbed and bent white process (Fig. b^8); of these there are ten on each lobe or twenty in all (as shown on the accompanying cut), four being in cross row near the top, six in a second row in line with the apex of the frontal triangle, four in a third row a little higher than the top of the ocelli, one a little in front of and above the largest ocellus, and two behind the ocelli, the lower one of which is slightly longer and more slender than the other (the processes in both body and head are exaggerated in the outline figures in order to show them distinctly; actually they are scarcely longer than the supporting tubercles); color of head pale green, the ocelli black. (Fig. b^7.)

As the larva grows, attaining .18 or .2 in length, the color of the body changes to gray with a reddish tint; the lines distinct, and in addition to those first discovered is another over the feet and legs; under side grayish white. Duration of this stage thirteen to nineteen days.

After first moult: length, at twenty-four hours, .22 inch; nearly the same shape, more slender, the dorsum a little depressed at 5 and 6, the curve on posterior segments less strong; the tails more slender, and somewhat longer in proportion; color pale buff; the mid-dorsal stripe is pale black with a vinous tint, narrow, and through each of the buff dorsal bands runs a fine red line; the lateral stripe is broad, deeper colored than the dorsal, and extends to the tip of the tail; next below is a yellow line, and a narrow pale vinous stripe running with the spiracles, then the yellow basal ridge, and under it another stripe; surface thickly covered with fine conical tubercles, each with a short, upright, whitish, clubbed and bent hair or process; under side, feet and legs, yellow-green; head more globular, very little broader at base than above, a little depressed at top, the surface thickly covered with rather deep rounded indentations, between some of which are minute tubercles with processes similar to those on the body; from back to front six nebulous dusky stripes, caused by a dark brown or black coloring at the bottom of the pits, one following the suture on either side, another outside each of these, coming nearly to the ocelli, the third short, at the side; color yellow-buff, the ocelli black. (Figs. *c*, c^2.)

In the darker examples, the mid-dorsal stripe is nearly as wide as the drab dorsal band, and the lateral stripe is blackish with a red tint.

Duration of this stage from five to seventeen days.

After second moult: length, at twenty-four hours, .32 inch; shape and color as before, except that the buff is more yellow (Figs. *d*, d^2 dorsum of 7 and 8); the tubercles and hairs, or processes, still clubbed, slender, thickening gradually from base to top, and bent (Fig. d^3); head as before, color yellow-green. (Fig. d^4.)

In the darker examples, the lateral stripe is deep black along the edges, pale within.

Some larvæ went into hibernation at this stage, soon after the moult; others to maturity. With these last, the duration of the stage was from eight to sixteen days.

After third moult: length .5 to .53 inch; scarcely different in shape, the dorsum somewhat more arched; the stripes deeper colored and rather heavier; the buff area green tinted. (Fig. *e*.) The hairs, or processes, have become tapering,

and the same form holds in the succeeding stage; so the tubercles are more sharply conical. To next moult, eleven to fifteen days.

After fourth moult: length .74 to .86 inch; in about ten days was fully grown.

Mature Larva. — Length .96 to 1 inch; stout, obese, thickest in middle, the dorsum much arched, most so on 7 to 11; ending in two short, sub-conical tails which meet sharply at base; surface closely covered with small pointed tubercles, of irregular sizes, each with a short, stiff, tapering, whitish hair, or process (Fig. g^5); color buff in shades, and striped longitudinally with black; on mid-dorsum a narrow stripe, somewhat macular, edged on either side by a yellow-buff line; on mid-side a broad stripe, partly replaced by yellow; the area between these two stripes is banded, next the dorsal by brownish buff, next the lateral by reddish buff, the latter cut longitudinally by a reddish line; beneath the lateral band is a yellow line, followed by a brown-buff stripe running with the spiracles; then the yellow basal ridge, under which is a narrow stripe of brown-buff; under side, feet and legs yellow-brown; head small in proportion to the size of the body, sub-globose, well rounded frontally; the surface thickly covered with pretty deep indentations, between some of which are very small tubercles, bearing processes or hairs like those of the body; color yellow-brown; across the top six brown stripes (characteristic of the genus, so far as observed), three on either lobe; the inner one follows the suture halfway down the triangle, the second is parallel with the first, narrower, and tapers to a point well down the front; the third is on the side over the ocelli; the indentations covered by these stripes are of a dark brown or black, at bottom, and this gives a mottled appearance to the latter; the frontal triangle dark brown, or black, at base, the mandibles a shade lighter; ocelli black. (Figs. g, g^2 natural size; g^3 section of 7, g^4 of 7 and 8, g^6 head, all enlarged.) In the darker variety, the lateral stripe is broad and black, and the spiracular one is nearly as conspicuous. (Fig. f, greatly enlarged.) From fourth moult to pupation, in the only instance observed, thirty-one days.

Chrysalis. — Length .5 inch; breadth at mesonotum .19, at abdomen .2 inch; cylindrical, stout, the ventral outline much arched from end to end, the dorsal from the thoracic depression to end still more so; head case truncated, dome-shaped at top; mesonotum without carina, rounded every way, curving from its summit to the top of the head; the depression rather deep, angular; abdomen sub-conical, obese; wing cases somewhat elevated, beveled down to the abdomen

on the margin; the cremaster consists of a simple blunt, but somewhat trifid ridge, the two outer lobes representing the anal projections of the larvæ, and the central lobe the intermediary tip; anal orifice and plate well defined (the shape differs in the several species of the genus, as far as observed), naked, there being neither hooks nor straight bristles; color of head and wing cases brown, with darker stripes corresponding to the cell and interspaces of the wings, also with a dark marginal border, a dark patch at the shoulder; the antennæ and tongue cases black; some dark stripes across the head; mesonotum dark yellow-brown; abdomen light yellow-brown, dotted with black points or very short streaks, mostly two to each segment, and in longitudinal rows; there are a dorsal, subdorsal, and mid-lateral row, and others on the ventral side. (Figs. *h*, *h*^{2}.) The only pupa observed died before imago.

CHRYXUS is found throughout the Rocky Mountains from Colorado to British America. The first account of locality and habits appears to be that given by Mr. Mead, who spent several weeks in Colorado, in 1871. He says, Rep. Wheeler Expedn., V. 777: "This Chionobas was found in more elevated regions, still keeping below timber line.[1] It was brought by the Expedition from Gray's Peaks. My first specimens were taken July 8th, on the Arkansas divide, in company with Colias *Meadii* and other rare mountain species. It was not very uncommon by the roadside. It seems to be found in small numbers through all the mountain region around the South Park, rarely, however, below 9,000 feet. None were seen after July."

Mr. David Bruce has kindly written for me the result of several years' observations on this species. He says: *Chryxus* is a true mountain insect. I have never seen it below 8,000 feet elevation. Although it is not an abundant species, it is by no means uncommon in its favorite haunts. At the lower levels, it is usually found on gravelly or bare tracts, on the mountain side. The trails and wagon roads in the cañons, the prospecting holes and 'dumps' of the mines, are also much frequented. It has a peculiar habit of taking short walks on the ground or rocks, leisurely pacing around or across the spot several times, then remaining quiet for a long time. When disturbed, it flies swiftly for a short distance, alighting on a stone, or the earth, and after a few minutes is apt to return to its first starting place, which seems to be selected as a post of observation. It frequently alights on flowers, remaining a long time, the yellow blos-

[1] Mr. Bruce: "Timber line in Colorado is between 11,000 and 12,000 feet. On Mount Gibson, the timber stops as abruptly as a picket fence around a garden; then come low but luxuriant willows, etc., for another 1,000 feet, and these stop, and the true alpines and grasses are all you meet with, — but these are abundant. The region of 'eternal snows' is never attained in Colorado."

soms of Potentilla being especial favorites. On a cloudy or showery day I have often taken them from the plants with my fingers.

"At the higher elevations *Chryxus* takes long flights when startled, and the wind generally assists in carrying it beyond the reach of the collector. The females are more addicted to grassy places, and will take longer and higher flights when alarmed, dropping suddenly into the grass and often hiding so closely as to prevent capture. I have thus many times lost individuals when I saw the exact places at which they dropped. *Chryxus* has the habit of lying flat on the ground, with wings closed, as if dead. When in this position on the disintegrated granite, it is very difficult to detect it. C. *Uhlerii* and C. *Semidea* or the insect which passes by the name of *Semidea*, but which seems to be different from the White Mountain form, do the same thing. C. *Bore*[1] does not frequent the 'barrens,' and therefore the habit is not so noticeable in that species. But H. *Ridingsii* does so persistently. I believe this is for the purpose of concealment; the insects remain perfectly still in the presence of danger. They appear to know when they are observed, for they are off the moment the eye catches them. The marbling of the under side so harmonizes with the color of the ground or rocks that I have many times failed to detect them after careful search, and on laying my net down, they would spring up, perhaps within an inch of it.

"Although *Chryxus* has not the excursive, bustling flight of many butterflies, it is strong-winged and active, always on the alert, requiring quick action of eye and hand to capture it. The species occurs from about 8,000 feet to the very tops of the mountains of the front range, 14,000 feet. I found it not uncommon on all the peaks near South Park, at this altitude generally in company with C. *Semidea*. Individuals taken on the summits are usually more yellow than those found below. The dark red ones I have in most cases found in the open places among burnt timber, and therefore at a low elevation, and they are rare. The species flies from the middle of June until the middle of September. My first recorded date of capture is June 13th, and a female taken September 10th was quite fresh and bright colored, evidently just from pupa. I am decidedly of the opinion that examples taken in September are produced from eggs laid the same year. I have taken fresh examples in the same locality in which I had taken others three months earlier, and I believe these late flyers to have descended from the early ones. Many times I have obtained eggs from the females confined over grass which was planted in a can, but my experience is

[1] This species is not really *Bore*, as was pronounced, in 1886, by Dr. Staudinger, on seeing a single example. He informs me now, after seeing several examples, that it would seem to be a gray variety of *Crambis* Freyer = *Also*, Boisd. It appears to me to be a distinct species, and I have named it Chionobas Brucei. (See Can. Ent., XXIII., February, 1891.)

that they are very uncertain in the matter of laying eggs in such circumstances, laying two or three in a day, and often none at all. I have found this so with all the species of this genus. I should say that *Chryxus* was a rather long-lived insect. One individual which was easily recognized by an aborted fore wing frequented a small rocky patch for fifteen days, at least. The place was always damp from the gradually melting snow above, and was a favorite resort for many species of butterflies."

Mr. Fletcher informs me that *Chryxus* (but whether the typical form, or the variety *Calais*, is not known to me) was taken by Professor J. Macoun, at Kananaskis, in the Rocky Mountains, 24 June, 1886, at the altitude of 4,100 feet; also that Mr. J. M. Macoun found it at Sproal Landing, British Columbia, at 1,375 feet, and at Deer Creek, in same region, 1,380 feet.

Professor Owen writes me: "The railway guide puts Banff at 4,500 feet. All my captures varied but little from that height. Some ran perhaps 500 feet higher, but only a few, and those on a hill about 1,000 feet above the valley. The species was most abundant in open timber near the Sanitarium Hotel, was scarce in thick timber higher up, as also in the open, rocky ground above the timber."

Mr. Bean is a resident of Laggan, and therefore has been able to note the characteristics of this species with precision. He writes: "I have compared the Colorado pair of *Chryxus* you sent with the Laggan material. I find one female which, on the under side of the hind wings, is a copy of the female sent. Above, it is of the same color, but shows stronger contrasts by the fact of the dark shades being darker than in your specimen; but they are practically alike. I had a Colorado female from you years ago, and that also I find one or two sufficiently near to. But the rest of my females do not compare very exactly with the Colorado specimens that I have. There is one male which is a little less red than the male you sent" (I had sent Mr. Bean one of the dark males, like that shown by Fig. 1), "but otherwise it is practically a copy of it. The prevailing style at Laggan in both sexes chiefly occurs at about 5,000 feet. Those found above timber, or at timber line, are duller. But the species I have only on three occasions found above timber line, and then at about 7,800 feet. At the line there appeared quite a colony last year (1890), and the pattern tended away from that of lower elevation."

The type *Calais* was taken by Mr. C. Drexler, at Albany River, Hudson's Bay, 1861. In the drawings sent me by the late Philip Henry Gosse, representing butterflies taken by him, in 1832, near Carbonear, Newfoundland, was one of the under side of a species that agreed well with *Calais*. It is evident, therefore, that *Chryxus* and its variety inhabit the continent, in Canada, nearly from ocean to ocean.

I first received eggs of *Chryxus* from Mr. Nash, then at Rosita, Colorado, 2d August, 1884; these began to hatch on 8th, the larvæ nibbling through the shell, not entirely around the top, which lifted to permit egress and fell in place again. The first moult was passed 23d August, the second on 2d September. By 12th, two of the larvæ had gone into lethargy, but the third, which had been sent to Mrs. Peart, passed the third moult 13th September, and the fourth 9th October. This one was mailed to me, and died on the road. The other two were sent to Clifton Springs, New York, and died before I received them again, in March following. The experiment so far had shown that the larvæ differed in habit, some hibernating after the second moult, some going to the fourth and last. I fed these larvæ, as I do all the Satyridæ, on blue-grass, Poa pratensis, and I find it preferred to all other sorts.

On 27th June, 1886, I again received eggs from Mr. Nash, at Rosita, which were hatching 6th July. The larvæ began to pass their first moult on 20th, one passed the second on 25th, the third August 10th, the fourth 23d. Soon after, this one ceased feeding and was left out of doors. The others of this lot had died by the way. Meantime, two larvæ from eggs sent by Mr. Bruce, at Denver, had been feeding. These had hatched 1st August, passed the first moult 17th and 18th, the second 26th and 27th, the third on 3d and 6th September. One passed fourth on 14th September. They became fully grown in September, but were feeding a little up to 11th October, and showed no disposition to go into hibernation. But a disease attacked them, the head turning black and then the adjoining part of the body, and both died 21st October.

The one which had hibernated was brought into the house 13th January, the weather being at that time quite warm. It was not observed feeding until 9th February. Early in March was full-grown, became pale in color, rested for days deep down in the sod, and I was confident that pupation was close at hand. But on attempting to clear away the grass with scissors in order to get a clear view, I wounded the skin and the larva soon died.

There was still another lot of three larvæ, from eggs sent by Mr. Bean, laid by a female of the dark variety, and which began to hatch 17th July, 1886. The larvæ passed their first moult 5th August, the second on 22d August. These soon after became lethargic, and were sent to Clifton Springs, to go in the refrigerating house. When I received the box again, 21st March, one larva was alive, and then moving about. As soon as it was placed on a sod, it began to eat. It passed its third moult 9th April, fourth on 24th, and ten days later was mature. For two months thereafter it eat nothing, was seen lying on or in the sod, or on the ground, or sometimes had climbed high up the net that covered it, or it rested for hours on one of the supporting sticks. I supposed it would pupate,

and knowing nothing of its habit, prepared soft earth and covered it with moss, also laid piles of stones. But all was in vain, and the larva lingered till 4th July, and that day died.

A year later, on 10th June, 1888, eggs were again received from the late W. S. Foster, then at Salida, Colorado. They began to hatch 17th June, to pass the first moult 30th, the second 11th July, the third 19th. On 31st, one passed the fourth, and two others the next day. A fourth larva had fallen asleep after third moult, was placed in the cellar, and died there. On 1st September, one of the larvæ was found to have just pupated, at thirty-one days from the last moult. It was low down in the sod, on its side, and of course unattached, as there are no hooks to the cremaster. This pupa was sent to Mrs. Peart, and is figured on the Plate. It died before imago. The other two larvæ were sent to New York, to be received again, 16th April, 1889. One only was alive, and was wide awake when I opened the box. I laid it on a bit of sod in a flower-pot, neglecting to tie a net over it, and went on with the examination of larvæ of other species. In less than five minutes I returned to the *Chryxus*, but it had run away and I was unable to find it. I could not have looked for such behavior in a larva so naturally lethargic. So ended my experiments and adventures with this Chionobas running through five years. It is a sorry account of loss, partly due to my own carelessness, partly to causes uncontrollable by me. Yet I did reach the pupa, and got a history of all the stages, which lacks only the duration of the pupa stage to make it complete. Sandberg gives the length of the pupa stage of C. *Bore* as about six weeks, in Lapland; Mr. Scudder, that of the only C. *Semidea* pupa which formed in his possession, and gave imago, as nineteen days. Mr. Fyles found the pupa stage of C. *Jutta* to be forty and forty-one days, as he informs me; while one of the same species in Mrs. Peart's charge gave imago after twenty-one days.

The larvæ are sluggish at all stages, moving very slowly, resting in one place for a long time. I never saw a quick movement, and therefore the running away of the larva, as before related, surprised me. In the younger stages they rest mostly on the leaf, heads up or down, but as they become heavy, they lie on or in the sod, and ascend to feed. I never saw one curled in a ring, as is the habit of Arge *Galathea*, but when in the sod they are often bent nearly double, or the head and anterior parts are curved down. Seen indistinctly through the grass they have a very reptilian look, like a section of a small, slender snake, not uncommon hereabout. Like all the Satyridæ, they eat at the top of the grass leaf, mowing down the edge in as wide a swathe as the mandibles will take in, and in successive cuts till the leaf is eaten through; then they back down and repeat the process.

The larvæ from Canada were all of the dark variety, represented by figures *b*, *b*^{2}, and *f*, those from Colorado were always light, with narrower dorsal and lateral stripes.

The larvæ from Canada hibernated after second moult, and pupation would naturally occur early in the following summer, or perhaps in May. All the examples of the imago from Banff before spoken of were taken on or about 20th June. The Colorado larvæ in part hibernated after the second, also the third moult, and these would probably reach the imago stage in June. Others went on to maturity and hibernated fully grown. Such larvæ would pupate early in the spring, and give the earliest butterflies. One larva pupated the same season, in September, and this supports Mr. Bruce's opinion that fresh butterflies fly late in the season, out of eggs laid in the previous spring. There would be an appearance, in Colorado, as of three distinct broods of the imago, early, midsummer, and late, and so Mr. Bruce has found it.

All persons who have attempted to rear larvæ of this genus discover that it requires time and patience, and any degree of success is reached through many failures. Several of the most experienced breeders of larvæ in the United States and Canada have tried their skill on C. *Macouni*, with hundreds of eggs distributed among them, but scarcely has a larva got beyond the second moult. One only reached the fourth, and that died before imago. For this reason, exceedingly little has been published of the early stages of any Chionobas, whether American or European, and that little is imperfect and scrappy, except in the case of *Jutta*, in which Rev. Mr. Fyles succeeded in rearing the species from egg to imago, as related by him in the Canadian Entomologist, Vols. XIX. and XXI.

I have dealt with five lots of *Chryxus* larvæ, and the duration of the several stages was as follows: —

Time from egg to first moult	15, 14, 17, 13,	days,	Colorado; 19, Canada.
" " first to second moult	10, 5, 9, 12,	"	Colorado; 17, Canada.
" " second to third moult	8, 16, 8,	"	Colorado.
" " third to fourth moult	16, 11, 12,	"	Colorado; 15, Canada.
" " fourth to pupation	31,	"	Colorado.

By which it appears that not only have the Canada larvæ hibernated at one stage earlier than the Colorado, but that each stage of the former was prolonged.

DESCRIPTION OF THE PLATE.

CHRYXUS, 1, 2 ♂, 3, 4 ♀; 5 Var. ♀.

a Egg; a^2 micropyle.

b, b^2 YOUNG LARVA, dark variety, b^3 the light var.; b^4 outline showing the processes; b^5 process on 3 to 13 and on front of 13, b^6 same, on 2 and rear of 13; b^7 head, b^8 process on same.

c Larva at first moult; c^2 head.

d Larva at second moult; d^2 section of dorsum, 7 and 8; d^3 process on 3 to 13; d^4 head.

e Larva at third moult.

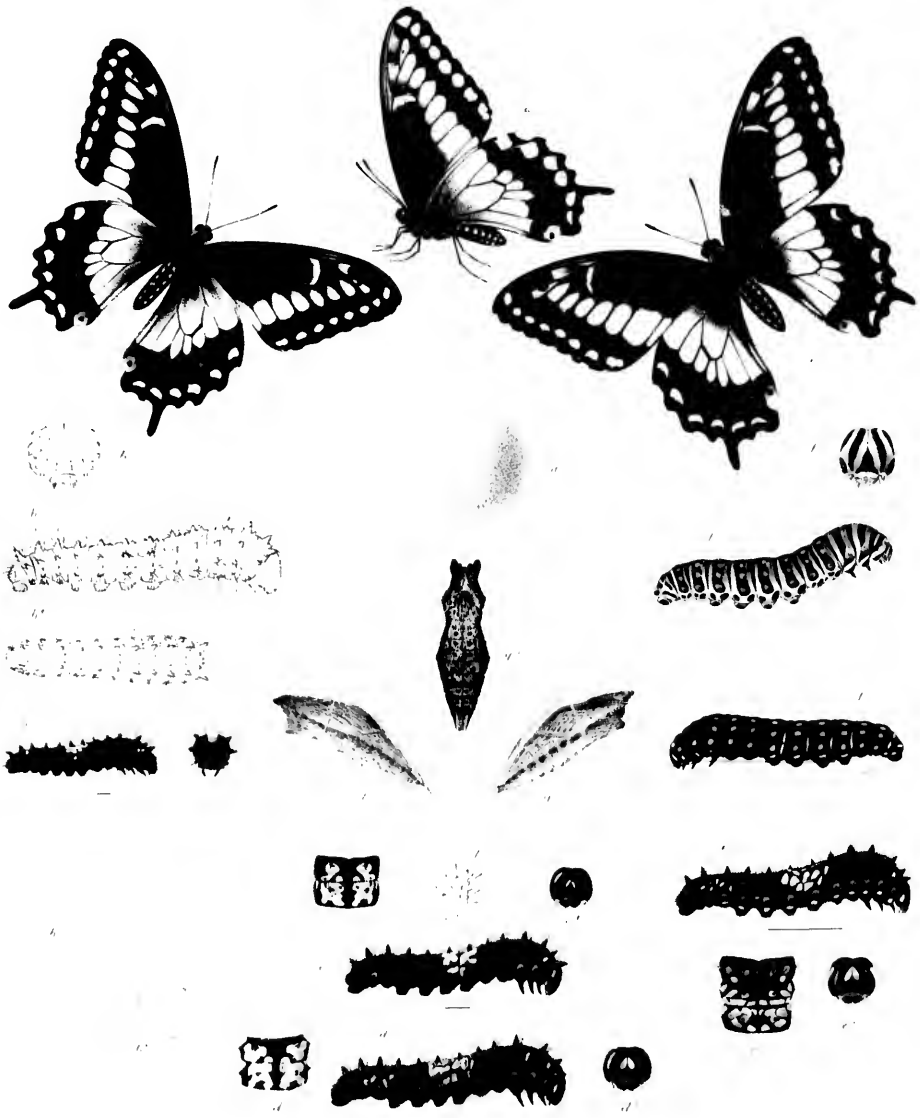
f ADULT LARVA, dark variety, enlarged.

g g^2 ADULT LARVA, light variety, after four moults, natural size; g^3 side view 7; g^4 dorsal of 7, 8; g^5 process on body; g^6 head.

h CHRYSALIS, enlarged; h^2 end of last segment, showing the cremaster.

PAPILIO.

III.



AMERICUS 1 2 ♂ 3 ♀

ZOLICAON

a Egg magnified *e* Larva mature after 4th moult natural size
b Larva young *f* back view
c *d* 1st to 3rd moults *g* *h* Chrysalids

PAPILIO III.

PAPILIO AMERICUS, 1–3.

Papilio Americus, Kollar, Denkschr. Akad. Wissenschr. Wien, Math. Nat. Cl., Vol. I., p. 350. 1850; Staudinger, Exot. Schmett.
Sudalus, Lucas, Rev. Zool., 1852, p. 133, pl. 10, fig. 4.

Male. — Expands about 3 inches.

Upper side of primaries black, marked and spotted with yellow, of secondaries yellow in the middle area from margin to margin, black next base, and on the outer limb in a broad belt; primaries have a sub-marginal row of eight small, equal, rounded spots and a discal of eight, separated, sub-oval, small on anterior half; a narrow bar crosses the cell next inside the arc, and there is a patch at the base of the second sub-costal interspace. Secondaries have a sub-marginal row of small equal crescents; in the interspaces above these are clusters of blue scales; above the anal angle an orange ocellus with black pupil; fringes of both wings black at the ends of the nervules, yellow in the interspaces.

Under side much as above, the colors paler; the marginal spots enlarged; secondaries sometimes have the basal area solid black, in which case the yellow band corresponds in width to that of upper side, but sometimes the yellow ground extends to base, and is there more or less dusted with black scales; on both wings the marginal spots and the outer parts of the discal bands are tinted, or quite covered, with orange.

Body black, the shoulders yellow; on the abdomen two sub-dorsal rows of yellow spots, and another on either side (as in the *Asterias* group), and more or less of a row on last segments on either side of the ventral line; legs and palpi black, as are also the antennæ and club. (Figs. 1, 2.)

Female. — Expands from 3 to 3.25 inches. Closely like the male in color and markings. (Fig. 3.)

The male figured was received by me from one of the Wheeler Exploring Ex-

peditions, about twenty years ago, labeled "Camp Apache." So far as I know, the species has not been reported as within the United States since. It is much paler in color than specimens I have seen from Central America. These latter also have the basal area on under side of secondaries deep black. The female was loaned me by the American Entomological Society, and belongs to its collection. Its locality is given as "United States of Colombia," and it is deeper colored on upper surface than the male, but less so than the Central American examples spoken of. On the under side the yellow extends to base of secondaries, and the black dusting lies pretty thick on the basal area and down the inner margin. A female loaned me by the late Henry Edwards, and labeled, "Mt. Bach, Bogota, 9,000 feet elevation," is very near in the shade of yellow on both surfaces to the Arizona male. The yellow on under side of secondaries reaches the base, and it is very little dusted black. Arizona is far away from the usual habitat of the species, which lies from southern Mexico to Ecuador. Of the habits of *Americus* I know nothing, but as belonging to the *Asterias* group, it would behave much like the other members, its larvæ feeding on umbelliferous plants.

PAPILIO III.

PAPILIO ZOLICAON, *a–g*.

Papilio Zolicaon, Boisduval, Edwards, Butt. N. A., Vol. II., pl. 6, p. 25. 1875.

PREPARATORY STAGES.

EGG. — Spherical, flattened at base, smooth; color yellow-green. (Fig. *a*.) Duration of this stage about ten days.

YOUNG LARVA. — Length, at twelve hours from the egg, .1 inch; cylindrical, thickened from 3 to 5, tapering gradually on dorsum and sides to 13; color deep black; on 8 a gray-white dorsal patch, which partly covers 7, sometimes much broken into spots; high on the side, on 2, 3, 11, 12, are white points, but often in part or altogether wanting; the surface covered quite thickly with short fine black hairs; armed with three rows of black tubercles above the spiracles, three on either side, running from 2 to 13, one to each segment, a dorsal, sub-dorsal or upper lateral, and mid-lateral; those of the dorsal row are very small, sub-conical, each with a single black hair or process at top (Fig. b^7); on 2 in front and within is another similar but smaller tubercle; those of the upper lateral row are large, conical, largest on 2 to 5 and 11 to 13, smallest on middle segments; at the summit of each a long tapering clubbed process, and around the sides, rising from low tuberculations, are several shorter, similar processes, on 2 twelve such; on 3 and 4 eight; on the middle segments five and six (Fig. b^6); those of the next row are nearly similar, but are smaller, and bear three and four processes on their sides; on 2 to 4, in line with the spiracles, or nearly, is a demi-row, like those above; in the same line, in front of 6 to 10, are two short hairs to each, placed vertically; below the spiracles is another full row, except on 2, less pointed, rounded, each bearing two to four processes, on 2 replaced by two hairs; along base are short hairs, one to the segment on 2 to 4, three on 5 and 6, four on 7 to 12; also over each pro-leg are four; on the shield are four long hairs on either side, directed backward; all tubercles and processes

black, except on the dorsal patch, where they are concolored; the tentacles of 2 red; head sub-cordate, broader than high, black; on each lobe are ten low conical tubercles, with tapering process; there are also two others within the frontal triangle; in all twenty-two, arranged in nearly regular cross rows; one on forehead, of four; one running with the apex of the triangle, of eight; one placed obliquely between the second and the ocelli, taking in the two on the triangle, of eight; and one behind the ocelli. (Figs. *b* to b^5.) Duration of this stage between three to five days, at Coalburgh, W. Va.

After first moult: length, at twelve hours, .16 inch; shape very much as before; color black-brown; the saddle patch of 8 extends well down the side, and over dorsum of 7, sometimes broken into separate spots on 7; some examples had a single white spot on the sides of 10 and 11, one had three spots on 11 and one on 10; the fine hairs over surface as before; the tubercles and processes much as before; the latter more numerous (Fig. c^3, sub-dorsal); the tubercles of the dorsal row orange at base; the upper laterals usually black to base, but sometimes there is a narrow ring of orange on the first and last segments ıe second laterals black; the infrastigmatal row mostly black, if any are orange it is on the anterior and last segments; surface of body covered with short stiff black hairs; head very much as before, shining black; on the sides of the triangle near apex appeared traces of the white spots developed at next stage. (Figs. *c* to c^4.) To next moult from two to three days.

After second moult: length, at twelve hours, .3 inch; shape as before; color black; the patch more extended, covering the rear of 6; small white spots on the rear of 2 and of 3, and sides of 10, 11, 12; the fine hairs over surface as before; the tubercles generally as at second stage, but with a greater number of processes about the sides; the upper laterals show a little red-orange at base; the mid-laterals sometimes orange at base, sometimes black; those of the lowest row broadly orange at base and nearly to tips; head as before; an inverted cordate white spot at the apex of the triangle. (Figs. *d* to d^3.) To next moult about two days.

After third moult: length, at twelve hours, .54 inch; shape as before; color black-brown; the patch is broken into irregular and separated spots, more or less yellow stained; on the side are several white spots, one on rear of 2, two or three on 11, two on 12; a spot now appears over each foot and pro-leg, as well as on 5, 6, and 11, in the same line; the fine surface hairs as before; the tubercles nearly as before; those of the dorsal row mere points after 5, largest on 4, a little

smaller on 3, still smaller on 5; those of the upper lateral row black to base; of the middle row mostly with a little red-orange at base; in the lower row all are orange from base to tip; head as at third stage, but a white stripe appears on the cheek. (Figs. *e* to e^2.) As the stage progresses, the spots on 7 and 8 change to yellow, as also does the cordate spot on front face; all other spots remain white. Duration of this stage four to five days.

After fourth moult: length, at twenty-four hours, .9 inch; banded black and light blue-green, the base greenish white; the spots gamboge-yellow; the tuberculations very slight and in part wholly lost; the dorsal row appears only on 3 to 5, and is scarcely distinguishable, sometimes wholly wanting; the tubercles of the upper lateral row are low, broad, blunt-tipped; of the next row are wanting except on 3 to 5, and here are small; the lower row shows slight rounded elevations on the anterior segments only. As the stage proceeds, the green bands on the fronts of the segments become more yellow, and the spots first deep yellow, then orange. At from four to six days from the moult was fully grown.

Mature Larva. — Length 1.8 inch; breadth about .3 inch; cylindrical, stout; when in motion nearly even-sized from 3 to 11; at rest, thickened on 3 to 5, and sloping very gradually to 12; the surface much covered with exceedingly short fine black hairs, hardly more than points; color green and black, in transverse bands, green on front and rear of each segment, velvet-black in middle; the front is yellow-green, the rear blue-green, the anterior edge of this last tinged with yellow; the base white, and the green shades gently into the white on the side; 13 nearly white; the junctions of the segments pale dull black; 2 has in front a square ridge, compressed, the top arcuate, the corners a little rounded, yellow along the top, orange at the corners and on sides; on the front are two round orange spots in line with the middle and lower row on the rest of the body; 3 is sometimes wholly without orange spots, but sometimes there are three, more often one, on the lower row, the upper ones, if present, very small; after 3 are three spots to the segment, nearly equal, nearly flat, the whole forming three longitudinal rows to 12; these are placed on the black band, sometimes entirely within, sometimes quite to the front and open there; along base are two black spots from 5 to 12, over the pro-legs large, oval; the legs tipped with black; feet black, at base of each a black patch; 13 has a black crossbar on the front, broken into three; another along base of the leg; the shield black; under side dull black; the tuberculations are still less conspicuous than in the early part of the stage; head obovoid, narrowing upwards, depressed at the suture; yellow in front, whitish yellow at side; from the suture at top a black tapering

band runs to the outer end of the mandibles, another from the top passes down the side; the frontal triangle black; ocelli black, on a black patch. (Figs. *f*, f^2.) From fourth moult to pupation seven to eleven days.

Black Variety. — One of several larvæ reared came up black at fourth moult, though previously it did not differ from its fellows; at the junctions of some of the middle segments were narrow stripes of yellow; the spots along base white. (Fig. f^3.)

Chrysalis. — Length 1.2; breadth across mesonotum .33, across abdomen .4 inch; greatest depth .35 inch; shape of *Machaon* and *Asterias* groups; the surface throughout rough, wrinkled, corrugated, and especially on all ridges and prominences; head case produced, narrow, ending in two sub-pyramidal processes, a little divergent, the ridges carinated, the space between angular, the angle varying in individuals; a low rounded tooth on either slope near the angle (some examples are as in figure g^3, but others have the slope finely and irregularly toothed throughout, while the prominence next the angle is large and compound); mesonotum prominent, sub-pyramidal, blunt-topped, directed forward; the process at base of wing also sub-pyramidal, in some examples the three ridges distinct and carinated, terminating in a blunt point, in others the one of the ridges in the direction of the process on head is suppressed, and in such case the summit is a carinated and curving ridge; abdomen conical, moderately arched on the dorsal side, nearly as much on the ventral; between the bases of the head processes are two fine tubercles, corresponding to the dorsal rows of the larva, and on either side of the abdomen is a row of small blunt ones, of the upper lateral larval row; also on 4 is one on either side from the mid-lateral row, and on 6 and 7, on middle of the side, is one each of the infra-stigmatal row; on the ventral side are six black points in longitudinal row between the antennæ and tongue cases; and in the hind margin of wing case, close to the edge, in the spaces between the nervules, are ten more points, the ninth opposite the apex, the tenth up the costal margin; color either brown or green; if the former, of two shades, a pale wood color, or blackish, the ventral side of thorax darker; a dark stripe along side from end to end; if green, the ventral side is yellowish, the side stripe wanting; the dorsum bright, with all tubercles and granulations yellow. (Figs. *g*, g^2, g^3.)

Comparing the chrysalis of *Zolicaon* with a long series of *Machaon* and of *Asterias*, I see no points of difference except that in part of the *Machaon*, the processes at top of head are often short, whereby the angle between is enlarged, sometimes reduced to almost nothing. But the general features of these, though

they belong to two sub-groups, are the same, even to the minute tubercles on the margin of the wings.

The figure of the adult larva in Volume II. was done from a colored drawing sent me by Mr. Stretch, but the chrysalids were from life by Mrs. Peart, and the figures may be studied in connection with those now given. The minute wing tubercles are distinctly shown, whereas on the present Plate they have inadvertently been omitted.

I have nothing to add as to the territory over which *Zolicaon* flies. Its range is from Montana to Colorado and westward to the Pacific, and from southern British Columbia to Arizona.

The statement before made as to there being but one larval brood in the year may now be corrected. The butterflies from over-wintering chrysalids appear in southern California early in March, and the imagos in descent from these are out during the last days of May and in early June. The third brood of the butterfly is coming from chrysalis during all of September, at Berkeley, according to dates given me by Professor J. J. Rivers. Part of the chrysalids of each brood hibernate, and all of those of the last one. There is exceedingly little variation in the markings of the butterfly throughout its range.

I first received eggs of *Zolicaon* on 3d March, 1883, from Mr. W. G. Wright, at San Bernardino, Cal., laid on carrot; but none hatched. On 2d April after, nine eggs came. On 5th, the first larva came out, and during 6th and 7th, several. I saw one of them thrust out its tentacles at some affront from its fellow. This I mention, because an impression seems to have prevailed among many lepidopterists that a larva has not the use of these organs until one of the later stages. In other species the young larva discover them, and probably the habit is general throughout the genus. On 10th April, two passed first moult; on 13th several passed second; on 15th the first passed third, and the same one passed fourth on 19th. Others passed fourth from 20th to 27th. The first pupation occurred 30th, and the last of the lot pupated 3d May. One female imago came out on 1st June, and the rest went over the winter, to give butterflies early in the spring. The larval period was twenty-four days, that of the egg ten.

On 4th June, 1887, eggs were received, which failed to hatch, but they were laid by a female of the second brood of the year.

On 5th April, 1890, another lot of eggs was received. These began to hatch on the 8th. On 11th some of the larvæ passed the first moult; on 13th, the second; on 15th, the third; on 20th, the fourth; the first pupa formed on 27th, the last one on 30th April. In this case the larval period was but nineteen days, that of the egg nine. All the chrysalids went over to spring of 1891, before giving butterflies. Of six, one was green, five brown.

EXPLANATION OF THE PLATE.

AMERICUS, 1, 2 ♂ ; 3 ♀.

ZOLICAON, preparatory stages of, the earlier ones magnified.

a EGG.

b YOUNG LARVA; b^2 head ; b^3 outline, side view ; b^4 dorsal ; b^5 head, showing the processes ; b^6 a tubercle of segment 5, sub-dorsal row ; b^7 of dorsal row.

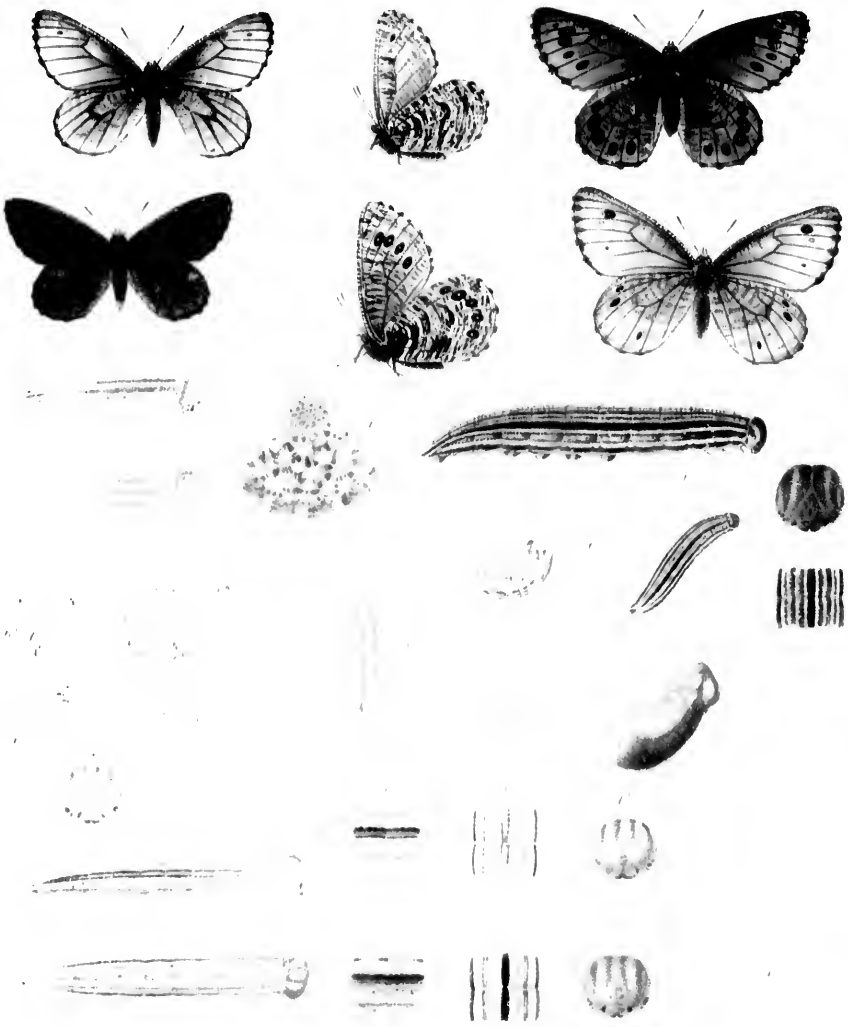
c LARVA at first moult ; c^2 dorsum of 7 and 8 ; c^3 sub-dorsal tubercles of 4 and 5 ; c^4 head.

d Larva at second moult ; d^2 dorsum of 7 and 8 ; d^3 head.

e Larva at third moult ; e^2 dorsum of 6, 7, 8 ; e^3 head.

f MATURE LARVA, natural size ; f^2 head ; f^3 black variety.

g-g^3 CHRYSALIDS, showing the three shades of color.



HELIBERT. FABR. FORM. 1. 2. 3. 4. VAR. 5. LATREILL. FORM. 6.

CHIONOBAS III.

CHIONOBAS UHLERI, 1-6.

Chionobas Uhleri, Reakirt, Proc. Ent. Soc. Phil., Vol. VI., p. 143. 1866; Streeker, Lepidoptera, p. 28, pl. 4. 1873; Mead, Report Wheeler Expedition, Vol. V., p. 776. 1875.

Early Form.

Male. — Expands 1.8 to 2 inches.

Upper side reddish brown, the depth of color varying; the darker examples have the base of the cell of primaries brown, and all the nervures and branches heavily edged with brown; so are the apices of primaries and the hind margins of both wings; the basal half of costal margin of primaries densely sprinkled with grayish yellow; on the extra-discal area there is usually but a single ocellus, which is small, black, and with or without a minute white pupil; this is placed on the upper discoidal interspace; but occasionally there is a second ocellus, on the second median; and very rarely there is a third, which lies on the second discoidal interspace.

Secondaries more or less mottled in darker shades, owing to the thinner texture of the membrane, the markings of the under surface appearing; often without any ocellus, but sometimes one, small, black, with or without pupil, is placed on the lower median interspace, and occasionally there is a second, on the lower sub-costal, and more rarely, a third, on the upper discoidal; fringes of both wings fuscous at the ends of the nervules, sordid white in the interspaces.

Under side of primaries paler, the hind margin and apex flecked with brown on a gray-white ground; the cell much covered with fine brown transverse streaks; faint traces of such streaks over the disk; the ocelli repeated; in one example under view in which there is one ocellus above, there is a second below, on the second discoidal interspace; in one which shows two ocelli above, there are three below, and in another with two above, there are four below; but most often where there is one ocellus above, there is but one below.

Secondaries gray-white, with a tinge of yellow, much covered with transverse

dark brown streaks, usually most dense on the basal half, but often pretty uniformly distributed over the whole wing, though on the basal area they are more confluent, taking the form of irregular concentric bars, limited without, on the middle of the disk, by a nearly continuous heavy stripe; this begins on the costal margin, takes a more or less sinuous course to the upper branch of median just outside the cell, bends roundly, almost at a right angle, and in a sinuous but in general a straight course, strikes the middle of the inner margin; next outside this basal area is often a narrow whitish belt, but frequently there is no appearance of this, by reason of the fine brown streaks; beyond to margin are either fine separated streaks, or they partly coalesce so as to make submarginal nebulous patches; the ocelli repeated, but varying in number; in one example in which there are two ocelli above, there are three below; in another there are one above and three below; in another there are three above and five below; in three which have no ocellus above, there are none below.

Body above concolored with primaries, beneath, usually dark brown, but sometimes the abdomen is yellowish; legs yellow-brown; frontal hairs of the palpi dark brown; antennæ gray-white, finely annulated with fuscous; club fuscous above, ferruginous below and at tip. (Figs. 1, 2.)

Var. Obscura. — Upper side dusky brown; in the figure on the Plate there appear to be three ocelli on upper side of primaries, and three on secondaries; but in the insect this was intended to represent there is but one on one wing and two on the other, the appearance of the additional spots being caused by the transparency of the wing; on the under side there are four small ocelli on primaries, and three points on secondaries. (Fig. 5.)

Female. — Expands 1.8 to 2.2 inches.

Upper side red-brown, the shade varying in individuals, as in the male; the under side as in the male; there is much variation in the number of ocelli on both wings; one example under view has no ocellus on either wing above, and but one beneath, on upper discoidal interspace of primaries; another has two on primaries, three on secondaries, beneath three and three; another has one and three above, beneath three and two; another, and this is represented by Figure 5, has on upper side four large pupilled ocelli, besides a small blind one placed on the lower subcostal interspace, and five large ones, nearly equal and all pupilled, on secondaries; beneath, all the large ocelli are repeated, but the small one is lost.

Later Form. — Upper side, in both sexes, pale ochraceous; beneath pale yellow-white; the brown streaks on under side of secondaries reduced in number

the wing being rather flecked than streaked, the predominating color white. (Fig. 6 ♀.)

In no example have I seen a definite band, such as is the rule with most species of the genus; there is often the suggestion of such a band as shown in Figures 2 and 4, but the inner side is lost in the markings of the basal area. Indeed, these figures represent as near approach to a band as I have been able to discover. In many examples, especially those of the later flight, there is no trace of the outer limit of a band, and the dark markings are largely obliterated over the whole wing.

With regard to the number of ocelli on upper side: —

Of 14 ♂, 3 have 4 on primary, 3 on secondary,
2 " 2 " " 2 " "
2 " 1 " " 4 " "
7 " 1 " " 0 " "

Of 12 ♀, 1 has 5 on primary, 5 on secondary,
3 have 4 on primary, 5 on secondary,
2 " 4 " " 3 " "
2 " 1 " " 3 " "
2 " 1 " " 0 " "

Egg. — Conical, narrowing but little upwards, truncated at top, the sides moderately curved; marked by nineteen or twenty vertical rounded ribs (of a large number of eggs, one only had twenty ribs, all the others nineteen), nearly straight, about as high above the surface as broad, each ending in a rounded prominence at the rim of the summit; the interspaces nearly flat, crossed by very fine equidistant creases (they seem to be creases rather than ridges); the micropyle in the centre of a flat rosette of five-sided, shallow cells, the walls of which are raised, threadlike, on the surface; outside of these are one or two rows of similar larger cells, and beyond a network of ridges radiating from central rounded prominences; these last are not all alike, and are not regularly formed, some being long, and sometimes a small one is so close to a large as to make part of it; the rays stand out boldly at the origin, but fall rapidly, and rarely cross the entire space between the elevations; color chalk-white. (Fig. *a*, micropyle and summit a^2.)

Duration of this stage about thirteen days.

Young Larva. — Length, at twenty-four hours from the egg, .1 inch; thickest anteriorly, tapering from 2 slightly and regularly on dorsum and sides, but after 8 rapidly on dorsum, the last segments curving to 13, which ends with two short, sub-conical tails, not quite meeting at base; furnished, on either side above the

spiracles, with three rows of blackish, low, conical tubercles, a dorsal, sub-dorsal, and lateral, one tubercle to the segment in each row from 3 to 12; on 2 there are four, on the front, near together, equidistant, not quite in vertical line; there is also a process in front of and above the spiracle, and below it a tapering hair; on 3 and 4 each is a second process in front of the lateral; those of 3 and 4 in vertical row on middle of the segment, on the remaining segments in triangle; 13 has the three on the front part, and a second three to the rear, one of them being at the tip of the tail; also between the tails, a little below the tip, on either side is a smaller tubercle and process; each tubercle from 3 to middle of 13 gives out a very short, thick, clubbed, bent white process (b^5); those on 2 and rear of 13 are longer and less heavily clubbed; under the spiracles is another row of smaller tubercles, two on 2, one on 3 and 4 each, two from 4 to 12, and one on 13; also over the feet is a short hair to each, over the pro-legs two, and over the anal leg three, two near together at the rear, one towards the front (in figure b^4 by mistake four are given, the second from the front should have been omitted); color of body at first gray-green, in two days less gray, more green; marked by longitudinal red-brown lines, one mid-dorsal, one sub-dorsal, and these two are of equal breadth; one mid-lateral, broad; and a fine line runs with the spiracles; (this is macular, and indeed merely a row of pale dots); the basal ridge yellowish; under side, feet and legs pale yellow-green; head broader than 2, sub-globose, the front well rounded, broadest below, narrowing upwards, depressed at the suture; the surface covered with shallow indentations, and showing a few tubercles like those of the body, each with an exceedingly short, slightly clubbed and bent white process; of these there are ten on each lobe, or twenty in all, disposed as in *Chryxus;* (the processes on both body and head are exaggerated in the outline figures, in order to show them distinctly; actually they are scarcely longer than the height of the supporting tubercles); color of head greenish with a brown tint; the ocelli dark brown. (Figs. b to b^6.) Duration of this stage ten to thirteen days.

This larva in its first stage is as closely as possible like that of *Chryxus* in shape and in the number, arrangement, and form of the tubercles and processes.

After first moult: length, at twenty-four hours, .18; nearly the same shape, more slender; the tails sub-conical, meeting at base; color whitish yellow on dorsum, pale greenish yellow on sides; the basal ridge less green; the mid-dorsal stripe narrow, red-brown; the sub-dorsal line same color; the lateral stripe broad, pale brown, with a greenish tint anteriorly, the edges dark brown; a brown line runs with the spiracles, and another is under the yellowish basal ridge; surface thickly covered with fine conical tubercles each bearing a short clubbed and bent

process; under side, feet and legs yellow-white; head more globular, very little broader at base; the surface thickly covered with rather deep rounded indentations, between some of which are minute tubercles with processes similar to those on the body; from back to front six nebulous dusky stripes, as in *Chryxus*, and which seem to be characteristic of the genus; (these stripes were not visible for some hours after the moult); color yellow, with a brown tint. (Figs. *c* to c^3.) Duration of this stage about fourteen days.

After second moult: length, at twelve hours, .36 inch; shape as before, color nearly, the dorsum and sides slightly buff-tinted, and through these areas run fine, abbreviated, red-brown streaks; the basal ridge pale yellow; the upper two stripes darkest on the edges, greenish buff within; the lateral blackish on the edges, the interior dusted with same; the processes still clubbed, slender, thickening gradually from base to top, and bent; under side, feet and legs, greenish white; head as before, color brown-green. (Figs. *d* to d^3.)

Some larvæ went into hibernation at this stage, soon after the moult; others continued to feed. With these last, the duration of the stage was about fifteen days.

After third moult: length, at eighteen hours, .45 inch; shape as before; the color more decidedly buff, more heavily streaked; the stripes, especially the mid-dorsal and lateral, very dark, nearly black; the basal ridge pale yellow, the brown stripe beneath it as before; under side, feet and legs, greenish white; the processes have lost the club shape and have become tapering; the head closely as in next succeeding stage. (Figs. *e* to e^3.) Duration of this stage about seventeen days.

After fourth moult: length, at twelve hours, .6 inch; in eight days was fully grown (in the only larva which went to pupa).

Mature Larva. — Length 1.05 inch; stout, thickest from 4 to 8, the dorsum on these segments nearly level, but sloping rapidly from 4 to 2, and from 8 to 13; ending in two short, sub-conical tails, which meet at base; surface thickly covered with small pointed tubercles, of irregular sizes, each with a short, stiff, tapering, whitish hair or process; color buff in shades, and striped longitudinally with black; on mid-dorsum a rather broad stripe, continuous from 2 to 13, narrowing at either end, black; the sub-dorsal narrower, gray-black; the lateral broad, black, running from 2 to end of tail, narrowing on the anterior segments to half the width on middle, and tapering posteriorly to a line on 13; with the

spiracles a greenish buff stripe; under the buff basal ridge a narrow blackish stripe; between the dorsal and sub-dorsal, and the sub-dorsal and lateral stripes is a band of greenish buff, through which run abbreviated longitudinal black streaks; under side, feet and legs, greenish buff; head small, sub-globose, well-rounded frontally; the surface thickly covered with pretty deep indentations, between some of which are very small tubercles, bearing hairs or processes like those of the body; color brown; across the top six broad dark brown stripes, nearly occupying the whole front, three on either lobe; the inner one follows the suture somewhat more than halfway down the triangle; the second is but little narrower and tapers to a point very close to the ocelli; the third is on the side, and also nearly reaches the ocelli; the indentations covered by these stripes are blackish brown at bottom; the frontal triangle brown, with fine dark streaks arranged like an inverted W; ocelli black. (Fig. *f*, natural size; f^2 to f^5, greatly enlarged.) From fourth moult to pupation, in the only instance observed, seventeen days.

The attitude of the larva before pupation is shown by figure *g*; down in the sod, on its back, unattached.

Chrysalis. — Length .5 inch; breadth at mesonotum .18, at abdomen .19 inch; cylindrical, stout (but somewhat less so than *Chryxus*); the ventral outline much arched from end to end, the dorsal from the thoracic depression to end still more arched; head case truncated, dome-shaped at top (rounding both ways); mesonotum rather more angular than *Chryxus*, but without carina and rounded both ways, curving from its summit to top of the head; the depressions rather shallow, less deep than in *Chryxus*; the wing cases slightly elevated, bevelled down to the abdomen on the margin; abdomen conical, tumid; the cremaster somewhat less produced than in *Chryxus*, but of essentially similar form; naked, there being neither hooks nor straight bristles; surface smooth, but on the wing cases are very fine granulations, and the top of head case shows a more decided roughening; color yellow-brown, the abdomen a shade darker than the head and mesonotum; the wing cases slightly green-tinted. (Fig. *h*, life size; h^2 to h^5, enlarged.) The only pupa observed died before imago.

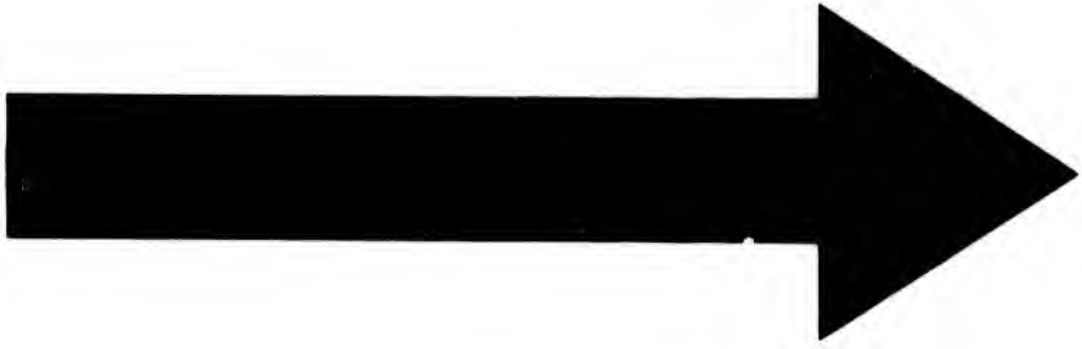
As may be seen by the foregoing description, the early stages of *Uhleri*, with the exception of the egg, are in no essential respect different from the same stages of *Chryxus*.

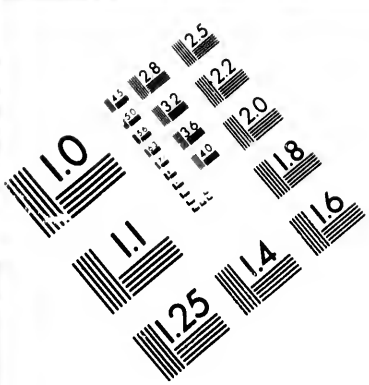
Uhleri was described, in 1866, by Mr. Reakirt, from examples brought from north Colorado by the late James Ridings, who was the first lepidopterist to collect in Colorado, so far as recorded. Mr. Ridings went by overland stage to

Denver, and that early in the season, but his trunk was lost, and with it his collecting apparatus, and did not come to hand for several weeks, or until August. And so it happened that all the butterflies he took were of the later flight. The original description of *Uhleri* therefore is taken from the pale form, which, in the words of Mr. Reakirt, is "dull ochraceous yellow;" the under side of hind wings "marbled with irregular markings . . . sometimes congregated into spots, at others disposed in transverse lines, the darkest portion near the base. . . . The waves from the outer border of the transverse band" (*i. e.*, up to base) "are so interlaced and contiguous, as to preclude all possibility of tracing any inner outline to this band: the outer is more distinct, yet not nearly so well or clearly defined as in the allied species; the reticulations appear to be diffused over the whole surface." Mr. Reakirt was correct in his definition; as I have before remarked, this species is specially characterized by the absence of a discal band on hind wings.

Mr. Theodore L. Mead followed Mr. Ridings, and spent most of the summer of 1871 in collecting butterflies in Colorado. By that time the railways had been opened to San Francisco. Mr. Mead says in the Report cited: "C. *Uhleri* was abundant in the lower mountain regions of Colorado, inhabiting grassy spots, and making only short flights when disturbed or otherwise, soon alighting and being lost to view in the short dry grass. It may be found during the months of June and July. Seventy-three specimens were taken." The author notices the variation in the number of the ocelli, as also the ornamentation of the under surface: "In some specimens there is but a single ocellus — on the primaries; in others, four are present on the fore wings, and five upon the secondaries. . . . Some indication of the median band may generally be seen, but in some specimens the hind wings below are uniformly mottled with blackish transverse streaks," etc. Mr. Mead mailed me all his collection as fast as made, and I therefore was able to examine it. The specimens with four and five ocelli were females; nearly all the males had but one ocellus on primaries, and none or but one on secondaries.

Mr. David Bruce has kindly written for me his observations on this species, made during the last five seasons, thus: "About the middle of May, before the snow has disappeared from the ravines, *Uhleri* makes it appearance in Colorado. It is the first of its genus to be on the wing. My earliest specimens bear date 18th May, at Clear Creek Cañon, elevation 6,000 feet. All these early examples, at this low altitude, were females of dark color, with both wings well furnished with ocelli. The first males appeared May 26th. By the middle of June, both sexes are rather common on the mountain sides where vegetation is rather scanty. They are fond of settling in damp places on the roads. At such times,





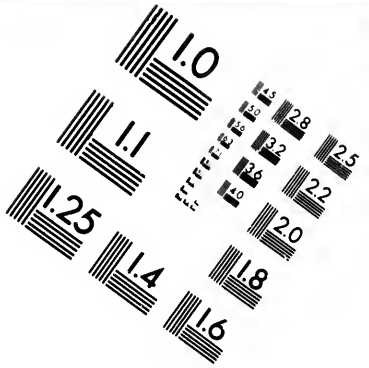
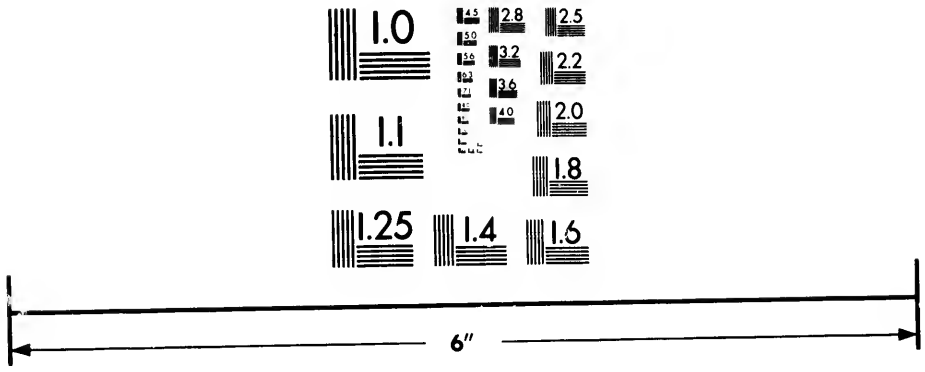
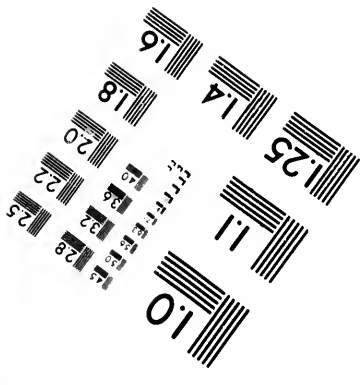
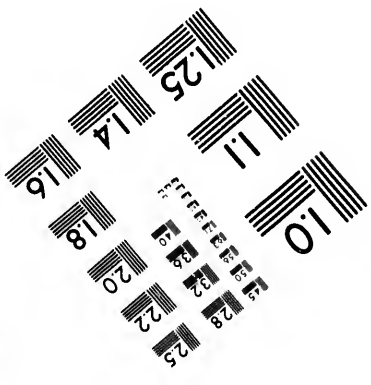


IMAGE EVALUATION TEST TARGET (MT-3)







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when disturbed, they fly a short distance up to the rocks and presently return. They have not the sudden, headlong flight of *Chryxus* when disturbed, and are more easily captured. I have often taken several individuals at one cast of the net when so engaged. I once saw a Papilio *Indra*, a Lemonias *Nais*, and several Pamphilas, in company with two or three *Uhleri*, sipping with great enjoyment from a depression in the gravelly road, after a thunder-storm. Such times and places are the lucky chances of the collector, as the insects are then so intent on their occupation that they may be quietly observed, and captured at leisure. Like *Chryxus*, *Uhleri* has the habit of lying flat on the ground with closed wings, motionless, and is then thoroughly concealed. It is not so partial to flowers as is *Chryxus*, but a gravelly spot among burnt timber is its special haunt. At such a place, in the Platte Cañon, near Kenosha summit, where the timber had been burned several years ago, and grass had grown in bunches here and there, I captured, on 28th June, more than fifty examples in two hours. The altitude was 9,200 feet. These specimens were all rather light colored, and few had more than one ocellus in each wing, while many were entirely without. About the end of July, *Uhleri* disappears, but towards the end of August and as late as 3d of September, I have taken a few pale colored individuals, which I am convinced proceeded from eggs laid the same year. These late ones are generally females, and I have failed to get eggs from them, and concluded they could not have been impregnated. On the other hand, the females of the early brood will readily lay eggs when confined over grass.

"I have taken *Uhleri* on the foothills near Golden, at the entrance to Clear Creek Cañon, elevation 5,500 feet, and it is found in some numbers at Hall Valley, Park Co., at 10,000 feet; but above this very rarely."

It would appear from this relation by Mr. Bruce that the dark form of the species is first to appear. This would be the outcome of the larvæ which have hibernated full grown, and changed to pupæ in the first warm days of spring without feeding. At the higher elevations, the larvæ would hibernate at an earlier stage, and pupation would only be reached some weeks after spring had opened. There would thus be a difference of from four to six weeks in the appearance of the imago. There would be an early flight in May and first of June, and a second in July. These last are lighter colored than the others.

Some larvæ from eggs laid by the May females reach pupa and imago the same fall, as Mr. Bruce has taken fresh examples as late as 3d September. Others reach maturity and hibernate as larvæ. The species is therefore in part double-brooded as to the imago.

I can find no evidence that *Uhleri* is found north of Colorado, nor in the south of that State, nor to the west, in Utah. But probably it may yet be taken in

Wyoming. In Montana and northward into Canada, it seems to be replaced by *Varuna*. Mr. Fletcher sent me several examples of supposed *Uhleri* from different localities in Canada, but they were *Varuna*.

I first received eggs of *Uhleri* from Mr. Bruce, 18th July, 1886, laid 13th. The larvæ began to hatch on 23d July, or at ten days from the laying of the egg. I put them on grass, in a flower pot, covered with a bag. Day after day there were fewer in number, until on 5th August the last one had disappeared. I have had the same trouble with some other species, without being able to discover what it was owing to. But sometimes minute spiders are in the sod, and prey on the small larvæ, sometimes heterocerous larvæ come out of and return to the ground, and are as mischievous as spiders. And the young Chionobas larvæ have a tendency to leave the plant and wander, and so are lost. I have succeeded better when for the first few days they have been confined in a tube, or a tin box, instead of trusting them to the plant as soon as hatched.

Early in June, 1889, I again received eggs from Mr. Bruce, laid 27th and 28th May. These hatched at thirteen days. The larvæ began to pass the first moult 20th June, the second moult 4th July. All had passed second by 8th July. One passed third moult 1st August, another on 6th, a third on 9th, and this last one went at once into lethargy. On 22d, I missed another, and on cutting away every leaf of the grass, and opening the roots, I found the larva had burrowed into the ground about one third inch below the surface, and had begun its winter sleep. I sent it and the first one spoken of to Clifton Springs, New York, to go into the refrigerating house.

But one of this brood passed its fourth moult, 27th August, and I sent it to Mrs. Peart, at Philadelphia. This was the one from which the adult figures on the Plate were drawn. It came back to me 10th September, and pupated 13th September, in the attitude shown on the Plate. Unfortunately the pupa was wounded in the process of formation, and after taking its portrait, it was found best to put it in alcohol. This was the only pupa obtained, and therefore the duration of that stage remains unknown. It appeared therefore that from eggs laid by a female of the earliest flight, one larva went to pupation the same season, while the rest hibernated after third moult.

The same year, on 22d June, thirty-five eggs were received. On 22d August, several larvæ of this lot were living, but except two, all were in hibernation after second moult. The two passed third, and then slept.

In 1890, five eggs were received on 15th July, and hatched 19th. The first moult occurred 1st August, and I sent the larva to Mrs. Peart. It passed the third moult middle of September, the fourth on 1st October, and though appar-

ently well, and feeding after the moult, it died on 14th October. The other and only remaining larva passed the second moult 20th August, the third, 1th September, seemed to become semi-lethargic after a few days, would occasionally feed a little, and at last died the 29th October. The conditions for this brood were not natural, and doubtless on the peaks of Colorado the larvæ would have gone into winter quarters after second or third moult.

These results from breeding the larvæ sustain Mr. Bruce's view, based on observation of the imago, that the late butterflies come from eggs laid by the females of the earliest flight, and that the species is in some degree double-brooded; while the hibernation of some larvæ at the third, others at the second moult accounts for the appearances of fresh butterflies in succession during early and mid-summer.

EXPLANATION OF THE PLATE.

UHLERI, 1, 2 ♂, 3, 4 ♀, earliest flight; 5 var. ♂; 6 ♀ latest flight.

a EGG; a^2 micropyle.

b, b^2 YOUNG LARVA, b^3, b^4 last segments; b^5 process on 3 to 13; b^6 head.

c, c^2 Larva at 1st moult; c^3 head.

d, d^2 Larva at 2d moult; segments 7 and 8; d^3 head.

e, e^2 Larva at 3d moult; segments 7 and 8; e^3 head.

f ADULT LARVA, natural size.

f^2 Same, enlarged; f^3 dorsal view of segments 7 and 8; f^4 process on body; f^5 head.

g Larva when near pupation.

h CHRYSALIS, natural size; h^2, h^3 same, enlarged; h^4 side view of last segment; h^5 front view of the cremaster.

VARUNA 1 2 3 4 ♀ 5 6

CHIONOBAS IV.

CHIONOBAS VARUNA, 1–7.

Chionobas Varuna, Edwards, Canadian Entomologist, Vol. XIV., p. 2. 1882.

MALE. — Expands 1.6 to 2 inches.

Upper side brown, varying from reddish to dusky, the basal half of both wings darker; in many examples the dark area is limited without by a blackish stripe, which on secondaries corresponds to the outer border of the mesial band of under side; throughout this wing the markings of the under side reappear; costal edge of primaries gray-white dusted brown, apex pale fuscous, and the hind margin is bordered with same; the ocelli small, black, one to four in number, usually blind; occasionally there is a fifth, minute, on the lower sub-costal interspace; secondaries have a narrow fuscous marginal border; the ocelli run from two to five, most often five, never large, often minute.

Under side of primaries paler, over costa, apex and hind margin gray-white, dusted brown; the cell much crossed by brown streaks; along the hind margin, in the middle of each interspace, is a little patch of white; the ocelli repeated, enlarged, sometimes all pupilled; secondaries gray-white or yellow-white, sometimes very largely covered with brown, which is dark next base and on the mesial band, pale beyond this to margin; or the prevailing color is white, with dark brown transverse streaks over basal area, and with a narrow space of nearly clear white against the band; the band is often quite solid, darker along both edges, but sometimes it is broken, made up of dark streaks on a light ground; on the inner side its general course is circular, with a rounded sinus on the posterior part of the cell; without it is also circular, the two sides being nearly parallel, with a rounded, or sometimes angular prominence opposite the cell, and a slight incision on or a little above the sub-costal nervule; but, in some examples, the inner edge of the band is present only for a little space on each margin; the extra-discal area more or less streaked brown, sometimes most densely in the line of the ocelli, as seen in Fig. 6; along the margin little white spots or patches, as on primaries; the ocelli almost always five, but occasionally four or three.

Body black-brown, beneath, the thorax black, abdomen gray-brown; legs light brown, the femora dark; palpi brown, the long frontal hairs mostly black; antennæ gray-white, narrowly fuscous on upper side; club orange below and at tip, above blackish. (Figs. 1, 2; 5, 6; 7.)

FEMALE. — Expands from 1.8 to 2.2 inches.

Closely like the male; the ocelli on primaries from one to four, on secondaries nearly always five; in one example under view four, in another three (Fig. 3); the two sexes scarcely differ in regard to the ocelli. Under side as in the male, but usually of a darker hue. (Figs. 3, 4.)

VARUNA flies in northern Montana and Dacota, and so far as appears, in Canada near the Boundary Line, north of those States. It is allied to *Uhleri*, but may be readily distinguished by its dusky coloration, the excess of ocelli in both sexes, and by the definite band on under side of hind wings. It was originally described from examples taken by the late H. K. Morrison, who wrote: "This Chionobas was taken in Dacota Terr., on my way to Montana, in May (1881). It was found on the plains, elevation about 1,200 feet, and in all about 100 were taken. All the *Uhleri* I have taken were in mountains, never at less than 5,000 feet elevation, and from that to 11,000 feet," etc. I had 4 ♂, 3 ♀ from Mr. Morrison, and have them here still, though they now form part of Dr. Holland's collection. All are smaller than the average of Montana examples before me, and they are less dusky than these, though one of the females is as dark as any from Montana. For several years after 1881 nothing was heard of *Varuna*, till Mr. W. G. Wright, in 1890, rediscovered it in northern and central Montana. Mr. Wright says: "*Varuna* inhabits the foothills of all the low, isolated mountains, namely, Bear Paw, Highwood, Little Belt, Great Belt, Snow, Little Rocky, and Judith. I have never seen it flying west of the Missouri River, nor on any of the spurs of the chief Rocky Mountain chain. None of the mountains named reach timber line, nor have much water, or open glades or meadows. *Varuna* flies only on the lower slopes, say at 1,000 feet or so above the level land. I saw none on the level plains. They frequent grassy slopes, and little dells or valleys, among scattering oak and pine trees in open glades. But I never saw them in the forest, or even in shaded places, such as butterflies of the genus Satyrus prefer. They sit on bare spots among the grass, ready to fly up and follow any passing butterfly of another species, chasing it a few yards or rods, and then perhaps returning to the old place; or, if too far away, gently settling on a new spot, but with a hesitating way, with wings upraised, ready to give a strong stroke, in case a lizard or a snake

should be lying in wait for it. In no case did I see one feeding on flowers. The flight of all species of Chionobas observed by me is gentle and leisurely, and for short distances, and they are easy to capture.

Varuna seemed to be on the wing but about two weeks, namely, from the 10th to 27th June. I was in the region before and after these dates, but saw none of the butterflies except within the period mentioned."

Mr. Wright sent me his whole catch of *Varuna* for inspection, 33 ♂, 5 ♀. Of the males: —

1	has	5	spots	on	fore	wing,	5	on	hind	wing.
1	"	5	"	"	"	"	4	"	"	"
16	have	4	"	"	"	"	5	"	"	"
5	"	4	"	"	"	"	4	"	"	"
4	"	4	"	"	"	"	3	"	"	"
3	"	3	"	"	"	"	4	"	"	"
1	has	2	"	"	"	"	5	"	"	"
1	"	1	spot	"	"	"	5	"	"	"
1	"	1	"	"	"	"	3	"	"	"

Of the females: —

3	have	4	spots	on	fore	wing,	5	on	hind	wing.
1	has	3	"	"	"	"	3	"	"	"
1	"	2	"	"	"	"	5	"	"	"

Of four males by Mr. Morrison: —

1	has	4	"	on	fore	wing,	5	on	hind	wing.
2	have	2	spots	"	"	"	5	"	"	"
1	has	1	spot	"	"	"	5	"	"	"
3 ♀	have	4	spots	"	"	"	5	"	"	"

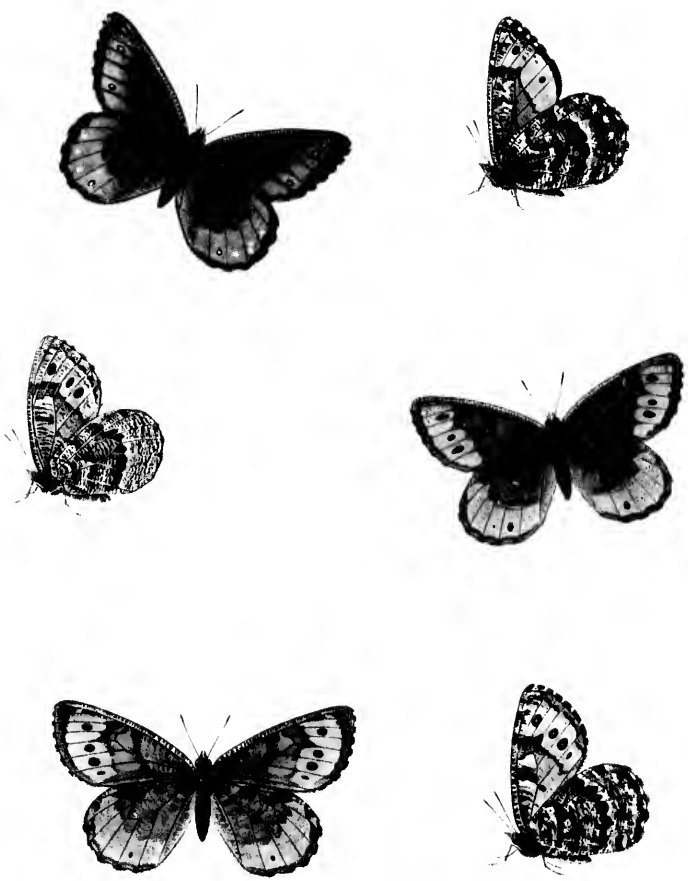
Of five males from Canada: —

3	have	4	spots	on	fore	wing,	5	on	hind	wing.
1	has	4	spot	"	"	"	4	"	"	"
1	"	1	"	"	"	"	3	"	"	"

Summing up: Of forty-two males, twenty-two have five and four ocelli on fore wing, five and four on hind wing; twenty-six have five on hind wing; twenty-eight have four or more on each wing; while but four have only a single spot on fore wing, and these have three to five on hind wing. This is in strong contrast to *Uhleri*.

CHIONOBAS.

II.



CHRYXUS. 1 2 ♂ VAR.

3 4 ♀ CALAIS. TYPE: 5 6 ♀ SAME FORM

CHIONOBAS II.

CHIONOBAS CHRYXUS, 1–6.

Var. CALAIS, Scudder. Female, type.

I DEEMED it best to give a Plate to CALAIS, for the reason that the individual named by Mr. Scudder nearly thirty years ago still remains unique, and it may some day be of importance that its likeness is preserved. (Figs. 3, 4.) Figs. 5, 6, represent a female *Chryxus*, from Banff, which, on the under side, and in the outlines of the band, agrees well with *Calais*. I have been unable to find a male with a band in same style.

Figs. 1, 2, represent a form of male *Chryxus* sometimes found in Colorado, though never of such size as in this male from Banff, sent me by Mr. H. K. Burrison. Similar males were taken at same place by Prof. E. T. Owen, 1890. The dark upper side, with pale extra-discal area, agrees well with the *Calais*. On the under side, the band stands out in high relief, and what Mr. Bean calls "the color areas" are contrasted conspicuously.

I asked Mr. Bean to look over his large collection of *Chryxus*, taken at Laggan, and tell me how they compared with the figures on Plates I., II.; and he obligingly writes as follows: "Comparing my materials with your figures, I find as follows, beginning with the females, and the upper side: my examples are chiefly of the type of Figs. 3 and 5, Pl. I. About three quarters are of this type, but varying from light to rather dusky brown. About one in five tend away from that type, and in various degrees approach Fig. 5, Pl. II. I have none with the upper side of the hind wings showing such a contrast of color as in *Calais* female, Fig. 3, Pl. II., though several have the fore wings pretty close to that of this figure.

"As to the under surface: while I have females which come nearer to Fig. 4, *Calais*, than does Fig. 6, yet I have not one quite of the detail shown in Fig. 4. Most of my examples are nearer to the pattern of Fig. 6.

"As to the males: on the upper surface of the fore wings my males are much of the pattern of Fig. 1, Pl. II., showing a strong contrast of color between the

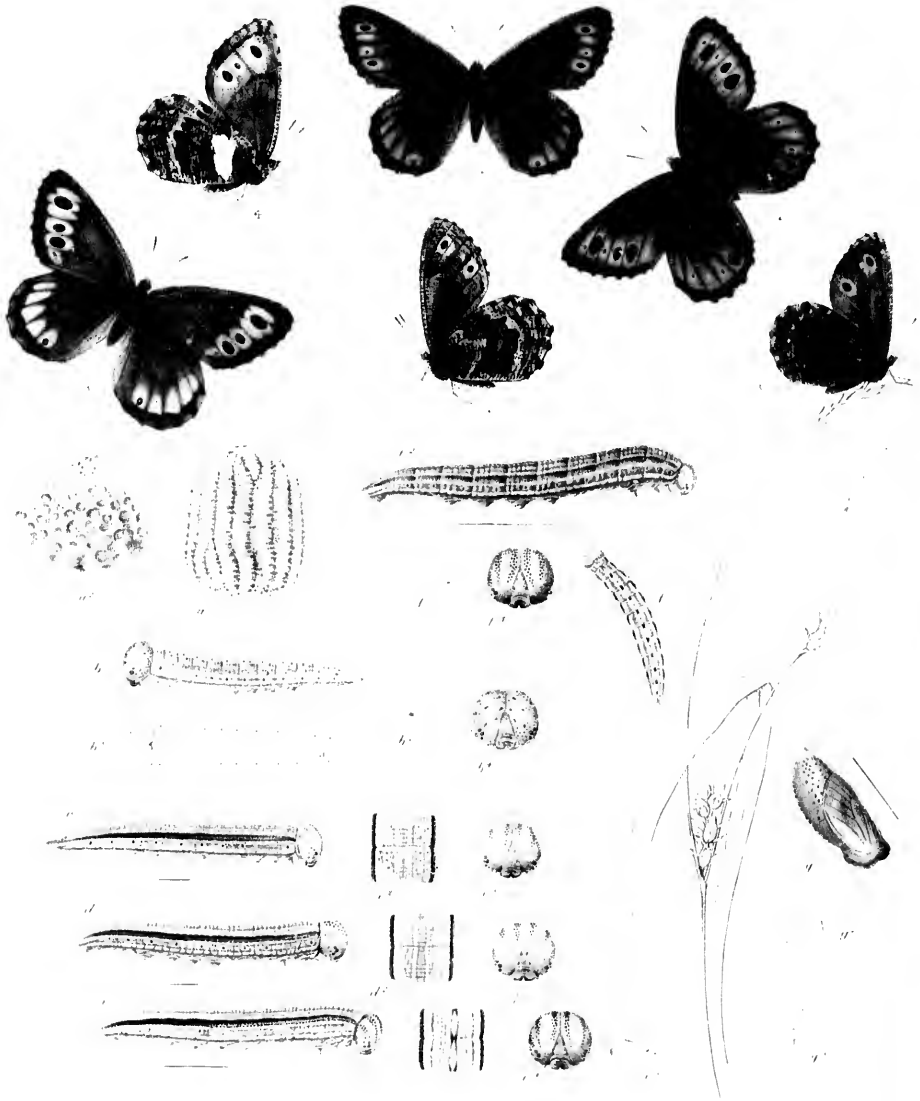
basal and sub-marginal areas. On the under side the majority range somewhat near, in pattern of the hind wing, band, etc., to Fig. 2, Pl. I.; and differ from Fig. 2, Pl. II. An occasional specimen has an unusual amount of rich dark brown throughout the wing, and this makes a striking contrast in coloration.

"There remains a minority of more dull contrasts and more sombre coloring. These mostly occur above timber line. The under side of the hind wing is more definitely separated into color areas, instead of being mottled or wavy throughout. The band is ordinarily made more conspicuous because the areas next to it on either side are dull and pale. But these two styles are not separable by any hard and fast limitations. Both tendencies are presented in various degrees, and they combine in many individuals. The small female you sent me from Hall Valley, Colorado, is more unlike the prevailing style of Laggan female than is the *Calais*.

"I find no evidence to support the view that *Calais* is a species distinct from *Chryxus;* but it is possible that *Calais* of Hudson's Bay may be that exceedingly rare thing in nature, — a true variety. *Chryxus* is a sparsely but widely distributed species, the very opposite of a local species."

CHIONOBAS.

V.



JUTTA. 1 2 ♂ 3 4 ♀ 5 ♀ 6 ♂ VAR

1 a Egg magnified 1 c Larva mature magnified
b Larva going to 2d moult d ♀ Chrysalis

CHIONOBAS V.

CHIONOBAS JUTTA, 1–6.

Chionobas Jutta, Hübner, Samml. Eur. Schmett., Vol. I. p. 25, figs. 614, 615. 1806–1819 ; Möschler, Wien. Ent. Monatschr., Vol. IV. p. 342. 1860 ; Scudder, Proc. Ent. Soc. Phil., Vol. V. p. 3. 1865 ; id., Butt. N. England, Vol. I., p. 149. 1890 ; Fernald, Butt. Maine, p. 75. 1884.
Balder, Boisduval, Icones Hist. Lep., p. 189, pl. 39, figs. 1–3. 1832.

Male. — Expands about 2.2 inches.

Upper side yellow-brown, the marginal borders, especially on secondaries, darker ; primaries have a broad dark brown sexual band, a small part of which lies within the cell, the remainder across the median interspaces ; on the extradiscal area are two or three black ocelli, if two, placed on the upper discoidal and lower median interspaces ; these are small, usually blind ; if a third is present it is on the upper median, minute ; all these stand on diffuse brownish yellow rings ; sometimes but one ocellus is present, the upper one of the series, and the position of the others is indicated by yellow patches ; secondaries have a single small ocellus on the lower median interspace, and there is often (not always) a small yellowish spot on each of the interspaces above the ocellus to the outer angle, next the marginal border ; fringes white, less pure next inner angle of primaries.

Under side of primaries paler brown, with a yellowish tint over the extradiscal area ; the costa crossed by fine, alternate streaks of dark brown and yellow-gray ; the apical area gray, with abbreviated transverse brown streaks ; the ocelli repeated, usually enlarged and pupiled ; secondaries sordid gray-white, more or less streaked with blackish brown, finely and transversely ; in some examples there is an absence of the mesial band, as shown in Fig. 6, but generally this is distinct ; sometimes the outer limb is lighter, more gray, than the basal area, especially just outside the band ; the band is broad, bends at a right angle on the median nervure, and is narrowly bordered on both sides by black, while within it is streaked like the rest of the wing, though usually the darker shade prevails ; the outer edge is twice and deeply crenated next costa, then projects considerably and sharply on the upper discoidal interspace, to be fol-

lowed by a shallow angular incision, and then runs to the inner margin in a straight course, slightly crenated in each interspace; the inner border has a slight angular incision on the costal interspace, followed by a rounded prominence on the nervure, and a deep angular sinus in the cell, then irregularly wavy to margin; the edges on the posterior half of the band are nearly parallel, and this part is broad, while the anterior half is comparatively narrow, and very irregular; the ocellus often wanting; in some examples there is a row of yellow points in line with the ocellus and to the outer angle. (Fig. 6.)

Body above dark brown, beneath, the thorax black, abdomen sometimes black, sometimes dull gray-yellow; legs dark brown, the under side yellow-brown; palpi furnished with long black hairs; antennæ fuscous above, finely annulated whitish, red-brown below; club red-brown above, testaceous below. (Figs. 1, 2, 6.)

Female. — Expands about 2.25 inches.

Upper side colored as the male; the ocelli usually three in number, large, with white pupils, or small and unpupiled, sometimes round, but generally ovate, and the middle one is smallest; sometimes there are one or two more, minute, on the lower sub-costal and lower median interspaces; each larger ocellus is surrounded by a yellow, sometimes red-brown, nimbus, and these are often diffuse and confluent, thus forming a broad band, as seen in Fig. 5. Secondaries have a large or small ocellus, pupiled or blind, and sometimes one or two additional minute ones; in one example from Quebec there is a second pupiled ocellus on the upper median interspace; sometimes the sub-marginal yellow or fulvous area is much extended, and takes the form of large cuneiform spots, but other examples show nothing of this, the light color being limited to a nimbus about the ocellus. Under side as in the male, varying in the same manner; the larger proportion of the examples under view have the band distinct, but others show very little of it. (Figs. 3, 4, 5.)

Egg. — In general as in C, *Chryxus*, somewhat narrower in proportion to the height, the breadth to height being nearly as 1 to 1.15; the base flattened, rounded; broadest at about one fourth the distance from base, narrowing upwards very gradually till near the top, the sides not much arched, the top flattened; marked by vertical ribs varying in number from sixteen to twenty-one; in part these are quite straight, in part a little sinuous, occasionally one branching either at top or bottom; narrow at the summits and rounded, the slopes nearly flat, each slope with many irregular horizontal narrow excavations with intervening little ridges; the micropyle is in the centre of a rosette of five-sided cells, outside of which are three or four rows of similar cells, gradually enlarging;

beyond these to the ends of the ribs the flattened space presents shallow cells of irregular sizes, sometimes confluent, oftener separated (Fig. a^2); in some examples this flat area is much restricted, the ends of the ribs coming nearer the rosette; these ends are depressed and send short spurs toward each other, so that the interspaces make low, cushion-like welts; color yellow-white (Fig. a). Duration of this stage from ten to sixteen days.

Young Larva. — Length, at twenty-four hours from the egg, .11 inch; shape of *Chryxus* and *Uhleri;* the tubercles and processes the same in number, position, and shape as in those species (Fig. b^3, process from 3 to middle of 13); color gray-white with a pink tinge; the stripes as in the allied species named, yellow-brown, the mid-dorsal one rather heavy, illy defined, the sub-dorsal a line, the lateral broad, clearly defined; a pale brown line runs with the spiracles, and another underlies the dull white basal ridge; under side, feet and legs yellow-green (Figs. b, b^2); head as in the other species, and tuberculated in same way; color yellow-green with a tint of brown (Fig. b^4). Duration of this stage twelve to fifteen days.

After first moult: length, at twenty-four hours, .23 inch; nearly the same shape as before, and as in the species mentioned; the tubercles and processes as in those species, the latter being short, upright, clubbed, and bent; color variable, some individuals being light gray-green, others wholly light green, others still green-yellow; through the light ground run exceedingly fine and abbreviated longitudinal streaks of red-brown; the dorsal stripe of the general hue, edged on either side by a whitish line; the sub-dorsal line red-brown; the lateral band dark on both edges, and either vinous or dark brown within, but greenish on the anterior segments; a brown line runs with the spiracles, and another lies under the pale yellow or buff basal ridge; under side, feet and legs green-yellow (Figs. c, c^2); head as in the other species, indented in same way, with similar tubercles and processes, and nebulous dusky vertical stripes; color pale green-yellow, sometimes with a brown tint (Fig. c^3). Duration of this stage twelve to fourteen days.

After second moult: length, at twenty-four hours, .34 inch; shape as in the second stage; color very much the same, but the brown streaks are more decided; the lateral band as before; the sub-dorsal, spiracular, and sub-basal lines red-brown; the ridge buff; under side yellow-green (Figs. d, d^2); head as before (Fig. d^3). To next moult six days, in the fall.

After third moult: length, at twenty-four hours, .5 inch; shape as before; color greenish buff; on mid-dorsum traces of a blackish band now appear, consisting of dark patches at the junctions of the segments; the brown streaks take the form of rather indistinct continuous lines; the sub-dorsal stripe blackish, and below it, on the light area, a brown line; the lateral band as before, more decidedly black on the edges; the processes nearly as in the last two preceding stages, rather more slender, the top less clubbed; head as before (Figs. *e* to e^4). To fourth and last moult twelve days in the fall, sixteen in spring.

After fourth moult: length, at twenty-four hours, .65 inch; shape as before; color brown-buff; the mid-dorsal stripe broken by definite black spots at the junctions of the segments; the lateral band black on its upper edge; the basal ridge yellowish. One larva differed from all others observed, in that on the dorsal area of 4 to 7 appeared three longitudinal rows of pale black rectangular spots, arranged in checker. In about twelve days from the moult the larvæ were full-grown.

Mature Larva. — Length, 1.1 inch; shape of *Chryxus* and *Uhleri*, stout, obese, thickest in the middle, the dorsum much arched, sloping rapidly from 4 to the head, ending in two short, sub-conical tails; surface thickly covered with short, stiff, tapering red-brown hairs or processes, from sharp, conical tubercles (Fig. f^3); color greenish buff in shades, the sides more green than dorsum; striped longitudinally as in the allied species mentioned; the mid-dorsal stripe pale green, broken by sub-rectangular blackish spots at the junctions of the segments, which spots are incised deeply at either end; the lateral band broad, running from 2 to end of tail, pale green, the upper edge blackened; basal ridge yellowish; under side, feet and legs greenish buff; head sub-globose, well-rounded frontally; the surface thickly covered with shallow indentations, between some of which are very small tubercles, bearing hairs, or processes like those on the body; across the top six dark stripes, as in the allied species mentioned (and probably present throughout the genus). (Fig. *f* slightly, f^2 greatly enlarged). In several cases the adult larvæ have hibernated, and in the spring, without feeding, have pupated; in other cases the hibernation has taken place in first larval stage, and after both first and second moults. But no pupa has been reached in the same season in which the egg was laid.

Chrysalis. — Length, .6 inch; breadth at mesonotum .18 inch, at abdomen .2 inch; the ventral outline arched, the dorsal, from the thoracic depression to the end, very much so; head case closely as in *Chryxus*, truncated, dome-shaped

at top; mesonotum nearly as in *Chryxus*, more rounded longitudinally, and less angular than in *Uhleri*, without carina, rounded transversely, followed by a slight depression; the wing cases but little elevated; beveled down to the abdomen on the margin; abdomen conical, tumid; the cremaster consists of a two-coned ridge (Fig. g,[3] the tip of the cone g^2), naked, there being neither hooks nor bristles; surface smooth, but on the wing cases are very fine granulations; color yellow-green, the wing cases more green, less yellow; the abdomen dotted with brown points, sub-ventral and lateral, in longitudinal rows, and dorsal, extending from the extremity to the mesonotum (Fig. g). Duration of this stage, according to Mr. Fyles, about thirty days.

JUTTA inhabits the boreal regions of both hemispheres. In North America, it ranges from the eastern coast of Labrador to and beyond the Rocky Mountains, possibly to the Pacific. According to authorities quoted by Mr. Scudder, it occurs even in Greenland, and on the main land as far to the north as lat. 58°, west of Hudson's Bay. I formerly received examples from Godbout, Province of Quebec, on the lower St. Lawrence. Mr. Fletcher has taken it at Nepigon, Mr. Bean at Laggan, Alberta Terr., Captain Geddes at Emerald Lake, near Laggan, and Mr. Burrison at Ottertail, twenty-four miles west of Laggan, so far the most western locality noticed. The most southern localities recorded are Ottawa, Quebec, and Bangor, Maine. Following Mr. Scudder: "In Europe it was long supposed to be confined to points north of lat. 61°, in Norway, Sweden, Lapland, and Finland, but has latterly been found in isolated spots about Stockholm, St. Petersburg, and in the neighborhood of Riga, lat. 56° 30′. In Asia, it apparently occurs throughout the whole breadth of Siberia, as it is found on the northern banks of the Amur River."

As will be seen, the habits of this butterfly in Europe and America, as recorded by several observers, are different in some important respects.

The only person, so far as I know, who has, up to the present time, reared *Jutta* from egg to imago, is the Rev. Thomas W. Fyles, of South Quebec, Province of Quebec; and he relates his experience, first, in the Seventeenth Annual Report of the Entomological Society of Ontario, 1887, p. 10; later, in the Canadian Entomologist, XX. p. 131, 1888, and XXI. p. 12, 1889. He visited the Gomin swamp, near Quebec, on 31st May, and in its inner recesses, after wading through deep sphagnum moss and water, doubting whether he "might not sink bodily out of sight in the treacherous bog," noticed at a distance a growth of young bushes which seemed to indicate a drier spot. With great difficulty he reached that, and found it to be a ridge thrown up for drainage purposes.

"Suddenly a fluttering brown object arose before me, made a short flight, and then settled down a few yards away. I noticed the mottling of the under wings, brought down my net, and captured my first specimen of *Jutta*. Soon a second specimen arose, but a king-bird, Tyrannus Carolinensis, gave chase to the butterfly, and, after much doubling and twisting, caught it. It was long before another specimen rewarded my search, but at length a third did make its appearance, and I had the good fortune to secure it."

Mr. Fyles made another expedition to the swamp, June 12th, and captured two or three females. On the first trip, he says he noticed what grasses grew in the swamp. "I found several all rooted in the sphagnum. I took home roots of every kind, and potted them in sphagnum. I placed the pots containing these in a box, and filled up the interstices to the level of the rims of the pots, with sphagnum. I then made an arched lattice over it, and covered this with a piece of netting." The females captured, as related, he placed in this cage. "On 17th, I found a number of eggs, not laid on the blades of grass, but scattered over the netting. When the larvæ appeared, by means of a camel's-hair brush I placed a few of them on each plant; but I soon found that they congregated on the sedge (Carex oligosperma, see Plate). This, then, I concluded, was their favorite food plant. I kept the cage on the seat of an open window, and whenever it rained removed the covering of the box and let the larvæ have the benefit of the shower. In dry times, I occasionally sprinkled them at sunset with soft water."

In August, he noticed that they were seriously decreasing in number; discovered a wounded larva, and on thoroughly examining the sphagnum, pulling it in pieces, found "several very well-grown specimens of the Myriapod, Lethobius Americanus" (said by Packard to feed on insects and earthworms). "On the approach of winter the care of the larvæ became perplexing, the more so as I was about to leave for England. I at length resolved to place the case near a window in an outer passage leading to a dairy. I left the larvæ abundantly supplied with sedge growing in well-soaked sphagnum. On my return in February, only six of the larvæ remained. They were torpid, but fresh and plump. A mild day came, and one of them revived, but the mild day was followed by a bitter night, and the adventurous larva perished. When the others began to revive, I removed the cage into a room where the temperature could be better regulated. Of the remaining larvæ, one afterwards died, four went to chrysalis. The chrysalids were naked, unattached, and lay on or partly below the surface of the sphagnum. One of them I sent to Mr. Edwards, and one I preserved as a specimen. The other two produced butterflies 31st May and 1st June." The chrysalis sent me is the one represented on the Plate.

In Can. Ent., Mr. Fyles gives the period of the several stages thus: eggs laid 17th June, hatched 1st July, 14 days; first moult, 6th July, 5 days; second moult, 30th July, 24 days; third moult, 14th August, 15 days; fourth moult, 1st September, 17 days; pupation, 21st April; emergence of the two imagos, 31st May and 1st June, or at 30 and 31 days. Therefore, from laying the egg to the fourth moult was 75 days; the egg stage 14 days; the larval, to fourth moult, 61 days; the pupal about 30 days. Mr. Fyles, on his return, supposed that a fifth moult had taken place during his absence. He recently has written me: "I noticed changes in color which led me to suppose the larvæ had again moulted, but increased knowledge of the Satyrinæ has shown me that this could not have been the case."

The recital in Can. Ent. XX. ends with these words: "The perfect insect appears in this locality from May 31st to June 15th." The conditions under which these larvæ were bred seem therefore to have been natural, and the butterflies apparently came forth in the very days they would have, had they grown in the swamp. And it is to be inferred that the earliest *Jutta* butterflies come from larvæ which hibernate full grown. It is remarkable that all the larvæ that survived the earlier stages reached the adult stage the same season in which the eggs were laid.

Mr. Fyles continues: "You may wish to know something of the habits of *Jutta* in its native haunts. I have never found this insect before the 31st of May, nor after the 15th of June. Through the first week in June, it may be met with at its best, but even then one seldom sees the slightly hoary appearance which is found in the bred specimens, the down which gives this appearance is so soon lost. *Jutta* delights in sheltered nooks on the margin of the swamp. I know several such, in which, during the season, I am very sure to meet with it. I find it resting on the surface, usually on sedge, or on Vaccinium, not on trees. I have never seen it settle on the swamp spruces that surround the marsh, nor even upon the Kalmia and other shrubs. It is with us (I say 'with us,' for Holmgren speaks of *Jutta* congregating around, and settling on, trees) decidedly a ground insect. It may easily be taken, if approached warily, and under cover of a bush, but when it takes to flight it is in vain to follow it. It is very pugnacious, and is sure to rise and give chase for a few moments to a passing butterfly. I have often watched the flight of a stray Vanessa or Grapta, knowing that *Jutta* would rise and betray its position to me."

I inquired of Mr. Fyles as to his visits to the swamp later than 15th June, and whether he could say that there was no late flight of *Jutta* to correspond with the difference in the age of the larvæ at hibernation. He replied: "The late Mr. George J. Bowles informed me of this locality for *Jutta*, and said that the

species was on the wing from 1st to 15th June. He gave me directions and a rough map which enabled me to find the spot. It is a sphagnum swamp many acres in extent, such as is commonly called by the French Canadians a 'savane.' It is surrounded for a considerable distance by a thick growth of swamp laurel (Kalmia), Labrador tea, black spruce, tamarack, etc., and the whole district is popularly known as 'the Gomin.' I have for some years past visited this swamp regularly two or three times a week, in favorable weather, from the beginning of May to the beginning of October (the whole season with us), and the earliest appearance of *Jutta* which I have witnessed was on the 31st May. I have never seen it on the wing after the 15th of June. I have looked most carefully, year after year, for a second flight, but have never seen a sign of it."

On page 155, Butt. N. E., Mr. Scudder asks: "Where, in a morass mostly under water, can the half-grown larvæ find a suitable place to hibernate, and where, in the still higher waters of spring, can the caterpillar securely pupate?" To this Mr. Fyles replies: "The sphagnum rises with the water and is never submerged."

I will now give my own experience with the larvæ of *Jutta*. In 1886, I received ten eggs from Mr. Bean, at Laggan, laid 29th and 30th June. The larvæ hatched on 11th and 12th July, and at once went into hibernation. In August, they were sent to Clifton Springs, N. Y., to go into the refrigerating house there, but came back dead the following spring.

In 1889, I received four lots of eggs from Mr. Bean, between 26th June and 2d July, laid from 20th to 25th June. The oldest ones hatched 1st July, the youngest, 7th July. On 14th, the first larvæ began to pass their first moult; on 20th August, one passed its second; and 8th August, this larva died while trying to pass its third moult. All the other larvæ hibernated after the first moult, and died during the winter.

In 1890, I again received eggs from Laggan, laid 1st July. They hatched 11th; on 26th, the larvæ began to pass the first moult. On 23d October, there were living five larvæ, all in hibernation after the second moult. Mr. Bean wrote me, 15th October, that he had more than forty larvæ from the same lot of eggs, all then past the second moult and about to hibernate. Therefore, larvæ from Laggan, in different broods, have hibernated direct from egg, after the first moult, and after the second.

In 1888, I received five eggs from Mr. Fletcher, at Ottawa, laid 3d July. The female was caught fully two weeks later than Mr. Fyles has ever seen *Jutta* at the Gomin, and probably came from a larva which had hibernated in second or third stage. The eggs hatched 19th and 20th July. On 4th August, one larva passed its first moult, on 15th, its second. I had sent one to Mrs. Peart, at

Philadelphia, where it passed its second moult, 25th August, and was returned to me. Both were asleep in September, and were sent to Clifton Springs. One of the two came back alive, 16th April, 1889. On 20th, was feeding; on 10th May, passed the third moult; on 26th May, the fourth moult. A few days later it had changed color, from yellow-buff to pale yellow-green. It became full grown by 10th June, and by 13th showed signs of approaching pupation. It was on a sod of blue grass, Poa pratensis, set in a large flower-pot, and around the plant was sphagnum moss. The larva would disappear in the moss for hours, then for hours be wholly or partly in view. I saw it last on 18th June, and as it did not come out I supposed it had gone down to pupate. On 23d, I searched the moss and then the earth, and found no trace of the larva; but did find a newly-made pupa of a noctuid, and concluded, inasmuch as a noctuid larva had been caught in the act of devouring an adult larva of Erebia *Magdalena*, that the *Jutta* had gone in the same way. From the day that this larva began to feed in the spring to its third moult was 20 days; from third moult to fourth, 16 days; from fourth moult to maturity, 15 days; total from first feeding to maturity, 51 days. Had pupation occurred by 20th June, the imago might have been expected to appear 25 or 30 days later, or about middle of July.

In 1891, Mr. Fyles sent me forty-three eggs, which were received 18th June. They began to hatch 22d. Four larvæ passed the first moult, 18th July, but another passed the second on the same day, and another had passed its second on 16th. This last one, A, passed the third moult, 22d July. On that day one larva passed its first moult. Larva A passed the fourth moult, 2d August. By 1st September, it had ceased feeding and changed from buff to green, had become very stout and smooth, the creases on the segments were quite obliterated, and there was every appearance of speedy pupation. The sod was surrounded by wet sphagnum, and on this or in the grass the larva would lie motionless for two or three days at a time, and then, when I confidently looked for a pupa, I would find the larva had moved, or perhaps climbed up the netting. Finally I sent it north to be subjected to a cool, even temperature, but it died during the winter.

The periods of larva A were thus: from egg to first moult, 15 days; from first moult to second, 11 days; from second to third, 6 days; from third to fourth, 11 days; from fourth to maturity, about 25 days. These changes, up to fourth moult, had been rapid, only 43 days intervening between hatching and the fourth moult.

At the time larva A had reached its full growth, another, B, which Mrs. Peart had, was equally advanced; changed color, and was obese and smooth. This larva behaved just as A had done, did not pupate, and finally died 20th Decem-

ber. It had been supplied with moss, and during the last weeks seemed to be favorably hibernating. Another larva, C, died 5th August, while trying to cast its skin for the fourth moult. A fourth, D, got through that moult, but being unable to get rid of the old face, its jaws became deformed, so that after I had got the face off, the larva could not feed, and died. Thus four of this lot of larvæ passed fourth moult. A few others hibernated after only one moult, and were mailed to Mr. Fletcher. When Mr. Fyles sent the eggs to me he overlooked a single one, and from it obtained a larva which proceeded to its second moult and then hibernated, and he wrote me, 23d February, 1892, that it was then alive and healthy looking. If any of these small larvæ run their full course, it seems certain that their butterflies should show themselves at least a month later than 15th June; and I do not understand why there is not a second flight.

While these Quebec larvæ were feeding I had in hand a brood hatched from a lot of twenty-five eggs sent me by Professor Braun, at Bangor. The eggs were laid from 7th to 9th June; began to hatch 18th. One larva, E, passed first moult, 1st July, and by 9th, four more had passed the same moult. On 14th July, E passed its second, on 20th, the third, on 2d August, the fourth. On 1st September, E looked like A from Quebec, had changed color in same way, and was obese and smooth. On 21st September, had lain motionless nearly three days, and I felt sure now of a pupa. But I was disappointed, and this larva also was sent north, and died there. Another larva, F, passed the first moult, 3d July; the second, 15th; the third, 23d; the fourth, 4th August, and soon after died. So it is that I have never obtained a pupa of *Jutta*, though several larvæ were reared to maturity.

Larva A was but thirty-five days from hatching to fourth moult; B was thirty-seven days; and in both cases there was plenty of time for pupation, and the emergence of the imago the same season, before cold weather set in.

Professor Braun wrote me, December 14, 1891, that of a large number of *Jutta* eggs which he sent out, the preceding season (besides those sent me), so far as he could learn, all the larvæ died before or shortly after the first moult. But that he carried one hundred and twenty larvæ to the bog, and put them on sedge which had been planted in pots, set in a box, and bedded in the sphagnum. He visited them weekly, and gave new plants when necessary. "About half of them died when quite young; about fifty passed the first moult, and thirty-six the third, and were rolled up for hibernation at my last visit to the place, 24th September. I intend to take off the cover of leaves and moss as soon as the snow goes, that is, about the time the young plants begin to leaf. My other experiment at home was not successful. Of about fifty young larvæ I only succeeded in getting three to the second moult, and one of them to the third; but all three lingered and died."

On May 2d, 1892, he wrote again: "About a week ago, I was at the bog, and investigated the larvæ. The spring is very late here, and the plants are but just coming out. I found the larvæ curled up among the moss. Some have died, but I counted fifty-eight live ones. They have eaten all the small sprouts of sedge which were inside the box, and even of the moss. It seems to me that this is the only way of rearing these larvæ successfully."

I wrote Mr. Braun also to ask if he was certain there was no second flight of *Jutta*, and his answer was: "Since 1882, I have taken *Jutta* every season. It is found in the Stillwater bog only, about five miles from Bangor. The road to Stillwater goes through the bog, which is about one half mile long and one quarter mile wide, and is surrounded by spruce mixed with birch and juniper. The insect flies in numbers only on the left side of the road leading to Stillwater, for the reason, no doubt, that the food plant of the larva is found only on that side. The bog is covered with a luxuriant growth of long, soft brown moss, through which, among a variety of shrubs and plants, sprouts up the Juncus articulata, which is the food plant of *Jutta*. In 1884, the first week in May, while looking for the earlier Geometridæ, I found a full-grown larva which I then supposed to be a noctuid, but which I now know to have been of *Jutta*, on a blade of this plant. I have never found any larvæ since, in spite of diligent search, and I conclude that they feed only at night, and hide in the moss by day. I can say with certainty that this insect has only one brood or one flight here. The butterfly appears in small numbers in the last week of May. All are males, no females being seen until about five days after the first male makes its appearance. The first week in June, I have found both sexes, and sometimes pairs in copulation have risen from the moss at my approach. At the end of the second week in June, they gradually disappear. I have never taken a fresh specimen later than 10th June. A very few worn ones linger to the third week, when they all suddenly are gone. I visit the bog several times during the collecting season, from 1st May to 1st October, in search of Geometridæ and Noctuidæ, but *Jutta* I do not find. If there were a second brood or second flight I should certainly see it, even though there were very few individuals. In no other part of the State, so far as I can find out, does *Jutta* exist, and when the Stillwater bog is drained, as it will be in a few years, this butterfly will become extinct in Maine. *Jutta* has a low, jerky flight, and alights suddenly when pursued, vanishing under the eyes of the collector. It drops into the moss, and it is useless to search for it; but, if let alone, it will soon rise again and come back to the place from which it started. This is the only time to catch it, for it is not to be caught by running after it. The flight of the female is not so quick as that of the male. On my trips in former years, this butterfly was not so shy as it is now. Of late years

they have been persistently hunted by myself and a few of my young students, and have learned to take more care of themselves. *Jutta* is not common by any means. I think the entire flight of any one year will not exceed two hundred individuals, about one quarter of which we take. The last two seasons I have tried a different plan of capture. On tying a battered live female to a plant, the Labrador tea, two or three males will very soon appear, and can easily be taken. We only preserve good specimens, releasing unhurt all that are worn. To get eggs, I pot one of the food plants, cover it with a net, and introduce one or more females. I keep these alive by feeding with molasses, a few drops of which are sprinkled on the net, and to this the insects come regularly. Each fresh female will lay from seventy-five to one hundred eggs in course of a week, which is as long as she will live in such confinement. Dissection has shown that rarely are all the eggs laid.

"As regards the females resting high in trees, as you tell me Ménétriés and Holmgren state, it seems to me like a fable. In ten years' collecting I never saw one on bush or tree. They fly still lower than the males. I believe I have once or twice seen a male alight on the trunk of a little juniper-tree, about three feet from the ground, after I had stirred it up several times from the moss and persistently pursued it. I ought to know the movements of this butterfly, having had years of experience in studying its habits. I have taken with the net about three hundred specimens. As Mr. Fyles says, 'it is a ground insect,' and of that there can be no doubt whatever."

Mr. Scudder accompanied Professor Braun to the swamp, in 1890, and writes me: "The only *Jutta* I saw settled right at my feet, and my net was over it in an instant. It was much as if it came at my bidding."

Mr. Fletcher took a single example of *Jutta*, a female, in his garden, at Ottawa, and another at Nepigon. This latter "was flying past very quickly. I struck at it, and it almost immediately dropped to the ground and I threw my net over it." As to the other; "it flew over a fence into the garden, and after flying backwards and forwards three or four times, like a Grapta, which, strange to say, I took it for at first, it settled on the leaves of some low beans. I approached it quietly, and then it flew off to the ground, and lay over so that the wings were almost horizontal with the ground, and thus I caught it by putting a glass bowl over it, for I had no net.

"There is a small bog within half a mile of this garden, but I never could find the butterfly there. Within ten miles there is another very large bog, and the railway runs through it, the trains stopping at a station within two hundred yards of where I took this specimen. Is it possible it might have flown into a passing train?"

Captain Gamble Geddes, at Toronto, writes that the single specimen of *Jutta* taken by him, 1884, near Emerald Lake, Alberta Terr., elevation about 6,000 feet, was in a dried-up swamp through which the trail he was following ran. It was a female, and the time was the first week in August, the appearance of the species being delayed according to the elevation.

Mr. Burrison says of the single *Jutta* which he took at Ottertail, elevation 3,700 feet, the date 1st July: "On my way from Banff to Glacier, I found, on reaching Ottertail, that the train would have to be held some little time while the bridge over the Wapta, or Kicking Horse River, was being repaired. I whiled away the moments, never daring to get far away, by netting what butterflies I could. The road ran near the river and through a bog, and on the edge of this, either on a low plant or directly on the moss, I took this *Jutta*."

All records of the habits of this species therefore agree in this, that it is only to be found in bogs or morasses, and Mr. Scudder thinks it is confined "even to very limited stations within them. Holmgren calls particular attention to this, stating that it is found on the rocky islands, near Stockholm, only where sphagnum abounds, and that a quarter of a mile therefrom in a marshy area of about fifty acres, he has searched in vain for it." M. Ménétriés, Enum. Acad. St. Petersburg, p. 107, says: "Mr. Bremer has taken a great many examples of *Jutta* in a marsh about twenty-five versts north of our capital." On p. 108: "This butterfly is found at the end of May in marshes, often inundated, where grow here and there small and stunted pines; it is upon the trunks of these that the insect rests, its color so resembling the bark that it is difficult to discover it. It is necessary to shake or beat the branches to cause it to fly."

Mr. Scudder quotes Holmgren: "When it alights, it is generally upon the tree trunks, and, in the pairing season, the female usually rests high up in the tree, and it is in this search after the females that the males fly around and up the trees." M. Ménétriés got this at second-hand, but the account is supported by Holmgren from his own observation, and it indicates a curious difference in habit from that of the American *Jutta*. As to this habit of hiding in and resting on trees, farther observations are much to be desired.

NOTE. — As I am revising the proofs of this paper, I am able to add the following particulars: Professor Braun writes, May 19th, "I visited the bog on 14th, and found that about one half the larvæ looked as if they would pupate in a few days. I changed them to another spot where the plant was abundant, and have no doubt that by the middle of next week most will have pupated."

On 29th: "I was at the bog Saturday, 21st, and found five chrysalids of *Jutta*. Seventeen larvæ had fixed themselves for pupation among the grass stems and next the net; the rest were still feeding. One of the five pupæ gave a male

butterfly this morning, and the others will do likewise by to-morrow. These pupæ were quite soft when I found them, and must have formed on 20th, which would make seven days for the length of the pupa stage."

On 30th: "I was at the bog last Saturday, 28th, and found to my dismay that somebody had destroyed my poor *Jutta*. The frame and covering were broken and torn, and trampled into the moss. All the larvæ were gone, but I found fifteen that had been killed, apparently in the act of pupating, and six crushed pupæ. This is the end of the work which had given me so much delight. Some boys have done this." The last sentence explains the situation. Just so the arboreal ancestors of these boys behaved among the primeval birds' nests.

I have also a letter from Mr. Fletcher, of June 30th: "I went to the peat bog, twelve miles from Ottawa, on 23d, to search for *Jutta*. I had the good fortune to disturb one example, which I secured. This confirms the fact that my specimen, taken July 1st, 1888 (as herein related), was bred near here, and not brought in moss to the gardeners, as Mr. Fyles has suggested."

EXPLANATION OF THE PLATE.

JUTTA, 1, 2 ♂ (from South Quebec), 3, 4 ♀, bred, from same loc., 5, ♀, from Bangor, 6 var. ♂, Quebec.

a EGG; a^2 micropyle.

b b^2 YOUNG LARVA; b^3 process on 3 to middle of 13; b^4 head.

c Larva at 1st moult; c^2 dorsum of segments 7 and 8; c^3 head.

d Larva at 2d moult; d^2 dorsum of 7 and 8; d^3 head.

e Larva at 3d moult; e^2 dorsum of 7 and 8; e^3 form and proportions of processes from 3 to 13; e^4 head.

f ADULT LARVA, after 4th moult, a little enlarged; f^3 process of dorsum; f^4 head.

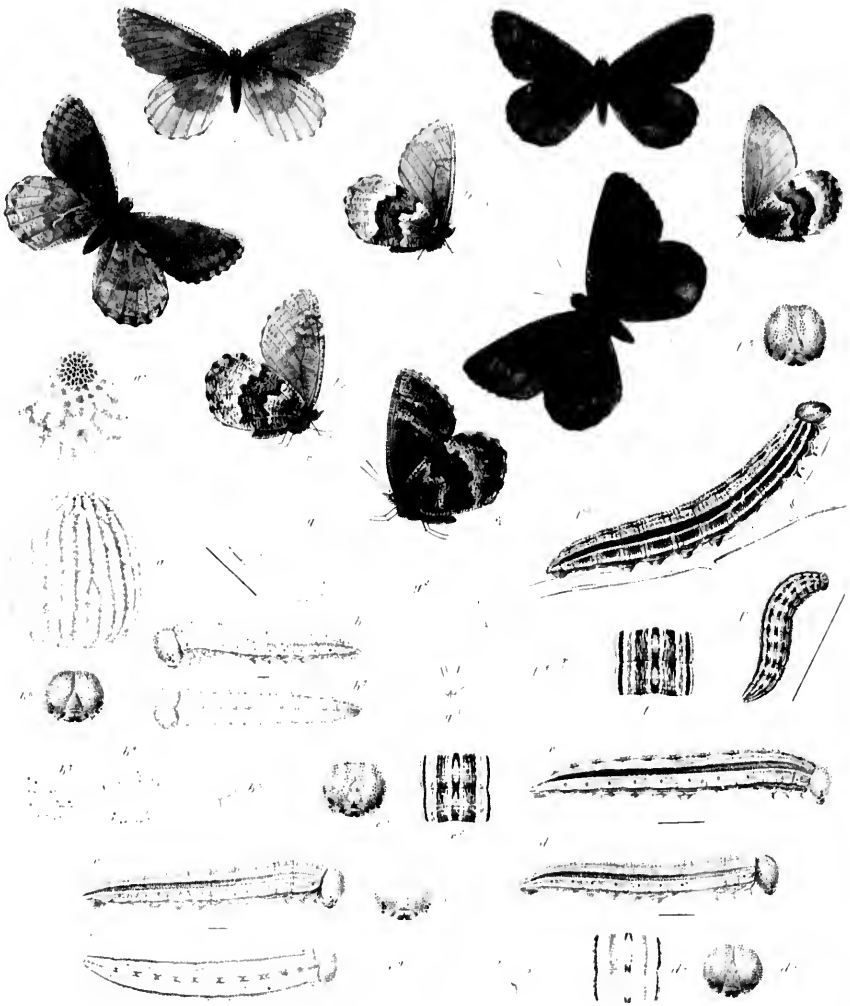
f^2 ADULT, after change of color.

g CHRYSALIS, much enlarged; g^2 ventral view of cremaster, g^3 side view of one of the cones of the cremaster.

The plant is Carex oligosperma.

CHIONOBAS.

VI.



CRAMBIS 1 2 3 4 ♀ BRUCEI 5 6 ♂ 7 . .

a a' Eggs, BRUCEI magnified *f f'* Larva mature, magnified
b b' Larva young *g g'* moult *h h'* Chrysalis.






CHIONOBAS VI.

CHIONOBAS CRAMBIS, 1–4.

Chionobas Crambis, Freyer, Neuere Beiträge zur Schmeiterlingskunde, Vol. V. p. 99, pl. 440, figs. 3, 4. 1845; Butler, Cat. Diurn. Lepid., Satyridæ, p. 163. 1868; Staudinger, Cat., p. 27. 1871.
Also, Möschler, Wein. Entom. Monats. 1863.
Oeno and *Also*, Scudder, Proc. Ent. Soc. Phil., Vol. V. p. 113. 1865; Kirby, Cat., p. 70. 1871.

Male. — Expands 1.8 to 2 inches.

Wings somewhat translucent; upper side dark brown; costa of primaries a little streaked with gray-white; on the upper discoidal interspace a small black ocellus, not always present; on each subcostal interspace a yellow point; fringes yellowish, pale fuscous at the ends of the nervules. Under side of primaries nearly of the same color as above, the costal margin and apex dusted brown; the ocellus, if present, pupilled with white.

Secondaries variable; one example under view has the area from base to outer side of the mesial band dark brown (the inner edge of the band undefined), everywhere slightly mottled with gray-white, but the dark color greatly predominates; the space beyond the band sordid gray-white, finely streaked with brown, rather more densely next the margin: another example (Fig. 2) has the band boldly defined on a gray ground that without makes a belt nearly half as broad as the band; beyond to margin light brown, streaked with dark brown; on the other side of the band the clear gray space is narrow, but gray a little streaked occupies part of the costal interspace; the rest of the basal area brown; the edges of the band are dark, the interior gray and brown; the inner edge shows an angular incision in the costal interspace, followed by a slight prominence on the sub-costal nervure, and by a sinus between this and the submedian, nearly square at the bottom; the exterior edge projects a little on costa, after which is an angular incision to the discoidal nervule, then an arch, doubly crenated, to the lower branch of median, from which to the margin, in one example, the course is straight, in the other, with a double even crenation in the lower median interspace.

Body black above and below; the femora black, tibiæ red-brown on upper side, gray underneath; palpi black; antennæ fuscous above with a little cretaceous at the joints, and the same hue along the under side; club red-brown above, tipped black, cretaceous below. (Figs. 1, 2.)

FEMALE. — Expands 2 to 2.25 inches.

Wings opaque; upper side darker than the male; costa of primaries rather gray than brown, dusted and streaked with black-brown; the ocelli vary; one example has a single black point on a yellow spot on the lower median interspace, and a small yellow spot on each interspace above, making a row of six spots (Fig. 3); another has a similar black spot, on the under side pupilled with white, but the yellow spots are wanting; a third has two rather large equal black ocelli, the upper one on the upper discoidal interspace, and both are pupilled beneath. Secondaries, in all the examples, have a complete extra-discal row of five yellow spots (repeated in white beneath), and the hind margin is edged by a series of blackish serrations, either obscure or well-defined; in all the examples the band on under side is defined on both edges, and is about one fourth broader than in the male. (Figs. 3, 4.)

From 2 ♂, 3 ♀, from Labrador, sent me as *Crambis* by the late H. B. Möschler, who made a specialty of Labrador insects.

I know nothing whatever of the present species beyond the fact that it is credited to Labrador, and, according to Möschler, flies in July and August. In my Catalogue of Diurnal Lepidoptera of America north of Mexico, 1884, I gave as localities for *Crambis*, Labrador, boreal America, Alaska, Colorado, and New Mexico. But what was then supposed to be *Crambis* in the Rocky Mountains is *Brucei*. *Crambis* is a larger species than *Brucei*, of a different color, transparent in a less degree, and only in the male, and is conspicuously marked by ocelli, and common rows of yellow points; while *Brucei* is equally transparent in both sexes, and is without ocelli or points. I have been unable to see Freyer's book, and know of but one copy in the United States, and that is inaccessible. But Mr. Butler, Cat. p. 163, pronounces his figures "not good." Möschler gives *Crambis* as a synonym of *Alsо*, Boisduval. I have in my possession Dr. Holland's copy of Boisduval's Icones, in which are figured and described both C. *Alsо* and C. *Oeno*. I have no doubt whatever that *Oeno* is *Semidea*, Say. The figure agrees as closely as is possible with *Semidea* insects from Labrador and the White Mountains of New Hampshire (but copies of the Icones vary in respect to the figures of *Oeno*, and some of them are very badly colored). As to *Alsо*, it is more like *Brucei* than *Crambis* in coloration and appearance of upper surface, and the

text says that the author thinks it is the same species as *Eritiosa*, Harris, from the White Mountains, a mistake for *Semidea*, Say. It does look more like *Semidea* than *Crambis*. But on the under side it is not like either of the species named. Moreover, Boisduval says his drawing and description were made from a Siberian example. I think, therefore, *Also* may be dismissed as no American species. Mr. Möschler sent me these insects labelled "*Crambis*," after the date of his paper referred to, and probably he had seen reason for changing his mind about the identity of *Crambis* with *Also*.

Note. — As I was writing the description of *Crambis* above given, having occasion to examine closely the insects, I discovered, adhering to a leg of one of the females, a good eggshell, compressed, but not flattened so as to injure the side ribs. Mrs. Peart will be able to make a figure of this egg, which shall be given on a subsequent Plate. That egg, with the insect, has been in my cabinet more than twenty years, unnoticed, of course.

CHIONOBAS VI.

CHIONOBAS BRUCEI.

Chionobas Brucei, Edwards, Canadian Entomologist, Vol. XXIII. p. 154. 1891.

MALE. — Expands 1.8 to 1.95 inches.

Wings semi-transparent; upper side uniform gray-brown; costa of primaries sordid white, streaked transversely with dark brown, the light color much predominating; fringes of both wings yellow-white, fuscous at the tips of the nervules. Under side of primaries nearly of same color as above, a shade lighter; sometimes the whole wing is flecked with brown scales, but often the area behind the cell is immaculate; in all cases the cell is so flecked, in varying degree, and the apical area is both specked and streaked brown on a dull gray-white ground; the costal margin much as above, but the dark streaks are heavier. In no example viewed is there an ocellus on either wing, or a trace of one.

Secondaries gray-white, sometimes with a tint of yellow over disk and to margin; next base nearly black, with whitish scales sparsely scattered through this; on the basal side of the band is a strip of nearly clear ground, but little dusted brown; beyond the band a broader area of clear color, similarly dusted, and gradually the dusting increases, and fine streaks come in, reaching a maximum near the margin, where the dark color takes the form of loose patches in the interspaces; the band is prominent, both edges black, the interior more or less densely covered with black scales and streaks on the whitish ground; the inner edge shows a narrow crenation on or just below the costal nervure, followed by a rounded prominence on sub-costal, and by an angular sinus between sub-costal and sub-median, square at the bottom, or sometimes erose; the exterior edge projects a sharp tooth on costa, which is followed by an angular sinus reaching to the discoidal nervule, then a slight arch to lower median interspace, and arching again to inner margin; but sometimes the curved part is crenated to margin.

Body blackish above, black below, with some gray hairs near and at the ex-

tremity; the femora black, tibiæ red-brown on upper side, gray-white underneath; palpi black; antennæ fuscous above, alternated with cretaceous, which last covers the under side on lower half, the upper half red-brown; club cretaceous above, red-brown below, a little darkened at tip. (Figs. 5, 6.)

FEMALE. — Expands 1.8 to 2 inches.

Transparent as the male; closely like the male on both sides, and in the color areas of the under side of secondaries. (Figs. 7, 8.) I have had ten examples of both sexes under view in drawing up the foregoing description, and none of them show an ocellus on either wing. I applied to Mr. Bruce to examine his collection as to this point, and he writes that, of ninety-three examples present, none show an ocellus. Apparently the absence of ocelli is a feature characteristic of this species, in contradistinction to both *Nephelobis* and *Semidea*.

EGG. — Sub-conic, the breadth to height nearly as 1 to 1.15, the base flattened, rounded; broadest at about one third from base, narrowing upward considerably, the sides much arched; marked by about twenty vertical ribs, very nearly straight, occasionally one branching either at bottom or top; these are narrow at the summits and rounded, and the depressions are shallow and rounded, the slopes excavated much as in *Jutta*, but are not so decided in the shape and character of the spurs; the top flattened; the micropyle is in the centre of a rosette of five-sided cells, outside of which are three or four rows of similar, less regular, larger cells; beyond these is a confused mass of flattened ridges, broken up, lying in every direction, and not a continuation of the ribs; color dull white. (Figs. *a*, a^2.) Duration of this stage about eleven days. This egg resembles that of *Semidea* at all points more closely than any of the species observed.

YOUNG LARVA. — Length, at twenty-four hours from the egg, .08 inch; shape of *Chryxus*, *Jutta*, *Semidea;* segments 2 to 4 nearly equal, arched dorsally, then tapering regularly on dorsum and sides to 11 and more rapidly to 13, which ends in two short and stubby projections, — scarcely to be called tails, — which are separated by an angular sinus at base (closely as in *Semidea*); the tubercles are brown, the processes from them white, and both are the same in number, position, and shape as in the other species named, and indeed in all the species of the genus observed (Fig. b^5, process on dorsum from 3 to 13); color pale greenish white; a dorsal stripe and sub-dorsal line of pale brown, and a lateral band of same hue; under side dull white; feet and legs translucent, whitish; head broader than 2, sub-globose, broadest below, depressed slightly at the suture; surface covered with shallow indentations; a few tubercles like those on the body

are present. (Figs. *b* to b^5.) The number and position of the head tubercles is the same as shown by the cut accompanying the text of *Chryxus*.

At about ten days from the egg the color becomes greenish gray, and the stripes are more distinct, the lateral one broader and darker. Duration of this stage fifteen to eighteen days.

After first moult: length, at twenty-four hours, .15 inch; nearly the same shape as before, the anterior segments arched in the same way; the projections at extremity very short, blunt; surface thickly covered with fine conical tubercles, each bearing a short, cylindrical, and bent process (Fig. c^3); color of body pale buff; the mid-dorsal stripe gray with illy-defined dark spots at the junctions of the segments, the ends of these spots more or less incised; the sub-dorsal line red-brown; the lateral band pale black on the posterior half, greenish gray anteriorly, dusted black, edged below by a whitish line; the basal ridge yellow-white; under side greenish buff; feet and legs translucent, white, but there is a break in the middle stripe on either side (a feature observed in no species except *Semidea*); head closely as before, pale green-yellow, with six vertical stripes, as in the genus, pale brown. (Figs. *c* to c^3.) Fig. c^4 shows the usual attitude of the larva at rest, during the earlier stages. To next moult, thirteen to seventeen days.

After second moult: length, at twenty hours, .26 inch; shape as in the second stage; processes same; color buff; the mid-dorsal stripe gray-green, with brown, not well-defined, spots at the junctions, as before, edged on either side by a whitish line; the belt between this and the red-brown sub-dorsal line is gray-green, streaked finely and longitudinally with red-brown; the belt below the sub-dorsal line light buff, bisected by a fine brown line; the lateral band pale black, darker posteriorly, edged below by a whitish line, and that by a brown one; another brown line on upper, and one on under, side of the yellow-white basal ridge; head as before. (Figs. *d* to d^3.) To next moult, thirteen to twenty days.

After third moult: length, at twelve hours, .35 inch; shape as before; the processes as at last previous stage; color buff; the dorsal area obscured by blackish, abbreviated longitudinal streaks; the mid-dorsal stripe gray-green, the spots at the junctions as before, but darker; the sub-dorsal line obsolete; the middle of the buff belt next below streaked with brown; the lateral band nearly as before; the basal ridge yellow-buff; head as before. (Figs. *e* to e^3.) To next moult, seven to ten days.

After fourth moult: length, at twenty hours, .5 inch; the processes considerably longer in proportion than in the previous stages. (Fig. f^3.) In about eight days was full-grown.

Mature Larva. — Length, .9 inch; stout, indeed obese, thick in the middle, tapering rapidly from 5 to head, and from 9 or 10 to 13, ending in two short, blunt projections; surface thickly covered with fine conical tubercles of irregular sizes, each bearing a cylindrical, slender, bent process; color buff, in shades; the mid-dorsal stripe gray-green, with a rectangular spot, incised sharply at either end, at the junctions, edged on either side by a whitish line; the dorsal area gray-buff, obscured by blackish longitudinal streaks, which are confluent on the lower edge at the junctions; the buff area below this is cut in the middle by two brown lines; the lateral band broad, deep black, paler on the anterior segments, edged below by a light buff line; the spiracular band dark gray; basal ridge light buff, with a gray stripe beneath it; under side, feet and legs gray-buff; head small, scarcely broader than 2, sub-globose, broadest below, narrowing towards the top, slightly depressed at the suture; the surface thickly covered with shallow indentations, between some of which are small tubercles with processes like those on the body; color greenish yellow, with a brown tint; across the top six dark brown stripes, as in the allied species, but the middle one on either side is broken. (Figs. f to f^5.) No larva bred by me reached pupation; but Mr. Bruce sent a dead pupa, from which Mrs. Peart was able to make the outline figure given.

Chrysalis. — Length, .5 inch; breadth at mesonotum .2, at abdomen .22 inch; cylindrical, stout, the ventral side arched; the dorsal, from the thoracic depression posteriorly, much more so; head case truncated, closely as in *Semidea* and *Uhleri*, less than in *Jutta*, dome-shaped at top; mesonotum without carina, rounded every way; the depression slight; abdomen sub-conical; wing cases bevelled down to the abdomen on the margin; cremaster naked, without hooks or bristles, the ridges V-shaped, converging but not attingent, elevated, compressed. (Figs. g to g^3.) The cremaster resembles that of *Semidea* rather than any of the allied species so far observed.

C. Brucei inhabits certain lofty peaks of Colorado, and Mr. Bean reports finding it at Laggan, Alberta Territory. He says, Dec. 29, 1890: "I have only found it as yet on one mountain, and scarcely any are to be had there." Probably, therefore, the species lives in Montana, though I have not heard of an example being taken in that State. Mr. David Bruce has kindly written an

account of its habits, times of flight, and localities, as observed by himself, as follows: "C. BRUCEI is found on most of the mountains around South Park, at between 12,000 and 13,000 feet elevation, but I have never seen it in such numbers anywhere as on Mts. Bullion and Hayden, which are twin mountains, and may be called one locality. South Park proper is on the south of these mountains, and is a succession of grassy valleys, surrounded by a broken range of varying altitude. Every mountain and peak, as well as every gulch and creek, has a name, not all found on the maps, but well known to the miners and cattlemen. For convenience, I call it all the South Park District. I first took this species on the opposite side of the valley from Bullion, two or three worn examples, in the month of August. But I have never found it at the same place since, and I think these were blown across the valley. I have never seen *Brucei* at a lower altitude than 12,000 feet. It does not fly to the tops of the rocky peaks, like C. *Semidea*, nor does it frequent the same localities anywhere as that species, but is confined to grassy depressions on the sides of the mountains. It is of a gentle flight and playful habit, and may be seen in companies of a dozen or more, circling around and pursuing each other, or hovering about a tuft of grass, where probably a newly emerged female is drying her wings. If approached suddenly, it is apt to be alarmed, and will make a wild, dashing flight for a short distance, and then dive into the herbage, where it will elude search by holding itself perfectly still; or it may make a succession of short, leaping flights, and is then very difficult to capture. When caught, it will lie in the net as if dead; but this trick is practiced by all the species of Chionobas and Hipparchia that I have had experience with. On the eastern side of Bullion Mountain *Brucei* is very abundant, though local. The entire slope of the mountain is well covered with grass and wild flowers, but from the peculiar position of the surrounding peaks the greater part of this mountain meadow lies in shadow until the afternoon; but one central spot, about an acre in area, feels the uninterrupted rays of the sun all the day. On this favored place C. *Brucei* and Pyrgus *Centauriæ* absolutely swarm. By standing still I have frequently taken scores in a few minutes. Sunshine is a necessity with the *Brucei*. The thinnest cloud will stop their flight, but the moment the sun is out again they are up and busy. The air at this altitude cools rapidly when the sun's rays are absent, and a few minutes' cloudiness is sufficient to chill the collector. If the insect is on the wing when the cloud covers the sun, it drops at once into the grass. The mountain storms, that often occur without a minute's warning, are thus instinctively guarded against.

"My recorded captures are from June 10th to August 20th, but I have not taken from one of these dates to the other in any one year. In some years the

ground is covered with snow to the middle of June, and again, by August 12th, I have known sharp frosts and driving snow to cut off everything; but it generally rains about this time of the month, followed by a few weeks of fine weather. In 1889, frost and snow occurred in August, and everything was apparently killed, yet through September, when the weather was fair, plenty of butterflies were to be found, many of which had doubtless emerged before the cold snap, but had not paired then. But by 20th August, generally, the *Brucei* are old and so worn as to be almost unrecognizable, and will sit in a listless way on the flowers as if waiting for death. These late individuals are always females, and I have never seen a male later than July. As the snow lies on the very spot on Bullion where this species occurs until late in May, in the most favorable seasons, it is evident that the larvæ, or part of them, must mature the first year. I found a pupa of *Brucei*, 22d July, 1889, while I was searching at the roots of Sedum for the larvæ of Parnassius *Smintheus*. It was buried in the light soil near the surface; was apparently alive and about to disclose the imago, as the markings of the wings were plainly to be seen through the transparent skin. But the imago died in the pupa, and in this condition was sent to Mr. Edwards. I have examined several hundreds of *Brucei* (I have certainly taken as many as three hundred), and never found any variation in color or markings worth mentioning.

"There are few or no birds on these high stations to destroy the larvæ or catch the butterflies, but mice, ground squirrels, spiders, and predaceous beetles are legion. Parasitic diptera and ichneumon flies are as numerous as on the lower levels; a large gray Asilus, too, is ever present like an evil spirit, capturing *Brucei* without the least effort. It is therefore surprising that so frail a butterfly should hold its own so persistently."

A few examples of *Brucei* have been taken the present year (1892) near Pike's Peak, and one near Gray's Peak, both localities having an elevation above 13,000 feet.

Mr. Bruce, then at Hall Valley, Colorado, sent me eggs of C. *Brucei*, which were received on 14th, 18th, and 21st July, 1890. The first lot began to hatch on 18th; on 3d August, three larvæ passed the first moult; on 16th, one passed the second, another on 19th; on 29th August, one, A, passed the third moult, and another, B, the same moult, in Philadelphia. On 8th September, A passed the fourth moult, and B had done likewise on 6th; on 15th September, a third larva, C, also passed the fourth. A and C, at Coalburgh, were feeding as late as 8th October, but had become very stout, and were evidently full-grown. A few days later they seemed torpid, but on 18th October, A died. A month later there remained C, adult, and two which had passed the third moult, all in hibernation. B was reported as also hibernating, but soon after died. I left the larvæ out of

doors, on a shaded porch, and up to the middle of February they seemed to be healthy, but shortly after all died. The largest one had been attacked by a fungoid growth on one side, at the spiracles. So I failed to get a pupa. Many of the hatched larvæ died when quite young, or disappeared unaccountably. But the five that passed the third and fourth moults proceeded as satisfactorily as any Satyrid larvæ from the lowlands could have done. One nearest allied species, *Semidea*, on the other hand, is exceedingly difficult to rear, indeed almost impossible. The food, Poa pratensis, agreed with my larvæ. The advanced ones became excessively stout, and segment 2 was so large, and rose above the head so high and abruptly, that it seemed as if the pupa must have taken form within, and would shortly appear.

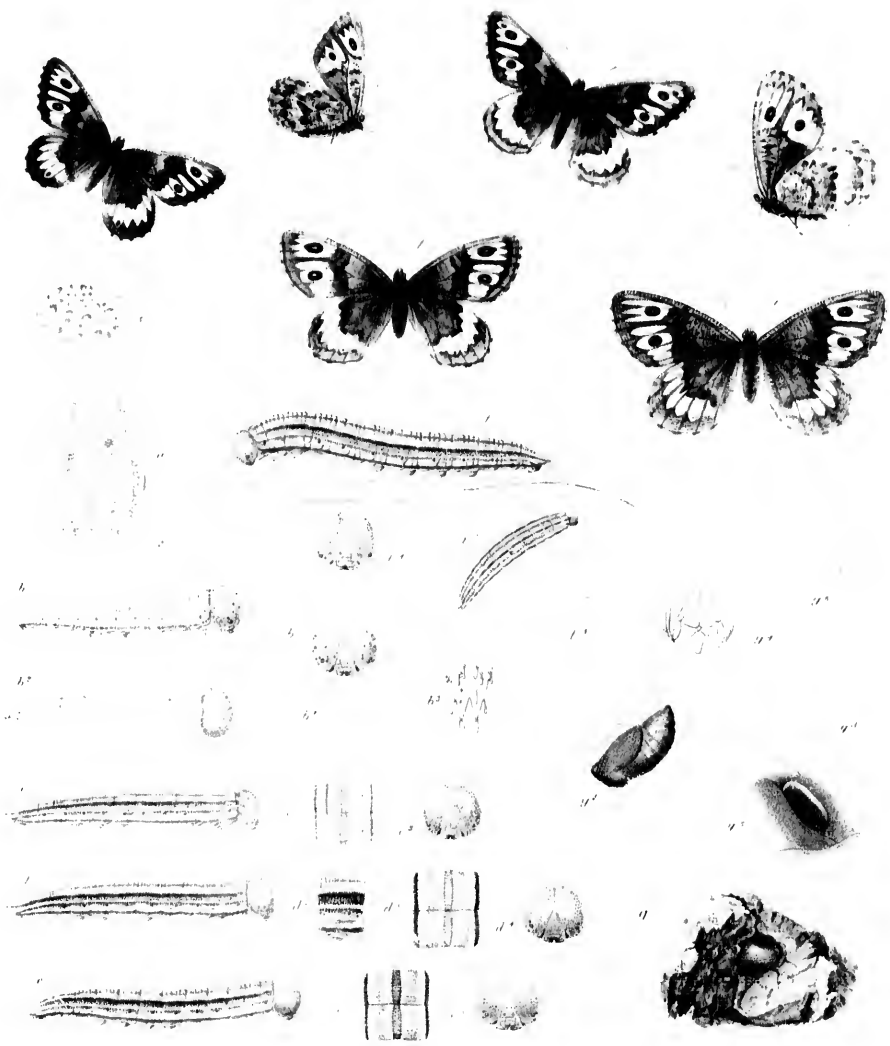
In 1891, I again received eggs from Mr. Bruce, at the same place, and they began to hatch 28th July. On 13th August, two larvæ passed the first moult, others soon after; on 29th, two died in trying to pass the second moult; a third passed second, in Philadelphia, 5th September, and presently died. All the other larvæ stopped at first moult, and were sent to Canada to hibernate in a snowbank, but died before I received them in the spring.

These attempts seemed to show that larvæ hatched in the early part of the summer may reach the adult stage the same season, if the weather conditions are favorable, but that those hatched some weeks later will pass only the earlier moults. Others may probably hibernate direct from the egg. The first would pupate as soon as the melting of the snow had uncovered them, which would be late in May, and from these would come the butterflies of middle June. The larvæ which have hibernated after third, second, first moults, or from the egg, would reach imago in successive detachments up to the middle of July, or somewhat later. In this way the appearance of the species on the wing for so long a period as seventy days, as testified by Mr. Bruce, is accounted for.

EXPLANATION OF THE PLATE.

CRAMBIS, 1, 2 ♂, 3, 4 ♀.
BRUCEI, 5, 6, ♂, 7, 8, ♀.

a EGG; a^2 micropyle.
b, b^2 YOUNG LARVA; b^3, b^4 last segments; b^5 process on 2 to 13; b^6 head.
c, c^2 Larva at 1st moult; c^3 process; c^4 attitude during the younger stages; c^5 head.
d Larva at 2d moult; d^2 segments 7 and 8; d^3 head.
e Larva at 3d moult; e^2 segments 7 and 8; e^3 head.
f ADULT LARVA, a little enlarged; f^2 greatly enlarged; f^3 segments 7 and 8; f^4 process; f^5 head.
g CHRYSALIS, enlarged; g^2 side view of last segments; g^3 front view of the cremaster.



RIDINGSII EARLY FORM 1, 2 ♂, 3 ♀ LATE FORM, 4 ♂, 5, 6 ♀

a a' Egg magnified f Larva mature magnified
b Larva 9 days to 3rd moult d Chrysalis 9th same

NEOMINOIS I.

NEOMINOIS RIDINGSII, 1–6.

Neominois (Satyrus) *Ridingsii*, Edwards, ♀, Proc. Ent. Soc. Phil., Vol. IV. p. 201. 1865; Reakirt, ♂, l. c., Vol. VI. p. 145. 1867; Strecker, ♂, ♀, Lepid. No. 4, p. 29, pl. 4, fig. 6, ♀. 1873; Mead, Rep. Wheeler Expedition, Vol. V. p. 774. 1875; (Neominois) Scudder, Bulletin Buffalo Soc. Nat. Hist., Vol. II. p. 241. 1875.

MALE. — Expands 1.6 to 1.8 inches.

EARLY FORM: Upper side dusky gray-brown, pale over the basal areas, beyond to margin dark; a common extra-discal series of buff spots, on primaries separated in the lower discoidal interspace; the four above this confluent, their outer extremities lanceolate, and bearing on the upper discoidal interspace a white-pupilled black ocellus; the fifth spot is long oval, narrower than the interspace — the upper median; the sixth is sub-oval, broad, and carries a second ocellus, usually equal to, but sometimes a little smaller than the other; the next two spots are sometimes completely confluent, and are about half the length of the sixth; on secondaries the spots form a continuous band of nearly even width, the upper three more or less incised on the basal side; the outer ends serrate, or partly lanceolate; a small black patch near the outer edge of the spot in lower median interspace; occasionally a minute pupilled ocellus is present on the lower sub-costal interspace of primaries, outside the line of the principal ocelli, as seen in Figure 4; fringes fuscous, yellowish at the tips of the nervules.

Under side paler; the cell of primaries and the basal and marginal areas of both wings covered with fine abbreviated dark streaks; the spots and ocelli of primaries repeated; the buff band of secondaries rarely clearly repeated, but the position of the outer edge of it is indicated by a black serrated line; the marginal inscriptions usually extend across this line well toward the mesial band; this band is closely as in the allied genus Chionobas, light within, dark near and along both edges; the elbow without rectangular on the lower discoidal inter-

space, with equal serrations from the angle to costa (though sometimes the lower two are much prolonged, acuminate); on the basal side a small angular sinus on the sub-costal nervure, and a large rectangular, or sometimes rounded, projection on the median.

Body dusky gray-brown; beneath light and concolored with the wings; femora light gray, the tibiæ red-brown; palpi whitish, with many black frontal hairs; antennæ fuscous above, cretaceous below; club red-brown beneath and at tip. (Figs. 1, 2.)

FEMALE. — Expands from 1.8 to 2 inches.

Very like the male; some individuals have a small ocellus on the upper median interspace. (Fig. 3.)

LATE FORM: A little larger than the other; paler colored, especially beneath, where the inscriptions are faint and the space which on the upper side is occupied by the buff band is scarcely outlined; the mesial band but a shade darker than the basal area. (Figs. 4, 5, 6.)

EGG. — In general like the egg of Chionobas *Uhleri;* sub-conic, the base and top flattened and about equally rounded; broadest at two fifths the distance from base, towards the top narrowing gradually, the sides considerably arched; marked by nineteen and twenty vertical ribs, nearly straight, occasionally one branching; these are rounded, somewhat broader than high, broader than in *Uhleri*, the bases finely incised, making pretty regular crenate edges; the interspaces rather narrow, nearly flat, very slightly convex, crossed by many horizontal, equidistant raised threads; the micropyle is in the centre of a flat rosette of irregular hexagonal shallow cells, the walls of which are slightly raised; outside of these are two rows of similar larger cells; the remainder of the area varies; some examples, as in the figure, resembling C. *Jutta*, showing shallow rounded cells, irregular in size and position, separated by welts or cushions somewhat raised in the middle and rounded; others are as in C. *Uhleri* and C. *Brucei*, covered with low knobs from which radiate thread-like spurs; in some examples the ends of the ribs come nearer the rosette, and are depressed, with short spurs from one to the other; color chalk-white. (Figs. *a*, a^2.) Duration of this stage eleven to thirteen days.

YOUNG LARVA. — Length, at twelve hours from the egg, .13 inch; shape of Chionobas; thickest anteriorly, tapering from the head on both dorsum and side to 13, ending in two sub-conical tails which meet at base (as in C. *Jutta* and

others, but not as in C. *Brucei*); furnished with three rows of pale black, low conical tubercles on either side above the spiracles, a dorsal, sub-dorsal, and lateral; one tubercle to the segment in each row from 3 to 12; on 2, four at the front, near together and equidistant, standing in a line somewhat obliquely back from the top; a process in front of and above the spiracle, and under it a tapering hair; on 3 and 4 each a second process in front of the lateral one; the tubercles on these segments are in vertical row, on the middle of the segment, after 4, in triangle; on 13 is a second triangle, the apex of which is at the tip of the tail; also on the inner side of the tail, a little below the tip, is a smaller tubercle; each bears a clubbed and bent white process; these are at least twice as long as the height of their tubercles, and become longer after 11 (much longer than in any species of Chionobas viewed); under the spiracles is another row of minute tubercles, two on segment 2, one on 3 and 4 each, two on 5 to 12, one on 13, with similar processes; over each foot is one short hair, over the pro-legs two, the anal leg, one; color at first pale whitish green, with no stripes, the under side nearly the same; but after about twenty-four hours from the egg appeared two dorsal lines close together, and a sub-dorsal line, all pale brown, a lateral stripe a shade darker, the basal ridge buff, with the faintest tint of red; at three days from the egg the general hue had become yellow-green; head subglobose, a little broader than high, broader than 2, narrowing upward a little, depressed at the suture; surface covered with shallow indentations, and showing a few tubercles like those on body, each with its clubbed and bent glassy white process, the proportions of which to the tubercles are closely as in figure b^6; of these four are in cross row near the top of the face, six in a line with the apex of the frontal triangle, four a little higher than the lower ocellus, one a little in front of and above the largest ocellus, and two behind each group of ocelli; in all twenty, ten on each lobe; color at first pale green, later decidedly green. (Figs. *b* to b^6.) Duration of this stage about twenty days.

After first moult: length, at twenty-four hours, .17 inch; nearly of same shape as before, the tails same; color greenish white, with a tint of gray over the dorsal area; the mid-dorsal stripe pale green, edged on either side by a brown line; outside of this is a narrow whitish space; the sub-dorsal line brown; the lateral band pale green, much blackened, especially after 5; the basal ridge buff; the whole upper surface thickly covered with fine conical tubercles, each with its short, appressed clubbed process or hair; under side, feet and legs gray green; head very much as before, the surface covered with rather deep rounded indentations, between some of which are minute tubercles and processes; from back to front six nebulous brown stripes, one following the suture on either lobe,

another outside of this, reaching nearly to the ocelli, the third short, at the side (these are as in Chionobas, and the middle stripe is continuous, as in C. *Jutta*, and not broken, as in C. *Brucei*); ocelli brown; color pale yellow-green. (Figs. c to c^3.) To next moult, about fifteen days.

After second moult: length, at twelve hours, .24 inch; shape as at second stage; the tubercles and processes essentially the same; color yellow-buff, the sides pale green; the buff dorsal area shows a tint of green, and is considerably flecked with brown; the mid-dorsal stripe green, and as before; the lateral band as before; the spiracular greenish band dusted brown; basal ridge yellow-buff; under side, feet and legs gray-green; head as before. (Figs. d to d^4.) To next moult, thirteen days.

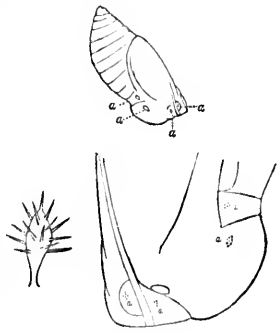
After third moult: length, at eighteen hours, .32 inch; same shape and color as at third stage, except that the buff is darker. (Figs. e to e^3.) To next moult, twenty-three days.

After fourth moult: length, at eighteen hours, .52 inch; reddish buff, lighter next the pale black mid-dorsal stripe; the sides pale green. (Fig. f^2.) In twenty-nine days from the moult the only larva observed reached maturity.

Mature Larva. — Length, .96 inch; stout, obese, tapering rapidly from 5 to head, and from 8 to 13, ending in two short sub-conical tails which meet at base; surface thickly covered with small pointed tubercles of irregular sizes, each bearing a rather long, clubbed and appressed whitish process (but these are of irregular length); color reddish buff, the sides pale green; banded and striped as in Chionobas; the mid-dorsal stripe pale black, the buff dorsal band a shade darker than the adjoining upper lateral band, the sub-dorsal line which in the early stages was distinct is now obsolete; the mid-lateral stripe or band much obscured by black, especially next its upper edge; the green spiracular band dusted brown; basal ridge buff; below this a narrow space of green-buff which shades into the gray-green of under surface; feet and legs gray-green; head small, sub-globose, well-rounded frontally; surface covered with pretty deep indentations, between some of which are glassy processes like those on body, those on the lower half of the face longer; color brown-yellow; across the top six not very distinct brown stripes, less strongly presented than in Chionobas, the brown color being only in the bottom of the pits, three on either lobe; the inner one follows the suture half-way down the triangle; the second is narrower and ends nearly at the ocelli; the third is at the side, short;

these stripes and other peculiarities are closely as in Chionobas. (Figs. f, f^3, f^4.) From fourth moult to pupation, in the only example observed, forty-four days.

CHRYSALIS. — Length, .45 inch; breadth, at mesonotum, .18, at abdomen, .22 inch; cylindrical; the ventral outline arched from 13 to base of head case, the dorsal outline of abdomen strongly arched; head case short, projecting but little beyond the mesonotum, compressed transversely, the summit rounded both ways, the sides not excavated (Fig. g^4); along the posterior edge of the pro-thoracic spiracle a small flattened cylindrical process, perhaps serving as a guard or protector to the spiracle (Fig. g^5); on either side of head case two small clusters of exceedingly fine processes shaped much like what is called an Indian-club, the thicker portion beset with sharp, tapering spurs (Fig. g^6); one cluster being near the centre of the exposed portion of the eye case, one in the middle of the side of the pronotum just in front of the spiracle; a third on the extreme side of the metanotum, and a fourth on the mesonotum just in front of the third (the position of these clusters is shown on the cut (a), and the shape of the processes in the second figure); mesonotum rather prominent, highest posteriorly, narrow at summit and rounded, but without carina, the sides sloping, very little convex; followed by a slight excavation; the wing cases somewhat elevated, bevelled down to the abdomen; this last sub-conical, tumid; the cremaster small, bluntly rounded, compressed, the ridges not prominent, naked, without hooks or bristles; color red-brown, darkest anteriorly, the divisions of the abdomen green; wing cases green, around the margins brown. (Figs. g^2, g^3.) Pupation took place at about a half inch under the surface of the earth, in a cavity made by the larva by pressure and of about twice the diameter and one fourth greater length than the pupa. (Fig. g.) Nothing of the nature of a spun cocoon was present.



RIDINGSII was named in honor of Mr. James Ridings, who first made known the species. He had taken a few examples at Burlington, Boulder County, Colorado, in 1864, but gave no information as to habits. We are indebted to Mr. Theodore L. Mead, who, in 1871, spent some months in Colorado in collecting and observing butterflies, for our first knowledge on this point. In his Report

of the Wheeler Expedition he says of *Ridingsii:* "About the first of June, on the plains near Denver, a few specimens were found hiding in the short, parched grass, and flying up when disturbed, exactly as is the habit of Drasteria among the moths. The color of these butterflies harmonizes excellently with that of the dry herbage, and renders them quite difficult of detection, even when near at hand. It appears to be a rare species about Turkey Creek, but in the sage-brush country, about Twin Lakes (Arkansas Valley, 8,000 feet elevation), is very abundant in July, appearing there in company with Satyrus *Charon*. It is, however, much less partial to flowers than is the case with that species, and has almost entirely the habits as well as the appearance of Chionobas rather than Satyrus."

Mr. David Bruce, who has enlarged our knowledge of so many species of Coloradan butterflies, writes me on *Ridingsii:* "It seems to occur in plenty in suitable locations throughout eastern Colorado, certainly as far as Salida, which is at the geographical centre of the State. Around Denver, especially on the prairie land to the north of the city, are a number of ponds (they are dignified by the name of lakes, because it sounds better, but most of them are mere mudholes in a dry season). About these places flowers are plenty, and of course insects are abundant. On the dryer uplands in the immediate vicinity, on and among the short grass, cacti, and sage-brush, *Ridingsii* is sure to occur, from 5,000 feet, the elevation of Denver, up as high at least as 7,000 feet. It is not partial to damp spots where the herbage grows high and rank, but to a dry soil more or less covered with bunch-grass. This is its favorite home. On the lowlands the snow soon melts, and this butterfly is flying there by the end of May or beginning of June. Eggs from the early females produce a second brood of the imago in August and September, the examples of which are paler and slightly larger than the spring brood. In higher localities, they appear about the end of June. I found them on the Arkansas Divide, 8,000 feet, July 11th, in fine condition and very active. At the same place, twelve days later, they were still plentiful, but worn, mostly ragged, and sat sluggishly on the flowers of Rudbeckia and other compositæ with Satyrus *Charon* and Melitæa *Minuta*, which two species were also common and the worse for wear. *Ridingsii* is an easy species to catch, and the collector may, with care, secure almost every one he sees. When disturbed, it takes a short, springing flight, so like the leap of a gray species of Orthoptera which frequents the plains that I have often been deceived. After it has been flushed two or three times in succession, it becomes thoroughly alarmed, and will then take a long flight and drop suddenly. If it alights on grass, it dives to the roots and hides; if on the bare ground, it lies flat on one side, motionless and as if dead. It is then very apt to be overlooked.

I have been surprised at the difficulty in detecting them when I have seen them alight, and after a vain search, I have only discovered them by violently fanning the earth with my net. The motion of the air would turn the insect over and render it visible. While thus shamming, it may be picked up with no effort on its part to escape, or even a sign of life. I have never found this species above 9,000 feet, and then in but one place, near Granite, in the central part of the State. It closely resembles Chionobas *Chryxus* and C. *Uhleri* in general habits. I have taken it flying with the latter species, the two pursuing each other and indulging in a mild flirtation."

Mr. Wright says: "At Maiden, Montana, I got one female *Ridingsii*, no other one seen. It was near the top of a rather low peak, at the altitude of about 4,500 feet, higher peaks and low valleys about in all directions. The soil was gravelly to rocky, with much grass and small flowering plants growing among the stones, and a few small trees scattered about. Upon starting up the *Ridingsii*, it flew rapidly, low, just above the grass, and suddenly dropped among some stones. I cast the net over the spot, but I had much trouble to find the insect, so completely was it concealed. I searched the hilltop many times afterward, hoping to find another, but in vain."

Mr. Fletcher writes that the species is not to be seen in Canada, so far as he is aware.

Mr. Mead says: "Specimens were brought from southern Utah by the Expedition." Undoubtedly the species found in Utah is *Dionysius*, Scudder, now known to inhabit western Colorado as well as parts of Arizona.

I first received eggs of RIDINGSII from Mr. H. W. Nash, at Rosita, Colorado, 4th August, 1884. The females that laid them were taken on the mountains near the town, at about 9,000 feet. The eggs began to hatch on 8th, and the larvæ were not observed to eat, and soon died. But, 10th August, Mr. Nash sent other eggs, which were hatching 17th. On 28th August, one larva passed the first moult; on 3d September, the second, and was asleep a few days later. This was the only larva that advanced so far as the second moult, and it died during the winter.

On 17th June, 1886, I received eggs from Mr. Bruce, at Denver, laid on 12th. These were hatching on 25th. A few of the larvæ appeared to eat nothing, and in course of next two days had disappeared. I thought they had gone down to the base of the plant, but could not find them. One larva passed first moult on 19th July, a second passed same moult on 21st, and a third on 25th. On 7th August, number one passed its second moult; on 20th, the third moult; and on 13th September, the fourth. On 18th September, I sent it to Mrs. Peart for its portrait. But this larvæ failed to reach pupa.

On June 23, 1888, the late William S. Foster, at Salida, elevation 7,000 feet, sent eggs which were laid on 17th. These began to hatch 29th. One larva passed the first moult 10th July, another 14th. Number one passed its second moult 25th July, the third 6th September, and then went into hibernation. One of this lot, at Philadelphia, passed the second moult 12th August, the third 3d September, and then hibernated. Both died during the winter. The rest of the brood had died in the early stages.

On 5th March, 1889, I received from Mr. T. D. A. Cockerell, at West Cliff, Colorado, altitude 7,500 feet, a hibernating larva, which I recognized as *Ridingsii*, past the second moult. It had been found under a stone. I left it out of doors, and 4th April, discovered that it had recently passed its third moult. On 13th April, it passed the fourth. On 13th May was changing color, becoming blue-green, and was evidently approaching pupation. On 14th, it had disappeared. I searched for it, 18th, and found it half an inch below the surface, where it had made a little hollow for itself in the leaf mould which had been provided in anticipation of this mode of pupation. The same day it pupated. Its likeness is given on the Plate. Unfortunately, it died before imago.

The same year, 1889, I again received eggs from Mr. Bruce, at Denver, laid 12th. These began to hatch 25th. On 9th July, some of the larvæ passed their first moult; one reached the second on 19th. None went beyond this, and all had become lethargic by 8th August. I have therefore failed to rear any one larva from the egg to pupa; yet, at one time and another, every larval stage has been reached. The only pupa observed came from a larva which had hibernated on its native peak. The species has proved as difficult to rear as any of the Chionobas.

It appears that larvæ from Denver, 5,000 feet, from June eggs, of the earliest flight of the imago, reached the fourth moult the same season; that other larvæ from same place, also from June eggs, reached the second moult in July, and then hibernated; that two larvæ from June eggs, Salida, 7,000 feet, reached the third moult, and hibernated; and one from Rosita, 9,000 feet, from egg laid early in August, hibernated after first moult. The larva found at West Cliff, 7,500 feet, had hibernated after second moult. There were also young larvæ which apparently went to ground immediately from the egg. These observations favor Mr. Bruce's view that at the lower elevations this species has a second brood of the imago in the fall, while at the higher elevations there is but one brood of the imago, though freshly emerged individuals make their appearance for some weeks, because of the different ages at which their larvæ had gone into hibernation.

EXPLANATION OF THE PLATE.

RIDINGSII, early form 1, 2 ♂, 3 ♀; late form 4 ♂, 5, 6 ♀.

a EGG; a^2 micropyle.

b, b^2 YOUNG LARVA; b^3 last segments; b^4 process on body; b^5 head.

c, c^2 Larva at 1st moult; c^3 head.

d, d^2, d^3 Larva at 2d moult; d^4 head.

e, e^2 Larva at 3d moult; e^3 head.

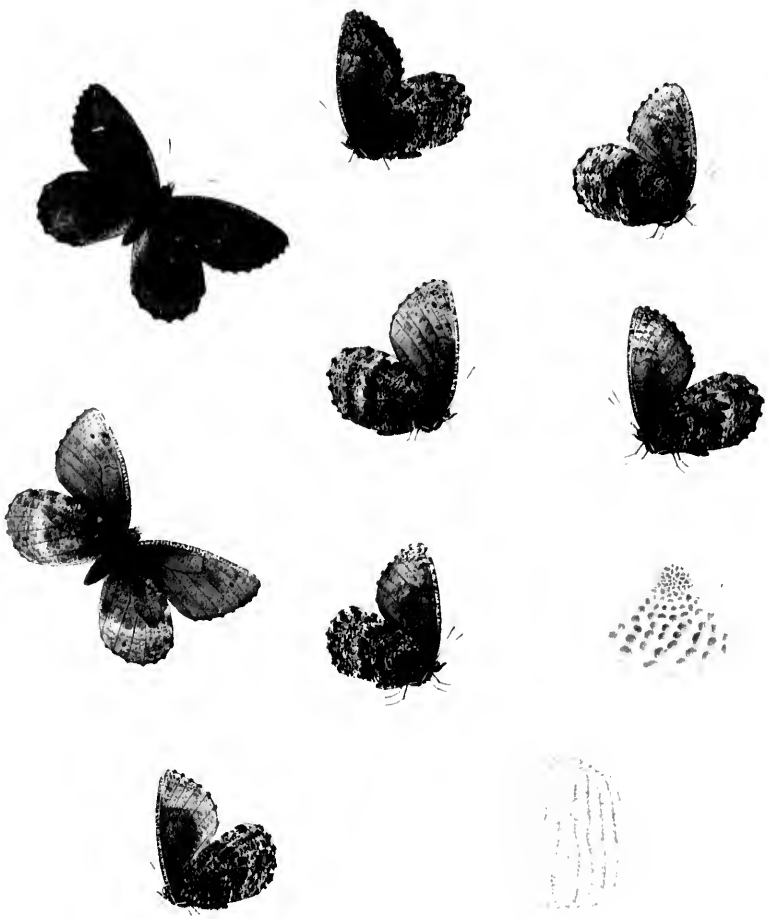
f^2 Larva at 4th moult, enlarged; f^3 process on body; f^4 head.

f ADULT LARVA, greatly enlarged.

g^2 CHRYSALIS, enlarged; *g* showing mode of pupation in the ground; g^3 side view of cremaster; g^4 ventral view of head case; g^5 flattened cylindrical process next pro-thoracic spiracle; g^6 one of the minute processes on head case, pronotum, and metanotum.

CHIONOBAS.

VII.



GENUS 1 2 3 3 4 ♀ 5 6 VAR. 3

ASSIMILIS ♂ ♀ *Staudinger*

CRAMBIS *Herr Schäff*

CHIONOBAS VII.

CHIONOBAS ŒNO, 1–8.

Chionobas Œno, Boisduval, Icones, Vol. I. p. 195, pl. 39, figs. 4 to 6. 1832.
Var. *Assimilis*, Butler, Cat. of Satyridæ, p. 163, pl. 2, fig. 10. 1868.

Wings somewhat translucent, as in C. *Semidea*.

Male. — Expands from 1.8 to 2.1 inches.

Upper side from livid-brown to yellow-brown; costa of primaries yellow-white, streaked brown and black; occasionally there is a small blind ocellus on the upper discoidal interspace; secondaries disclose more or less distinctly the markings of the under surface; fringes of both wings yellow-white, fuscous or brown at the tips of the nervules.

Under side of primaries paler; in some examples the larger part of the wing is sprinkled with dark scales, in others is densely covered by fine, abbreviated, transverse brown streaks, most so in the cell; the apical area more or less gray. Secondaries yellow-gray, mottled and streaked with dark brown, pretty equally distributed from base to margin; but sometimes the basal area has the ground gray-white, and outside the band is a narrow space of same color; the band well defined on its outer edge, which in the main is arched, but sometimes made angular by the prominence of the serration on upper median interspace, the anterior half in narrow serrations, sometimes sharp, sometimes rounded, the posterior half crenated; the inner edge most often not clearly defined, and the mottling of the basal area is continued through the band; but when this edge is distinct, the course from costal margin to about one third across the cell is straight, then is incurved, or makes a sinus in the cell and submedian interspace, and crenated or erose to inner margin; midway between the band and hind margin is a row of whitish points, one on each interspace.

Body fuscous above, black below; the upper half of the femora black, the rest and the tibiæ yellow-brown; palpi yellow-white with the frontal hairs black;

antennæ fuscous above, paler below, and ringed with cretaceous; club cretaceous below, red-brown above. (Figs. 1, 2, 6.)

FEMALE. — Expands from 2 to 2.1 inches.

Like the male, but usually more yellow; the ocellus on primaries present, and sometimes there are three small whitish spots on the lower interspaces, in line; on secondaries a small blind ocellus sometimes appears in the lower median interspace, the under side of primaries sometimes much streaked at apex and over the basal two thirds of the wing, with an obscure mesial band, the outer side of which is irregularly crenated, and throws a sharp projection along upper branch of median. (Figs. 3, 4, 5.)

VAR. ASSIMILIS. — The band is wanting, or there is scarcely more than a suggestion of it. (Figs. 7, 8.)

ŒNO flies in Labrador, at least along the coast; also at Fort Chimo, Davis Straits, in Ungava. Two examples were taken by Mr. Ludwig Kumlein, Naturalist of the Howgate Polar Expedition, 1877–78, at Quickstep Harbor, Gulf of Cumberland, lat. 66°; and were mentioned by me in Bulletin 15 of the U. S. National Museum as *Semidea*, Say. Mr. Butler gives Repulse Bay, which is of about the same latitude, but several degrees to the west, as a locality. The species is also found in Colorado, inhabiting the tops of the loftiest peaks. It has been taken in New Mexico, though I do not know the locality, as is evidenced by a pair formerly received by me from one of the exploring expeditions. I am not informed that *Œno* has been taken to the northward of Colorado. In that State and in Labrador the variety *Assimilis* accompanies the parent form.

About twenty years ago, a collection of butterflies made by Lieutenant W. L. Carpenter, U. S. A., in Colorado, was sent me, and among them were two pairs of *Œno* which had been caught in copulation. They had been killed and put in envelopes without separation, and in this condition I found them. These are before me as I write. Both males are dark; in one the band is distinct on both edges, in the other the outer edge is defined, the inner lost. One female is dark, the other very yellow, and in this last the band is wanting; that is, it is the variety *Assimilis*. In the dark example the band is faint throughout. I sent Mr. Butler an example similar to the one shown on the Plate, figure 7, and another like 8, and he replied that both were *Assimilis*. An excellent uncolored figure of this form is given in the Cat. Satyr., and the description reads: "Under side color of *Œno*, but the band is less distinct."

Mr. Bruce has kindly furnished me with notes on the localities in Colorado

inhabited by *Œno*, and its way of life: "The tops of the Front Range of the Rocky Mountains are generally irregular plains sloping towards the west. On these comparatively little snow lies, as they are swept by the violent west winds which blow throughout the winter and spring months. Owing to this the snow accumulates in immense rolls and wreaths just on the extreme verge of the eastern side of the mountain, and extends downward in vast fields. These accumulations melt slowly, but by the middle of June, in ordinary seasons, the upper levels are nearly free, except in depressions and on rocky declivities. On the very rim of these mountains, as the snow recedes, a bare space of gravelly earth, or decomposed granite, occurs, the result of constant attrition by the elements; and it is this narrow belt, entirely clear of vegetation, on the upper side of the snow fields which still clothe the mountain side, that *Œno* frequents. There it can be found from the middle of June until the end of August, or during a period of fully six weeks. Though during August the snow all disappears except in deep chasms, the butterfly holds to its favorite haunt, occasionally straying a few hundred feet downward where the character of the surface accords with that of the belt. It is a strong-winged and vigorous species, shy and wary. By watching where it alights and approaching with caution, however, it may easily be covered by the net; but when on the wing it is useless, indeed impossible, for the collector to follow it. It sweeps over the mountain edge and across the snow with a bold dash, and takes a long excursion, but generally returns in a short time and alights as suddenly as it started. I took several fine examples on a warm and still July morning this year (1893) by sitting quietly on a rock in one of the favorite haunts. The butterflies played around me and apparently fought for a position, — a jutting point on the edge of the snow. On this they would walk a few inches in their jerky manner, stop a few seconds and begin an almost imperceptible gliding, then stand quiet a moment, and walk again, — about which time a rival would appear, and the usual skirmish in the air would ensue; and I generally improved the occasion by catching both of them. Like the allied species, it lies flat on closed wings, especially if the wind is blowing. About midday they take short flights on the plateau, the females apparently for the purpose of depositing their eggs, and the males to feed on the flowers, preferring spots where the rocks crop up through the scanty vegetation. For shelter during storms they return to the mountain verge. I once took quite a cluster of them in a crevice under a huge overhanging rock where I had taken refuge during a furious hailstorm. I have found this species at all elevations above 12,000 feet in Park and Summit counties. It is found, as I have said, at the highest points attainable and is common; yet from its frequenting such inaccessible localities, collectors have not often captured it.

"*Œno*, on its belt, seems to be on the constant watch for intruders, and will even chase the rufous humming-bird, which is common in the same region. Erebia *Magdalena*, Melitæas *Anicia* and *Palla*, Pieris *Occidentalis*, Colias *Meadii*, Vanessa *Californica* and Chrysophanus *Snowi*, all inhabit the higher slopes and levels, and *Œno*[1] is on the alert for every individual of them that crosses its domain. This habit is observed in the whole genus Chionobas, but appears to be more developed in *Œno*, which is a bolder and stronger species than some of its congeners. *C. Brucei* is far more quiet; a little playful dancing in the air is occasionally indulged in by half a dozen at once, but they take no such flights as *Œno* does. As *Brucei* lives on the grassy places on the slopes and plateaus, the habitats of the two species sometimes overlap, and they may be found in company. I have now and then seen C. *Chryxus* with *Œno*, though as a rule this species lives at a lower altitude."

Chionobas *Œno* was described by Dr. Boisduval, sixty years ago. He says of the under side of the hind wings: "Marbled with black and white, crossed in the middle by a blackish band which is crenated on its posterior edge and is sometimes entirely lost in the marbling of the base." That agrees with the species as it is known to-day from Labrador and Colorado. The figure agrees with the description in Dr. Holland's copy of the Icones, which he has kindly loaned me for examination, except that the outer edge of the band represents an aberration in which the crenations are flattened except the three on the disk, and the upper two of these are serrated rather than crenated. This is a peculiarity sometimes seen in other species of the genus, even in quite a different group, as in C. *Californica*. But all copies of the Icones have not the plates so well colored as the one before me, for one was sent me which had unintelligible black lines disposed over the region of the band so as to destroy that feature. Therefore it is safest to follow the description, which is drawn with Dr. Boisduval's usual felicity.[2] He speaks of having under view several examples, and goes on:

[1] In the text of C. *Brucei* (Chion. VI.), Mr. Bruce says of that species: "It does not fly to the tops of the rocky peaks like C. *Semidea*." This should have read "like C. *Œno*," which was the species Mr. Bruce had in mind.

[2] I copy the description from the Icones: —

"Ses ailes sont d'une texture mince et assez délicate. Le fond de leur couleur est en dessus d'un gris-brunâtre-livide mêlé de jaunâtre. Les supérieures sont presque transparentes près de l'extrémité, qui est un peu plus jaunâtre que le reste de la surface, avec la pointe apicale et le bord marginal chargés de quelques petits atomes noirâtres.

"Les ailes inférieures sont à-peu-près du même ton que les supérieures, et leur transparence est telle, que l'on voit à travers tout le dessin du dessous. Leur extrémité est un peu plus claire, avec quelques atomes noirâtres condensés vers le bord marginal.

"Le dessous des ailes supérieures est un peu plus jaunâtre que le dessus, avec le sommet et le bord de la côte grisâtres et piqués de brunâtre.

"Le dessous des ailes inférieures est varié et marbré de noirâtre et de blanchâtre, traversé au milieu par

"It is very rare in collections; is found in Russian Lapland. I have also a female which I received from M. Eschscholtz as coming from Siberia. M. Sommer has sent me two others which do not sensibly differ from the type, and which were taken in Labrador." In view of the language of the Icones, it is singular that no two later authors have agreed as to what *Œno* was. It has usually been confounded with *Semidea*, Say, and *Crambis*, Freyer. With these is mixed up *Also*, Bois., described in the Icones next to *Œno*. The late Mr. H. B. Möschler, in a paper on the genus Chionobas, 1863, gave the series thus: —

1. *Also*, Bois. = *Crambis*, Freyer.
2. *Œno*, Bois.

He says nothing of *Semidea*, but in later years sent me Labrador examples of *Œno* with the labels "*Semidea*," and therefore must have changed from his first view.

Mr. S. H. Scudder, Proc. Ent. Soc., Phil., Vol. V., 1865, says: —

1. *Œno*, Bois. = *Also*, Bois. = *Crambis*, Doubleday's Gen^{a}.
2. *Semidea*, Say = *Also*, Bois.

In the Butt. N. England, 1889, Mr. Scudder does not mention *Œno*, but gives *Semidea*, with *Also*, in part, as a synonym.

Mr. A. G. Butler, Cat. Satyr., 1868, says of the sub-group: —

1. *Crambis*, Freyer.
2. *Œno*, Bois. = *Also*, Bois.
3. *Assimilis*, Butler.
4. *Semidea*, Say.
5. *Subhyalina*, Curtis.

Mr. W. T. Kirby, Cat., 1871, says: —

une bande noirâtre, crénelée sur son côte postérieur, qui quelquefois se perd presque complètement dans les marbrures du fond. L'extrémité offre près du bord quelques petits groupes d'atomes noirâtres un peu plus serrés, et formant une raie maculaire peu prononcée.

"La frange est blanche, entrecoupée de noirâtre. Le corps est brunâtre. Les antennes sont d'un jaune-testacé pâle, avec la base d'un gris brunâtre.

"Les supérieures (de la femelle) sont plus arrondies, et leur sommet offre souvent un très petit œil à peine visible.

"Les dessous de ses ailes supérieures est plus jaunâtre, plus fortement saupoudré d'atomes noirâtres; le sommet et la côte sont plus blanchâtres; la cellule discoïdale parait traversée par deux légères traînées d'atomes noirâtres, formant comme deux raies très peu distinctes. Au-delà de la cellule, on voit une autre traînée noirâtre, coudée en angle aigu comme dans les espèces, et très peu marquée.

"Les dessous des ailes inférieures offre à-peu-près le même dessin que dans le mâle; mais il est un peu plus varié de blanchâtre, et la bande transverse est mieux dessinée."

1. *Œno*, Bois.; var. a. *Also*, Bois.; var. b. *Crambis*, Freyer.
2. *Semidea*, Say = *Also*, Bois. (but this last is plainly a mistake for *Bootes*, as the reference shows).

Dr. O. Staudinger, Cat. 1871, says: —

1. *Crambis*, Freyer.
3. *Semidea*, Say = *Œno*, Bois. = *Also*, Bois.

In my Synopsis of N. Am. Butterflies, in Vol. I., 1872, I followed Kirby, as the latest authority, having myself but a very slight acquaintance with some of these forms, and none at all with others. At that date no collection in America had all of them, and very few individuals of any, even of *Semidea*. It was not till Mr. Bruce explored the peaks of Colorado that it became possible to understand what *Œno* was, and the limitation of *Brucei* made clear the position of *Crambis*.

In my Catalogue, 1877, I gave: —

1. *Semidea*, Say = *Œno*, Bois. = *Also*, Bois.
2. *Crambis*, Freyer = *Assimilis*, Butler.
3. *Subhyalina*, Curtis; and the same in the Revised Cat. of 1884.

To-day, 1893, I give the series: —

1. *Crambis*, Freyer.
2. *Brucei*, Edw.
3. *Œno*, Bois.; var. *Assimilis*, Butler.
4. *Semidea*, Say.
5. *Subhyalina*, Curtis.

This is very nearly as Mr. Butler gave it, as stated above.

As to C. *Also*, I reject it altogether as American. The description of the under side hind wing says: "It is brownish beyond the middle, with some grayish atoms and small marbling of same color near the outer border. The posterior third is of a whitish gray which has something of violet, with streaks, atoms, and little undulations of blackish. The band is present as in the other species, but the inner side is lost in the basal color." I suppose by "the other species" the author meant either *Œno*, next preceding, which has a crenated band, or *Œno* and *Balder* (the second preceding and which has a dentated band, as the description says). The whole description of *Also* is too general to differentiate any species, and the figure is evidently poorly drawn and poorly colored and gives no help. The band on the outer side is irregularly wavy, totally unlike either of the species spoken of, and the inner edge for half its course is indicated by a

heavy incurving black line, whereas it should be "totalement fondue avec la couleur de la base." I have never seen an insect like that figure, and the description is valueless. Boisduval says he described from a single male which came to him from Siberia, and adds: "I have received from Mr. John Leconte, under the name *Eritosa,* Harris [a mistake for *Semidea,* Say], an example taken in the White Mountains of New Hampshire, which seems to me to belong to this species." That is all! He has seen a single example of *Semidea* from America, which "me parait appartenir à cette espèce," just described from a single example from Siberia. It is only now, after the lapse of more than half a century, that the species of this sub-group can be distinguished and limited, and to accept the conjecture of even Dr. Boisduval, great naturalist though he was, as if it were a scientific and final determination, based on the inspection of one *Semidea* and one insect from Siberia, is out of the question. Whether *Also* is to-day anywhere received as a species I am not informed, but, in 1871, Dr. Staudinger, Cat., doubted whether there was such a Siberian species.

CRAMBIS.

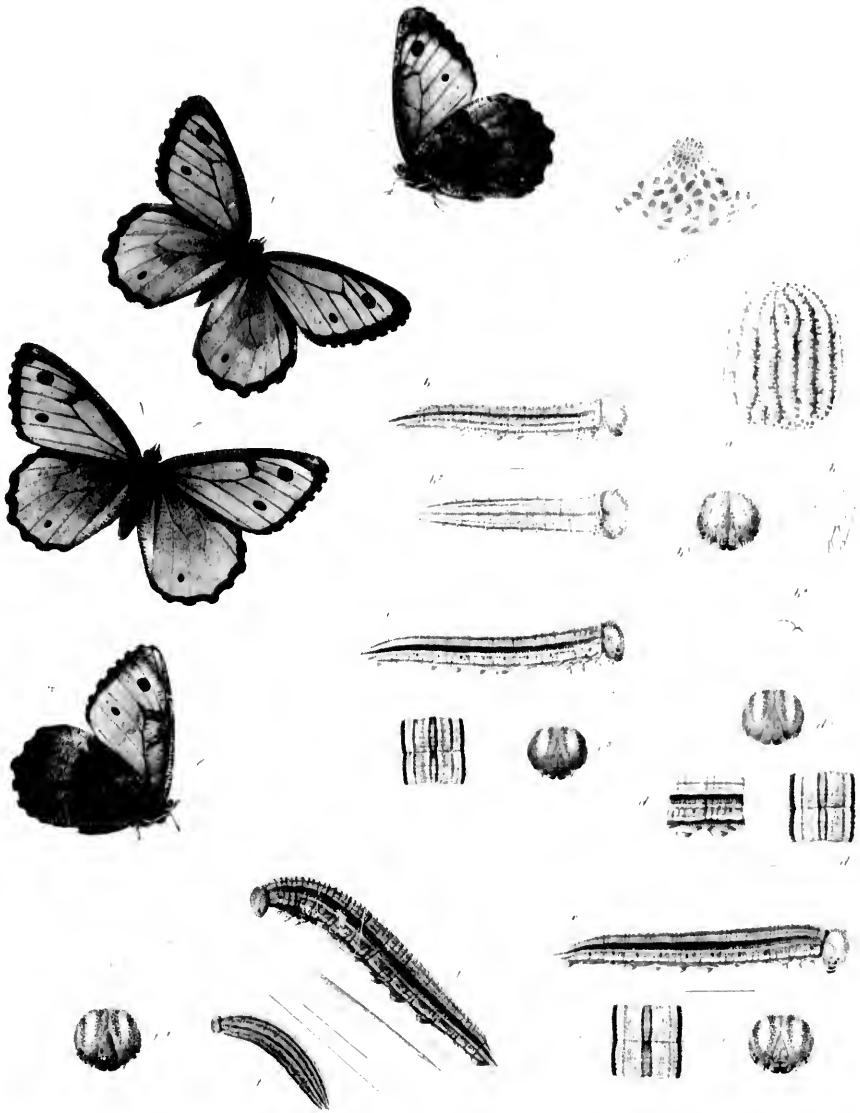
Egg. — Nearly as in C. *Brucei*, but the sides less arched, and the top nearly as in C. *Jutta;* subconic, the base flattened and rounded; broadest at about one third from base, narrowing upward considerably, the sides moderately arched; marked by twenty-two vertical ribs, very nearly straight, occasionally one branching either at bottom or top; these are narrow at the summits and rounded, and the depressions are shallow and rounded; the slopes with many irregular horizontal excavations, with little intervening ridges (closely as in *Brucei*); the top flattened; the micropyle is in the centre of a rosette of six-sided cells, outside of which are three or four rows of similar, less regular, larger cells; beyond these to the ends of the ribs the flattened space presents shallow rounded cells of irregular sizes, but in general the smallest are next the micropyle; these are much as in *Jutta*, but they are more numerous, and often run together; color dull white. (Fig. *a.*) The egg here described was found attached to the leg of a female *Crambis*, from Labrador, as stated on a previous page in a note under the head of that species.

EXPLANATION OF THE PLATE.

Œno, 1, 2, ♂, from Colorado; 3, 4, ♀; same loc.
5 ♀, from Labrador; 6 ♂, same loc.
Var. Assimilis, 7 ♀; 8 ♂, intermediate; both from Colorado.

CHIONOBAS.

X.



MACOUNII 1 2 ♂ 3 4 ♀

a Ovum *magnified* *d* Larva *mature* *nat size*
b c Larva *young to 3d moult* *e* *magnified*

CHIONOBAS X.

CHIONOBAS MACOUNII, 1–4.

Chionobas Macounii, Edwards, ♂, Can. Ent., Vol. XVII, p. 71. 1885; Fletcher, 19 Ann. Rep. Ent. Soc. Ontario, 1888, p. 85; id., Insect Life, Vol. II, p. 45. 89; Scudder, ♂, ♀, Butt. N. England, Vol. II, p. 1775. 1889.

Male. — Expands about 2.6 inches.

In this species the sexual band on the fore-wing is wanting.

Upper side brown-orange, but varying, some examples being as light colored as *C. Californica* female, while in others the orange is obscured, brown, and even dusky; the nervures and branches brown, sometimes dark and conspicuous; hind margins edged by a blackish border of nearly even width throughout, but sometimes widest on primaries; costa of primaries dark brown; in some examples there is a trace of a brown band from the costal border along the outer end of the cell, prolonged a little on the upper median nervure; on secondaries the costal margin is edged with brown, and a little before the outer angle, and corresponding to the outer border of the mesial band of under side, is a black patch of loose scales; primaries show two black ocelli, one on the upper discoidal interspace, large, white-pupilled; the other small, usually blind, sometimes pupilled, on the second median interspace; an example under view has two additional small black ocelli, one in the interspace above each of the others; secondaries have a small ocellus, either blind or pupilled, on second median interspace; fringes alternately yellow-white and brown-black.

Under side of primaries paler, in the light examples inclining to yellowish, especially beyond the cell; in the darker ones there is a wash of brown over yellow, and the cell is much streaked transversely with darker brown; costal edge gray-white streaked black; the apex gray; hind margin with a brown border, wavy on the inner side, the outer edge black; the ocelli repeated.

Secondaries gray-white over costal margin and to middle of cell, yellowish elsewhere, densely irrorated and finely and transversely streaked with light and

dark brown, most so next base and along the hind margin; the mesial band broad anteriorly, narrowed to about one half on the posterior part, edged on both sides by black, the interior streaked as on the basal area; in the examples viewed there are two styles of exterior outline, as represented in figures 2 and 4; one showing a sharp projection at the elbow, before which the course is sinuous, after the bend crenated on second median interspace, then erose to margin; in the other there is no elbow, but an arch, somewhat flattened, from the first branch of sub-costa, to lower branch of median; in all, the basal edge of the band lies in a double curve, largely convex on the sub-costal nervure, deeply concave on the median, thence to inner margin wavy; the ocellus repeated, but reduced; in line with it across the wing a pale yellow point on each interspace.

Body blackish brown above, beneath, the thorax black, abdomen dark gray-brown; the femora black, tibiæ and tarsi reddish yellow; palpi with many long black hairs; antennæ red-brown; club yellow-brown, the tip ferruginous. (Figs. 1, 2.)

Female. — Expands from 2.5 to 2.7 inches. Upper side as in the male, varying from light to dusky brown. Beneath as in the male, but some examples have a broad mesial band on primaries entirely crossing, dark on both edges, the portion which covers the cell broad, with a spur along the upper median nervule. Mr. Fletcher says: "The females are found to vary very much. Most of them are darker than the males, with larger ocelli, and the nervures almost always clearly marked out with black; some, however, are of the beautiful golden brown of *C. Californica*." Figure 3 represents the latter description. It had been intended to give one of the darkest females, but the space would not admit of it. It may be done on a later Plate. In this extreme variety there is a suggestion of *Chryxus*, or rather of *Calais*.

Egg. — Sub-conic, the base flattened, though somewhat rounded, the top rounded, broadest at about two fifths the distance from the base, narrowing above slightly, the sides moderately arched; marked by from seventeen to twenty-one vertical ribs (examples varying) much like those of *Chryxus*, somewhat sinuous, a few branching at top or bottom; these ribs are narrow at their summits and rounded, the slopes a little convex, each with many fine and irregular excavations, with little intervening ridges; the micropyle is in the centre of a rosette of shallow six-sided cells, the boundaries of which are raised like threads; outside of these are three or four rows of larger and irregular cells, three to six-sided, and beyond, a network of low ridges radiating from central rounded knobs, much as in *Uhleri;* in some examples viewed the knobs were

wanting, but the radiating threads were present to a greater or less degree, the cells sometimes running quite to the ends of the ribs (the figure represents this last-mentioned structure); color gray-white. (Figs. *a*, a^2.) Duration of this stage about twenty days.

YOUNG LARVA. — Length, at six hours from the egg, .13 inch; shaped as in the genus, thickest anteriorly, tapering from 2 to 8 slightly and regularly on both dorsum and sides, after 8 rapidly on dorsum, arching to 13, which ends in two short, sub-conical tails not quite meeting at base; the tubercles and processes the same in number, position, and shape as in *Chryxus* and the other species observed (Fig. b^4, process from 3 to middle of 13); color at first pinkish white, blue-gray on dorsum and over the anterior segments; two days from the egg gray-green, the lines red-brown; the basal ridge buff, and beneath it another brown line; under side, feet and legs greenish yellow; head as in the other species of the genus, tuberculated in same way; color at first greenish yellow, later dull yellow. (Figs. *b* to b^4.) To next moult, at Coalburgh, twelve days. Mr. Fletcher gives the length of this stage, at Ottawa, as twenty-one days, Mr. Scudder, at Cambridge, twenty-three days.

After first moult: length, at twelve hours, .2 inch; nearly the same shape as before; the tubercles and processes as in *Chryxus*, the processes short, clubbed, and bent; color yellow-buff with a tint of green; the dorsal stripe and sub-dorsal line, as well as the line under the basal ridge, pale brown; the lateral band red-brown on a green ground which shows on the anterior segments, dark along the upper edge; the buff of the dorsal area much streaked longitudinally and finely by red-brown; a pale green band runs with the spiracles; basal ridge yellowish; under side, feet and legs greenish yellow; head as in the genus, sub-globose, indented, tuberculated, and with processes like those on the body; the dusky vertical stripes as usual; color greenish yellow. (Figs. *c* to c^3.) Duration of this stage in the only larva which reached the second moult the same season, at Coalburgh, twenty-two days (1890). In 1888, all the larvæ, six in number, went into hibernation after the first moult; so all larvæ have behaved at Ottawa.

After second moult: length at twelve hours, .35 inch; shape as at the last previous stage; the processes and stripes same, except that the lateral stripe or band discovers more green; color of body nearly as before, but more yellow, less green; head as before. (Figs. *d* to d^4.) Duration of this stage at Ottawa, in spring, fifty-nine days.

After third moult: length .5 inch; scarcely differing from last previous stage. (Figs. *e* to e^3.) Duration of the stage, at Ottawa, twenty-three days.

After fourth moult: length, .63 inch; in about twenty days was full-grown.

Mature Larva. — Length, 1.15 inch; obese, thick in the middle, tapering about equally to either end (2 of the same diameter as 12), and ending in two short sub-conical tails, which meet at base; surface thickly covered with fine, sub-conical tubercles of somewhat irregular size, each bearing a short spine or tapering process; general color brown-buff, striped and banded longitudinally as in the genus; the mid-dorsal stripe pale black; the lateral band black, more or less disclosing a green under-color, especially on anterior half; the spiracular band greenish buff; the ridge clear buff; under side, feet and legs gray-green; head small, as in the genus, sub-globose, broadest below, narrowing very little towards the top, slightly depressed at the suture; the surface thickly covered with shallow indentations, with many tubercles and processes like those on the body; across the top six dark stripes, as in the other species of the genus. (Figs. *f*, natural size, f^2, greatly enlarged, f^3, process with its tubercle, f^4, head.) All larvæ observed have died before pupation.

Macounii was originally described from twelve males taken by Professor John Macoun "at Nepigon, on the Canadian Pacific Railway, at the northern extremity of Lake Superior. In the last week of June, 1885, the same collector took a male and two females at a far distant locality, Morley, in the district of Alberta, lying at the eastern base of the Rocky Mountains. Up to the present time these are the only known stations for this handsome species, which, in some respects, is the most remarkable of the whole genus. In size and general appearance it approaches nearest to *C. Californica*, but the sexual bar, such a conspicuous feature in the males of Chionobas, is entirely wanting in *Macounii*." (Fletcher, in Insect Life.)

Mr. Fletcher and Mr. Scudder are the only persons beside Professor Macoun known to me who have taken this butterfly, and I shall give the substance of Mr. Fletcher's account, from his paper in the 19th Report of the Entomological Society of Ontario. "Our trip was made in the beginning of July, 1888, and was from Ottawa to Nepigon and back. Starting from the hotel at Nepigon near the railway and going down to the Hudson Bay post is a tract of low woodland, and beyond this are fields and meadows. Turning westward, along the track, high rocks and banks soon come down to the railway on the right; but to the left are low woods with open grassy glades which at once tempt the ento-

mologist. Nor will he be disappointed, for this is the now celebrated 'Macoun's glade,' the home of Chionobas *Macounii*, and many other little beauties. Upon July 5th we reached Nepigon, at 12.20 P. M., and by 1 o'clock had unpacked the necessary apparatus, disposed of dinner, and were ready to start. We had picked up half a dozen empty tomato cans, and having removed the two ends, covered one of them with a piece of netting kept in place by an elastic band. After passing a deep gully a few hundred yards along the track, we turned in by a bridle path towards Macoun's glade. Insects of all descriptions were in the greatest profusion. In no place, except perhaps Vancouver's Island, have I seen such enormous numbers of specimens. As we stepped into the pathway, I was carefully pointing out to my companion that we were now in the exact spot where the original *Macounii* was taken, when he rushed by me and sprang out into the bushes, exclaiming, 'Look out! there is one — here it is!' and the first specimen was secured. A minute later I had another. I had been at Nepigon once before at exactly the right season, and again a month later, but had not seen a specimen, and had begun to think that there might be some mistake about the locality. It was all right now, though, and as we were to stay a week we felt confident of getting eggs. We took four more males that day. The most important part of an afternoon's work was settling a spot for our cages. In the glade was a great profusion of flowers and grasses, a few spruces, cedars, and pines, mixed with poplars, aspens, and birches — all which were dotted about in a waving sea of grasses.

"On the 6th we started at once to the glade with the set purpose of getting females, and were successful. As we stepped into the glade, there sailed away from our feet a light brown butterfly with black stripes, so much the size, appearance, and graceful flight of Limenitis *Disippus* as almost to have escaped our notice. Something about it, however, seemed different, and a few steps and a twist of the wrist captured our first specimen of the female *Macounii*. During the day we secured altogether nine females, and tied them in three cages over clumps of grass, Avena striata. When we left we carried away with us upwards of 250 eggs, which we afterwards distributed to every one we knew of who would take the trouble to rear the larvæ." These collectors by no means confined their attention to *Macounii*, but during the week captured many other rare species, and obtained eggs of nine or ten of them.

Mr. Fletcher has kindly written for this paper a few lines on the habits of *Macounii*: "It has a free and graceful flight, not unlike that of Limenitis *Disippus*, which the males when on the wing closely resemble. The females are of a more golden yellow, and can be told at a glance. When disturbed, it flies off

rapidly for a long distance, after the manner of the Argynnids *Atlantis* and *Aphrodite*. When closely chased it will sometimes fly over the bushes or high over the trees. It is decidedly a wood butterfly. There are two localities at Nepigon where it occurs. The first of these is a clearing surrounded by trees and bushes, and it is almost invariably among the bushes that the butterfly appears. When undisturbed, or on dull days, it flies slowly with the usual dropping Satyrid flight, and frequently alights upon the leaves or upon the lichen-covered trunks or boughs of the trees. When the wings are closed and the upper ones are dropped between the hind ones so as to hide the conspicuous ocelli, the resemblance to the lichens is so complete that it is almost impossible to detect the insects. They are, however, very wary and difficult to catch when so resting, and although seeming to appreciate the protection they derive from their coloration and this habit of resting on trees, are quick to sail away at the slightest movement. When at rest on leaves they can be easily taken by a quick stroke from beneath.

"The other locality is in open spaces along a path which runs through a peat-bog, thickly wooded with high bushes, willows, spiked maples, etc. Although there are high rocks near at hand, this butterfly seldom leaves the protection of the bushes. It is, on the whole, an extremely local insect, rare, rather hard to catch, fragile, and short-lived, the season where it flies lasting only about ten days or a fortnight."

Mr. Scudder says, Butt. N. E. p. 1777: "The butterfly has a very different flight from that of some species of the genus, and belongs properly to a distinct section from *Semidea*, and one to which *Jutta* also belongs; its movements are swift, and notwithstanding their Satyrid character, are not altogether unlike those of Basilarchia *Archippus* (Limenitis *Disippus*), which on the wing it much resembles."

Mr. Scudder has recently written me that his last study of this genus brings him to regard *Macounii* as nearest *Chryxus*, not *Jutta*.

Although Messrs. Fletcher and Scudder distributed 250 eggs of *Macounii*, as related, no one except Mr. Fletcher succeeded in rearing larvæ from them to maturity, and then only one individual. Nearly all the larvæ died in the first stage. From eggs obtained by Mr. Fletcher on another visit to Nepigon, in 1890, he got two adult larvæ the next year, but these as well as the adult of 1889 died before pupation. I received about forty of the first lot of eggs on July 23d. They began to hatch the next day. On emerging, the larva nibbles the top of the egg in a circle of the diameter of its head, but leaves a narrow space which serves for a hinge as the flap is raised; it works itself out slowly

and with apparent difficulty, and the flap falls back to its place. The larvæ were put on blue grass, Poa pratensis, and for three or four days seemed to feed well. On 30th, a small red ant was discovered eating one of them, and on investigating, at least a score of the larvæ were missing. On August 5th, one larva passed the first moult, the rest partly disappeared, so that on August 27th there remained but six, one only having moulted. I sent them to Clifton Springs, New York, to go into the refrigerating house there, but in April, 1889, all were dead.

On 28th July, 1890, I received six more eggs from Mr. Fletcher, and they hatched 31st. On August 7th, there was but one larva, and it passed its first moult on 16th; was sent to Mrs. Peart, and passed its second moult while with her, and I received it again in hibernation in November. It was left on a shaded porch, under a net; was observed to be active on a mild day, last of February, 1891, and fed. It died late in April, not having reached the third moult.

Mr. Fletcher, in Insect Life, gives his experience: "The eggs hatched in three weeks, and notwithstanding the larvæ ate readily of all the grasses and sedges offered them, there was great mortality among them. They hatched July 27, 1888, passed first moult August 17th, grew very little, and hibernated after first moult. They were left out of doors upon a living plant of Carex pedunculata, and rested exposed upon the leaves, where they finished feeding without any protection and without spinning any web. During February, 1889, much snow fell, and they were covered by four feet of it until the middle of March. When the spring opened three larvæ revived, but only one would feed; this passed its second moult April 15th, the third June 13th, the fourth July 6th. As with many other grass feeders, this caterpillar furnishes a good instance of protective mimicry. It is extremely sluggish in its habits, generally feeding very early in the morning, and then resting for several hours, head downward, at the base of the tuft of sedge, where the color, shape, and longitudinal stripes give an exact resemblance to the dead leaves and scales always found at the base of these plants. The distinct dorsal and lateral stripes divide the body into widths equal to the leaves, and the faint sub-dorsal and stigmatal lines indicate the midribs, whilst many small black dots around these lines not a little resemble the minute parasitic fungi which so often discolor the leaves of grasses."

In the last of July, 1889, Mr. Fletcher carried this larva, then adult, to Washington, where Miss Sullivan, of the Entomological section of the Agricultural Department, made a drawing of it which appeared in Insect Life. Mr. Fletcher wrote me from Washington: "My *Macounii* larva is full grown, and although still feeding I daily expect pupation." From Ottawa, August 5th: "The larva

is a puzzle to me. It eats a little, but is just the same as it was when I went away." August 23d: "This larva gets smaller and lighter in color daily." September 10th: "It is evidently in hibernation; has ceased feeding, is pallid and much contracted, but healthy looking, and holds on to its sedge bravely." October 25th: "Is in hibernation and in good condition." April 11th: "My *Maconnii* is still frozen in." June 11th: "It died this spring; was perfectly sound on the snow going, but two days after the snow melted away from it, and while I was away from home, the mercury suddenly dropped very low, and the larva began to discolor, and soon was dead." I have given these particulars, as they show that this larva hibernated twice, and that its existence, had it pupated the second spring, would have filled two years.

In 1890, Mr. Fletcher succeeded in getting two larvæ through the winter, and they reached the adult stage July, 1891. He sent one of them to Mrs. Peart, who made colored drawings of it, from which the figures on our Plate are taken. This larva was returned in September, and both from their appearance were expected to pupate within the month. They however went again into lethargy. On March 7th, 1892, Mr. Fletcher wrote: "All the larvæ are dead. My two-year old *Maconnii* that went into winter quarters in good condition dead like the rest!" In another letter: "I am sure that both *Maconnii* and *Jutta*, at Nepigon, require two years between egg and imago. Eggs are never laid there till the first week in July; they hatch in about seventeen days, and only have time to pass their first moult that season. Spring does not come on and snow leave the woods before June 1st. The larvæ must therefore be ready to pupate at once on the melting of the snow, or they would not have time for the pupæ to give butterflies that year."

EXPLANATION OF THE PLATE.

MACONNII, 1, 2, ♂; 3, 4, ♀.

a Egg; a^2 micropyle.

b, b^2 Young larva; b^3 last segments; b^4 process on body; b^5 head.

c, c^2 Larva at first moult; c^3 head.

d, d^2 Larva at 2d moult; d^3 head.

e, e^2 Larva at 3d moult; e^3 head.

f Adult Larva, natural size; f^2 same, enlarged; f^4 process or spine on body; f^5 head.

ARGYNNIS.

VII.

ASTARTE [illegible] ALBERTA [illegible]

[illegible] ALBERTA [illegible]

ARGYNNIS VII.

ARGYNNIS ASTARTE, 1–4.

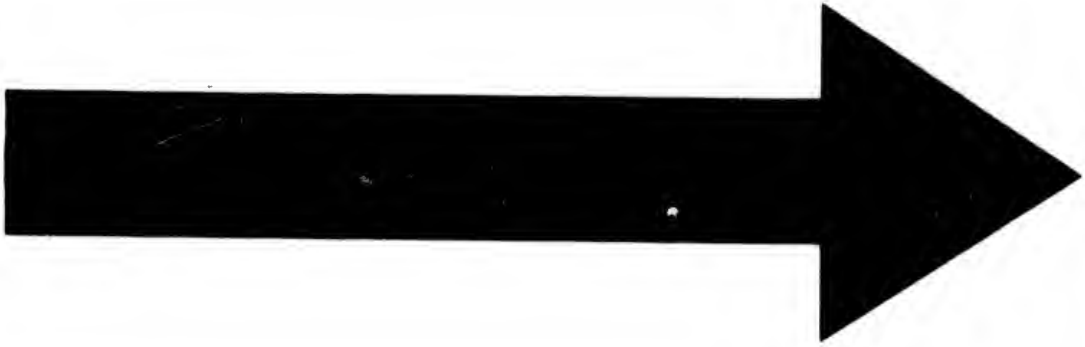
Argynnis Astarte, Doubleday and Hewitson. *Melitæa Astarte*, Doubl. and Hew., Genera of Diurnal Lepidoptera, pl. 53, fig. 5. *Argynnis Astarte*, id., Vol. I., p. 181 (footnote [1]). 1848. *Victoria*, Edwards, Canadian Entomologist, Vol. XXIII., p. 198. 1891.

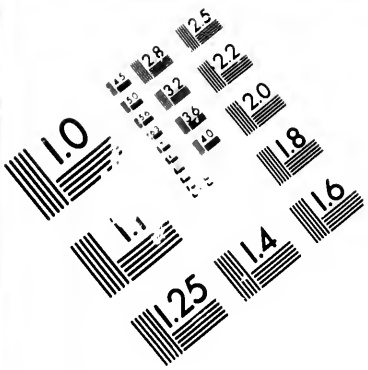
MALE. — Expands two inches.

Upper side pale fulvous; primaries a little obscured next base, secondaries largely, the dark area covering nearly half the wing; the black markings on both wings rather heavy; a common black marginal border, narrow on primaries, one third wider on secondaries; a common series of small sub-marginal spots, sub-oval on primaries, crescent on secondaries, on neither wing touching the marginal border; the rounded spots largest on primaries; the discal angular band heavy on primaries, light on secondaries; a bar on arc of cell of primaries, another crossing the cell a little within, a rounded elongated spot depending from sub-costal nervure, and a crescent near base; in the sub-median interspace an angular cross-bar; on secondaries a V-shaped spot at the end of cell.

Under side of primaries faded fulvous, brownish over the basal part of cell; small patches of orange-ferruginous in the sub-costal interspaces; the markings repeated, reduced, pale; secondaries orange-ferruginous, deepest next base; a marginal black line, within which is a heavier parallel one; next this on each interspace a small yellowish patch, which crosses the inner line nearly or quite

[1] The footnote referred to reads: "Melitæa *Astarte*, t. 23, fig. 5, is an Argynnis. I was misled by the markings of the under surface, which resemble those of the first species of the present genus (Melitæa *Maturna*), Ochs." On page 175 is given "No. 16. Argynnis, n. sp., Rocky Mountains, North America." Dr. H. S. Skinner, who has kindly looked this matter up for me, says: "The species is figured only as to its upper side. It is not mentioned in either the Argynnis or the Melitæa lists in the work, but in a footnote, on page 181, in line print[illegible] Melitæa, is the mention I quote above." Mr. Elwes, Trans. Ent. Soc. Lond., Dec. 1889, says: "*Astarte* is an almost unknown species, which was discovered in some part of British Columbia, perhaps in the Cascade Mountains, many years ago, by some of Lord Derby's collectors. The type is in the British Museum." Where this information was obtained does not appear; but Doubleday evidently knew nothing of it in 1848.





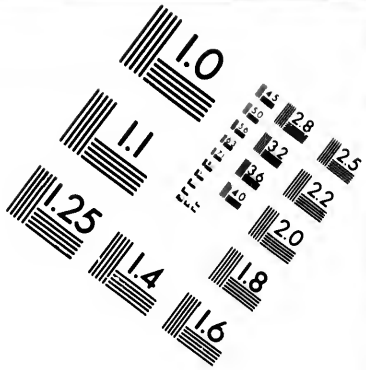
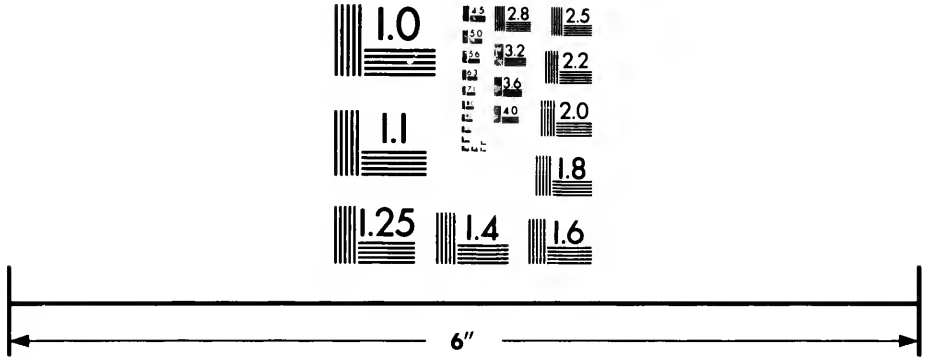
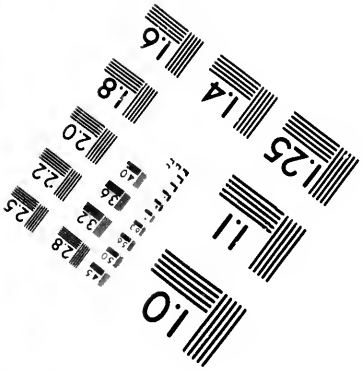
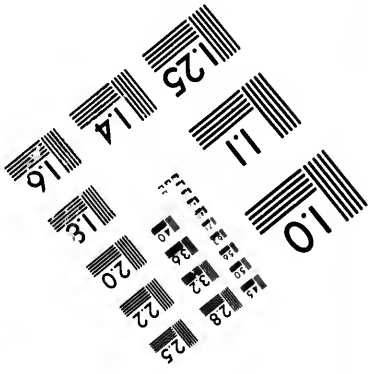


IMAGE EVALUATION TEST TARGET (MT-3)







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to the margin, and on basal side of it are a few black scales, which, in the two or three posterior interspaces, take crescent shape; the round spots of upper side repeated; close above these is a narrow transverse band of connected yellow-white crescents, not well defined, each with scattered black scales at the top; across the disc, a broad angular band of yellow-white, with something of a margaritaceous sheen, edged on both sides rather heavily by black; this band may be considered a chain of spots, as the separating nervules are black, and the one in the cell is prolonged nearly to the yellow band, and cut almost in two by the black bar on the arc of the cell; the deep orange space beyond the band discovers no spot except a small whitish triangle in the cell; at the base, whitish patches at the tops of the interspaces, which are dusted with black, the posterior ones also edged without by black.

Body red-brown above, the abdomen beneath gray-yellow; legs red; palpi have long red frontal hairs, among which are a few black; antennæ fuscous above, red below; club black, tip ferruginous. (Figs. 1, 2.)

Female. — Expands 2.1 inches.

The black markings heavier, the inner marginal line of the male has become diffuse, — a band; color as in the male. (Figs. 3, 4.)

This species was described by me, in 1891, as A. *Victoria*, from a single male furnished by Mr. Bean. He did not suspect that it could be *Astarte* of Doubleday, which, though attributed to the Rocky Mountains by that author, was catalogued by Mr. Kirby, in 1871, as belonging to Jamaica. Doubleday had not described *Astarte*, but gave a figure of the upper side only, which in the genus Argynnis is not the distinguishing side. Moreover, he had taken it at first for a Melitæa. The type, however, was in the British Museum, and on sending an example of *Victoria*, which was furnished by Prof. Edward T. Owen, and taken by him at Laggan, in 1893, to Mr. A. G. Butler, he compared it with the type, and pronounced the two to be one species beyond a doubt. It is remarkable that the single specimen should have been taken so long ago as 1848, and how much earlier is not known; and that no other example of the species should have been noticed till 1888. *Astarte* is not closely related to any other North American species of Argynnis, though it has affinities with the *Charicleа* subgroup in the discal band of the under side of secondaries.

Mr. Bean writes me of the localities and habits of this species as follows: —

"Astarte is at present known only from the mountains on the eastern face of the Rocky Mountain central range, in the Bow Valley, on the western edge of Alberta Province, latitude 51° 25′. It occurs on two mountains near Laggan.

one of them three miles southwest, in the main range, the other a low smooth mountain directly north of Laggan. Upon each *Astarte* has two established resorts, the two highest and most definite summits. These summits, on the mountain first mentioned, are respectively at 8,500 feet and 8,000 feet. On the mountain north of Laggan the two peaks have altitudes of 8,000 and 7,600 feet. On the inferior summit of this mountain I found the species, in 1888. On either of these four high points males may be seen on most fine days in the proper season. The mountain south of Laggan proves to be the better locality. The male has the same preference for ultimate peaks so observable in the male of our local alpine Chionobas near to *Subhyalina*, Curtis (figured on the plate of Chionobas VIII. as *Subhyalina*), but it is noticeable that while the Chionobas is often content with almost any knife-edge or rock-waste on a mountain ridge, if above 7,500 feet, for *Astarte* nothing will answer except the tops of the peaks. A subordinate summit, if sufficiently isolated, may attract a few, but the crown of the highest peak will be the permanent play-ground of the male, year after year. The flight of the male is exceptionally swift. He surges up over the edge of the peak in a wild rush, with wings in constant racing action, and takes a whirl or two across the plateau, rousing into transient vigor every sleepily careened Chionobas. His curiosity and nervous energy satisfied, he executes an expert half-turn in mid-air, and dashing off at a tangent, drops out of sight over the cliff wall, while each somnolent Chionobas settles down again upon his chosen boulder, and, with closed wings, tilted at an angle of 45°, leans sidewise, like a ship under a press of sail.

"*Astarte* seems always on the lookout for an entomologist, whose advent is carefully noted, and at any approach of such a monster nearer than about fifteen feet, its wings rise to half-mast, vibrate there a doubtful instant, and away goes the butterfly, making sure of its safety while it is safe. (This necessarily refers to the male.)

"The altitude range for this species, so far as observed, extends from 6,700 to 8,500 feet. The former figure is closely the altitude of Agnes Lake, where both sexes of *Astarte* occurred in 1892. At 8,500 feet, also, the female has been found, and it is at that altitude the male is most frequently seen. When I have met with either sex at elevations intermediate between these extremes, it has usually been along some stony gully or rocky ridge leading from the crest of the mountains.

"The Bow Valley timber line being 7,000 feet, and that of Colorado averaging at least 11,000, shows a margin of 4,000 feet at timber line. Considering only latitude as a cause of difference, acting uniformly at all altitudes, then 8,500 feet here equals an altitude of 12,500 in Colorado. But it is my belief that the climatic difference between the two districts increases rather abruptly at a cer-

tain altitude. For there is a secondary cause of difference in the vastly greater area of permanent alpine snow-fields here than in Colorado, and this cause would act much more powerfully at 8,000 feet and above than at timber line. The consequence of this would be, and I believe is, that the habitable belt does not extend so high above timber line here as in Colorado. I think it likely that 8,500 feet here would be equivalent to an altitude in Colorado of 14,000 feet." (It would appear by this that Argynnis *Helena* of Colorado, which frequents the loftiest peaks, and *Astarte* in Alberta, live at equivalent altitudes; so also Chionobas *Œno*, in Colorado, and C. *Subhyalina*, in Alberta. Mr. Bruce tells me that the habits of *Helena* are very much the same as Mr. Bean describes those of *Astarte*. W. H. E.) Mr. Bean continues: "There seems to me little doubt that the usual home of this butterfly is among the boulder-strewn ledges on the upper slopes of the mountains, and chiefly within a few hundred feet of the summit altitude. This is indicated by the fact that the males, though not flying about the peak tops so freely at midday as during the morning hours, often become active again later in the day, and seem as abundant toward the end of the afternoon as in the morning. It is my impression that but few of these butterflies are matured in a season upon any one mountain, and that nearly all the males are very frequent visitors to the summits in their vicinity. The female has no apparent preference for these extreme heights. She does not devote her valuable time to racing madly across windy summits for the mere nonsense of the thing.

"The male appears most freely during the last week in July, and two or three days in August. New females have been found July 24th, 31st, August 2d and 3d, also September 17th. Females much worn were taken August 2d and September 17th, indicating emergence respectively about August 12th to 15th, and September 5th to 10th. My dates, including both sexes, show a term of emergence lasting from thirty to about sixty days, according to the season.

"The food plant is not known, but it is probably not violet, or the butterfly would have been noticed in those parts of the lower slopes where the yellow violet grows; and there my collecting has been through the last two seasons.

"Examining my *Astarte* series, selected to illustrate the biological method of the species, I find a basis for the following statements: —

"Melanochroism does not occur.

"The figure-pattern is not differentiated for sex; marked uniformity obtains, especially among the males. The females are usually moderately larger than the males, and a little more variable in expanse of wing.

"Non-typical tendencies in figuration appear to be somewhat rigorously suppressed. The fixed lines of pattern are maintained with approximate precision, variation being restricted to narrow limits, so that throughout the series the figure pattern is extremely formal, definite, and uniform"

ARGYNNIS VII.

ARGYNNIS ALBERTA, 5–8

Argynnis Alberta, Edwards, Canadian Entomologist, Vol. XXII., p. 113. 1890.

Belongs to the *Chariclea* sub-group.

Male. — Expands 1.9 inch.

Upper side pale yellow-fulvous; the markings closely as in A. *Helena*, but reduced, pale black; the mesial stripes on both wings interrupted, macular; the extra-discal rounded spots on primaries minute, the sub-marginal crescents wanting, represented by small clusters of scales at the summits only, leaving a clear space to the margin, which is edged by an even stripe; on secondaries the rounded spots are larger, and so are the clusters of scales; the marginal border is extended on each nervule so as to encroach on and make narrow the clear space.

Under side of primaries pale red-brown, uniform throughout; the black markings obsolescent or altogether wanting. Secondaries brown, the extra-discal area paler, with an indefinite yellow-white stripe next above the rounded spots; the sub-marginal lunules yellow-white and confluent; across the disc a belt of same form as in *Chariclea* and *Helena*, pale yellow-brown, obscured in the median interspaces. (Figs. 5, 6.)

Female. — Same expanse.

Upper side brown, dusky, obscure, sometimes of a slaty hue rather than brown, and always with a peculiar smooth surface suggestive of grease imperfectly removed; the markings pale, diffuse; the mesial stripe on primaries has here become a broad band, and the clusters of scales are merged in a continuous stripe; on secondaries all the markings about the base and on the disc are obsolescent; the outer clusters of scales large and diffuse, and the margin is edged by a crenated band. Under side as in the male. (Figs. 7, 8.)

Egg. — Conoidal, much rounded at base, the top truncated and a little depressed; the breadth and height almost equal, broadest at about two fifths the distance from base, the sides much arched, after the middle narrowing upwards rapidly, the top rather less than half the breadth below; marked by about forty vertical ribs, thin, but slightly elevated, often straight, sometimes slightly sinuous, eight or ten of them ending at from one third to two thirds from base, there joining the long ribs; the ends at top do not form a serrated rim as in many species; between the ribs the rounded depressions are crossed by many low horizontal ridges; the micropyle is in the centre of a rosette of flattened five-sided cells, and beyond are three or four rows of irregularly five-sided large shallow cells to the rim; color when first laid, pale yellow. (Figs. *a*, a^2.) Duration of this stage ten days.

This species discovers a greater number of ribs than any which I have observed. *Freya* comes next, with 36; *Charielea*, 30 to 34; *Helena*, 32; while *Montinus* has but 25; *Frigga*, 20 to 22; *Bellona*, 21 or 22; *Triclaris*, 26; *Myrina*, 15 or 16.

Young Larva. — Length, .06 inch.

Cylindrical, of even size from 2 to 8, then tapering on both dorsum and side very gradually to 13; each segment well rounded; color yellow-brown, pale in line of the spiracles; marked by eight longitudinal rows of dark, flattened, tuberculous spots, three above and one below the spiracles on either side; the spots sub-triangular, or oval or rounded, in the upper rows bearing two small blackish tubercles, from each of which springs a long, tapering hair, thickened at the end; on the anterior segments these hairs are turned forward, on the middle are nearly upright, on the last are turned back; on dorsum of 2 is a long and broad oval spot corresponding with the four uppermost rows, with four hairs along the front and one behind and between each pair of these; the spot on this segment of the third row has two hairs, but the next two have three, and these three spots are a little below the line; on 2, also, in front of the spiracle, are two short hairs in vertical line; the spots below the spiracles are rounded, and, except that on 13, have four divergent hairs on each from 4 to 12, three on 3 and 4; along the base is a line of minute tubercles with very short hairs, on 2 and 13 two each, on the rest but one; under side pale yellow-brown; feet and legs color of body; head obovoid, bilobed, dark-brown, shining, with many short hairs. (Fig. *b*.) The larvæ went into lethargy at once from the egg, and died during the winter.

This species was discovered by Mr. Thomas E. Bean, who has kindly written for me an account of its habits and localities as follows: —

"Argynnis ALBERTA occurs on the mountains, near Laggan, with Colias *Nastes*, Chrysophanus *Snowi*, Argynnis *Astarte*, and the alpine Chionobas near *Subhyalina*, Curtis. In 1890, I took one pair on a mountain near Hector, B. C., two miles west of the Alberta Province line. On that mountain lives Chionobas *Brucei*, never yet observed at Laggan, only nine miles distant. *Alberta* frequents the upper slopes and slides of the mountains, at strictly alpine elevations; the females often being found higher on the inclines than the males. When suddenly disturbed, the female is liable to rise high and convey herself tumultuously half across a mountain. Habitually, however, and unvexed, her flight is deliberate, and she alights frequently. She has a certain dignity of manner which commands respect. An air of speculation marks her, denoting a mind preoccupied with problems. The male spends much of his time flying slowly and searchingly down the slides, so close to the ground that he almost seems gliding on the surface. He is less easily caught than the female, except when at flowers. Both male and female fly very low, and on alighting rest with wings spread flat on the ground, which is the approved mode among our local species of Argynnis and Parnassius. Even *Astarte* follows the prevailing fashion, but it is far more wary and alert than *Alberta*. Considering relatively these two species, the comparison is suggestive in view of their community of habitat and their respective relationship to other species in the genus. In habits of flight, and in topographical preferences, they are distinctly unlike. They differ greatly in regard to pictorial differentiation for sex. And it seems about a proved fact that one of these species is diverse from the other in important details of development, *Alberta* having a biennial imago, appearing in the even-digited years, while *Astarte* presents the imago yearly. According to my experience, *Alberta* is on the wing only in alternate years. I have searched its territory during six summers, 1888 to 1893 inclusive. In 1888 it was first found, and was met next in 1890, and then in 1892; but in the intermediate seasons, 1889, 1891, 1893, none were seen. I find no mention of any other butterfly conditioned by a similar lapse of the imago with the exception of Chionobas *Aëllo*. The species seems to be characterized by a twice-hibernating larva, and meanwhile conditioned in its secular progress by causes which restrict its cycles of development to one unvarying periodicity. This undeviating periodic mode results in 'off-years' for the imago. As an illustration: the females of 1888 will have laid their eggs and died, before winter. The young larvæ hibernating under the ample protection of the snow, the larvæ feed during the summer of 1889, and hibernate still another winter. In the summer of 1890 they mature, and in quick succession follow chrysalis and imago. Again, during a few brief days, *Alberta* flowers out in its dark beauty along the alpine escarpments, and passes the time of day with

the commonplace every-year butterflies, and hides away her eggs shrewdly here and there for the benefit of posterity. Thus is one cycle completed and another established.

"I am reluctant to assert the strictly biennial imago as a demonstrated fact, yet its probability is greatly supported by careful observations made in 1891 and 1893, as also by the fact that I had no difficulty in finding the butterfly in 1890 and 1892. According to this view, the species has a triennial cycle of development and is subject to an astonishing fixedness of habit, by force of which an archaic periodicity is steadily and exclusively maintained, resulting in restriction of the secular progress of the species to a single stream, and thereby limiting the imago to a biennial flight. Admitting an imago strictly biennial, the restrictive periodicity seems unavoidably implied. It is difficult to understand why, in a long series of considerably variant summers, *Alberta* should not have been able in some favoring season to steal a march on fate by maturing a few individuals earlier than the mass, thus capturing for the imago the barren years, and starting a supplementary stream of secular progress in cycles of development beginning and ending on the odd years, as 1891, 1893, etc.

"*Alberta* inhabits a very limited altitude range, and this is the only fact known to me which helps to explain why the species may have remained permanently subject to such limitations as have been suggested. Species which range from the larch groves at 6,800 feet to the mountain tops at 8,000 or 8,500 feet, as most of our alpine lepidoptera do upon occasion, could not permanently maintain such inflexible routine. Sooner or later the individuals maturing near the lower levels would deliver such a species from its disability. But *Alberta* has not this resource. Its ordinary range is between 7,400 and 7,900 feet, and it frequents most the steep slopes and slides at 7,500 feet and above, not flying far below its usual range, and manifesting no partiality for extreme altitudes. I have not noticed it below 7,200 feet, and seldom so low.

"Of the early stages the egg and first larval stage only are known. The food plant has not been ascertained; certain indications render it somewhat probable that this will prove to be Dryas octopetala.

"A series of *Alberta* consisting of thirty males and twenty-five females justifies the statement that while a majority of females are conspicuously melanochroic, and only an occasional individual is lacking that tendency, among the males, on the contrary, melanochroism is not found.

"Should further research result in certain proof that *Alberta* flies only in the even years, the fact will strengthen the probability that others of the alpine butterflies likewise develop in three-year cycles. These species, however, owing to more mobile customs of growth, advance the secular progress in two periodic

lines, the sequence of one line of advance being alternate to that of the other. Such a species would traverse the centuries in two processions, one having a year the start of the other, so that a cycle of development in the one procession completes its course a year in advance of the correspondent cycle in the other. But the wayfaring children of *Alberta* apparently all travel in one caravan."

Mr. Bean sent me ten eggs of *Alberta*, laid on Dryas octopetala in confinement, July 20 and 21, 1890. There were some other plants in the can, he wrote, on which a few eggs were laid, but nearly all were on the leaves and stems of the plant first mentioned. The eggs hatched on 30th and 31st July, or after ten days. The larvæ at once went into hibernation, and died in course of the winter. Mr. Bean told me that the larvæ with him were lost in the same way.

CHIONOBAS VIII.

CHIONOBAS SUBHYALINA, 1–5.

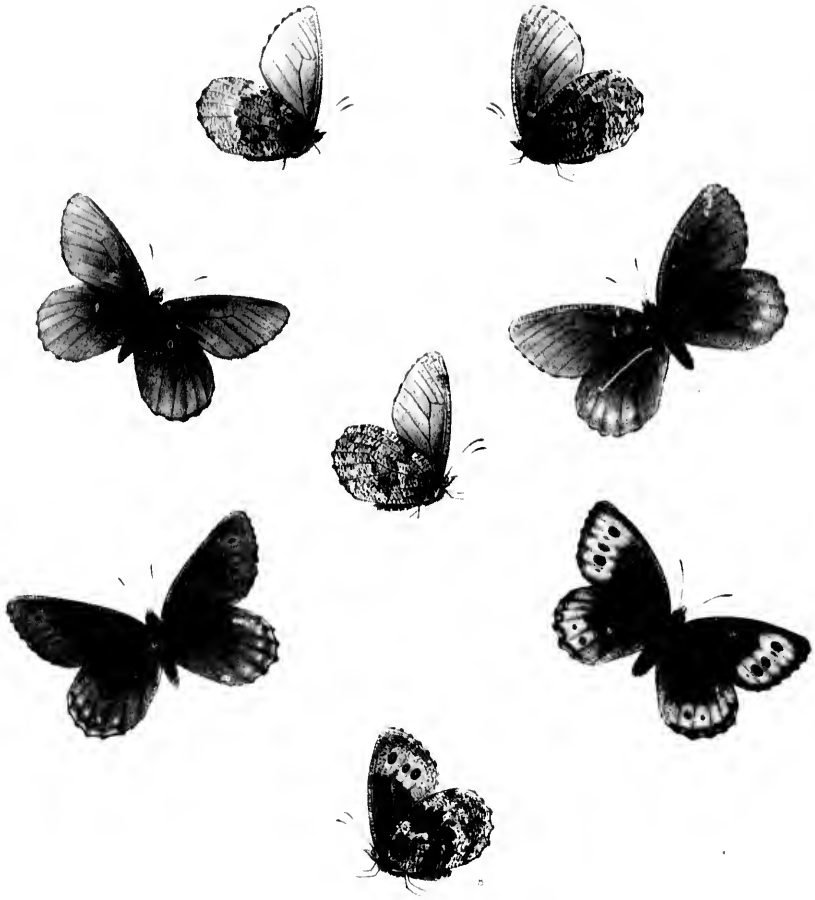
Chionobas Subhyalina, Curtis, in Appendix to Ross's Narrative N. W. Passage, p. 68. 1835; Edwards, Canadian Entomologist, Vol. XXV., p. 137. 1893; *Beanii*, Elwes, Trans. Ent. Soc. Lond., p. 476. 1893.

Male. — Expands from 2 to 2.1 inches.

Shape of C. *Brucei* and C. *Uhleri*, and fully as transparent as the former; primaries narrow, produced apically and pointed, the hind margin sloping inward more than in *Semidea* or *Œno*. Upper side pale gray-black; primaries sometimes have a faint sexual stripe, oftener no trace of it; one example under view shows two light sub-apical points, transverse, pupils of incomplete ocelli; costal edge whitish, freckled next base with black; fringes of both wings yellowish white, dusky at the ends of the nervules.

Under side of primaries paler, the costal and apex gray-white, or yellowish white, streaked and mottled with brown; in some examples the rest of the wing is free from markings (as shown in Fig. 1); but in others the extra-discal area and the costal half of the cell are covered with transverse, abbreviated streaks of brown, more or less distinct (as shown in Fig. 4).

Secondaries vary much, some showing a distinct though faint mesial band (Fig. 2), others almost none at all (Fig. 3), with intermediate grades; sometimes there is no more than a suggestion of the band in cloudy patches on either margin; where the band is complete, the edges are darkened and definite, the outer one crenated from the elbow on upper branch of median to costa, and wavy or crose from elbow to inner margin; on the inner edge there is a prominent projection on the sub-costal nervure, either angular or rounded, followed by a nearly rectangular sinus in the cell; the whole wing is covered with whitish or luteous scales, intermingled with which are brown ones more or less grouped into fine, abbreviated streaks, especially over the basal area and along the inner margin; sometimes there is a narrow space of nearly clear white just outside the band; on the edge of hind margin a pale dot in the middle of each interspace, and often



SUBHYALINA 1 ♂ 2 ♂ 3 ♂ 4 5 ♀

NORNA 6 ♂ 7 8 ♀

an obscure series of diffused yellow-white patches halfway between the band and margin. (Fig. 3.)

Body black; the femora black; tarsi brown, with red spines; palpi black; antennæ pale black above, ringed beneath with cretaceous; club black. (Figs. 1, 2, 3.)

Female. — Expands from 2 to 2.2 inches.

All the wings broader than in the male, the apex of primaries more rounded, the inward slope of hind margin less and the arch of same margin greater. Upper side as in the male; the yellowish patches on disk of secondaries beneath reappear above, obscure, diffused, in some examples; under side of primaries as in the male, but the brown streaks are more conspicuous and more extended; in one of three examples under view there is a straight, extra-discal row of four small, oblong, whitish spots in the discoidal and median interspaces, and a corresponding row of four whitish spots on secondaries, which are more distinct, irregular, and unequal; in all three the band is faint, and on the inner side is more or less lost in the dark hue of the basal area. (Figs. 4, 5.)

The description by Curtis is as follows: —

"*Subhyalina.* Wings semi-transparent, fuscous, costa freckled with black and white, two small black spots towards the apex with white pupils, most distinct on the under side.

"Expansion one inch, eleven lines.

"*Male* black, antennæ ochreous, the club elongated; wings semi-transparent, pale fuscous, nervures ochreous, costa black, freckled with white; two indistinct white dots towards the apex with blackish ocelli, cilia whitish, spotted with black; *under side* of superior wings similar to the upper, but the ocellated spots are distinct, and the surface, excepting the disk, is mottled with ochre and pale black, lightest at the apex; inferior wings spotted and mottled with black and dirty white, forming a waved and curved pale line beyond the middle, with three or four whitish dots beyond it.

"A single male was preserved, and probably was taken with the last species (H. *Rossii*), of which, at first sight, I thought it had been only an old and faded specimen, but on examination it proved to be in good condition."

This description was published in 1835, and the insect was taken in 1830. It remained in the collection of Mr. Curtis, and after his death, together with his other Arctic specimens of butterflies and moths, was purchased by Mr. Henry Doubleday, and presented by him to his friend M. Guénée. After the death of M. Guénée, his entire entomological collection passed to Mr. Charles Oberthur. Mr. Elwes claims to have had before him the original *Subhyalina*, the type, loaned

him by Mr. Oberthur, and from this single example determines *Subhyalina* to be synonymous with two species which are quite distinct from each other, namely, C. *Crambis* and C. *Œno*, besides *Assimilis*, which he speaks of as a species, though as I have hereinbefore shown, it is but an unbanded form of *Œno*. Now, I refuse to believe that the insect in M. Oberthur's collection is the type insect of Curtis, and in proof thereof offer in evidence Curtis's name and description. He described a nearly transparent insect, using the strongest word the language affords to express that peculiarity in selecting the name "hyaline," which means crystalline, like glass, transparent. "Subhyaline" means almost transparent, and the wings of the insect should permit the label on the pin to be distinctly seen through them, as is the case with C. *Brucei*. He says it is black, and to express the shade of black, uses the word "fuscous," — "pale fuscous." This word is applied both to blackish brown and to gray-black; but his use of the word "black," unqualified, in the beginning of the description, fixes the color he intended to signify. He also says that it had an old (which implies worn) and faded appearance, but that nevertheless, "on examination, it proved to be in good condition;" that is, the normal appearance of the insect was as one old, or worn, and faded. Now *Crambis* is a red-brown (the red decided), and the wings are semi-opaque. It is not hyaline in the least degree, but exactly the reverse. *Œno*, with *Assimilis*, is not transparent at all, but a little translucent. Transparent and translucent mean very different states. As to color, *Œno* is a livid brown, or a yellow-brown, individuals varying. It is not black of any shade, and therefore not fuscous, as Curtis uses that term. Boisduval, in describing *Œno* in the Icones, says it is of a "gris-brunâtre-livide mêlé de jaunâtre." The plates of *Œno* in Part 14, and of *Crambis* in Part 13, show the coloration of these widely different species. They are both so antagonistic to the description of Curtis that the claim that one or both are his species really does not deserve serious consideration. When an alleged type does not agree with the description, and especially if it is antagonistic, reliance is to be placed on the description alone. That is the rule in entomology. It is manifest that the type of Curtis, during the fifty years since it left the Curtis collection, must have been destroyed, and the label has been attached to another insect, near, or pretty near, the original, so far as the owner of the collection could remember. M. Guénée was not a student of butterflies, but of moths, — the Heterocera in general. Mr. Curtis may not have labeled this type insect, or Doubleday may have done it, and incorrectly. M. Guénée may have lost the insect, and then attached the label to another, as near to it as he could remember. Whatever it was, in passing through four hands in the years since 1835, the type *Subhyalina* must have been lost or destroyed. Type specimens were not valued half a century ago as

they are to-day. Insects in cabinets have a hundred enemies, and the chances are largely against the survival of any particular specimen for so long a time. Museum pests, mould, careless handling, or other accident, do their work. Loss of types in entomological collections is a frequent occurrence, and loud complaints have come from the Museum of the treatment which such collections as the Linnæan, and that of Stephens, have been subjected to in this particular. Three years after the Stephens collection came to the Museum, Mr. J. F. Dawson, Ent. Ann., 1858, wrote: "Suppose the Stephens collection, instead of coming to us direct from the hands of its compiler and owner three years ago, had become antiquated, like the Linnæan; or *suppose the question of the types to be discussed some sixty or seventy years hence*, with no more definite knowledge to assist the inquirer than the Stephensian types and the Stephensian descriptions would supply, might it not be argued *that the types*, in the instances under discussion, *must be ignored*, as they never were intended to represent the true Loppa pulicaria, Steph., *because they are antagonistic to the descriptions?*" Mr. McLachlan, Trans. Ent. Soc. Lond., 1871, p. 443, says: "Before the Linnæan collection was placed in its present quarters, it was so maltreated by additions, destructions, *and misplacement of labels*, as to render it a matter of regret that it exists at all. Any evidence it now furnishes is only trustworthy when confirmed by the descriptions."

Mr. Elwes, having found the label of Curtis attached to an example of either *Crambis*, or *Œno*, or *Assimilis*, proceeded to rename the Laggan species, to which I had recently applied the name *Subhyalina*, Curtis, as *Beanii*. The description of Curtis applies well to this Laggan form. It is remarkably transparent, it is pale fuscous, and it has the peculiar old and faded appearance called for, to a greater degree than any other member of the genus as yet known to live on this continent. In the lesser details given by Curtis, the description fits well. And I hold that this form is the real *Subhyalina* of Curtis.

The locality or date of capture of *Subhyalina* by the Ross Expedition is not given, nor is the locality of H. *Rossii*, though the capture of the latter is set down as having occurred on 18th and 20th July, 1830, and 14th July, 1831. Apparently these butterflies were taken at about long. 75° and lat. 70°, in the region named Boothia Felix by Captain Ross. From that day to a recent date nothing more was heard of *Subhyalina*. We owe its rediscovery to Mr. Thomas E. Bean, at Laggan, Alberta, Canada, and he has kindly furnished me notes as follows: —

"*Subhyalina* is known in this district as occurring on one alpine summit, at Hector, B. C., two miles west of the Alberta line, and on two such summits near Laggan; one of these in the central range, three miles south of the Bow River,

the other on an isolated mountain, three miles north of the river. The relative position of these ascertained localities, the constancy of the occurrence of the butterfly, year by year, and the degree of its abundance are sufficient indications that it is of general occurrence on the alpine summits of Bow Valley. Its observed range of altitude extends from 7,300 feet, for occasional stragglers (timber line, at Laggan, being 7,000 feet), to 8,500 feet,[1] the latter height regardless of the food plant, as the males habitually frequent rock-wastes at the points and ridges of the peaks. The females seldom reach such localities, but chiefly inhabit sedgy slopes in a belt of altitude between 7,500 and 7,800 feet. The larva is not known beyond the first stage. The butterfly appears chiefly during the last half of July; the earliest captives being on July 7th (in 1888, an early season), both sexes. In 1892, a late season, five males were taken August 4th." Mr. Bean wrote me February 18th, 1891: "I can say now, that my lot (of *Subhyalina*) are all one form, differing chiefly in degree of definition of the band beneath the hind wing." Mr. Bean was satisfied, in 1889, that "this mountain-top Chionobas," as he calls it in letter of 20th April, was neither *Semidea* nor any of the allied eastern species, and says: "It is a subhyaline edition of *Jutta*, of a primitive pattern, totally devoid of fulvous areas or fulvous suffusion; the entire under side of secondaries marbled gray and black, the central dark band obscure in most, but defined in a few. I could not obtain fertile eggs of it last summer, though I made great efforts. It is a big task to go after these mountain insects; the labor is something tremendous. The right method would be to go up into the mountain for a time and live there. In that way something might be accomplished worth the effort; a thorough mountain-top campaign would be the thing." Shortly after, Mr. Bean became satisfied that this species was the *Subhyalina* of Curtis and as such sent it abroad.

[1] 8,500 feet at Laggan is equivalent to 12,500 feet in Colorado, at which C. *Œno* flies. Both *Subhyalina* and *Œno* are summit species, inhabiting the loftiest peaks in their districts.

CHIONOBAS VIII.

CHIONOBAS NORNA, 6–8.

Chionobas Norna, Thunberg, Diss. Ent. Nov. Ins. Suec., Part II., p. 36, pl. 5, fig. 11. 1791; Esper, Eur. Schmett., pl. 108, fig. 4. Boisduval, Icones, p. 185, pl. 36, figs. 4–6. 1832; Edwards. Can. Ent., Vol. XVIII., p. 16. 1886.

MALE (from Finland). — Expands 2.2 inches.

Upper side dusky brown, somewhat translucent; on primaries a blackish sexual dash; two small black, blind ocelli, each with a pale, restricted nimbus, in the upper discoidal and second median interspaces, and in each of the two intervening interspaces a pale patch; on secondaries a series of yellowish diffused patches corresponding to the definite spots of under surface; fringes of both wings luteous, dusky at the ends of the nervules.

Under side of primaries paler; the costal edge sprinkled with gray and black, the hind margin and apex mottled gray, and on costa above the ocellus a gray patch; the ocelli repeated, and pupilled white. Secondaries brown, mottled with gray-white along the basal edge of the band, and from the band to base along the costal margin, also for a narrow space outside the band, and again along the hind margin; the rest of the extra-discal area brown on a gray ground; the series of spots is sordid white, except the one in second median interspace, which is pure white; the band dark brown, scarcely at all dusted gray, narrow next costal margin and for two interspaces, then abruptly expands on the outer side to nearly twice the first width, and so continues to inner margin; the outer edge in its general course is arched, with rounded crenations in the interspaces; the inner edge has a small prominence on the cell next sub-costal followed by a rounded sinus on median, thence wavy to the margin. (Fig. 6.) Out of several examples of this species from Finland and Lapland, sent me for examination by Dr. Holland, I find the Finland males come nearest the Alaska females in my collection, and thinking it probable that males of this type will hereafter be taken at Nushagak I have given the figure on the Plate.

FEMALE (from Alaska). — Expands 2.2 inches.

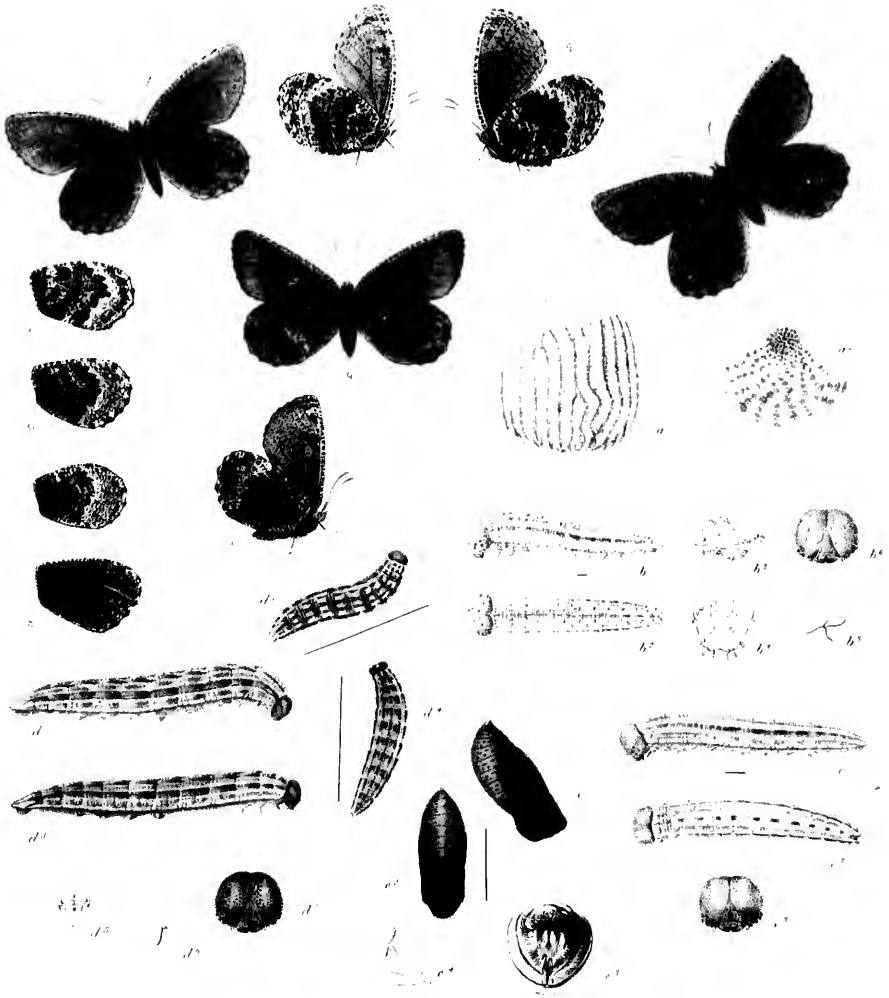
Upper side dusky brown, with a common extra-discal broad yellowish band; on this, on primaries, are three black, white pupilled ocelli, and two minute black spots, one in the lower discoidal, the other in the sub-median interspace; on secondaries a small pupilled ocellus in the lower median interspace, and a second, smaller but still pupilled, in the interspace preceding; fringes yellow-white, dusky at the ends of the nervules.

Under side of primaries much streaked with dark brown, even upon the yellow band; the three ocelli repeated. Secondaries mottled with pale black and gray-white, darker next base; the extra-discal spots yellowish; the mesial band black a little dusted with yellow-white, in general as described in the male, but the outer edge is serrate, followed by an incision on lower discoidal interspace, then crenated to the margin; the basal side as in the male. (Figs. 7, 8.)

In 1885, I received three females of *Norna* from Nushagak, one of which was sent to Dr. Staudinger, as mentioned in my paper in the Canadian Entomologist; the other two remain in my collection, or rather form part of that of Dr. Holland, as all of this collection has passed over to him. These are the only examples of the species known to me to have been taken on this continent. In Europe, *Norna* flies in Scandinavia; Boisduval says, in the high mountains. Mr. Elwes says, "It is found all over Scandinavia, as far south as Jemtland, where I have taken it in open marshy forests;" and speaks of it as having been taken in Siberia, in the Altai Mountains, Revision of Œneis, p. 469, 1893. I find nothing recorded of its habits of flight, or respecting its early stages.

CHIONOBAS.

LX.



SEMIDEA. 1 2 ♂ 3 4 ♀; 5 ♂ 6 ♂; VAR. NIGRA. 8 ♂ (WHITE MTS)

7 ♂ (PIKE'S PEAK); VAR. 9 10 ♀ (HUDSON STRAIT)

a a' Eggs *b* Larva young *b'* pupated *c* Larva 1st moult *c'* pupated *d* 4th " mature *e* Chrysalis

CHIONOBAS IX.

CHIONOBAS SEMIDEA, 1–10.

Chionobas (Hipparchia) *Semidea*, Say, American Entomology, Vol. III., pl. 50. 1828; Harris, Ins., 3d edition, p. 304, fig. 126. 1862; Chionobas *Semidea*, Scudder, Boston Jl. Nat. Hist., Vol. VII., p. 621, pl. 14. 1863; id., Proc. Ent. Soc. Phil., Vol. V., p. 20. 1865; French, Butt. East. U. S., p. 294, fig. 72. 1886; Œneis *Semidea*, Scudder, Butt. N. E., Vol. I., p. 124, pl. 1, fig. 9. 1889.

Male. — Expands from 1.8 to 2 inches.

Wings slightly translucent; upper side brown-black, with a tint of ochraceous; costal edge of primaries yellow-white transversely streaked and specked with black; in the upper discoidal interspace is often a minute blind black ocellus; the hind wings immaculate, save that in some examples there appear sub-marginal elongated dusky patches, suggestive of a stripe; fringes brown, darker at the tips of the nervules.

Under side of primaries paler, often a gray-brown; the apical area and upper half of the hind margin gray, flecked with black; sometimes the dark shade is in rather large patches, and the surface is mottled; some examples show a dark stripe running obliquely back from costa, beyond the cell, ending at the upper branch of median; often there is a dark stripe across the cell near the arc, and the cell is more or less streaked transversely; the ocellus, if present above, is repeated, and has a central white point.

Hind wings, in most cases, much covered with brown-black, but in others the gray prevails, except within the mesial band; in the darker examples the area next base is nearly black, shading outwardly into a belt less black, and along the band becoming clear gray, or nearly clear; outside the band about half the area to margin is, first, pure gray for a narrow space, then gray lightly streaked with black, and beyond much streaked and specked, with patches next the margin suggestive of a stripe; in others there is scarcely any gray on the basal area, and there is very little difference in color between the base and disk, while towards the margin the dark shades prevail; the mesial band is broad, bent exteriorly at about 60° on the upper branch of median (Fig. 2), from which point

to costa the edge is irregularly serrated; occasionally at the bend a sharp and much prolonged serration is present (Fig. 5); towards the inner margin the general course is concave, with two broad crenations in the interspaces; not unfrequently, however, there is no angle, but this outline is a curve from margin to margin, either nearly even and slightly erose, or crenated throughout; on its inner edge the band throws an angular projection on the sub-costal nervure, or just below it, in the cell, followed by a sinus of about 45° on median, thence a straight course to margin.

Body above brown-black, beneath black; legs dark brown; palpi black; antennæ fuscous above, red-brown beneath, sometimes cretaceous, and most so next base; club red-brown. (Figs. 1, 2, 5, 6, 7.)

Female. — Expands from 1.8 to 2 inches.

Wings a little broader than in the male, the apex of primaries more rounded, and the inward slope of the hind margin less; on the apical area are often two black dots with more or less of a pale nebula; under side as in the male, the band varying in same manner. (Figs. 3, 4.)

Var. Nigra. — Under side of secondaries deep black, the mesial band nearly or quite lost; a little specked with gray over the outer limb. (Fig. 8, ♂.) In New Hampshire this variation is not rare in both sexes.

Egg. — Shaped nearly as in C. *Brucei* and C. *Crambis*, but broader in proportion to the height, the sides less arched; sub-conic, the base flattened and rounded, broadest at about one fourth the distance from base to top, narrowing upwards slightly till the upper fourth is reached; marked by from twenty-four to twenty-eight vertical ribs, some straight, some sinuous or abruptly bent, some broken, and so not reaching from end to end; these ribs are narrow, rounded at the summit, the sides rounded and not spread at the base, as in the two species before named (the ribs are much like cotton threads laid on the face of the egg), separated by a wider space than in *Brucei* or *Crambis*, which space is flattened and crossed by numerous horizontal slightly raised striæ (this feature resembles C. *Uhleri*); the top flattened, the micropyle in the centre of a rosette of five-sided cells, outside of which are three or four rows of larger similar cells of irregular sizes; beyond these to the ends of the ribs the area is occupied by shallow rounded excavations, small, the outer ones largest, arranged in almost confluent and nearly regular strings, which are separated by comparatively broad spaces; these excavations are very much more numerous than in *Crambis* or any

other of the species which are subject to this style of ornamentation; color sordid gray-white. (Figs. *a*, a^2.)

The egg, as appears, differs in several respects from any of the species of the same sub-group, so far as has been observed. The egg of C. *Œno*, the species most closely allied to *Semidea*, I have not seen.

Young Larva. — Length .08 inch; shape of *Brucei;* segments 2 to 4 nearly equal, arched dorsally, then tapering regularly on dorsum and sides to 11, and more rapidly to 13, which ends in two slight projections, rounded, between which is a shallow depression (these are less prominent than in *Brucei*, and in that species the sinus is angular); the tubercles dark brown, their club-shaped processes white, translucent, and the same in number, position, and shape as in *Brucei* and *Jutta* (shorter than in *Uhleri*); color pale whitish green, the basal ridge same; a dorsal stripe of red-brown, not clearly defined and diffuse; also a sub-dorsal line of same hue; the lateral band pale black; feet and legs whitish, translucent; head broader than 2, broadest below, sub-globose, depressed at the suture; the surface covered with shallow indentations; a few tubercles and processes like those on the body (disposed as in the genus); color yellow-green with a tint of brown. (Figs. *b* to b^6.) Duration of this stage, at Coalburgh, W. Va., about eighteen days.

After first moult: length, at twenty hours from the moult, .14 inch; nearly the same shape as before, and like *Brucei;* the projections at extremity very short, coming to a blunt point, the space between rounded; surface thickly covered with fine conical tubercles, each bearing a short cylindrical process; color pale green, the whole dorsal area specked, or streaked longitudinally, with vinous red; the mid-dorsal greenish stripe is edged on either side by a buff line: a dusky patch on the front of each segment within this stripe; the lateral band pale red, darker along the upper edge; under it a buff line, and, next, the pale green, red-specked, spiracular band; basal ridge yellowish, and below another red stripe; under side, feet and legs whitish green; head scarcely different from the previous stage, pale yellow-green with a brownish tint; the six vertical stripes now appear, and as in the genus. (Figs. *c* to c^3.)

After second moult: length, at about twenty hours, .21 inch; nearly the same shape as before, same tubercles and processes; color reddish buff; the mid-dorsal stripe light buff; at the junction of each pair of segments a pale black spot lying about half on each segment, at each end deeply incised (making double V-shaped spots); the dorsal area is divided into two equal bands, the upper one reddish, the other light buff; the lateral band has both edges black, the interior

pale black on a red ground; the spiracular band reddish buff; basal ridge yellowish, and under it a red stripe; head as before. (Not figured.)

The third moult was not observed, nor was the fourth.

Adult Larva (after fourth moult). — Length, at rest, .93 inch; stout, thick in middle, tapering rapidly from 5 to head, and also posteriorly; ending in a pair of blunt, sub-triangular projections which meet at a rounded right angle at base; surface thickly covered with small, sharp, conical tubercles, of irregular sizes, each bearing a slender, tapering, nearly straight hair or process (much as in *Chryxus*, shorter than in *Jutta*, different from *Brucei*, in which the process is cylindrical); color variable, some examples being dusky green, others red-brown; the mid-dorsal and sub-dorsal stripes black, interrupted, the former giving either oblong and rectangular spots, or oblong and deeply incised at either end; the sub-dorsal is narrower, rather a series of oblique dashes, each cleft or forked posteriorly; a green example under view had the rear half of each segment of a paler color, making a complete series of cross bands, reaching to the base, most definite on dorsum, the fronts of the segments dusky; outside the sub-dorsal line the band is gray-green, immaculate; the lateral band is dusky, the rear of each segment paler, as lying within the cross bands; in this band is a black dash to the front on the upper edges of the segments; the spiracular band gray-green, immaculate, the spiracles brown or black; under side, feet and legs dusky green; head small, not so broad as 2, broadest below, sub-globose, flattened somewhat frontally, the surface covered with shallow indentations, between which are many fine tubercles with their short, straight hairs or processes; color dark brown; across the top six vertical stripes, as in the genus, blackish. (Figs. *d*, d^2.)

The other larva under view was red-brown, the cross bands pale; the lateral band edged on either side by a thin black line, the front half of each segment dusky, inclining to black along the upper angle; the spiracular band and the ridge dark brown on the fronts, pale dusky green on the rears; under side, feet and legs brown-green; head reddish brown, the stripes reddish. (Figs. d^3, d^4 to d^7.)

Mr. Scudder, Butt. N. E., p. 138, describes the larva as pale yellowish green, tinged with faint reddish brown at the apical half of each segment; on the sides also considerably tinged with reddish brown; the spiracular band grass-green, with a flush of roseate; the under surface pale grass-green. It is evident that the adult larvæ of this species differ in coloration and markings more than any others of the genus so far observed.

CHRYSALIS. — Length .53 inch; cylindrical, stout, the ventral outline moderately arched from end to end, the dorsal considerably arched from the thoracic depression posteriorly; head case truncated (as much as in *Chryxus*, somewhat more than in *Brucei*), dome-shaped at top; mesonotum without carina, rounded every way; the depression rather shallow; abdomen sub-conical, obese; wing cases somewhat elevated, beveled down to the abdomen on the margin; the cremaster consists of a projecting blunt bifid ridge, corrugated on under side, the anal orifice well defined, as are also the two outer lobes which represent the anal projections of the larva; naked, furnished with neither hooks nor bristles; color dead-leaf brown, the anterior parts darker, including the upper parts of the wing cases, mesonotum, and head case; on the anterior part of each abdominal segment a cross row of black dots, and on the posterior a row of black dashes. (Figs. *e* to e^1.) Duration of this stage, in an instance mentioned by Mr. Scudder, seventeen days. The figures were made by Mrs. Peart from a dead chrysalis furnished by Mr. Scudder, and were colored after his directions.

To Mr. Scudder we owe the larger part of the knowledge thus far gained of *Semidea*, and in the Butterflies of New England, he has treated of its geographical distribution, habits, and life-history, so far as observed in the White Mountains of New Hampshire. He says: "*Semidea* was first discovered about half a century ago, and described by Say from specimens sent him by Dr. Pickering and Mr. Nuttall, of Boston. Very few specimens seem to have been taken since that time, until 1859, when I made my first considerable collections in the White Mountains. Ascending the highest peak, on July 8th, for the express purpose of finding this butterfly, I secured my first specimen at about a mile from the summit, near the then footpath from the Glen. On ascending they became more abundant, and over forty were taken, and a friend even captured seven in his hands. Less than a week afterwards fifty-nine were taken.

"The butterfly is found most abundantly about one quarter to three quarters of a mile from the summit of Mt. Washington, or at an elevation of from about 5,000 to 6,200 feet above the sea. It often alights on the flowers of Silene acaulis, Linn., as well as upon some of the Ericaceæ, particularly on a species of Vaccinium, and is also fond of the flowers of Arenaria Grœnlandica; but the best collecting places are the sedgy plateaus of the northeastern and southern sides of the mountain.

"I have made several experiments in obtaining eggs, but only twice successfully. In the first place, a single egg was obtained lying on the ground; in the last, twenty, by imprisoning females in a lace bag over a pot of growing sedge on the very summit of the mountain. No eggs were laid upon the sedge itself,

but three or four on dead roots and sticks; most were laid on the netting, and a couple on the wire that supported it. It seems probable that the eggs are laid in nature near the base of the clumps of sedge which stud the plateau thickly. With all my watching, I have never been able to detect the females in the act of laying, but one often starts them up from deep down in the sedge.

"I have repeatedly taken the caterpillar feeding upon Carex vulgaris.

"In the east, *Semidea* is entirely confined to the White Mountains of New Hampshire."

Of the flight of this species, the author says: "One would suppose that insects whose home is almost always swept by the fiercest blasts would be provided with powerful wings, fitting them for strong and sustained flight; but the contrary is true. They can offer no resistance to the winds, and if they ascend more than their accustomed two or three feet above the surface of the ground, or pass the shelter of some projecting ledge of rocks, they are whirled headlong to immense distances until they can again hug the earth; their flight is rather sluggish and heavy; they are easily captured, though they fly singly, never congregating, and have their devices to escape pursuit. One is, when alarmed, or indeed at most times, they fly up and down the slopes, rarely along them, rendering pursuit particularly difficult. Another is, they will rise in the air to get caught by the wind, which often takes them out of sight in a moment. One will settle on the ground at a little distance from a crevice in the rock-piles, and as you cautiously approach you will see it edge away afoot, in its spasmodic fashion, to the brink of the crevice and settle itself; then if you come nearer, it will start as if to fly away, but close its wings instead and fairly drop down the crevice where you may see it but not reach it; to repeat the process, and get farther down, if again alarmed by the removal of the upper rocks. It rests on the ground, or on the leeward side of rocks, as I have often found it on a cloudy day, when it had not been upon the wing. As soon as one alights, it tumbles on one side with a sudden fall, but not quite to the surface, exposing the under side of the wings with their marbled markings next the gray rock mottled with brown and yellow lichens, so that an ordinary passer-by would look at them without observing their presence. It is an obvious case of protective resemblance. . . . If at rest for the night, or the wind be sweeping fiercely, the costal edges of all the wings are brought together. In walking, it moves by a series of spasmodic starts."

Mr. Scudder is of the opinion that the species is single-brooded. "It usually begins to appear on Mt. Washington the first week in July, becomes abundant before the middle of the month, and continues till about the second week in August. . . . They apparently lay most of their eggs during the last week of

July. Caterpillars have been found by several persons nearly full grown between 20th July and 2d August; and others, certainly full grown, on August 19th, and in September. These must have been born the previous year, as the eggs do not hatch before the first of August. And as all living chrysalids that have been found have been taken in the earlier part of the season, between June 10th and July, it would appear as if two years must be required for the full cycle of changes, and that the winter is passed in two conditions, both larval, one just hatched, or in a very early stage, the other full grown, or nearly so, a whole season being required for the development of the larva alone." But while the author believes the biennial cycle to be the rule, he thinks there are exceptions every year, some larvæ hatched early attaining full growth the same season, and changing to pupæ early the next year, and giving butterflies in July.

With regard to the mode of pupation: the late Mr. G. F. Sanborn, after a search of several hours among the surface stones and pieces of rock, found two living pupæ, and nine others that were either infested by parasites, or the empty shells of the previous year; "they were all found imbedded between the sides of the rock and the long, dense, crisp moss surrounding it, between half an inch and an inch and a half below the general surface where the caterpillar had entered. They were not attached to the rock or the moss, but lay in horizontal oval cells evidently formed by the movements of the caterpillar before pupation; the most particular examination revealed no trace of any web or silken thread even as a lining of the cell." Mr. Scudder has himself found pupæ beneath or beside surface stones, and Mr. C. P. Whitney has discovered larvæ ready for pupation in similar localities. Farther experience leads the author to feel "sure that the places chosen by the larvæ for pupation are exactly those chosen by it for daily concealment, the under side of surface stones which rest upon another stone, — a level, damp, cool, protected spot; here the caterpillar rests upon the lower surface with the roof grazing its back; and, pushing away whatever may interfere with the smoothness of the spot, changes to chrysalis without farther ado. I have but once found a cell which was anywhere near complete . . . when the (upper) stone was removed. The caterpillar was lying on its back when found, May 31st, and changed to chrysalis, June 2d, in the valley below." This, so far as I know, is all the information attainable as to the pupation, for no one seems to have been able to rear the larva from egg to pupa, or even to the adult stage; and in cases known to me where larvæ in the last stage have been found, and thereafter fed in captivity, all have died at the time when pupation appeared to be near.

In Psyche, Vol. V., page 129, 1891, Mr. Scudder gives later observations:

"Before noon, on July 17th, the morning being fair, I caged half a dozen *Semidea* females, on a pot of growing sedge, in an open south window, in the hotel at the summit of Mt. Washington. The afternoon and all the next day, the mountain was enveloped in clouds, and no eggs were laid before July 20th, when, by eight o'clock, a single one was seen. During that day and the next about eight or nine were laid. . . . Half a dozen more females were placed in the cage on the afternoon of the 21st," and next day cage and contents were taken to Cambridge, Mass., with the result of finding twenty-six eggs; several others were laid, up to 25th July.

The same month, 1891, Mr. A. P. Morse, of Wellesley, Mass., mailed to me, at Coalburgh, a dozen examples of both sexes of *Semidea* alive, of which seven were females. They had been turned loose into a small pasteboard box, and were four days *en route*, arriving on 14th July. Several were dead, some were nearly so, but two were active and flew out of the box as I opened it. These I put within a net over blue grass (Poa pratensis), and fed with sugared apple to which a little water was added. The next day I found seven eggs, all dropped on the ground. The last female died on 16th; that is, she had lived six days after capture.

On 31st July, 1892, Mr. Morse again sent living examples of same species from Mt. Washington, all females. But only one reached me alive. As soon as I offered her the sugared fruit she unrolled her proboscis and began to feed. But I allowed her three minutes only, and afterwards gave more food at intervals, because the insects cared for the previous year had gorged themselves, and some had died in consequence. This female lived with me six days, or to the tenth after capture, and laid fifteen eggs.

Again, in 1892, on July 13th, I received from Mr. Scudder two living females, remainder of five mailed from Mt. Washington on 10th; and next day sixteen alive, part of a lot of twenty-five mailed the 11th. Some of these lived till the 15th and 16th, and they laid in all thirty-five eggs, some on the way to me, others on the nets or the grass or ground. It had been supposed previous to these experiments and observations of Mr. Scudder and others that *Semidea* could not live at an altitude much lower than its place of habitat on the White Mountains.

The only other district within the United States in which *Semidea* has as yet been found is in Colorado, where it has occasionally been seen in two or three localities. Mr. David Bruce writes: "I can say very little indeed about *Semidea* in Colorado. I never met with it but once, at Marshall Pass, in the central part of the State. They were scarce, and the day was windy. The late William S. Foster had taken a few examples at the same locality, in 1888, and from his

examples which I arranged after his death, that fall, I first noticed the difference between this species and what we now call C. *Œno*, from Bullion Mountain. Mr. Oslar took his *Semidea* at Pike's Peak, in 1892, and I saw the difference between those and *Œno* at once, and sent you the three examples he gave me. Certainly I have never found *Semidea* in company with *Brucei* or *Œno*, on Mts. Bullion, Hayden, Gibson, and the Whale. I saw, in 1893, *Œno*, which had been taken by Professor Gillette on Long Peak; but there were no *Semidea* in his collection. All these peaks are on the eastern side of the Rockies; no one seems to have explored the mountains to the westward."

Mr. Ernest J. Oslar wrote me, in answer to inquiries: "It was during my descent of Pike's Peak, 1892, on the morning of July 8th, that on approaching Windy Gap, which is about 2,000 feet from the top, and on the west side of the mountain, above timber, I first beheld a C. *Semidea* dart up suddenly a few yards ahead of me, and after a swift and undulating flight fall suddenly to the rocks. Others were started, and I had to employ the utmost caution and patience to capture any of them, so wary were they, — alarmed at the slightest movement. They always flew up the mountain when surprised. After a laborious tramp up and down the slope for two hours, I was rewarded by having captured ten fine specimens, all of which proved to be males." One of these is shown on the Plate, figure 7. All the three sent me are small, size of the smallest examples from New Hampshire.

Prof. Edward J. Owen also encountered *Semidea* on Pike's Peak, in 1892. He says: "My specimens, I should say, were taken at about one thousand feet above the Half Way House (on the stage road, not the Half-way-House on the railroad). At the place of capture I was somewhat above timber (hardly above the so-called 'timber-line,' the elevation of which is 11,000 feet there), but on a rocky ridge with no timber very near."

It is apparent from the observations so far made that *Semidea* in Colorado lives at a considerably lower level than *Œno*, its nearest ally, and does not associate with it. The wariness of the species and its swiftness of flight, as reported by Mr. Oslar, is quite different from the habit on Mt. Washington, N. H. On this subject Mr. Scudder writes me: "To maintain life on an isolated peak, as on an oceanic island, insects must be either strong-winged or very weak-winged. The furious blasts which blow about Mt. Washington are far more intense than any I ever experienced in Colorado, and if *Semidea* had been inclined to battle with the wind and become in time stronger winged for the exercise, I do not believe it could have survived to this day. It would have been blown off the mountain. But it has become weak-winged through desuetude, and that has been its salvation. It makes no contest with the wind, but when caught by it

drops as soon as may be to the ground. The species lives in Colorado at an elevation several thousand feet higher, and the thin winds of that height it can contend against, and so maintain a combat which strengthens it even in defeat."

Semidea has been believed to inhabit Labrador, by which name is to be understood the Atlantic side of the peninsula only, and many collections in the United States and Canada contain examples so labeled, which were received from the late H. B. Möschler. He was in correspondence with missionaries at stations along the coast, and for years received invoices of Labradorian butterflies. I have two so labeled, but they certainly are *Œno*. A specimen called *Semidea* in my Report on the Lepidoptera of the Howgate Expedition of 1879, and taken in the Gulf of Cumberland, is also *Œno*.

On the other hand, I received among the collections made for the Smithsonian by Mr. Turner, some years ago, at Fort Chimo, Hudson Strait, and which lies in the district of Ungava by my maps, a female which seems to me to be true *Semidea*, approaching variety *Nigra*, and which is shown by figures 9, 10. It is russet to a greater degree than any example I have seen from other districts. We know so little of the butterflies of all the northern part of the continent that it is not safe to say that this species may not only be Labradorian, but an inhabitant of other and widely separated localities.

I have repeatedly received eggs of *Semidea*, and, as before related, have had eggs laid at Coalburgh. The period of the egg has varied between ten and fifteen days; Mr. Scudder says nine to fourteen. In 1891, out of sixty eggs received from Mr. Scudder and Mr. Lyman, came eighteen larvæ, and most of them fed on blue grass the day they hatched. But four did not feed at all, and presently disappeared, probably to hibernate in the ground. One passed its first moult at eighteen days from the egg, another at nineteen, and one of these the second moult at fourteen days from the first. I sent this one to Mrs. Peart for its portrait, and received it again, 22d September, still active and feeding. But after a few days it went into lethargy. The other larva fell into that state after the first moult. Unfortunately both died during the winter. Some of the eggs had been sent Mr. Fletcher, and he got one larva past first moult and then into hibernation. This also died in the winter. All my other larvæ had died or disappeared in their first stage.

In 1892 came fully two hundred eggs from Mr. Scudder; but not one of the larvæ from them reached the first moult. The weather was very warm at the time, and I attributed the loss to that cause. But Mr. Fletcher had a single larva from same lot of eggs reach the first moult, when it hibernated. It was found ...e alive in April, 1893, but had not vitality enough to enable it to feed.

On 25th July, 1891, I had from Mr. Scudder an adult larva found by him on Mt. Washington under a stone, and which is shown on the Plate by figures d^3, d^4. This was at once sent to Mrs. Peart, who wrote soon after: "It is very restless, but sometimes is caught eating, then again will remain quiet for a long time, in a little cave it has made in the moss." On 21st August: "The larva does not eat now, and has crowded between the wire of the cage and a stone; has not moved for several days. At no time has it made use of the stones that are piled on the earth to conceal itself, but of late has lain mostly on the bare ground." On 27th August it died, and with no evident reason; it had not changed color for pupation, and looked healthy.

On 15th July, 1892, I received a larva not long past its fourth moult, and which measured .6 inch at rest. It had been found by Mr. Gardiner Hubbard, son of my distinguished friend, feeding on sedge, at high noon. This was of the green variety, said by Mr. S. H. Scudder to be rare, and, indeed, unobserved by him before. It made the usual journey to the artist, and came back 8th August, full grown, upwards of .9 inch long at rest, and to all appearance healthy. It was obese, and the colors soon began to fade, as is usual with butterfly larvæ on the approach of pupation. I felt sure that the change would take place soon, probably within a few days. But it remained in about the same condition for two weeks, lying exposed on the sod, when, on 22d, it suddenly died. I think this larva at its home might have pupated in August, and that the pupa would probably have hibernated.

Such experience as I have had seems to show that the larvæ of *Semidea* hibernate direct from the egg, or during the first stage, or after both first and second moults; also when adult; and the pupa may probably hibernate. I have seen all the larval stages except the fourth, or the one following the third moult, and so far as I know that has not been observed.

Mr. Scudder mentions a large ichneumon-fly, I. instabilis, Cresson, as having come out of a wintering chrysalis; and a Pteromalus, P. Chionobæ, Howard, as having come from a chrysalis late in the summer. Mr. Shelley W. Denton reports that *Semidea* butterflies, on Mt. Washington, are subject to the attack of a black long-legged spider, Pardosa albomaculata, Emerton. He says: "I have seen this spider run after a butterfly which was being blown close along the ground, and after pouncing upon it, begin to suck the juice from the body. I tied a dead butterfly with a string, and placing it near a spider, drew it along for some yards, the spider following and evidently intent on getting a dinner. Doubtless these spiders destroy many larvæ also, for one sees them scrambling among the rocks, searching with a purpose that means mischief."

EXPLANATION OF THE PLATE.

SEMIDEA, 1, 2 ♂, 3, 4 ♀, from White Mountains, N. H.; 6, 7 ♂, same locality, showing variation in the shape of the hand; 5 ♂ from Pike's Peak, Colorado; 9, 10 ♀, from Hudson Strait; 8 var. NIGRA ♂, White Mountains, N. H.

a EGG; a^2 micropyle.

b, b^2 YOUNG LARVA; b^3, b^4 last segments: b^5 process on body; b^6 head.

c, c^2 Larva at 1st moult; c^3 head.

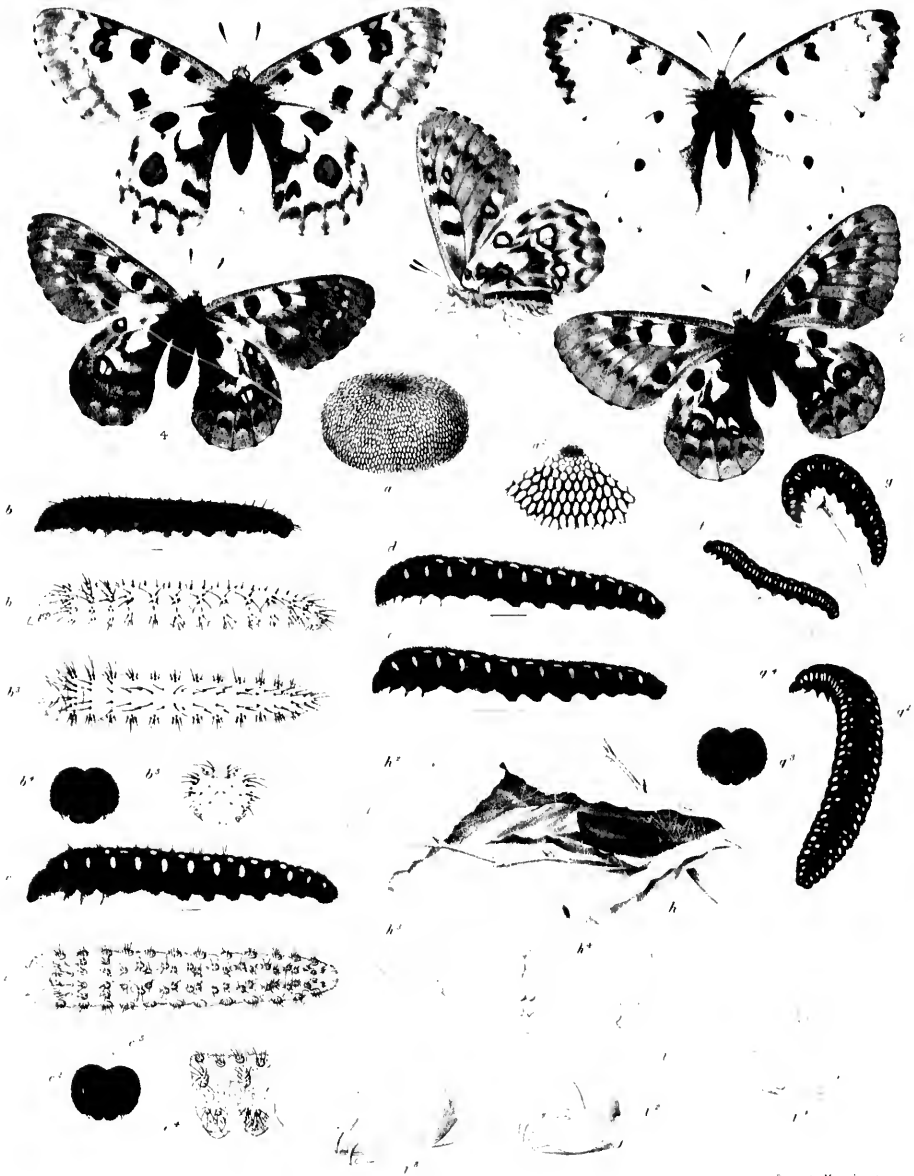
d^2 ADULT LARVA, green variety, a little enlarged; *d* greatly enlarged.

d^4 Same, red variety, a little enlarged; d^3 greatly enlarged; d^6 last segment; d^5 process on body; d^7 head.

e, e^2 CHRYSALIS, enlarged; e^3 front view of end of last segment and cremaster; e^4 side view of same.

PARNASSIUS.

I.



Drawn by Mary Beaut

SMINTHEUS — HERMODUR 1 ♂ 2 3 ♀ 4 ♀ VAR SMINTHEUS. 5 ♀.

a—a² Egg **SMINTHEUS**. *magnified* *f* Larva 4th *moult* *g* adult *nat size*
b—b² Larva *young* *g¹ g²* *magnified*
c—e *1st to 3rd moults* *h—h²* Chrysalis *i i²* Perplast

PARNASSIUS I.

PARNASSIUS SMINTHEUS, 5; VAR. HERMODUR, 1–4.

Parnassius Smintheus, Doubleday and Hewitson; W. H. Edwards, Butt. N. A., Vol. I., pl. 5–7, p. 21. 1872; id., Papilio, Vol. III., p. 136. 1883; id., Canadian Entomologist, Vol. XVII., p. 61. 1885.
VAR. HERMODUR, Henry Edwards, Papilio, I., p. 4. 1881.

DESCRIPTION of the early stages of SMINTHEUS.

EGG. — Echinoid-shaped, broad and low, the sides much curved, the top a little depressed, the base flattened; the upper surface completely incrusted with close elongated granulations (like seeds or grains), imperfectly hexagonal; in some cases there appears to be a little hole at each angle of the grain through the incrustation (as shown in Konopicky's figure of the egg, in Volume I.), but most often this feature is wanting; in the depression the grains diminish in five or six rows concentric about the micropyle, which is in the centre of a flattened rosette of five-sided cells; color ivory-white, a little stained green, most so on the top. (Figs. *a*, *a*^{2}.) Duration of this stage irregular, some eggs giving larvæ the same season, others in the following spring.

YOUNG LARVA. — Length .08 inch; sub-cylindrical, broadest at base, tapering very gradually on both dorsum and side from 3 or 4 to 13, the last segment narrowing rapidly and ending roundly; color black, covered with long black hairs (in Figure *b*, it was necessary to make these light, to show them against the dark surface); on the dorsum are four rows of these hairs, two on either side the mid-dorsal line, each springing from a little tubercle; on 2 to 4 they are arranged in cross-rows, on the middle of the segments, and on 2 they are equidistant from each other, but on 3 and 4 there is a wider space between the second and third than elsewhere; also on 2 is another cross-row of four, near the front, each tubercle of each pair placed a little to the outer side of the corresponding tubercle of the hinder row; segments 4 to 13 have the hairs arranged differently, those of the two inner rows falling on the anterior part of each segment, while

those of the two outside rows are at the extreme rear; the hairs on the anterior segments are curved and turned forward, those of 2 falling over the head; from 5 to 10 they are nearly erect, on the last segments are turned back; high on the side is a row of large flattened and rounded, sub-oval, tuberculous spots from 2 to 12, and partly outlined on the front of 13, from each of which spring four divergent hairs, from separated tubercles set almost in rectangle; on 2 to 4 is a demi-row of three hairs, small, short, in triangle, and in line with the spiracles, and this row is represented on the front of 13 by a single hair; along the base, from 2 to 13, are two hairs to each segment, their tubercles close together, the hinder one of the two always a little above the other; just over the feet and legs, and from 2 to 13, are two short, fine hairs to each; under side and legs greenish brown, the feet black; head obovoid, long, broader than high, depressed at the suture, the vertices rounded; color black, the surface rough; on each lobe eight short black hairs, two across next the vertices; six in cross line with the apex of the frontal triangle; six across the middle of the triangle, and one on each side near base; over the mandibles a fringe of six hairs. The larva from the first is able to project a lumpy brown-yellow mass from its osmaterium, but this does not bifurcate into tentacles till the next stage. (Figs. *b* to b^5.) Duration of this stage in May, at Coalburgh, five days.

After first moult: length, at twenty-four hours, .18 inch; shape very nearly as at first stage, rather more cylindrical, the elevation anteriorly somewhat greater, and the dorsal slope more decided; color black, the base and under surface greenish brown; the processes much as before, but instead of single tubercles over dorsum, there are now four corresponding rows of small, glossy black, flattened tuberculations, each from 3 bearing four short divergent hairs, separated at their bases; on 2 are two rows each, corresponding to the minute tubercles on same segment at first stage, each bearing a single hair; the upper lateral tuberculations as before but larger, and decidedly oval, and they bear from six to eight hairs each; there is now an infra-stigmatal row of same nature, small, one to each of 2, 3, 4, with fine hairs, from 5 two to each, smaller, nearly touching, the hinder one always higher than the other, and these bear four hairs; except on 13, on which is but a single hair, from a reduced tubercle; the hairs vary in length on each tubercle over the body; there are also many short black hairs between the tuberculations, as shown on c^4; from 2 to 13 inclusive, in line with the upper lateral tuberculations, is a chrome-yellow oval or rounded spot, on the rear of each segment, and above, in line with the sub-dorsal row of tuberculations, is to each a small and paler yellow oval, head nearly as before, broader in proportion to the height, the hairs much more numerous. At this

stage the tentacles are forked, but are short. (Figs. *c* to *c*^{5}.) Duration of this stage, in May, at Coalburgh, five days.

After second moult: length, at twenty-four hours, .28 inch; same shape as at the second stage; color black, the under side chocolate-brown; the same flattened tuberculations as before, but the hairs from these are shorter, and scarcely longer than the hairs which cover the body, and which are more numerous than before; the sub-dorsal light spots are oval, the long axis running with the length of the body, the lateral row as before, yellow, but sometimes pure white; head as before, the hairs more abundant. (Fig. *d*.) Duration of this stage, in June, four days.

After third moult: length, at twenty-four hours, .4 inch; scarcely differs in color and markings from the last previous stage. (Fig. *e*.) The duration of the stage I am unable to give, as all the larvæ in my charge died before fourth moult. In the next stage I was dependent on larvæ sent from Colorado and Montana.

After fourth moult (some days): length .56 inch; shape and color as before; the tuberculations have disappeared, and the whole surface is covered with short, stiff black hairs of uniform length.

Mature Larva. — Length .9 to 1.1 inch; nearly cylindrical, a little flattened, slender, of even size, or very nearly, from 1 to 11; color black-brown, the under side and legs chocolate-brown, feet black; surface thickly covered with short, stiff black hairs; marked by two rows of chrome-yellow, sometimes white, spots, on either side, one sub-dorsal, one lateral; the number of spots of each row varies; sometimes there are two from 4 to 11 or 12, in the sub-dorsal row, one on the middle of the segment, a smaller one on the rear; but sometimes, as seen in *g*, there is only one spot; the lateral row has three spots from 3 to 12, two on 2, four on 13, but sometimes there is but one on 2, and two on the others; the tentacles on 2 are short, tapering, truncated, light yellow; head obovoid, broader than high, deeply depressed at the suture, the vertices rounded; color black; surface rough, and bearing many short hairs. (Fig. *f*, natural size, from Colorado; Figs. *g*, *g*^{a}, enlarged, from Montana, and belonging to the var. *Hermodur*.)

Chrysalis. — Length, .6 inch; breadth at mesonotum .22, at abdomen .26 inch; cylindrical, the ventral outline moderately arched, the dorsal largely; head case short, narrow, rounded both ways; mesonotum not very prominent, dome-shaped, with no carina; the depression slight; a short pyramidal projection at

base of wing; the wing cases but slightly raised; abdomen conical, tumid; at the end bluntly rounded; cremaster without hooks or bristles; "almost completely aborted, being reduced to a broad semicircular tumescence involving the pupal rectum, and to two small tubercles, corresponding to the anal legs of the larva, directed forward and a little outward, situated at the divergent extremities of two short and low ridges forming together a V opening forward" (Scudder); whole surface, except the smooth wing cases, finely granulated; color yellow-brown with a tint of green. (Figs. *h* to *h*^{1}.) When about to pupate, the larva draws a leaf or leaves together by a few threads, making a pseudo-cocoon; but, as will hereinafter appear, Mr. Albert Koebele found a pupa on the ground, beneath a bit of wood, and with no appearance of threads or web. The length of this stage I am unable to give.

Mr. Henry Edwards described var. HERMODUR thus: "♀; the whole upper surface of the primaries is of a smoky-black hue, slightly transparent, the usual bands being lost in the ground color of the wing. The present insect expands only 2.3 inch. Southern Colorado." I have had in my possession this type female. It is nothing like so melanic as the examples now figured, and is smaller than most of the females received from Montana. In the Judith Mountains this black form is common, and grades into the smoky-black hue of the type. In the darkest examples there is no yellow whatever on primaries, and very little on secondaries, being limited to a narrow irregular discal band or stripe on the basal side of the red spots. But others have more or less yellow in the cell of primaries, and over most of secondaries. Between the extremes there is every degree of variation. The red spots are in excess, both as to number and intensity of color, but in some the spots are yellow, as in var. *Behrii*. The greater number of the females are large, expanding from 2.8 to 3.2 inches (Fig. 5). Fig. 2, of Plate II. of Parnassius, in Volume I., represents well the lighter examples of the female from Judith Mountains, and comes near the type of *Hermodur*. I gave it the name *Sayii*, and *Hermodur* would seem to be a melanic *Sayii*. However, I am very willing to accept the name given by Mr. Henry Edwards, and to extend his definition so as to cover all the black examples of the species. In most Montana examples the red is more solid and deeper colored than in the typical *Sayii*.

The males from Mt. Judith are usually large, expanding three inches, but I find no point in the color or markings in which they differ from the males of *Smintheus*, in Colorado. Several of both sexes observed were indistinguishable from a pair of P. *Intermedius*, sent me by Dr. Standinger as Ménétriés' *Intermedius*, from Siberia. These are not at all melanic, and the marginal borders are transparent. I have a female of this form which was taken on Mt. Bradley, California, by Mr. James Behrens.

Probably dark *Hermodur* will be found in certain localities in Colorado, and I formerly received a single example from New Mexico that was nearly as black as any from Montana, and on which the red spots were large and intense. But in size it was very small. Mr. Mead had noticed, in 1871, that occasionally, at high elevations in Colorado, the females were melanized and small, while at low elevations they were white and large.

I have seen great numbers of the Montana *Smintheus* from Mt. Judith, by the kindness of Mr. Wm. M. Courtis, M. E., and of Mr. W. G. Wright, both of whom collected at Maiden. The climate there is severe. Mr. Courtis wrote, 1883, that snow fell during every month of the year. "The season is very short. I think all the butterflies come at one time, like the flowers. Spring and fall flowers are only a week or two apart. The Parnassians come about 1st July, and now, 28th July, have almost entirely disappeared." Mr. Wright says, 20th June, 1890: "I have been here nearly a week, and have had very bad weather; rain every afternoon or night, the days more or less cloudy; no bottom land; high [illegible] sometimes rocky, sometimes smooth and grassy; some pine clad; all about as steep as rock and soil will be, say 35° to 45°." Owing, probably, to these conditions, the larvæ and pupæ being subject to cold and wet in greater degree than in the main Rocky Mountain range, the Judith females have become melanic, and the habits of the butterflies have come to differ somewhat from *Smintheus* proper. How far to the north *Smintheus* flies is unknown, but Mr. Bean takes it at Laggan, Alberta. All the examples I have seen from that locality are white and small.

Efforts were made for several years by different observers to discover the food-plant of *Smintheus*. Mr. Courtis wrote, 4th July: "A few days ago I took a walk and saw hundreds of the Parnassians, and caught ten or twelve, all males except one. To-day I went out and took nearly fifty, and have several pairs tied up under netting, with sedum. One pair have mated in the net." On July 8th: "I went out this morning, and took twenty or more pairs, and watched the females. They seem to fly to the ground, and either lay their eggs on the ground or [illegible] roots. I could not find eggs, though I saw them drop. I have a large number of females now tied up. Some which were let loose, after refusing to lay in confinement, laid at once on the grass and anywhere. The species is common, by hundreds on every hillside." In one letter Mr. Courtis sent me 140 eggs, and wrote: "Most of these came from females that mated after I caught them. I think they lay at the roots of plants, as they always drop to the ground, then climb the stalk and fly away. Those in confinement climbed sticks, and the window frames, laying eggs as they went, putting one on everything they touched, *except the sedum*. I made one lay on this by

keeping her moving, but she seemed very much excited. As soon as I put her on grass and sticks she laid every few moments." Again: "I noticed a female alight on sedum, drop to the ground, and climb up. She certainly laid an egg, though I could not find it."

Mr. Wright was at Maiden nearly three weeks. He says: "One cannot go far without seeing pairs in copulation, during the short season of pairing and on the limited areas on which the newly emerged imagos appear. Copulation takes place immediately on the emergence of the females, often while the wings are still limp. . . . Afterwards the males fly away, and are seen far beyond the breeding grounds, but the females remain there. Most of the females I take start up at my feet, and till the eggs are laid the female rarely flies. But the males are continually on the wing, hovering low to c[illegible] the female in hiding, or as she suns herself on a bare spot of ground. It is impossible to discover them when hidden, even though one may know with[illegible] few inches where they are. When a female is started by the male she flies straight and rapidly, and suddenly drops into the grass. Apparently this action is for the purpose of misleading or eluding the male. In life, especially at pairing time, both sexes have a strong odor that, on taking them from the net, I often found very disagreeable. I have seen the females lay eggs on grass, wild rose, blackberry, and one of the Compositæ, but never on sedum."

As related in Volume I., Mr. Mead had observed *Smintheus*, in 1871, and obtained eggs on sedum. He says: "Yesterday, Mr. B. brought me a female with an egg adhering to the ovipositor, and said that it had deposited several eggs on 'a tuft of grass.' On further inquiry he was not sure what the 'grass' might be, and I conjectured it might be sedum. . . . Accordingly, on searching, I found two empty eggshells on the plant, apparently punctured by some insect." Five days later: "The Parnassians lay freely. I have about one hundred eggs, laid indiscriminately on the box, or the cloth covering it, within which I had inclosed a female with the sedum. Very few were on the plant itself." On 21st August: "I opened an egg to-day and found a half-developed larva inside, apparently in a natural state." Six days later: "To-day I dissected an egg carefully and found a completely formed caterpillar." Some of these eggs were discovered, on the 10th January following, to have hatched, but when was unknown. All were dead.

Mr. Bruce wrote, 9th June, 1886: "I think the food-plant is neither sedum nor saxifrage, but Castelleia integra, a singular red-blooming plant. The butterflies seem attracted to the plant, and are always present where it occurs." On June 25th: "I have watched the females lay their eggs and find that they also lay on Artemisia, but the Castelleia is the favorite. I dug up several of these last

to send you, and on the first I touched were two eggs." On July 22d: "I have several times seen the females laying eggs on Castelleia, but I watched lots of them yesterday, and they laid on everything they happened to be on, even dry grass and stones. Sedum carpeted the rocks, and Castelleia was plentiful, and no doubt if the larvæ feed on either plant they would soon find their own. I saw a female with limp wings climb a dry stem of Castelleia, and I searched for the pupa skin, but could not find it." On 21st September: "During the last week I have in vain searched for larvæ of *Smintheus*. I believe they must partly feed up in the fall, for the snow is hardly off the ground in the spring before the insects are flying."

The late Mr. W. S. Foster, at Salida, Colorado, wrote me, 17th July, 1888: "I was at Marshall Pass, elevation 11,000 feet, on 15th, and saw a female *Smintheus* alight in a clump of grass, crawl down to the middle of it, and lay an egg on a stem. There was no sedum in this clump, though S. stenopetalum grew close by. Probably the female lays her eggs anywhere, and leaves the larvæ to find their food-plant."

Up to this time, no one had seen either larva or pupa of *Smintheus*, but July 11, 1889, Mr. Bruce wrote: "I send you to-day five larvæ. The Sedum stenopetalum is really the food-plant, and I have seen the larvæ eat nothing else. They bury themselves in the earth at night, and wriggle out early in the morning, as soon as the sun warms the ground; then eat voraciously for three or four hours, and bask for the rest of the day on a stone, or leaf, or on the ground. I am sorry to say that most, if not all, the larvæ sent are probably ichneumonized. I found thirteen larvæ, but a rat, or some other of the numberless vermin that infest the mining shanties, got the net off, and carried away or ate half of them. One larva had commenced a cocoon of leaves on the bottom of the tin, and unfortunately I disturbed it. I can find larvæ easily now that I know their habits. They do not touch Saxifrage aizoides, though that is abundant. I sat down several times and watched the larvæ eating the sedum, so there can be no mistake about that food-plant. The full-grown larvæ hide in the earth like cutworms. I have seen them partially buried several times, and have found them by pulling up sedum. The soil on the slopes is fine and friable, easily bored into by a larva. On disturbing one of them, it will sometimes curl up and remain quiet; but at other times they will run very fast and hide in the grass, and bury themselves quickly. I cannot say that they go deep into the ground, but far enough for concealment."

From Hall Valley, altitude 11,000 feet, 3d July, 1890: "Tuesday was a fine morning, so I walked up Gibson Gulch to my cabin on Bullion Mountain. About noon, a hailstorm came up, changing to a furious snowstorm which lasted all the

afternoon. I got to the cabin about five o'clock, cold, wet, and hungry. The next day opened cold but bright, and after the sun rose, the snow soon disappeared. I went out, and in a little time found four larvæ, which I send you." On 15th July: "I found a *Smintheus* larva basking on a rock, near sedum. It has now spun a slight web in the box, and is preparing to pupate. I would not trust these larvæ in anything that has so much as a pinhole in it, for they will somehow contrive to squeeze out. I found one nearly through a piece of wire gauze, it having elongated itself like a leech. I laid on the grassy slope and watched the butterflies retiring for the night. *Smintheus* would drop lightly on the grass with wings fully extended, and there lie a long time, the legs not being used at all. As daylight faded, they gradually closed their wings and slipped down into the grass. On the other hand, the Argynnids and Melitæas hung on the under side of leaves and flowers, sometimes in clusters of twenty or more." On 20th July: "*Smintheus* was flying on Bullion to-day literally by thousands, but very few were females. It is a singular characteristic of this species that one never sees two of them flirting or chasing each other, as other butterflies do. A Colias or Pieris will chase or circle round a *Smintheus*, but the latter gets away as fast as possible, and seems not to have the idea of playing. In Colorado, *Smintheus* is abundant for three months, and I have seldom found them in copulation. This I understand is different from the experience of observers in Montana, and perhaps the rougher and colder climate there shortens their lives, and they are compelled to propagate as quickly as possible. But early in June I have taken several pairs in copula, at Palmer Lake (south of Denver), and earlier than elsewhere. The species occurs there in immense numbers, and I have caught two hundred examples in a very short time. These first comers are large and white, nothing melanic about them. The conditions at that lake are favorable to an early development and a protracted seasonal life of the species; a long, deep, and fertile valley, very high and well-timbered mountains on the west side, the peaks attaining the highest altitude; on the east, rough undulating hills, with strangely formed sandstone ridges; plenty of vegetation everywhere, sedum often completely carpeting great areas of ground. The snow lies late in places, but in the valley proper it is sheltered and quite warm. *Smintheus* is here on the wing fully four months, from last of May to last of September. I have no doubt these late individuals come from the higher levels. There are gullies and gulches that butterflies will enter, and, never turning back, will keep right down the mountain till an open tract is reached. Here flowers abound, and butterflies of many species, as well as other insects, swarm."

On 22d July: "I send you this day several larvæ, the result of a hard day's work. I went to the very top of Mt. Hayden, one of the highest of the Front

range, 14,000 feet, and as I had hoped, I found insects and vegetation two weeks behind the lower region. All these larvæ were on sedum. I watched them eating it several times. One adult I found on a rock near sedum."

From Denver: "I have two females *Smintheus* confined, and they are very amusing creatures. They are in a large tin with a clump of blooming sedum, a yellow saxifrage, and some roots of grass, and stand on the sill of the open window — of course inclosed in a net. They will now and then crawl round the net and deposit an egg on it; they sun themselves on the sedum, sucking at the blossoms. I have watered the plants with a fine rose, and the instant the insects feel the spray, they hurry-skurry and squeeze down among the plants so that they cannot be seen at all, their habit doubtless during the frequent mountain storms." From Hall Valley, 27th September, 1890: "All is brown and desolate; sharp frosts at night and bright yet cold days have burned the vegetation; except in sheltered nooks not a butterfly is to be seen. I embraced the chance of a ride through the timber with a jack train that was hauling to the mines, and went up the Gibson. All I saw were two Colias *Scudderii*, half a dozen Colias *Meadii*, rather more Argynnis *Eurynome*, and about a dozen *Smintheus*. Of these last I saw but one female, and she was pouchless, and apparently not long out of pupa. The males were also fresh and very handsome. I think these late fresh examples come from eggs laid where the snow does not melt till July, and there are thousands of acres through the mountains in this condition. Did you know the males can use their claspers as a defensive weapon? It is so indeed. I had, on one occasion, filled the cyanide bottle with insects, at Gibson, and sitting down to lunch at my favorite spring, just above timber, I pinned my captures, turning out what were worthless. Among them was a male *Smintheus*, just taken. I saw that the omnipresent ants at once found the dead insects and tried to lug them off. (In Colorado, ants are the pest everywhere, on the prairies, the mountain-top, and in the crowded street; they will catch live butterflies right before one's eyes, and when the net incloses them.) The *Smintheus* was recovering from the effect of the poison, and I saw it struggling with an ant. Presently it turned its abdomen under, opened the claspers, seized the ant by the middle, compelling it to let go its hold, and then flew away with it."

Mr. Reakirt, in Proc. Ent. Soc., Phil., 1866, had said of *Smintheus*: "Mr. Ridings captured this fine species in July, solely within the mountain districts, usually when settled upon the flowers of some tree, and always near the edge of a water-course. It is abundant, but of difficult capture, not only from the natural obstacles interposed, but from its very quick and high flight, this commonly ranging from four to eight yards above the head." On this Mr. Bruce says: "As applied to *Smintheus*, nothing can be more erroneous. But

I think the account was intended for Limenitis *Weidemeyerii*, which it suits very well."

Mr. Albert Koebele, 1890, found *Smintheus* in east Washington, and wrote: "At Easton, I got fresh females as well as males. They came out from about 12 M. to 3 P. M. It was interesting to see the males swarming, often thirty or forty at a time, and each in search of a mate. This is all they do. Seldom have I seen any feeding except worn ones. The females look like a different species on the wing, flying much faster. If engaged in ovipositing, they run very fast over the ground and through various plants, to find a suitable place in which to leave their eggs. I never saw one lay on sedum, but always on some other plant, or on wood, chips, etc. Old and partially dried moss is a favorite place; so is almost any plant that is growing amidst sedum, as pentstemon or bunches of grass. Yet I cannot say that they do not lay on sedum also."

These extracts from letters written on the spot from day to day by expert observers give one an idea of the time and labor required to attain a tolerably complete history of the life and habits of some of our butterflies. It has taken twenty years to bring the history of *Smintheus* from nil to its present condition, and much still remains to be learned. It is clear that the eggs are laid anywhere, and on anything, but in the neighborhood of sedum, so far the only known food-plant of the larva. Most of the eggs hibernate, and do not hatch till the snow leaves them, but part are hatched the first season, and the larvæ are more or less advanced before cold weather sets in.

On 13th July, 1883, I received 140 eggs of *Smintheus-Hermodur* from Mr. Courtis, at Maiden, and they were kept in a cool place through the rest of the year, but not subjected to any degree of cold that would retard their hatching. They began to hatch the last day of January, 1884. I put some of the larvæ on the species of sedum common here, ternatum, and two days later found that the leaves had been nibbled a little. On 12th one larva passed its first moult, and by 16th three others had passed the same. But scores of the larvæ refused to eat, and died. On pressing one in the first stage with the side of a pin on dorsum, it would protrude its scent-organ, a mere shapeless lump, pale yellow-brown. But after first moult tentacles have appeared, two stout stubby prongs, green-yellow with a tint of brown. On 27th February the oldest larva passed the second moult, but soon after died. No other reached that moult.

June 13, 1886, twenty eggs, laid on Castelleia integra in confinement, were received from Colorado. In August, none having hatched, these were sent to New York to go in a refrigerating house. They came back, 21st March, some just hatching, but the larvæ refused to eat and died. On 3d April, 1890, a lot of eggs

and newly hatched larvæ came back from New York. The larvæ were placed on Sedum stenopetalum (from Colorado). On 4th two were observed feeding. They bored round holes the size of their heads in the thickest part of the fleshy leaf, and ate out the substance of the leaf, leaving an empty shell, as the larvæ of species of Lycæna and Thecla do. Later I saw others eating at the edges of the leaves without burrowing. One of the lot reached third moult, and died; the others had fallen by the way.

July 6, 1890, Mr. Wright, at Maiden, sent eggs of *Hermodur*. I left them in my room, where they were exposed to much hot weather, and in October discovered that most had hatched. Many were dead, but a few were not, and evidently just out. As soon as sedum was given these they began to feed. By 14th October half a dozen seemed very near the first moult, and a day or two later tried to pass it, but died with their skins half shed, not having vitality enough to get through.

July 25, 1889, I received ten advanced larvæ and three pupæ from Mr. Bruce. The pupæ had formed en route. I put the larvæ on S. ternatum, and three small-leaved species of sedum which I had bought from a florist. All these were attacked and the larvæ fed ravenously. They were surprisingly active on their legs, running like Arctian larvæ. Most of this lot were parasitized, a grub of a large Tachina fly coming from them. Of one sent Mrs. Peart, she wrote later: "The larva is lying on the bottom of the glass, drawn up, not curved much. I see a few threads fastened to a stick near it, and about the stems of the sedum are others, making a slight inclosure. Another larva pupated on a bit of cloth. There is some silk spread about on the cloth, and a few threads draw the edges together, forming a sort of cradle."

With the eggs received July, 1890, from Mr. Wright, came two mature larvæ of what would have produced *Hermodur*, somewhat larger than any I had seen from Colorado. They are figured, enlarged, g, g^2, so as to show distinctly the yellow spots, and as will be seen these vary in number in the two larvæ. Neither of them pupated.

Mr. Koebele wrote, July, 1890, that he had found a *Smintheus* pupa, at Spokane Falls, under a piece of wood, on the ground, with no web about it.

On 13th July, 1893, I received a larva past third moult from Mr. Arthur J. Snyder, and taken by him at Park City, Utah.

As appears, I have found it impossible to rear the larva from the egg, at Coalburgh. One reached the third moult, a very few the second, more the first. Probably a thousand larvæ have hatched, and fully ninety-five per cent. have died in the first stage, generally soon after leaving the egg, refusing food. But as larvæ after both third and fourth moult have been sent me, I have been able to see

every stage, and Mrs. Peart has made drawings of them all. Most of the larvæ have hatched in winter and early spring, but some in the fall of the year in which the eggs were laid, and this supports Mr. Bruce's opinion that some larvæ in natural conditions feed in the fall, and give the earliest spring butterflies.

Smintheus flies from the eastern side of the Rockies through Colorado, Wyoming, and Montana, as far to the west as eastern California and eastern Washington, its territory overlapping that of P. *Clodius*. I hope some day to be able to give a Plate showing all the stages of *Clodius*. Some of these I have the requisite drawings of now. The egg is quite distinct in shape and incrustation from that of *Smintheus*, low, broad quite at the base, and sloping up to the narrow and depressed summit. Mr. Scudder has suggested as descriptive of this form the word "spatangoid," from *spatangus*, a genus of sea-urchins; the egg of *Smintheus* being called "echinoid," from *echinus*, another genus of same family. Instead of being covered by a mosaic of separate grains, as in *Smintheus*, this egg has a smooth crust, much indented. The young larva differs in ornamentation from *Smintheus*.

How the keel or pouch seen in the females of different species of Parnassius is formed, and what purpose it serves, has been a matter of conjecture. In Volume I., I gave all the information then obtainable. In 1886, Mr. Elwes published a paper in Proceedings of the Zoölogical Society, "On the Butterflies of the Genus Parnassius," in which some new observations, mostly by Mr. Arthur Thomson, on the making and character of the pouch were related. Mr. Thomson had several imagos of P. *Apollo* emerge from pupæ at the Zoölogical Gardens. He says that he put the insects in a large gauze cage as soon as they were ready after emerging, and copulation between several of them immediately took place; that the first pair were in connection three and one quarter hours; the second three and a half hours; in each case the pouch developed perfectly, and the females began to lay eggs within five minutes of separation. Watching the formation of the pouch in the first pair with a glass, it "appeared to be about three sixteenths inch long, and not quite one eighth broad, with a very slight central depression the whole length, of a dark green color, and with minute transverse corrugations. This I found to be a membranous covering attached to the abdomen of the male, containing a dark green fluid. This membrane entirely covered the true pouch of the female, as I observed that the male appeared to be able to contract it, and did several times, so as to expose the pouch of the female, which was then quite white; and it has since occurred to me that this exposure of the pouch might be for the purpose of hardening it a little, as the pouches are quite soft during copulation; and this leads me to think that this membranous cover-

ing is the mould in which the pouch is formed." The seventh pair were in copulation about three hours, when "I separated them forcibly. The pouch was quite soft. . . . I then examined the membrane of the male, and found that by squeezing the abdomen, and holding up the membrane with a pin, a white, opaque, gelatinous substance issued from that part of the abdomen where the pouch of the female would be during copulation. Some of this substance I was able to pull out, but it began to harden immediately on exposure to the atmosphere, and became quite brittle and of a yellowish color. From this I am led to think that the male supplies the material of which the pouch is made, and that the female has really little to do with the making." As will appear presently, Mr. Thomson was not mistaken in this conjecture.

Professor Howes undertook the task of dissecting and examining the specimens sent him by Mr. Thomson, and is quoted as saying that Von Siebold believed the secretion was derived from the male, and to be functional in prolonging the coitus, adding: "I cannot agree with him that this is the case, the adhesion of the copulating individuals being assured by the hook-like claspers of the male. The pouch is densest in the vicinity of the female genital orifice, and its detailed structure conforms internally to the ventro-lateral parts of the male genital funnel. In view of this, the fact that it is impossible, in dissecting of specimens procured during copulation, to remove the pouch without bringing away the internal generative apparatus of the female, points to my mind to a direct connection between that apparatus and the pouch itself. It suggests the probability of an origin of the same from the body of the female, and not of the male, as is generally supposed." Messrs. Thomson and Howes therefore differ diametrically as to the principal point in question.

I now come to the observations of Mr. David Bruce, on *Smintheus*. He wrote from Denver, 9th June, 1886: "I have lost a whole day watching a pair in copulation, and anxiously waiting for them to separate. They had been together twenty-four hours, and as it was evening, and I was very tired, I gently pulled them by the closed wings, when they separated, and nothing of the pouch appeared on the female. I watched carefully with a glass from daylight in the morning till I separated them, and these are my conclusions. The pouch is entirely formed from the male. I have read Mr. Thomson's account. What he terms the 'membranous covering' is the true pouch itself. There is certainly some peculiar organ of the male under the pouch (or membranous covering). The semi-transparent nature of the membrane enabled me to see this, a V-shaped organ, which showed itself as nearly white through the semi-transparent sheath. It struck me as like the widely cleft point of a quill pen; occasionally, the male would work this organ back and forth, one branch of it having a piston-like

movement in each division of the pouch, and the pouch was soft and elastic and yielded to the motion. On separating the pair, to my surprise, instead of the pouch remaining on the female, the whole affair belonged to the male, and was visible for a moment or two, when it gradually withdrew into the abdomen of the male and disappeared. On separating, a large drop of green fluid came from each of the pair. This dries and leaves a stain on paper. The membranous covering yielded to the motion of the organ, yet enveloping it closely, and had a laminated or folded appearance. The green fluid, when I separated the pair, prevented my seeing very distinctly the true state of things, and by the time I had turned to the table and taken a piece of blotting-paper, the whole, pouch and organ, had disappeared. The fluid, I believe, was merely a lubricating secretion. I think the retractile organ is connected with the clasping apparatus. It seemed to me that something was abnormal about the protracted coitus in this case, and that the pair were unable to separate voluntarily. I have thought it possible that the reason for the existence of these pouches in Parnassius is found in the fact that they are additional safeguards for preventing premature separation by the violent storms so prevalent in the regions where these insects live."

Mr. Wright, at Maiden, says: "The pouch is positively absent in the virgin females. I have watched several cases of voluntary copulation, and find that the pouch begins to be visible soon after connection as a web of exceeding thinness. Later on it thickens and enlarges, becoming like tissue paper by the time the copulation ends; then gradually, and in course of an hour or two, it becomes like a shaving of horn, and finally brown or black, and rigid."

I consulted Mr. Scudder about these matters, as related by Mr. Bruce, and proposed to get fresh examples of *Smintheus* and *Clodius*, if he would dissect them, in order to discover what the organs were which had been observed at work moulding the pouch. He kindly offered to assist, and in due time received dry examples. Both Messrs. Bruce and Wright undertook to forward living examples of the males, and during 1892 such were mailed from Colorado and California, but all arrived dead, and so dried that Mr. Scudder found no advantage in dissecting them. In June, 1894, Mr. Bruce and I were in Colorado together, and we mailed some twenty males of *Smintheus*, but Mr. Scudder happened to be absent from home on their arrival, and the experiment failed. After that we never had an opportunity to take *Smintheus*.

Mr. Scudder published his observations on the organs of male *Smintheus* in the Transactions of the Entomological Society, London, for January, 1893, and I will now give an abstract of his paper. "Mr. Edwards having placed in my hand abundant dry material during the past winter, I soon reached a conclusion which seemed to throw new light upon the matter. . . . My dissections were almost en-

tirely of *Smintheus*, but as they left many points still unexplained, I was anxious to examine living examples. . . . Mr. Bruce sent me males of *Smintheus*, and Mr. Wright one lot of living males of *Clodius*, from California. Unfortunately none reached me alive except a single moribund example of *Smintheus*, too far gone to be useful. The structure of the male Parnassian is remarkable for having, as in the genus Anosia (Danais), the sides of the eighth abdominal segment expanded and posteriorly extended, forming a kind of false claspers concealing the greater part of the genitalia proper; in *Smintheus* and *Apollo* embracing also the inferior surface of the true claspers, and thus giving that segment a length twice as great along the ventral as along the dorsal line (Fig. *i*). It is beneath these 'klappen,' or false claspers, that Von Siebold says the secretion is poured forth, and he is certainly right, for all the crevices between the inner surface of this expansion and the outer surface of the organs beneath, which it closely clasps, are often filled completely, in all specimens I have examined to some extent, with a coagulated secretion, which, when compared under the microscope with a fragment from the pouch of the female, is of essentially the same character as it.

"In *Clodius* and *Mnemosyne* and other species, the false claspers do not embrace under surface of the true claspers, which are thus not at all concealed on an 'or view; and therefore there is in these species considerable modification of the parts I am about to describe, which are based wholly upon an examination of *Smintheus*. If the eighth abdominal ring is carefully removed, bit by bit (Fig. *i*²), which can hardly be done without rupturing some of the coagulated secretion, but often leaves broad sheets intact, all the accessory organs of generation are exposed to view, and a second striking feature is revealed; for it will then be seen that the sternal portion of the ninth (last) segment, to which are attached the claspers proper, is split along the median line and sends two posterior shafts side by side to the uttermost edge of the overlapping eighth segment. Directly beneath it, in the sense of toward the middle line of the body, i. e., lying between the lower posterior ensiform process of the ninth segment and the lower surface of the true claspers, is a pair of lamellate scimitar-shaped organs diverging at tip, and so closely connected with the sheet of coagulated secretion, and of so nearly the same color and texture as it, as to appear a part of the same. It is only when the processes of the ninth segment are in their turn removed that the form and structure of these parts can be made out; it is then seen that they have a membranous or tendonous structure, hardly chitinous, and certainly not the same as the hardened jelly-like substance of the secretion which is continuous with their edges and permeates the crevices in the region about. By uncovering the parts in front, it is seen to be formed mainly of two

slender blades curving in opposite senses (Fig. i^3, i^4), which lie under the protection of the inferior processes of the ninth segment, but when they pass forward dilate into triangular expansions which nearly fill the lozenge-shaped space left vacant between the curved base of the inferior processes of the ninth segment (following the similar curve of the eighth) and the slightly emarginate apex of the seventh; at their base appear to be attachments of the seventh; the opposite sides of the triangular basal expansion are thicker than the middle, as if there were a two-branched basal attachment connected by a slight membrane, to give greater support and rigidity to the attachment.

"This organ, which, so far as I know, has no homologue whatever among Lepidoptera, seems to me to be in just the place and of just the form to serve as the apparatus for moulding on its interior the abdominal pouch of the female out of the secretions which flow either from it, or through it, or around it, from glands in close connection with it; and consequently I suggest for it the name of *periplast*, indicative of its use. The attachments and the mechanism by which it may act, together with the precise position and relation to it of the adjoining secretory glands, can of course only be told from fresh specimens, and such specimens would doubtless serve also to correct in some particulars this preliminary description.

"It will perhaps be found that the membrane mentioned by Thomson, containing a dark green fluid, is an evaginable gland extended from near the base of the false claspers, and that when it protrudes beyond the tip, as Thomson's description would seem to imply, it secretes from its inner surface the material of which the pouch is formed, which is then moulded into shape in its inner surface by the scimitar-shaped periplast, which must have an extensile movement surpassing even that of the true claspers. This is a point which only an examination, first of living males, and then of pairs in union, can fully satisfy."

EXPLANATION OF THE PLATE.

SMINTHEUS, 5, ♀ (from Montana); var. HERMODUR, 1 ♂, 2, 3 ♀, 4 ♀.

a, EGG; a^2, micropyle.

b to b^5, YOUNG LARVA; b^4, head; b^5, outline of head and segment 2.

c to c^2, Larva at 1st moult; c^4, side view of segments 7, 8; c^5, tentacles on segment 2; c^6, head.

d, Larva at 2d moult.

e, Larva at 3d moult.

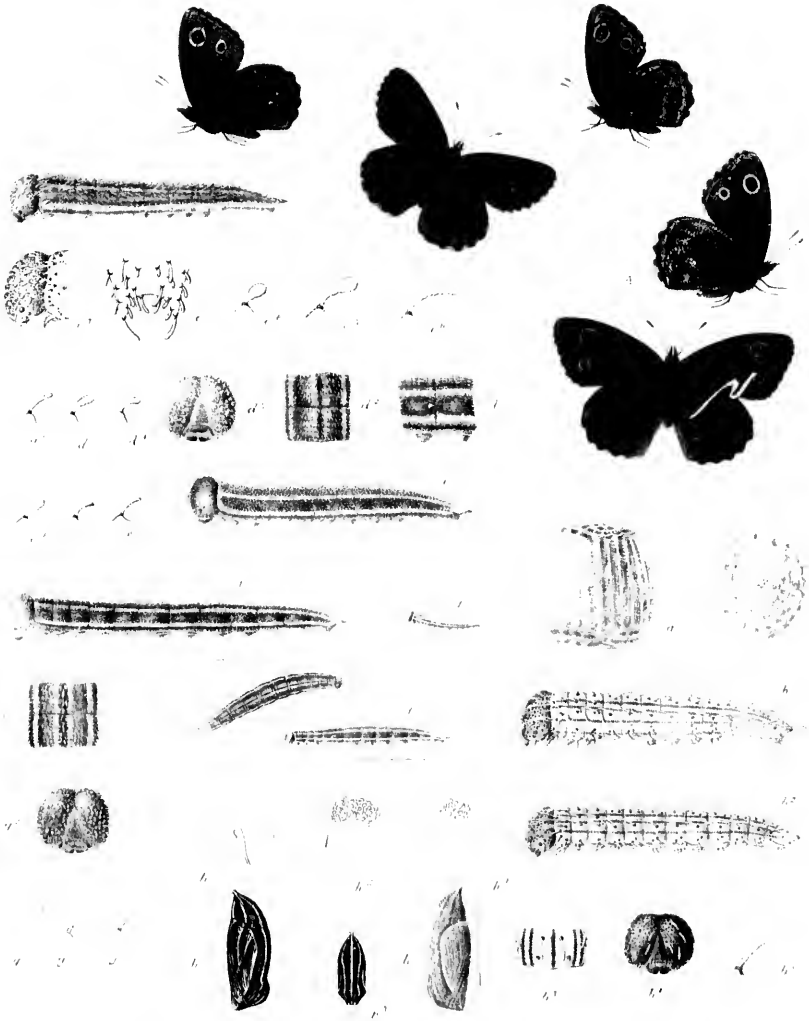
f, ADULT LARVA, natural size.

g, A second adult, enlarged; g^2, a third, still more enlarged; g^3, head; g^4, tentacles.

h, CHRYSALIS, in its pseudo-cocoon; h^2, outline of, h^3, side view of, last segment; h^4, front view, showing the cremaster.

i, The last segments of the male butterfly; i^2, i^3, same, with envelope removed, exposing the periplast, i^4.

SATYRUS.
III.



CHARON 1 2 ♂ 3 4 ♀ VAR SILVESTRIS 5 6

a – a² Egg magnified *f – f²* Larva 4th moult & adult

b – b² Larva young *g g²* parts magnified

c – e 1st to 3rd moults *h h²* Chrysalis

SATYRUS III.

SATYRUS CHARON, 1–5.

Satyrus Charon, Edwards, Trans. Am. Ent. Soc., Vol. IV., p. 69. 1872; id., Can. Ent., Vol. XII., p. 91. 1880. Mead, Rep. Wheeler Exped'n., Vol. V., p. 773. 1875.
VAR. SILVESTRIS, Edwards, Proc. Acad. Nat. Sciences, Philad., 1861, p. 163.

MALE. — Expands from 1.5 to 1.9 inches.

Upper side blackish brown; hind margins edged by a black line, anterior to which is a second, usually more or less macular, often wanting; on primaries a conspicuous black sexual dash; a sub-apical black ocellus, without pupil, with or without a pale yellowish ring or nimbus, and variable in size in individuals; in the second median interspace a second small ocellus, but often wanting; on secondaries there is occasionally a small blind ocellus near the anal angle; fringes concolored with the wings, but sometimes on primaries brown is alternated with gray.

Under side of primaries brown with more or less of a yellow tint, the apex mottled with dark gray; the basal two thirds crossed by many fine, abbreviated blackish streaks; the black marginal lines distinct, the inner one wavy or crenated; the ocelli repeated; the second one nearly always present, sometimes large and equal, usually the upper one large, the other small, but often this is reversed; always surrounded by yellowish rings and having minute white pupils.

Secondaries darker, mottled with gray on the extra-discal area, and sometimes on the basal; across the disk a rather obscure band, with deep black edges, the basal side not defined next costa, deeply incised in the cell and again in the second median interspace; but often the band is entirely merged in the color of the base; the outer side is very irregular, incised on costal margin, projecting two long and broad, converging and pointed teeth opposite the cell; but the band is often more or less lost, sometimes completely, as seen in Figure 5 (var. *Silvestris*); the ocelli are minute, from one to six in number, with or without white pupils, and stand on cloudy black patches.

Body, legs, and palpi dark brown; antennæ brown with fine cretaceous annulations on the upper side, altogether cretaceous beneath; club pale fulvous. (Figs. 1, 2, var. 3.)

Female. — Expands from 1.7 to 2 inches.
Paler colored than the male, but similarly marked. (Figs. 3, 4.)

Egg. — Conoidal, truncated, the summit flattened, the sides convex, the bottom rounded; marked by twenty-four to twenty-eight straight, sharp, vertical ridges, which start from the edge of the base and end at the rim of the summit; the spaces between the ribs roundly but not deeply excavated, and crossed by many equidistant fine raised threads; the micropyle is in the centre of a flat rosette of five-sided cells, outside of which are several irregularly concentric rows of five and six-sided depressed cells, increasing in size and distinctness to the edge of the summit, and having thin, sharp edges; color at first lemon-yellow. (Figs. a, a^2.) Duration of this stage twelve days, at Coalburgh, W. Va., in August.

Young Larva. — Length .08 inch; similar to S. *Meadii*, tapering on both dorsum and sides from 3 to 13, the last three segments curving roundly to the extremity; this is nearly square, a little incurved, and bears a conical tubercle at either side; the tubercles on the body as in *Meadii*, those on 2 and 13 longer than elsewhere; each bears a white process, cylindrical, slightly tapering, and ending bluntly, appressed, turned forward or back as in *Meadii*; color pinkish yellow, with a red-brown mid-dorsal stripe, and three others on either side, the upper two nearer together than the second and third; another brown line below the basal ridge; the head as in *Meadii*, and the tubercles and processes the same in number and position as in that species; but the processes do not taper, and some of them are a little thickened at the extremity. (Figs. b to b^5.) The larvæ went into hibernation at once from the egg.

After first moult: length, at twenty-four hours from the moult, .15 inch; the anterior segments thickest, the dorsum arched posteriorly; the last segment ending in two conical tails, the space between their bases roundly excavated; the body covered thickly with minute tuberculations from each of which arises a white clubbed and appressed process; these vary in length everywhere, but are longest on 2 and 13 (Figs. c^2 to c^6); turned back, except on 2, on that segment forward; color green; a pale brown mid-dorsal line, two such lines on the side, near together, and a third next above the yellow basal ridge; under side whitish green; feet and legs pale green; head sub-globular (closely as at first

stage), a little broader than 2; emerald green, the tubercular points white, the processes, like those of body, bent down. (Figs. *e* to e^6.) Duration of this stage about eleven days.

After second moult; length, at twenty-four hours, .3 inch; nearly the same shape as before, the dorsum more arched over the middle segments, ending as before; the tubercles smaller, the processes reduced, irregular in length and shape, some of them cylindrical; the tails red from base to tip; color of body bluish or gray green; the mid-dorsal line deep green, edged with yellow; the sub-dorsal line and the basal ridge yellow; head as before, the tubercles and processes smaller. (Figs. *d* to d^6.) Duration of this stage about eleven days.

After third moult: length, at twenty hours, .4 inch; the shape as at last previous stage; color yellow-green, the tails red; the tubercles and processes as last given, but still farther reduced; the lines or stripes as before; head as before, the processes smaller. (Figs. *e* to e^4.) Duration of this stage about twelve days.

After fourth moult: length, at eighteen hours, .54 inch. (Fig. *f*, natural size.) In about twelve days was fully grown. (Fig. f^2, midway between the moult and adult, greatly enlarged.)

Mature Larva. — Length ♂, .94, ♀, 1.02 inch; greatest breadth, .16 to .18 inch; cylindrical, thickest in the middle, tapering on dorsum and sides evenly either way; ending in two short conical tails which meet at base at a small angle; covered with fine white conical tuberculations, each giving a small white process, either tapering to a point, or cylindrical, or a little thickened at the end (the greater number tapering), and all slightly appressed; color yellow-green over dorsum, below the sub-dorsal stripe green (but sometimes whitish green throughout); the mid-dorsal stripe dark green a little edged with yellow; the stripe and ridge of equal width, yellow, or in the paler larvæ green-yellow; the tails pale red; under side, feet and legs, whitish green; head sub-globular, broadest near base, a little depressed at top; color bright green; more thickly covered with tubercles than at last previous stage, and these are reduced as are also the processes. (Figs. f^3, f^4, natural size; *g* to g^5, parts magnified.) From fourth moult to pupation, at Coalburgh, eighteen days.

Chrysalis. — Length ♂, .4 to .45 inch; breadth at mesonotum, .16 to .18; at abdomen, .2 inch; ♀, .5 to .6 inch; breadth at mesonotum, .18 to .2 inch, at

abdomen, .2 to .22 inch; cylindrical, abdomen conical; the ventral outline from top of head case to end of the wing cases not so much arched as in *Meadii*; head case short, the top narrow, square or a very little incurved, the sides excavated; mesonotum rather prominent, rounded lengthwise, carinated, the sides a little convex; followed by a shallow depression; cremaster long, tapering, compressed transversely, rounded at extremity, and armed with many stout hooks; color very variable, as thus: —

A: pale yellow-green throughout, the dorsal side from the head case, and all of the abdomen, thickly dotted and finely mottled with yellow-white; three narrow whitish stripes from head case to 13, one mid-dorsal, one sub-dorsal on either side; the dorsal edges of the wing cases also white; the ventral side from top of head case to end of wing cases granulated with white; on the wing cases are three stripes of green, the largest being on mid-wing and reaching the hind margin, the others short and stopping within the margin.

B: altogether whitish green; no bands on dorsal side, no stripes on wing cases.

C: greenish black throughout; finely dotted over the dorsal side and abdomen with yellow-white; the three bands as in A; the wing cases striped with black.

D: black with no tinge of green; the light stripes either yellow-white, or white with a pink tint. (Figs. *h* to *h*^{6}.) Duration of this stage ten to fourteen days.

To Mr. Theodore L. Mead is due the first notice of Satyrus CHARON, in 1871. In his Wheeler Expedition Report, he says: "This species was first met with near Twin Lakes, on the 9th of July. It was quite abundant in the sage-brush, and on flowers at the edge of the Lake. Later in the season, it was found in both the South and Middle Parks, though not so abundantly as in the Arkansas Valley, whence the expedition also brought specimens. Altogether one hundred and thirty-one specimens were taken by me. In August, females were obtained and inclosed with grass; several eggs were laid — very similar to those of *Nephele*."

Charon flies in the Rocky Mountains from New Mexico to British America, and beyond the mountains to eastern California. I saw it at Glenwood Springs, Colorado, along Grand River, in July, 1894, but it was less common than S. *Paulus*, or S. *Ariane*. Mr. David Bruce has found it abundant in other parts of that State, and has kindly written the following notes respecting its localities and habits: "*Charon* is common and generally distributed in dry grassy places, from the foothills to about 10,000 feet elevation. It flies rather briskly at a few

inches above the ground, stopping a moment at almost every composite flower, and circling around every bush and herb, in a deliberate manner, as if looking for a mate, or for a suitable place in which to deposit its eggs. Late in the season, when these objects have been accomplished, I have seen the species in the narrow cañons of the Platte and Clear Creek, frequenting the sunflowers in numbers, a dozen or more sometimes on the disk of one flower, associated with as many agrotid moths, and the whole party under the narcotic influence of the sweets they are imbibing, so as easily to be picked off. But though a lover of flowers, it is just as much pleased with the juices of a decaying carcass, or the fresh droppings of cattle and horses; and it will gather in crowds on the damp sand.

"I have seen it in the South Park district from June 20th till August 28th; at Palmer Lake, in the pleasant grassy meadows of the 'Divide,' as late as September 1st. These last fliers were light colored and worn, and passed most of their time on the flowers of Sedum stenopetalum, which grows there in profusion. Earlier in the season, its favorite haunts are the grassy slopes partially covered with dwarf oaks. In such a place it is difficult to capture despite its slow flight and frequent stoppages, for it dodges under and through the scrub, and winds around in the shadows in such a way that with its obscure coloring it is soon lost to view, — although it never hides like the species of Neominois and Chionobas. It is a quiet insect in the net, and the female will lay eggs freely in confinement."

In California, Nevada, Utah, and Montana, *Charon* flies with the allied species, S. *Œtus*, Boisduval.

I received twenty eggs of *Charon*, August 4, 1884, from Mr. H. W. Nash, at Rosita, Colorado, laid 30th July. These began to hatch 11th August, or twelve days after the laying. Most of the larvæ at once went into hibernation, but one of them ate a little and changed from pinkish yellow to green, as the larvæ change in the spring after feeding. But it hibernated before the first moult. This is the only instance in which I have known a larva of the genus *Satyrus* to feed in the fall. All the species have gone into hibernation direct from the egg.

These larvæ were sent to New York, to a refrigerating house, and I received them again March 7, 1885, with very little loss. The next day some were observed feeding, and had changed color to green. (Fig. b^2.) On 29th March, one larva passed the first moult, two on 31st, and so at intervals until the fifteenth and last larvæ passed the moult on 15th April. Therefore the difference in time at the first moult was seventeen days.

On 9th April, the first larva passed its second moult, or at eleven days from

the first; the last of ten larvæ (some having died, and some having been put in alcohol) passed this moult 21st; the difference being twelve days.

The first larva passed the third moult 21st April, the last of nine the same moult 7th May; the difference being sixteen days.

Number one passed its fourth moult May 3d, and pupated 21st, or at eighteen days from the moult; the pupa gave a male imago 2d June, at twelve days. The last of nine larvæ passed its fourth moult 6th June, or thirty-four days after the first larva had reached the same point. Some of the mature larvæ and pupæ were preserved, so that only four butterflies were obtained from this lot. Of six pupæ, two green ones and a black produced males. A whitish green one gave a female. The history of these larvæ shows how it happens that butterflies fresh from chrysalis may be found for several weeks in one locality.

On 2d September, 1888, I received from the late Mr. William S. Foster, at Salida, Colorado, several eggs of *Charon*. They began to hatch 11th, or at fourteen days from the laying of the eggs. The larvæ hibernated as before, were sent to New York, and came back 16th April, 1889. The first one passed its first moult 25th April, or eight days after beginning to feed; its second moult 5th May, at ten days; its third 11th May, at six days; its fourth 20th May, at nine days; suspended 31st, and pupated June 1st. From fourth moult to pupation twelve days. The last of the larvæ pupated June 8th. The first pupa gave a male imago June 15th, or after fourteen days. The last imago, a female, came out June 18th, after but ten days. In all stages the temperature hastens or retards more or less. There were seven pupæ, four of them green, three black and white. It is ascertained that the sex of the imago is not indicated by the color of the pupa.

Again in 1889, August 13th, eggs were received from Mr. Nash, at Pueblo. The larvæ came back from New York, 2d April, 1890, but I did not follow the changes carefully. About 1st June there were three pupæ, two green, one black and white.

In October, 1891, I sent young larvæ of *Charon* to Mr. Fletcher, at Ottawa, together with larvæ of several other species of Satyrids. The former were almost the only ones that survived. The species has in each case proved quite hardy, the loss during the winter having been very small.

These larvæ, as I believe are all Satyrid larvæ, are grass feeders, and they flourished on Blue-grass, Poa pratensis. In feeding, the larva stands astride the edge of the leaf, and beginning at the top eats vertically in two rapid cuts down, followed by two more, and so on to the farther side, the second segment stretched, but the feet and legs are not moved. When quite across, the larva backs down far enough to enable it to repeat the process.

I have reared larvæ of several species of the genus Satyrus, *Alope* and *Nephele*, *Ariane*, *Boopis*, but none have shown other than green chrysalids except *Charon*, and in a single instance *Ariane*. This individual was marked with dark clouds and stripes, but not to the extreme represented in the Plate.

The var. *Silvestris* was described as a species from California. It is *Charon* handless on under hind wing; and this variation is not uncommon wherever the species is found.

EXPLANATION OF THE PLATE.

CHARON, 1, 2 ♂, 3, 4 ♀, var. SILVESTRIS ♂, 5.

a, EGG; a^2, micropyle.

b, YOUNG LARVA just from egg; b^2, after feeding; b^3, one of the middle segments, dorsal view; b^4, head; b^5, process of body.

c, Larva at 1st moult; c^2, last segment; c^3, head and second segment; c^4 to c^6, style of processes.

d, Larva at 2d moult, side view segments 7 and 8; d^2, dorsal view of same; d^3, head; d^4 to d^6, processes of body.

e, Larva at 3d moult; e^2 to e^4, processes.

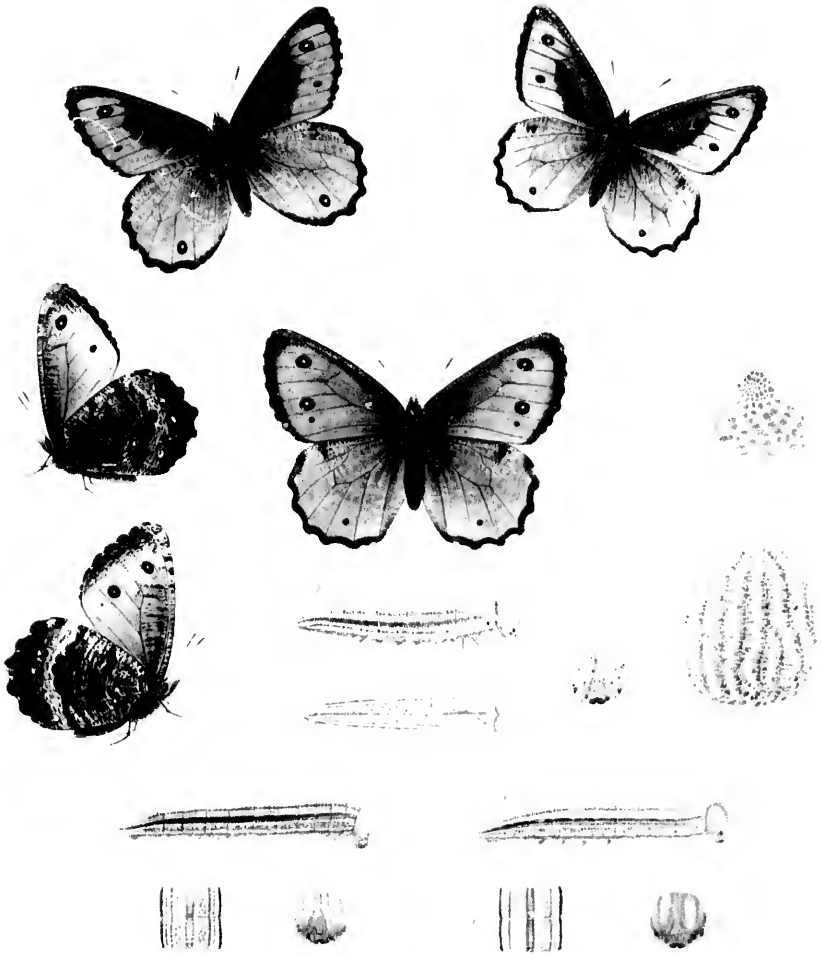
f, Larva at 4th moult, natural size; f^2, midway between fourth moult and maturity.

f^3 f^4, ADULT LARVA, slightly enlarged, dorsal and side view; g^2, dorsum of 7 and 8; g^4, head; g^5 to g^7, processes of body.

h, CHRYSALIS, green variety, h^2, black var., natural size; h^3, same much enlarged; h^4, cremaster, side view; h^5, same, front; h^6, hooks of cremaster.

CHIONOBAS.

XI.



GIGAS VAR

CHIONOBAS XI.

CHIONOBAS GIGAS, 1–5.

Chionobas Gigas, Butler, Catalogue of the Satyridæ in the British Museum, 161, pl. 2. 1868; Edwards, Butt. N. A., Vol. II, pl. 43, 44, p. 279. ♀, 1871; ♂, 1875.

Nevadensis, Felder, Reise Novara, Lepid., III, p. 89, pl. 69. 1868 (on title-page, 1867, but antedated one year).

Egg. — Sub-conic, the breadth to the height nearly as five to six; the base flattened, somewhat rounded, the top rounded; broadest in middle, narrowing upward gradually; marked by eighteen or nineteen ribs like those of *Macounii*, somewhat sinuous, a few branching at bottom, or else an abbreviated rib is placed between two long ones; narrow at summit, and rounded, the slopes flat, each with many fine and irregular excavations, the bases not quite meeting, the angles at the depressions and elevations nearly or quite equal, right angles; the micropyle is in the centre of a rosette of shallow six-sided cells, the boundaries of which are raised like threads; outside of these are two or three rows of similar irregular cells, gradually enlarging; beyond to the end of the ribs the flattened space is covered pretty thickly with shallow cells of irregular sizes, usually separated, but sometimes confluent; color gray-white. (Figs. *a*, *a*^{2}.) Duration of this stage from fifteen to eighteen days.

Young Larva. — Length, at twenty-four hours from the egg, .15 inch; shaped as in *Macounii*, and the genus; thickest anteriorly, tapering from 2 to 8 slightly, after 8 rapidly, the dorsum arching to 13, which ends in two short, sub-conical tails nearly or quite meeting at base; the tubercles and processes the same in number, position, and shape, as in *Macounii;* color at first pale reddish gray, the last segments more red, after a few days whitish green; the lines red-brown, the mid-dorsal and sub-dorsal slight, the lateral heavy, rather a stripe than line; the basal ridge lighter than the ground color, and under it a thread of brown; under side, feet and legs greenish yellow with a brown tint; head as in *Macounii*,

broader than 2, sub-globose, the front well rounded, broadest below, narrowing upward, depressed at the suture; surface covered with shallow indentations, and showing a few tubercles, each with its short clubbed and bent white process, disposed as in the genus; color greenish yellow, brown-tinted. (Figs. *b* to b^3.) Duration of this stage about eleven days.

After first moult: length, at twenty-four hours, .22 inch; nearly the same shape as at the first stage; the tubercles and processes as in *Macounii*, *Chryxus*, and the genus; color yellow-buff; the mid-dorsal stripe green, with red-brown edges, and bordered on either side by a narrow strip of yellow-buff, after which the ground is greenish buff to the narrow brown sub-dorsal stripe; the area next below is yellow-buff, cut through the middle by a fine brown line; the broad lateral band vinous-red, the edges black; then a narrow strip of yellow-buff, and the greenish brown spiracular band; basal ridge yellowish, and under it a line of red-brown; under side, feet and legs, whitish green; head broader than 2, same shape as before, indented and tuberculated as in the other species, with six vertical stripes as in the genus; color yellow, brown-tinted. (Figs. *c* to c^3.) Most of the larvæ treated have hibernated between first and second moult, two only having reached the second moult before hibernation. Duration of the stage in these cases fifteen and twenty-eight days, respectively.

After second moult: length, at twenty hours, .33 inch; shape as in second stage, the tubercles and processes same; color yellow-buff; the stripes as before, but the lateral is less black and on the lower and anterior part is green; head as before. (Figs. *d* to d^3.) All larvæ, whether hibernating after first or second moult, have died before spring. The larvæ have proved as difficult to rear as those of *Macounii*.

The female GIGAS figured and described in Volume II was one of three not fresh examples which had been taken by the late Mr. G. R. Crotch, near Victoria, Vancouver's Island; the male was copied from a drawing made at the British Museum, from Mr. Butler's type insect. At that date, 1874, these three females and the single male were the only examples of the species known to me in collections. I had therefore never seen a male *Gigas*. Of late years, many of both sexes have been taken by Messrs. Wright, Danby, Green, and others, and I have at present under view forty-eight examples, most of them sent by Mr. Wright; several fine ones by Mr. Green. The Museum male is of the yellow-brown variety, an extreme instance of which, in coloring, is shown on the Plate, Figure 5. It is a very rare variety, and of all the specimens before me there are but

two, both males. One female is nearly as pale, but has a decidedly red tint. The greater number of the forty-eight are brown rather than red, but a few are quite as red as any *Californica*. On the under side, which is the most important for specific characters in this group, there are two distinct types: the melanic, shown on the present Plate, and the yellow-white, more or less lightly flushed with brown, as seen in the female in Volume II. None of either sex under view have so pronounced a mesial band as that represented in the Museum male. In this species the whole hind wing is heavily and thickly streaked with black or black-brown; the outer limb is dark almost or quite to the band; and the edges of the band are heavy stripes, black in the darker examples, nearly as dark in the paler. The width of these edges is usually about one tenth inch, and there is no instance under view of a delicate outline, a simple black line, such as is common in *Iduna* and *Californica*. In most cases the basal edge of the band is indefinite, lost in the heavy streaks of the basal area. There is more or less white along the whole costal margin, but streaked like the rest of the wing. In a few cases all of the wing is mottled with white, except the outer limb. It is characteristic of the species that the band is broadly edged with black, and that the streaks over the whole wing are both heavy and multitudinous. The exterior edge of the band is roundly crenated, often quite evenly, with no prominences opposite the cell to break the general curve; but in some cases the two crenations in the median interspaces project somewhat, as shown in the figure in Volume II.

Iduna, in contrast to the other species, almost always has the male yellow-brown, often pale, as if faded in the sun. But as this pale hue is found in perfect examples, it must be natural. The under-side figures of this species given in Volume II are good. I have forty-nine examples before me, embracing twenty-eight recently sent by Mr. Wright, the choice specimens of his collection. Not one of the lot is so red as in the figure of the male in Volume II, and four fifths are not red at all. The hind wings beneath are all hoary — whitish. Where any black is present, it is in the border of the hind margin, usually rather dusky than black. In almost one third the examples there is no melanism at all. The whole wing is finely striated, as in the two under-side figures in Volume II, but often much less than in the figure 4 ♀, in which case there are large areas of immaculate white. The interior of the band is of the ground color of the wing, and the edges are but slightly darkened, often being mere threads of black, never heavier than a diffused line, and then only next the costa. In all but three the basal outline of the band is distinct throughout. The exterior side is in the form of a bent bow, the ends (at the two margins) turned back, and often there is not a crenation from end to end (as will be shown in the next Plate); but at times

the middle of the bow is crenated evenly; and occasionally the two crenations in the median interspaces are squarely truncated. Looking at these *Iduna* alongside the forty-eight *Gigas*, in no instance could an example of one species be taken for the other. They are as well marked and as distinct as are any two closely allied species of the genus, — *Œno* and *Semidea*, for example.

Californica, in contrast with *Gigas* and *Iduna*, is decidedly red. I have never seen a pale or a yellow brown one. Professor E. T. Owen sent me one hundred and thirty-nine examples, taken by himself, at Fort Klamath, Oregon, 1892, and kindly presented me thirty of them, 20 ♂, 10 ♀, selected with a view to embrace all the noticeable variations. These are before me, together with six others taken by Mr. James Behrens, in Siskiyou County, California. The figures in Volume II are excellent, and I cannot suggest an improvement. The finely striated surfaces of the hind wings, almost always free from melanism on the hind margins, and flushed with red-brown from these margins through the mesial bands, are well shown. This last feature is peculiar to *Californica* (though it is shared by *Macounii*), and is usual.

In these three species there are three distinct types, and they keep separate, though some of the variations of one run in the direction of the others. But some do not. If, as we may suppose, the three species, together with *Macounii*, are descended from the same parent species, the present state of things would seem to be what might have been expected, namely, that while distinct types have evolved, there are variations that are more or less intermediate, and variations that are in the contrary direction.

With regard to the ocelli on the wings of the three westernmost species, there is no difference to note. On the fore wings of the males I find one to three, on the hind wings none or one; of the females, two to four on the fore wings, none, one, and two on the hind wings.

In Volume II, I spoke of Chionobas *Nevadensis*, Felder, as if it might be a fourth species, because the colored figures of the plate in the Reise Novara, Lep., which I had seen at the Peabody Library, Baltimore, looked as if intended to represent neither of the other three. They are badly colored, however. I have recently seen a plain plate, at the Academy, Philadelphia, and am now satisfied that *Nevadensis* and *Gigas* are but names of the same insect. That also was Mrs. Peart's opinion, who examined the Plate with me. Apparently Felder's name has the priority, as the Catalogues credit *Nevadensis* to 1867, but *Gigas* to 1868. Mr. Butler informs me, however, that when his Catalogue of Satyridæ issued, in which the description and figure of *Gigas* were published, February, 1868, Felder's Part III, which contained *Nevadensis*, had not yet

been published. When it did appear, some Plates were antedated one, and some two years, that of *Nevadensis* among the rest. The name *Gigas*, therefore, cannot be disturbed.

I have bred the three species from the egg, two of them, *Iduna* and *Californica*, to adult larval stage, but failed to get pupæ, and *Gigas* to second moult. There was much difference in the duration of the several stages of the larvæ of the two first named, and in the behavior of the larvæ of all three. *Gigas* was bred twice; in one case, the larvæ hibernating after their first moult; in the other, two larvæ reached second moult, and hibernated, the remainder hibernating after first moult. *Iduna* was bred twice, in two successive years, some of each lot of larvæ reaching maturity the same season in which the eggs were laid. In one brood, the length of the larval period from hatching to maturity was seventy-six days, in the other, eighty-eight days; the remainder of the larvæ hibernating after second moult. Whereas, with *Californica*, bred once, one larva reached maturity in fifty-two days from the egg, and another in fifty-six days, other larvæ hibernating after second moult. The several stages of the two spoken of as in advance of the others passed with surprising swiftness for Chionobas. The larvæ of these three species and also *Macounii*, comprising the group, are built and marked on the same plan, and are very like each other through all the stages observed. All are brown or gray in longitudinal bands, alternated with bands of black; and with such a style of marking and coloration there is little room for individual variation.

GIGAS, so far as is yet known, is confined to Vancouver's Island. It has been taken on Mt. Findlayson and Mt. Austin; at Cobble Hill, Koksilah, and South Saarnich. Also as far to the north as Mt. Prevost, sixty miles from Victoria. Mr. Charles de Blois Green, C. E., says: "I took *Gigas* all the way from Victoria to Mt. Prevost, and should say that it is found over the whole southern part of the island."

Of the habits of *Gigas*, Mr. William H. Danby, of Victoria, writes: "The males are very alert when at rest, easily alarmed, and of an inquisitive disposition. This last was demonstrated by the alacrity with which they would chase Papilio *Eurymedon*, whenever that insect approached, — say at about fifteen feet. A *Gigas* would rise and make a dash at the stranger, driving it away at once. This habit I turned to account, using the Papilios as decoys, and by their aid finding *Gigas*, which always returned to the spot it started from. Thus I obtained more examples than I otherwise could have, because on the under side *Gigas* so closely resembles the black mosses on or among which it rests, that until it is flushed it is

difficult to perceive. The flight of the male, when undisturbed, is in undulations made with little effort, and it closely resembles that of Satyrus *Ariane*, but is more swift. The females fly with an easy and regular movement, and they are neither so quick nor so shy as the males, and consequently are more easily captured."

Mr. Green wrote in 1892: "I came across *Gigas* many times, last year, in different situations. I have never seen them doing anything else than sunning themselves, and when so engaged, they are not easily taken with the net. They prefer to alight on rocks, but at the same time, I have observed that if there is a dead tree lying across the rocks, they will make use of it; also, that if disturbed they disappear, but will in time return to the same spot. The only standing trees which I have seen them resting on are small dead ones."

On July 10, 1893, Mr. Green wrote: "I send you six perfect *Gigas*, which I was fortunate enough to obtain yesterday. I took three females and eight males, four of the last just out of chrysalis. The males fly high up the mountain, and go there to sun themselves on the bare rocks. If struck at and missed they dart down the mountain into the timber. When alighted they fold their wings back to back, so that nothing but the under surface is to be seen."

Mr. W. G. Wright made two trips to Vancouver's Island, in pursuit of *Gigas*. On the first, 1891, he was very successful; but the second, 1892, was nearly fruitless, owing to bad weather and limited time, he being on his way to Sitka. Mr. Wright has collected *Iduna* in three seasons, 1892, 1893, 1894, in the redwood region of northeast California; and he has taken Chionobas *Californica* in east Washington, and on Mt. Hood, Oregon; also in northern California. He is the only living collector who has taken the three species, and knows by personal observation their respective habits.

His first letter was from Victoria, June 30, 1891: "I have just come from Mt. Findlayson, and mail you to-day about two dozen eggs of *Gigas*. I got fifty-one of the butterflies, of which only two were females." Two days later, he sent fifteen more eggs, laid in Victoria by the female he had brought in on the second day, and wrote: "*Gigas* flies to the very top of a bald, rocky knob, Mt. Findlayson, the highest peak in this part of the island, elevation, I understand, about 4000 feet. The knob is almost solid rock, and it is covered in part with lichens and mosses, brown and black with age and exposure. But large areas are of clean rock, wind-swept, and similar in color to the mosses. Upon the rock this butterfly rests, with closed wings, and it is wholly invisible when quiet. So far as I saw, the males spend nearly all their time on the rocks. I never saw one on a flower, or alighted on anything but rock. Other butterflies also fly about and over the peaks, Papilios *Zolicaon* and *Eurymedon*, Argynnis *Bremnerii*, etc.

The *Gigas* take delight in rising up to chase any passing fly, follow it a little way, and then return to their own spots. If started up by myself, and not alarmed, they flew circling about for a few moments, and then alighted, frequently at my feet. I found them, therefore, easy to take on the wing, and when alighting. By one or two o'clock the chill sea air begins to be felt, as it comes in from the Strait de Fuca, and at once not a *Gigas* is to be seen. In the two days I spent on the mountain, none were taken after 1.30 P. M. The female that laid the eggs I found upon the highest peak, fluttering gently along the base of a big rock, and ovipositing, either as she flew or alighting a moment for the purpose. After capturing her, I sought a suitable place, sheltered, and bagged her over or in a little clump of bunch grass, parting the grass and putting the bag in the opening. So I left her over the night. The next day, the second butterfly taken proved to be a female, but I had killed it before I made the discovery of sex, because it had dropped among some stones and was rescued with difficulty. This female was taken at the base of the peak, some 300 to 400 feet below the highest point. The knob is so small that it is incapable of accommodating any large number of these butterflies, and on the second day, but one was taken after 11.30 A. M. — I had got them all. At 1.30 P. M. that day, I first observed the eggs, which were adhering to the sides of the bag.

"The approach to Mt. Findlayson from the railway station is through a dense forest, and over rough mountain side, say for three miles, one of which is along a cattle-path, if you can find it (I could not), and the rest through thicket. Arriving at the base of the knob, one wonders how he can ascend it. But there are little shelves that zigzag this way and that, and the ascent is less difficult than it seemed likely to be."

In a letter of 1892, Mr. Wright says: "Vancouver is cold, wet, dominated by high and raw winds, so much so that the fir-trees extend their branches only on the landward side, while toward the sea they are stunted and unable to grow. On the island and along the coast the rainfall is immense, but the Cascade Range stops it all, and the plains to the east of the range are consequently arid, as the rain-bearing winds are always from the ocean. Now, precipitation in itself does not count so much, but the consequences, in vegetation and aridity, are great, so that in crossing from the west over the Cascade Range is like going from a cool, damp spring into dry summer, and each region has its separate fauna and flora. It seemed to me, from what I saw of Vancouver and Sitka, that the climate of the former was considerably the colder and bleaker of the two. There, in the sub-arctic forest, *Gigas* lives, chiefly on rocky bare knobs, above the surrounding timber, and outside the shelter of it. That was my experience. As related, the

only ovipositing I observed took place upon the highest and bleakest point, at the immediate base of the rocky knob. There was a total absence of either sex at much lower elevation, or in the meadows which lie lower down, though I hunted through these and took other species of butterflies.

"On the other hand, Chionobas *Idana* inhabits the slopes of evergreen redwood forest, not the tops of the hills, whether bare or tree-clad, nor the grassy openings. This is the redwood district of northeastern California, on the Pacific coast. *Idana* simulated Limenitis in habits and flight, differing decidedly from both *Gigas* and *Californica*. It sails along with wings extended horizontally, as does Limenitis, and in a way not usual with Satyrids. It never alights on the ground, like *Gigas*, though the male does sometimes alight on dead leaves for warmth, when it is growing cool in the afternoon; but its usual place of alighting is on a green twig of tree or on a shrub. Its flight has the darting movement characteristic of the Californian species of Limenitis, and entirely unlike the movement of *Gigas*. The male likes best to take his position on the extreme point of a green twig that reaches out horizontally, and there, *with wings wide open, flat*, like Limenitis and Grapta, to sun himself. In such case he will not permit one to approach nearer than about twenty feet before taking flight. He must usually be taken on the wing. Now, neither *Gigas* nor *Californica* rest with wings open, so far as my observation goes. *Gigas* is much easier to capture than *Idana*, because it is most of the time at rest, and returns to the same spot after a chase with another butterfly, while *Idana* must be taken on the wing.

"In contrast to the other two species, *Californica* lives in a semi-desert country, both as to land and air, the hot, arid regions of east Oregon and Washington, and of northeast California, where the temperature is half-tropical. *Gigas* is semi-arctic, living amid the cold, dark fir forest; *Idana* is temperate, living in the mild, dark redwood forest; *Californica* is semi-tropical, living in open, dry, warm glades, in the 'bush-land,' on the border between the forest and the open plains. *Gigas* alights on bare rocks; *Idana* on green twigs; *Californica* on dead or dry grass. I never saw this last-named species alight on trees or limbs, but on the ground in grassy places, exactly after the habit of C. *Varuna*, as I saw it in east Montana.

"As to the climate of *Idana*, it is cool and damp all the year, with but little snow or ice; heavy and continued rains all the winter, and both early and late. The hibernating larvæ must be soaked for four months or more. This butterfly lives and breeds directly in the evergreen forest, the redwood slope, not in the sunny, grassy openings. I have been at all these places, and I know the difference in climate. To an eastern man these differences may seem apochryphal, because no such state of things is found on the Atlantic coast. But they are

real. The Coast Range of mountains, from British Columbia to Mexico, marks a positive line of climate, from moist and wet on the western side, to hot and dry on the eastern; and the fauna and flora change to correspond. *Gigas* lives in the latitude of Newfoundland; *Iduna* in that of Baltimore; while *Californica* ranges from the latitude of Winnipeg to that of Philadelphia. The corner of Washington bordering on the Strait de Fuca is a grand pile of rough mountains, culminating in Mt. Olympus, some 8000 feet high; this whole corner of the State, bordering on the sound, the strait, and the ocean, having an area nearly as large as Massachusetts. It is almost wholly unknown, unexplored, and uninhabited. It resembles Vancouver in climate, but apparently differs in geological formation, being less like a solid rock, and having soil and sand beaches. On the forestry maps of the U. S. Department of Agriculture, this region and Vancouver are represented as covered by the Sitka spruce. I see no climatic reason why *Gigas* should not be found in that corner of Washington. All this region is of very raw, rough climate, with high winds and chilling fogs. The Strait de Fuca, forming a gap between the mountain ranges, opens a pathway for the cold sea winds. *Californica* could not live on Vancouver's Island, any more than Argynnis *Diana*, of West Virginia, could live in the Chionobas *Semidea* district of New Hampshire. When climate offers no obstacle, *Iduna* does not go north to meet *Gigas*. The temperate belt of the western slope extends from San Francisco, on the coast, widening to the northward, till in southern Oregon it reaches from the sea to the Cascade Mountains, some two hundred miles, and in north Washington is reduced to a narrow strip between those mountains and the Sitka spruce region, and so to the Canada line and beyond. In California, on the coast, this belt includes the Redwood District, but in Oregon and Washington it is characterized by the Douglass spruce. There would seem no climatic obstacle to prevent *Iduna* from going north in that belt even to the latitude of Victoria, the habitat of *Gigas*. *Gigas* is not known south of the strait, though it may yet be found in the peninsula. It certainly does not come down the coast below the Sitka spruce region. Nor has *Iduna* been seen beyond to the north, or outside of to the east, the Redwood slopes of California. And thus there is left unoccupied by any species of Chionobas, a district of eight degrees of latitude broad, from 40° to 48°, or of five hundred and sixty miles. In proof that this district is really unoccupied, I will cite the names of experienced collectors, who, to my knowledge, have traversed it in various directions and at various times, some of them several times, stopping off where the country seemed particularly favorable for their object: Messrs. Crotch, Morrison, Koebele, Dunn, Owen, and myself. And not one of them has seen a Chionobas in west Oregon or west Washington. There certainly is indication of specific difference between these forms in their

widely separated localities of strongly contrasted climates, as well as in their habits and manner of flight; and all this is in line with the differences in the coloration of the butterflies themselves, and what you tell me of the behavior of the larvæ.

"*Californica*, on the other hand, as I have before said, inhabits the open, grassy glades of oak and pine (the grass all dead and dry when this butterfly appears) next east of the Cascade Range. Mr. Koebele took examples of it at Cle-elum, Kittitass County, Washington. This town is in the scattered pine region, at the base of the range, where only scanty crops of barley and oats are raised without irrigation.

"*Californica* has been taken in large numbers by Professor Owen and Mr. Cunningham, at Lake Klamath, in southwest Oregon. At that locality immense lava beds and salt marshes abound. The lake is a 'sink,' but a live one; that is, it receives more water than it can evaporate, and the surplus flows away by Klamath River. There are dozens of smaller sinks that are 'dead,' real dead seas; the water so salt and alkaline as to be poisonous. They never run off any water, but the depth varies according to the season's rains. The water is all the time becoming more salt, and these lake-beds will in time become 'dry lakes,' or mud flats, in dry seasons. So far as I know, *Californica* there inhabits the side hills and benches where the grass is already dried up for the summer, because the spring rains are exhausted, and there are no summer rains. Two specimens of *Californica* brought me this last season (1894) from the Sierras east of Red Bluff, in northern California, and the most southern locality in which this species has been seen, were taken near a green meadow, but yet up on the dry slope above it where the grass was dead (on 29th June), elevation 4500 feet. Here also were scattered pine-trees."

Professor Owen, in 1892, spent several weeks at Fort Klamath, and brought away some three hundred examples of *Californica*, nearly one half of which were in my possession for examination, as before related. Mr. Owen wrote me that he found these butterflies "on low ground, among scattered pine-trees, which rarely furnish dense shade; elevation about 4000 feet. They alight on dead and dry standing trees, logs, dry twigs, and dead leaves, also pine cones. They are low fliers, and I should compare their flight rather with Argynnis than Limenitis."

Mr. Cunningham lives near Fort Klamath, and for several years has been a collector of butterflies. He writes: "*Californica* frequents open glades, among scattering pines, with more or less vegetation under foot. It is also to be seen in more thickly timbered localities where there is a dense growth of 'buck brush' a name applied to a thicket of semi-thorny shrub. It is found of a dry hollow, or

'gulch.' I have never seen it on the ground, or on rocks, or moss, but I have several times seen it on dry logs and dry twigs. On one occasion I saw a pair in coition on the trunk of a green fir, but with that exception I never saw this butterfly alighted on a green tree. I have seen the female on a shrub, the 'chaparral,' a dry bush something like 'sage brush,' with few and small leaves.

"Its flight is not tremulous, or wavering, like some of the Satyrids, but there are three or four rapid strokes, and then with wings closed over the back, it sails straight ahead; then another movement of the wings, and another sail. Often the female will dodge into a bush when struck at, and no amount of shoving will dislodge her. The males are almost always in motion, apparently watching for the appearance of the females, and really I have rarely seen them at rest."

The most northern locality at which *Californica* has been taken is Enderby, east of the Cascade Range, in the latitude of Mt. Prevost, on Vancouver's Island, by Mr. Green, who was at the time engaged on the construction of the railway to Vernon (through Enderby) from the Canadian Pacific Railway. Mr. Green tells me that that district is very hot in summer,[1] "the altitude where I took the two females which were sent you is from 1300 to 2000 feet; the country timbered, with grassy and rocky openings."

These females, sent by Mr. Green, were unmistakably *Californica*, their under surfaces flushed with red-brown, as shown in the Plate of Volume II.

There is no doubt that the three species, *Gigas*, *Californica*, and *Idana*, more especially the first two, are badly mixed up in many collections. It has come to my knowledge that one of the American accumulators of butterflies, who has distributed his specimens by sale or exchange far and wide over both continents, sent out what he called *Gigas*, "received from Oregon," and which was not, and could not have been, anything but *Californica*, for no other member of the group lives in Oregon.

On the Plate to follow, Chionobas XII, phases of *Idana* and *Californica* will be figured, and the stages of both (except pupae) fully illustrated.

[1] Mr. James Fletcher, who was visiting Mr. Green, wrote me July 28, 1895, that this region is "in the hot, dry, desert part of British Columbia."

EXPLANATION OF THE PLATE.

GIGAS. 1 ♂ ♂, 3, 4 ♀ ; *c* var. *g*.

a, Egg ; a^1, micropyle.

b, b^2, Young Larva ; b^3, head.

c, Larva at 1st moult ; c^2, section of dorsum, segments 7, 8 ; c^3, head.

d, Larva at 2d moult ; d^2, segments 7, 8 ; d^3, head.

lines, the sequence of one line of advance being alternate to that of the other. Such a species would traverse the centuries in two processions, one having a year the start of the other, so that a cycle of development in the one procession completes its course a year in advance of the correspondent cycle in the other. But the wayfaring children of *Alberta* apparently all travel in one caravan."

Mr. Bean sent me ten eggs of *Alberta*, laid on Dryas octopetala in confinement, July 20 and 21, 1890. There were some other plants in the can, he wrote, on which a few eggs were laid, but nearly all were on the leaves and stems of the plant first mentioned. The eggs hatched on 30th and 31st July, or after ten days. The larvæ at once went into hibernation, and died in course of the winter. Mr. Bean told me that the larvæ with him were lost in the same way.

CHIONOBAS VIII.

CHIONOBAS SUBHYALINA, 1–5.

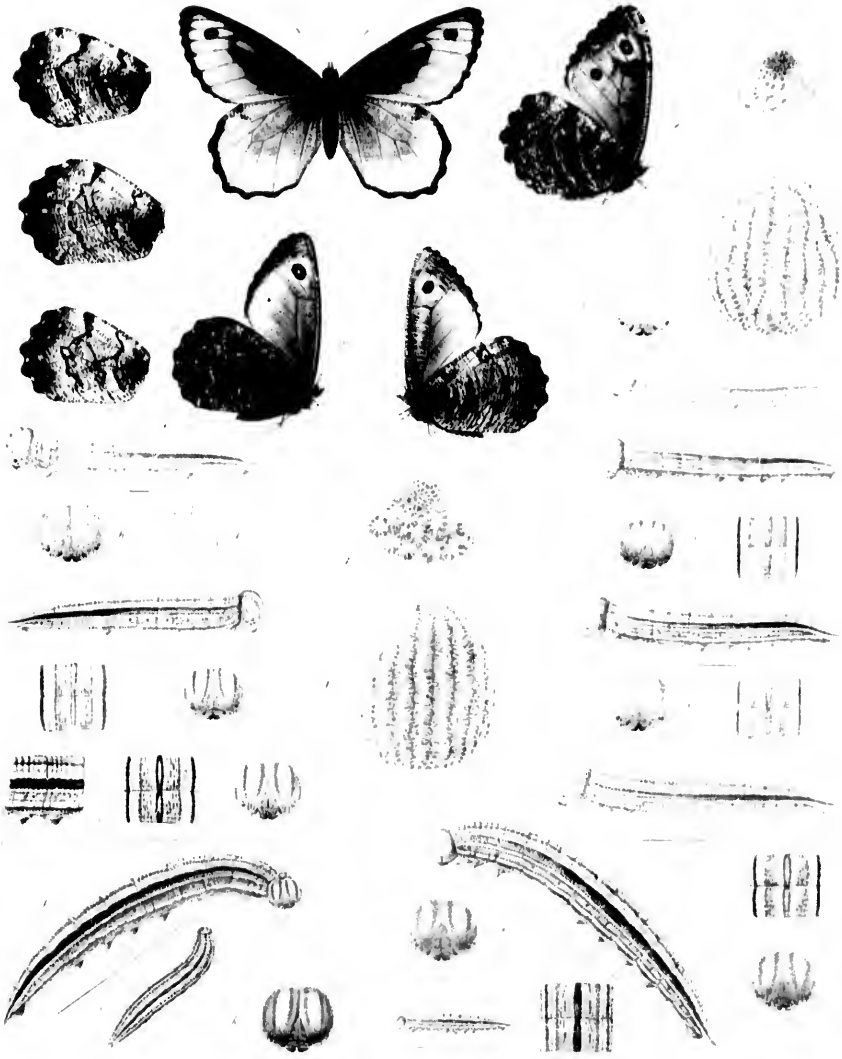
Chionobas Subhyalina, Curtis, in Appendix to Ross's Narrative N. W. Passage, p. 68. 1835; Edwards, Canadian Entomologist, Vol. XXV., p. 137. 1893; *Beanii*, Elwes, Trans. Ent. Soc. Lond., p. 476. 1893.

Male. — Expands from 2 to 2.1 inches.

Shape of C. *Brucei* and C. *Uhleri*, and fully as transparent as the former; primaries narrow, produced apically and pointed, the hind margin sloping inward more than in *Semidea* or *Œno*. Upper side pale gray-black; primaries sometimes have a faint sexual stripe, oftener no trace of it; one example under view shows two light sub-apical points, transverse, pupils of incomplete ocelli; costal edge whitish, freckled next base with black; fringes of both wings yellowish white, dusky at the ends of the nervules.

Under side of primaries paler, the costal and apex gray-white, or yellowish white, streaked and mottled with brown; in some examples the rest of the wing is free from markings (as shown in Fig. 1); but in others the extra-discal area and the costal half of the cell are covered with transverse, abbreviated streaks of brown, more or less distinct (as shown in Fig. 4).

Secondaries vary much, some showing a distinct though faint mesial band (Fig. 2), others almost none at all (Fig. 3), with intermediate grades; sometimes there is no more than a suggestion of the band in cloudy patches on either margin; where the band is complete, the edges are darkened and definite, the outer one crenated from the elbow on upper branch of median to costa, and wavy or erose from elbow to inner margin; on the inner edge there is a prominent projection on the sub-costal nervure, either angular or rounded, followed by a nearly rectangular sinus in the cell; the whole wing is covered with whitish or luteous scales, intermingled with which are brown ones more or less grouped into fine, abbreviated streaks, especially over the basal area and along the inner margin; sometimes there is a narrow space of nearly clear white just outside the band; on the edge of hind margin a pale dot in the middle of each interspace, and often



IDUNA ♂ ♀ VAR ♂

a. Egg b. Larval States

CALIFORNICA ♂ VAR b. a. Egg b. Larva

GIGAS ♂ VAR

CHIONOBAS XII.

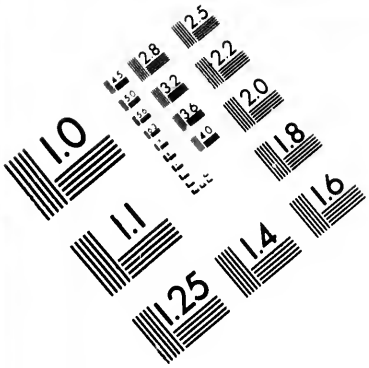
CHIONOBAS IDUNA, 1–5.

Chionobas Iduna, Edwards, Butt. N. A., Vol. II., pl. 43, p. 275.

Egg. — Sub-conic, shaped as in *Gigas;* marked by from twenty to twenty-two ribs, the summits and slopes of which are as in *Gigas;* the micropyle is in the centre of a rosette of shallow six-sided cells, the boundaries of which are raised like threads; outside of these are two or three rows of similar irregular cells, gradually enlarging; beyond to the end of the ribs a network of low knobs, with numerous little ridges radiating from each; these ridges are very short — not prolonged across the interspaces, and are less distinct than in some other species; color gray-white. (Figs. *a*, a^2.) Duration of this stage sixteen days in June and July, 1892; fourteen days in July, 1893.

Young Larva. — Length, at twenty-four hours from the egg, .14 inch; shape as in *Gigas* and *Macounii;* 13 ending in two short sub-conical tails, which meet at base; the body processes the same in number, position and form as in the species named; color at first pinkish gray, in less than one day green-gray, the stripes red-brown, the mid-dorsal and sub-dorsal narrow and equal, the lateral narrower than in *Gigas*, greenish anteriorly, elsewhere reddish; the basal ridge yellow-white, and beneath it a red-brown thread; feet and legs gray-white, translucent; head considerably broader than 2, the front well rounded, broadest below, narrowing upwards, depressed at the suture; surface covered with shallow indentations, and showing a few tubercles, each with its short, clubbed, and bent white process; color greenish yellow, with a tint of brown. (Figs. *b*, b^2.) Duration of this stage sixteen days in 1892, thirteen in 1893.

After first moult: length at one day, .25 inch; shape of the species named, the tubercles and processes same; color light buff; the mid-dorsal stripe green, with thin lines of brown at the edges; the dorsal area (or band) next the stripe



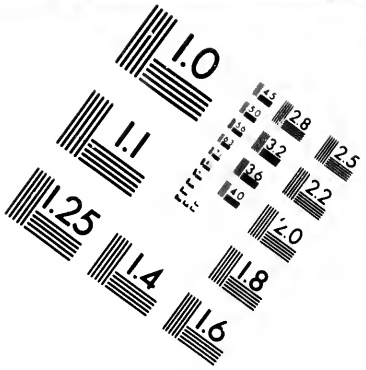
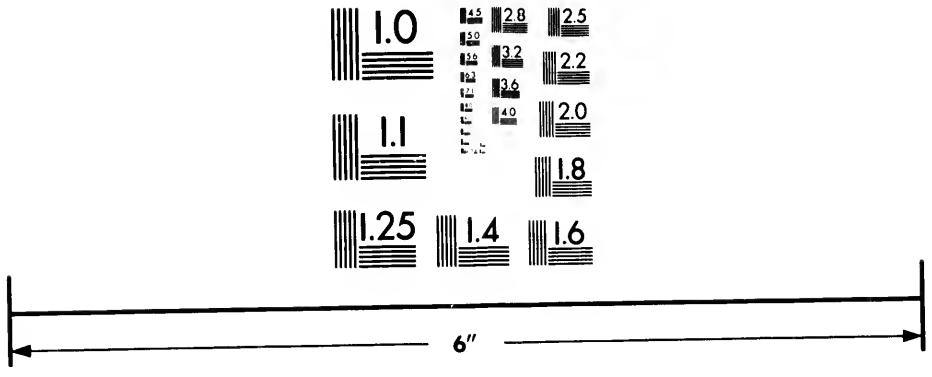
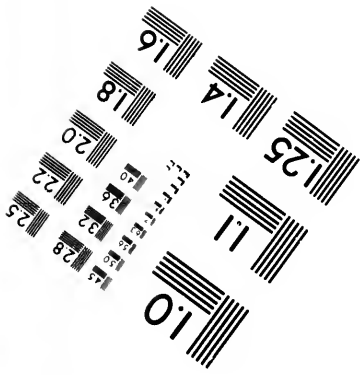
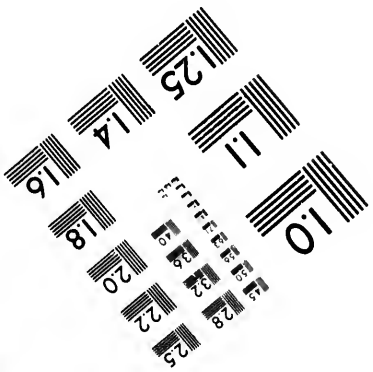


IMAGE EVALUATION TEST TARGET (MT-3)







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buff shading into pale green without, and all of it finely streaked longitudinally with brown; the sub-dorsal stripe brown, the area below this buff; the lateral stripe green anteriorly, on both sides thinly edged by vinous-red, the posterior half wholly of this last hue; the spiracular band greenish, and both over and under it a fine brown line; under side, feet and legs greenish white; head same shape as at first stage; color pale green-yellow, the six vertical stripes as in the genus, pale brown, not distinct. (Figs. *c*, c^2, c^3.) Duration of this stage nine to seventeen days in 1892; twenty-six days in 1893. Part of the larvæ hibernated soon after first moult.

After second moult: length, at one day, .34 inch; shape as in second stage, the tubercles and processes similar; color light yellow-buff; the stripes as before, except that the lateral is edged on both sides by black; the dorsal area more distinctly streaked brown; head as before, the vertical stripes still not distinct. (Figs. *d*, d^2, d^3.) To next stage eleven to fifteen days in 1892; fourteen to seventeen, in 1893. Some larvæ hibernated soon after the second moult.

After third moult: length, at twenty hours, .54 inch; same shape; color buff; the mid-dorsal stripe black, green within; the streaks on the dorsal area much darker; the sub-dorsal stripe lost; the lateral with heavy black edges, green within, vinous posteriorly; head as before, the vertical stripes more distinct. (Figs. *e*, e^2, e^3.) To fourth and last moult fifteen to twenty days.

After fourth moult: length, at one day, .6 inch. (Fig. *f*.) In fifteen to nineteen days was full-grown.

Mature Larva. — Length 1.1 to 1.3 inch; shape of *Gigas* and *Macounii*, thick in the middle, tapering about equally either way, and ending in two short sub-conical tails, which meet at base; surface thickly covered with fine tubercles (as in the other species), each bearing a short, tapering process; color brownish buff, striped and banded longitudinally, as in the genus; the mid-dorsal stripe black; next this the dorsal area, or band, is whitish shading into buff without, and streaked longitudinally and finely with black and dark brown; the sub-dorsal stripe slight, indicated by a line or two of black interrupted streaks; the area outside this pale buff, with a brown thread running through the middle; the lateral stripe or band black over the posterior two thirds, buff streaked black on the anterior segments; the spiracular band greenish buff; the basal ridge yellow-white, as are the feet and legs; head small, and, as in the genus, sub-globose, broadest below, narrowing a little upward, slightly depressed at the suture; the

surface thickly covered with shallow indentations, with many tubercles and processes like those on the body; across the top six vertical stripes, as in the genus, the indentations within these black. (Fig. f^2, greatly enlarged; f^3, dorsal view of segments 7 and 8; f^4, head.) The larvæ died without pupating.

I received from Mr. W. G. Wright thirty-three eggs of IDUNA, laid 18th to 21st June, 1892, at Mendocino, California. The larvæ began to hatch 5th July, and by 8th I had seventeen. Part of the eggs had been sent to Mrs. Peart, who wrote, 12th July: "I see no difference between the young larvæ of *Iduna* and those of *Gigas*, except that the former do not seem so bright in color; the stripes of *Gigas* were as bright as those of *Macounii* — very red." Ten of my larvæ lived to pass their first moult on 21st July and subsequent days. The first one passed its second moult on 29th July, others at intervals to 9th August. Shortly after, the number was reduced to six. The missing larvæ simply disappeared; I supposed they went to ground, or into the sod, for hibernation, but on searching could discover none. They are so very small and of such dull color that they might easily be overlooked. The first larva passed its third moult 9th August, the second one on 14th. No other reached that moult. Two were found dead, and the rest may have gone to ground. The second larva spoken of died before fourth moult, but the first reached that moult 4th September, but not without assistance in getting rid of its old skin. It had been constricted so long that the mandibles were deformed, and consequently the larva died from starvation. Mrs. Peart had brought one larva to fourth moult 24th August, and it continued to feed well and grew rapidly. On 26th August, it was .96 inch long; on 5th September, 1.3 inch, obese and evidently full-grown. But by accident it fell to the floor and was mortally hurt.

Twelve eggs were received from Mr. Wright, mailed from Mendocino, 25th June, 1893. These began to hatch 9th July, and eleven larvæ were obtained. The first one passed its first moult 22d July, and by 1st August nine larvæ had got through that moult. But three passed the second moult, and one of these was soon found to be in lethargy, and was sent to Clifton Springs, New York, to go into the refrigerating house there. One reached third moult 3d September, the fourth, 23d September. This larva was resting on its sod on 28th, in the morning, but at 2 P. M. was not to be seen or found, though I searched both earth and sod for it. By all which it will appear that these larvæ are grown in confinement with much tribulation. Mrs. Peart had been more successful, and had reared a larva which passed third moult 22d August, the fourth, 11th September. By 29th September, this had reached a length of 1.32 inch, and being mature and sleepy was sent to Clifton Springs. The two larvæ came back to me in the following March, apparently healthy, but both died during April.

So it happens that a pupa has never been seen in this group of Chionobas. In *Iduna*, *Californica*, and *Macounii* one or more larvæ have reached the adult stage, but refused to go farther. I have given them sand, friable earth, moss, and sod, hoping that in one or the other pupation might take place. But the larvæ have usually lingered for days or weeks, eating nothing, moving about a little, only to die as larvæ at last.

As was said under Chionobas XI, *Iduna*, in contrast to the allied species, almost always has the male pale yellow-brown, and Figure 1 gives a good representation of this hue. So also Figures 2, 3, 4, well show the peculiar hoary, thinly-streaked surface of the under side of hind wing, and the usual style of outline of the band. Figure 5 is taken from the only melanic *Iduna* observed.

Figure 7 is the likeness of a prettily marked *Gigas* female.

CHIONOBAS XII.

CHIONOBAS CALIFORNICA, 6.

Chionobas Californica, Boisduval ; Edwards, Butt. N. A., Vol. II., pl. 44, p. 281.

Egg. — Sub-conic, shaped as in *Iduna* and *Gigas*, but larger; marked by twenty-two or twenty-three ribs, somewhat sinuous, occasionally branching either near the top or bottom; narrow at summit, rounded, the slopes flat, the spurs between the fine excavations more separated than in the other species, and standing at all angles to the rib; the micropyle is in the centre of a rosette of shallow six-sided cells, the boundaries of which are thread-like; outside of these are two or three rows of similar irregular cells, gradually enlarging; beyond to the end of the ribs are two and three rows of little welts or cushions, with fine ridges radiating from each; these ridges sometimes cross the spaces between the welts, but most often do not; the arrangement is distinctly more star-like than in the other species named; color gray-white. (Figs. *g*, g^2.) Duration of this stage thirteen days, in July.

Young Larva. — Length, at one day, .16 inch; shape as in *Iduna* and *Gigas;* 13 ending in two short sub-conical tails, which meet at base; the processes same in number, position, and form as in the other species; color, just from the egg, pink with a gray shade over dorsum, in a few hours greenish gray over the whole dorsal area, the last segments vinous tinted; the mid and sub-dorsal stripes narrow, equal, red-brown; the lateral broad as in *Gigas*, vinous, green anteriorly; the spiracular band gray-green; the basal ridge yellow-white; under side, feet and legs gray-green, translucent; head as in the other species; color brownish yellow. (Figs. *h*, h^2, h^3.) Duration of this stage six to eighteen days.

After first moult: length, at one day, .26 inch; shape of the other species named; the tubercles and processes same · color yellow-buff, the stripes and bands as in the genus; the mid-dorsal stripe gray edged with vinous; next this

the ground is pale buff shading into darker buff, the whole area finely streaked longitudinally with pale brown; the sub-dorsal stripe a mere line, vinous, the ground below it pale buff, cut through the middle by a thread of brown; the lateral stripe vinous, gray-green within anteriorly; basal ridge yellow-white; under side, feet and legs pale buff; head same shape as before, indented and tuberculated as in the species named; color pale yellow-brown; the vertical stripes as in *Iduna*, but heavier because of the blackness of the indentations within them. (Figs. i, i^2, i^3.) Duration of this stage ten to twenty-one days. The larvæ whose stages were prolonged went into lethargy soon after second moult.

After second moult: length, at twenty hours, .35; shape as at second stage, the tubercles and processes same; color yellow-buff; the mid-dorsal stripe pale black, green through the middle; the dorsal area buff clouded brown, and streaked with darker brown; the sub-dorsal line vinous, the ground below it reddish buff, cut in the middle by a brown line; the lateral stripe, or band, black with a vinous tint, edged buff below; the spiracular band gray-green, edged on both sides by red-brown; the ridge pale buff, as are the under side, feet and legs; head as at second stage, with similar stripes (not figured). Duration of this stage ten days.

After third moult: length, at one day, .6 inch; same shape; color yellow-buff; the mid-dorsal stripe black, cut by green at the middle of each segment; the dorsal area yellow-brown, streaked with darker brown; the sub-dorsal line vinous, the area under it buff, cut as before by a brown thread; the lateral band broad, vinous-black; the spiracular band gray-green, thinly edged with brown; head as before. (Figs. j, j^2, segments 7 and 8; j^3, head.) To next stage nine days.

After fourth moult: length .68 inch; in twelve days was full-grown.

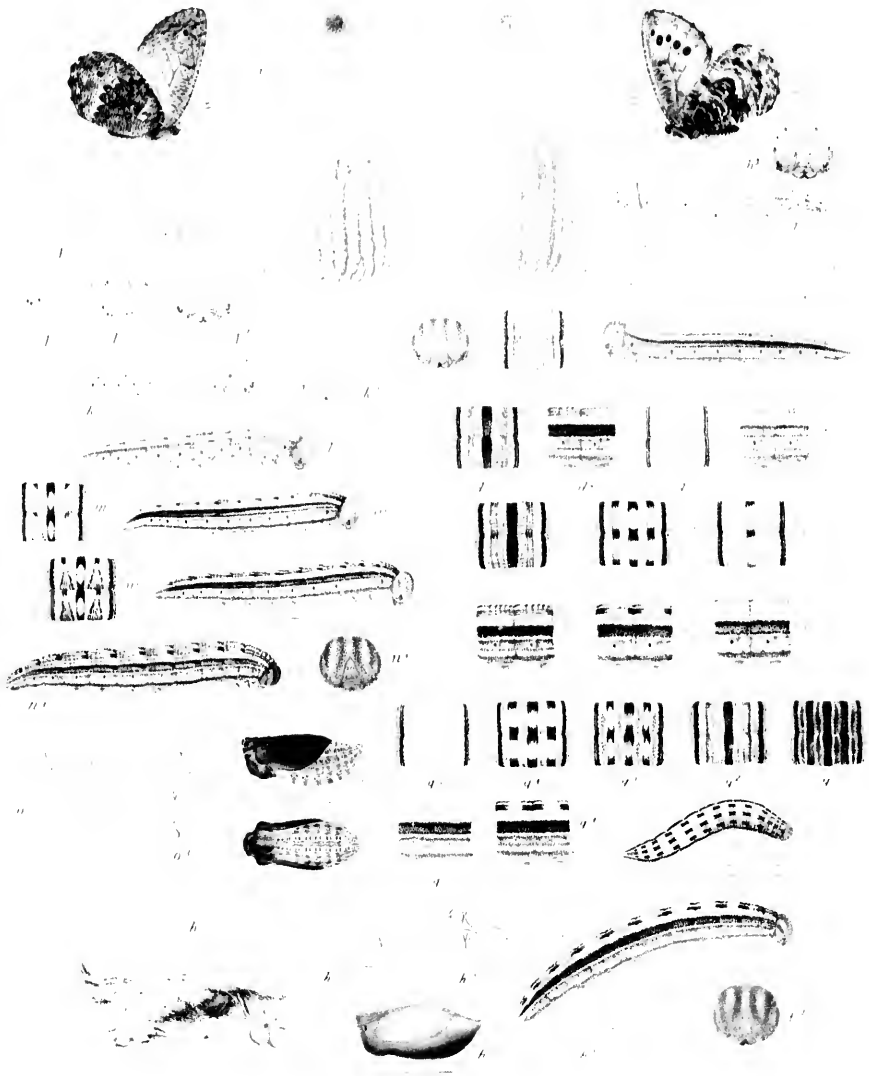
Mature Larva. — Length 1.18 inch, greatest breadth .16; shape of the group, thick in middle, tapering about equally either way, and ending in two short sub-conical tails, which meet at base; surface thickly covered with fine sub-conical tubercles of irregular sizes, each bearing a short tapering process; color brown-buff, striped and banded longitudinally as in the genus; the mid-dorsal stripe black; the dorsal band next the stripe whitish shading outwardly into brown, and throughout finely streaked longitudinally with darker brown and black; the sub-dorsal stripe scarcely more than a macular black line; below, the

ground is buff with black specks running through the middle; the lateral band deep black, a little mottled buff anteriorly; the spiracular band green-buff; the ridge yellow-white; under side, feet and legs brown-buff; head small, and, as in the other species, sub-globose, broadest below, narrowing a little towards top, depressed slightly at the suture; the surface thickly covered with shallow indentations, with many tubercles and processes like those on the body; across the top six vertical stripes, as in *Iduna* and the genus, the indentations within these black. (Figs. k, natural size; k^2, greatly enlarged; k^3, head.) The larvæ died without pupating.

I received, 6th July, 1890, twenty eggs of CALIFORNICA from Mr. Albert Koebele, then at Spokane Falls, Washington. These began to hatch on 13th, and by the 16th there were fourteen larvæ. On 30th July, three passed the first moult; others passed this moult at intervals up to 9th August. On 21st August, one passed second moult. All but two of the larvæ went into hibernation immediately after the second moult. One of the two passed the third moult September 2d, and fourth moult September 16th. The other I had sent Professor Riley at Washington, and it was returned to me after its fourth moult. Both these larvæ were torpid by 30th September, and were kept out of doors, shaded from the sun. On 5th February, 1891, I brought all the larvæ into the house. There were two alive, past second moult, and the two adults, the latter lying half buried in the sand that covered the earth of the flower-pot. They all looked healthy, and were put out of doors again, and so remained till 9th April. For some time previous to that date the weather had been cool, with several falls of snow, but suddenly a change to warm had come. I found the smaller larvæ and one of the adults dead, the other was of good color, and I hoped to see it pupate in a few days. Day by day it moved a little, and once was found on the sod, but by April 25th was dead.

EXPLANATION OF THE PLATE.

1. IDUNA, 1, 2, 3, 4 ♂; 5 var. ♂.
   - *a*, EGG; a^2, micropyle.
   - *b*, YOUNG LARVA; b^2, head.
   - *c*, Larva at 1st moult; c^2 section of dorsum, segments 7 and 8; c^3, head.
   - *d*, Larva at 2d moult; d^2, section, 7 and 8; d^3, head.
   - *e*, Larva at 3d moult; e^2, section, 7 and 8; e^3, head.
   - *f*, Larva at 4th moult.
   - f^2, ADULT LARVA, greatly enlarged; f^3, segments 7 and 8; f^4, head.
2. CALIFORNICA 6, var. ♂.
   - *g*, EGG; g^2, micropyle.
   - *h*, YOUNG LARVA; h^2, segments 12, 13; h^3, head.
   - *i*, Larva at 1st moult; i^2, segments 7, 8; i^3, head.
   - *j*, Larva at third moult; segments 7, 8, side view; j^2 same, dorsal view; j^3, head.
   - *k*, ADULT LARVA, natural size; k^2, same enlarged; k^3, head.
3. GIGAS 7, var.



VARUNA

a a¹ Egg *magnified* *b Larva* *q a a¹*

b q Larva a a¹ a² a³ a⁴th moult *a* *mag: d°*

ŒNO 2 ♀

a a¹ a² Egg *magnified* *b Larva young a a¹ a⁴th moult magnified*

a a¹ a² Chrysalis *mag: d°*

CHIONOBAS XIII.

CHIONOBAS VARUNA, 1

Chionobas Varuna, Edwards. Butt. N. A., Vol. III., Part 12, text and plate.

Egg. — Conical, narrowing but little upwards, truncated at top, the sides moderately curved; marked by twenty to twenty four vertical rounded ribs; these are as in *Uhleri*, nearly or quite straight, about as high above the surface as broad; the interspaces nearly flat; the horizontal striæ in the interspaces exceedingly slight; the micropyle is in the centre of a flat rosette of five-sided, shallow cells, the walls of which are raised, thread-like, on the surface; outside of these are two rows of similar larger cells, and, beyond, a network of ridges radiating from central rounded prominences; color chalk-white. (Figs. a, a^2.) Duration of this stage, about twelve days.

Young Larva. — Length at twenty hours from the egg, .1 inch; thickest anteriorly, tapering from 2 on dorsum and sides the last segments curving to 13, which ends with two short, sub-conical tails meeting at base; the tubercles and processes as in *Uhleri;* color gray-green; a mid-dorsal and sub-dorsal pale brown line; the lateral stripe gray-green anteriorly, a little darkened after 5 or 6; under side, feet and legs greenish white; head broader than 2, sub-globose, the front well rounded, broadest below, narrowing upwards, depressed at the suture; the surface covered with shallow indentations, and showing a few tubercles, each of which bears a short, slightly clubbed and bent white process; of these there are twenty, ten on either side, disposed as in the genus. (Figs. b–b^3.) Duration of this stage eleven days.

After first moult: length at twenty-four hours, .2 inch; nearly the same shape; the tails sub-conical; color whitish buff; the upper stripes slight, green edged with brown; the lateral vinous-black, green within on the anterior segments; basal ridge white; under side, feet and legs greenish white; head more

globular, very little broader at the base; the surface thickly covered with rather deep rounded indentations, between some of which are minute tubercles with processes similar to those on the body; from back to front six dusky stripes, as in the genus; color pale green-yellow. with a tint of brown. (Figs. *c*, c^2, c^3.) Duration of this stage, seven days.

After second moult: length, at one day, .34 inch; shape as before; the color variable; some larvæ are whitish buff, the upper stripes pale green, the lateral band green overlaid with pale black, the spiracular band greenish, the basal ridge white (Figs. *d*, *d*); others have the dorsum yellow-buff, the stripes and lateral band all black; the spiracular band and the ridge as in the other variety; both have the dorsum and sides much covered with fine rust-red longitudinal streaks; head as before, pale greenish-yellow. (Figs. d^2, d^2.) To next moult, about fifteen days.

After third moult: length, at thirty hours, .5 inch; shape as before; the markings more variable, as shown in figures *e*, e^2, e^3, *e* being very much like one phase of *d*, only that the lateral band is deeper black, and the mid-dorsal stripe has a black spot on the front of each segment; in e^2 all the upper stripes have black at the intersections of the segments, making rectangular spots with ragged edges; e^3 has the mid-dorsal stripe solid black, the sub-dorsal green, a little crocked at the intersections of the segments; all are streaked with russet, as at last previous stage; head as before. Duration of this stage, seven to eleven days.

After fourth moult: length, at one day, .7 inch; in seven or eight days the larvæ were fully grown.

Mature Larva. — Length, .90 to .94 inch; stout, thickest in the middle, tapering rapidly to either end; 13 has two sub-conical tails which meet at base; color very variable, as shown by the five figures, *g* to g^5; g^5 closely follows *d* of second moult; g^2 follows d^2; g^3 follows e^2 of third moult; g^4, dorsum and side views, was of pale color, the black spots in the stripes large; the full length *f*, f^2, are of this variety; *g*, of which but a single example was obtained, is much like adult *Uhleri;* the stripes and lateral band all black, the intervening bands solid green; all the varieties much covered with fine russet streaks; under sides, feet and legs of all, green with a tint of brown; head small, as broad as 2, subglobose, broadest below, narrowing a little upwards, very slightly depressed at the suture; the surface thickly covered with shallow indentations, between some of which are small tubercles with processes; color greenish yellow with a

tint of brown; across the top six broad dark brown stripes, as in the genus. (Figs. *f*–*f*^{3}, *g*–*g*^{5} same in vars.) From fourth moult to pupation, eleven to twenty days.

Chrysalis. — Length .48 inch; breadth at mesonotum .2, at abdomen .24 inch; a second was .46 inch, breadth at mesonotum .2, at abdomen .22 inch; another, probably a female, was .6 inch long, the breadths as in the first example; cylindrical, very stout, the vertical side much arched, nearly as much so as the dorsal side; head case truncated, rounded both ways; the eye cases rather prominent; mesonotum without carina, rounded both ways, curving from the summit to the top of head; the thoracic depression shallow; the wing cases considerably elevated, smooth, waxy-looking (as also is all the ventral side of the anterior segments), sloping down to abdomen; abdomen conical, tumid; the surface of head case at top and on dorsal side, and of all the abdomen, granulated but immaculate; the cremaster naked, without hooks or bristles; it consists of a blunt, trifid ridge, the two outer lobes large, knobbed, nearly or quite touching each other; the anal orifice and plate well defined. (The cremaster, as will be seen, differs considerably from that of *Uhleri* and from *Chryxus*, with which *Uhleri* is compared.) Color greenish-yellow, with a tint of brown over the wing cases and the ventral side of the anterior segments, also over head case and mesonotum, the abdomen a shade darker, — more brown. (Figs. *h*–*h*^{5}.) Duration of this stage, eleven days.

The mode of pupation of this species is peculiar, and I cannot describe it better than in Mrs. Peart's words in letters to me, August 23, 1894, and later in same month: "Did I tell you that the larva had disappeared, and as I had made the ground (of the flower-pot) soft — it being sandy — I felt about carefully until I found the sand stuck together with a film? Moving this slightly caused something to wiggle, and I knew it must be the caterpillar or its pupa, but I feared to disturb it more, and so left it to another day. Then I gently raised a corner of this little lid, which was formed of sand caught together with silk, quite smooth on the under side, and there lay a light-green and yellow-brown chrysalis in a very shallow hollow in the sand."

Four days later two pupæ were sent me, and Mrs. Peart wrote: "These two larvæ have formed pupæ, just as the first or ...ad, under the sandy coverlet. The wing cases were very waxy-looking, and of a greenish tint, when first exposed to the light. I think they grew darker being exposed."

Another pupa was received September 15th: "It formed just as did the other three sent you, weaving together some of the sand with silk; but there was a little depression in the sand just where the larva chose to make its bed, and, in

twisting about, it got partly from under the cover, so that I saw it all the time. When the pupa formed, it was partly uncovered. While the larva was resting after the web was spun — and it rested for nearly two days — it looked as if it were sitting up, or just like *Uhleri* in the grass, on the plate of that species. This pupa has the same waxy wing cases."

Mrs. Peart carried three of the larvæ over the winter, and in May, 1895, I myself saw the three pupæ from them in Philadelphia. Mrs. Peart called my attention to the fact that the sand in the three cases was assorted; that in the middle of the coverlet being very fine, that about the edges coarser. The whole thing, as it was turned up by forceps, seemed to be a substantial coverlet. On the plate the chrysalis *h* is shown just as it appeared when partly exposed under the spun cover, as before mentioned. Writing later of the last three pupæ, Mrs. Peart says: "The covering was slight, but in each case the pupa was completely hidden. The surface of the sand was quite level, and there was no appearance of its having been disturbed. Feeling about carefully, I found some silk threads, and lifted the cover just as I would a little blanket. The particles of sand were held together by the finest silk." In all, we obtained seven pupæ, not differing from each other in coloration; and, as all had formed in same manner, it may be assumed that the habit of the larva in concealing its pupa is peculiar to the species.

As said on a previous page, *Varuna* was originally taken in Montana and Dakota, and in Canada, near the boundary line north of those States. In recent years it has been found in Alberta, Canada, about Calgary, by Mr. F. H. Wolley Dod. In a letter to me of 28th May, 1875, Mr. Dod says: "VARUNA flies in much the same localities as Chionobas *Alberta*, but appears from a fortnight to three weeks later. In 1894, *Alberta* appeared on May 6th, and was quite over by the first week in June. This year Alberta appeared on 4th May, and is still to be seen (28th May). *Varuna* appeared on 15th May, and, had it not been for rough weather, it should now be in its prime. Its flight is much stronger and more playful than that of the other species. In your Part 12, Volume III., I see that Mr. Wright says that he did not find it flying on the level plains of Montana. Here it is essentially a plain-loving species (elevation 3,300 feet). *Varuna*, being the stronger species of the two, makes longer flights than *Alberta*, and, unlike that, may frequently be seen at play with another butterfly, and, although that other is sometimes *Alberta*, I suspect *Varuna* is nearly always the aggressor."

VARUNA eggs were received by Mrs. Peart in June, 1894, both from Mr. Dod at Calgary and Mr. Wiley, the last obtained about one hundred miles east of Miles City; and larvæ from both lots were raised to pupæ. The Calgary eggs hatched 28th and 29th June.

The first larva passed its first moult 8th July.

Passed its second moult 15th July.

Passed its third moult 21st July.

Passed its fourth moult 28th July.

Pupated 20th August.

Gave imago 31st August.

Mrs. Peart discovered no difference between the larvæ of the two lots, and both pupated in the same manner. I was in Colorado up to middle of August, and only saw a few of these larvæ in their latest stages and the pupæ. As with all Chionobas larvæ observed, part of the larvæ went into hibernation after the first moult, part after the second. Others reached the adult stage and then hibernated, and some pupated the same season in which the eggs were laid. There was remarkable variation in the color and markings of the larvæ, as is shown by the plate, and one type of the adult was closely like the larva of *Uhleri*. (Fig. 9.) The pupa was not at all roughened; on the contrary, the wing cases and the anterior portions were smooth, with a wax-like appearance. In the mode of pupation the species differs from all our other Chionobas.

EXPLANATION OF THE PLATE.

VARUNA, 1 ♀.

a, EGG ; a^2, micropyle.

b, b^2, YOUNG LARVA ; b^3, head.

c. Larva at 1st moult ; c^2, section of dorsum, segments 7 and 8 ; c^3, head.

d, *d*, Larva at 2d moult ; d^2, d^2, variety of same, segments 7, 8.

e, e^2, e^3, Larva at 3d moult, in vars.

f, ADULT LARVA, greatly enlarged ; f^2, dorsal view same, magnified ; f^3, head.

g-g^5, Adult larva, varieties, segments 7 and 8.

h, CHRYSALIS, in ground, under coverlet of woven sand ; h^2, magnified ; h^3, outline, natural size ; h^4, h^5, cremaster.

CHIONOBAS XIII.

CHIONOBAS ŒNO, 2.

Chionobas Œno, Boisduval. Edwards, Butt. N. A., Vol. III., Part 14, text and plate.

Egg. — Shape as in *Crambis* and *Semidea*, sub-conic; the base flattened and rounded, broadest at about one fourth the distance from base to top, narrowing upward slightly till the upper fourth is reached, then curving roundly to the edge of the summit; marked by twenty-four to twenty-six vertical ribs, a few straight, most sinuous, two or three short ones at top or bottom; the ribs narrow, rounded at top, spread at bottom so that their bases meet (in this point resembling *Crambis*, but differing from *Semidea*); the top flattened, the micropyle in the centre of a rosette of five-sided cells, outside of which are three or four rows of larger similar cells of irregular sizes; beyond these the space is occupied by shallow rounded excavations, small, the outer ones largest, arranged in confluent and nearly regular strings, which are separated by spaces of about same width as the excavations; in number and size these excavations resemble *Semidea* more than any other of the group observed; color gray-white. (Figs. *i*, i^2.) Duration of this stage, about eleven days.

Young Larva. — Length at one day from the egg, .09 inch; shape of *Semidea;* segments 2 to 4 nearly equal, arched dorsally, after 4 tapering regularly on dorsum and sides to 11, and more rapidly to 13, which ends in two short, rounded projections separated at base by a square, narrow sinus as in *Brucei;* the tubercles dark brown, their club-shaped processes white, translucent, and the same in number, position, and shape as in *Semidea* and *Brucei;* color gray-white, one sub-dorsal stripe and the base less gray; head broader than 2, broadest below, sub-globose, depressed at the suture; the surface covered with shallow indentations, as in the genus; a few tubercles and processes like those on the body, disposed as in the genus; color yellowish with a brown tint. (Figs. *j*–j^4.) Duration of this stage, nineteen to thirty-one days.

After first moult: length at fifteen hours after the moult, .15 inch; nearly same shape as before; the projections on 13 short and blunt, the space between rounded; surface thickly covered with fine conical tubercles, each bearing a short cylindrical process; color grayish yellow, the sub-dorsal stripe white; the spiracular and basal stripes white; head very nearly as at first stage, yellowish, brown-tinted; the vertical stripes very faint. (Figs. k–k^2.) To next moult, twelve to fifteen days.

After second moult: length at one day, .28 inch; nearly the same shape, with similar tubercles and processes; color gray-green; the stripes white; head as before, yellowish, brown-tinted. (Fig. l.) To next moult, about thirteen days.

After third moult: length at eighteen hours, .45 inch; shape not different; color yellow-buff; the mid-dorsal stripe black at the junctions of the segments, buff in the middle; the dorsal band nearly covered by a series of elongated triangles, each reaching across its segment, the apex of one touching the broad base of the preceding; composed of abbreviated, elongated streaks of black, but more of russet; the sub-dorsal stripe buff; the lateral vinous-black, the interior, especially on the anterior segments, buff; the spiracular stripe greenish buff; the basal clear buff; under side, feet and legs whitish; head as before. (Figs. m, m^2.)

After fourth moult: length at one day, .65 inch; color pale yellow, marked with black; the marking of dorsum much as at last previous stage; the triangles almost wholly black. (Figs. n, n^2.) The only larva which passed the fourth moult went into hibernation.

Mature Larva (after hibernation). — Length, .78 inch; greatest breadth, .18 inch; stout, obese, thickest in the middle, tapering rapidly from 5 to head, and from 11 to 13, ending in two short, blunt projections; surface thickly covered with fine, conical, irregular-sized tubercles, each bearing a cylindrical, slender, bent process; upper half sordid white or yellowish, with a narrow mid-dorsal band, black at the intersections of the segments, and a sub-dorsal composed of long triangles as after third moult, but with the black edges pale and very slight, and with few of the interior streaks which were present after that moult; the apex of each triangle black, and so there is formed a macular black row, suggestive of a band; the lateral band yellow-green with black edges, under which is a whitish line; the spiracular band whitish, along the upper edge brown-tinted; the basal ridge sordid white, underlaid by a black line; under side, feet and legs whitish green; head small, about as broad as 2, sub-globose, broadest below, nar-

rowing upwards, depressed at the suture ; the surface thickly covered with shallow indentations, between some of which are small tubercles with processes ; across the top six broad dark-brown stripes. (Figs. n^3, n^4.)

CHRYSALIS. — Length, .52 inch ; breadth across mesonotum, .18, across abdomen, .2 inch ; cylindrical, stout, the ventral side arched, the dorsal much more so ; head case truncated, rounded at top, the slope of the sides nearly flat, or very slightly incurved ; mesonotum rather prominent, rounded at top, the sides convex, the slope from top to the top of head case nearly a regular curve, though there is a little depression between the two ; the depression behind mesonotum rather deep ; abdomen conical, tumid ; the cremaster consists of a projecting trifid ridge, not corrugated as in *Semidea* and entirely unlike *Brucei* (which is bifid, and has two converging vertical prominent ridges) ; naked, without hooks or bristles, — color of top of head case and mesonotum greenish yellow, with a brown tint ; of under side of head case and the wings, blackish brown ; the abdomen is yellow and brown-gray, in alternating bands, the mid-dorsal and subdorsal bands gray, the two dorsal yellow, as in the lateral, and so on to ventral side ; each of the gray bands is very finely edged with carmine, and the spiracular band is much tinged with that color ; the two dorsal bands marked on each segment to base of mesonotum by a pair of short transverse black dashes ; the other yellow bands marked by two black points on each segment, instead of dashes ; the surface of the wing cases is finely corrugated, more heavily next base ; and the mesonotum and whole abdomen are also finely corrugated. (Figs. o, o^4.) Duration of this stage unknown, as the only pupa died before imago, but it is probably about eleven days.

I received eggs of ŒNO from Mr. Bruce, 24th July, 1894, while at Glenwood Springs, Colorado, and forwarded them at once to Mrs. Peart at Philadelphia. These began to hatch on 1st August, or at ten days from the laying ; and the first larva passed the first moult, August 20th, or at nineteen days ; the second moult, September 3d, at fourteen days ; the third, September 16th, at thirteen days ; the fourth, 27th September, at eleven days. Following this adult, it being the only one obtained that season, it was sent to Clifton Springs, New York, with several younger larvæ, and put in the refrigerating house there ; was received again on 23d March, 1895, in good condition, and pupated 1st April. I sent it to Mrs. Peart for its portrait, and it died without giving imago. This was the only pupa obtained.

After my return home four of the larvæ were sent me, 24th August, all past first moult ; and eight others, 15th September. All these were either just before

or just after the second moult. None of them advanced much beyond the second moult, and the few that survived were sent in November to Clifton Springs, but they died during the winter. It seems very unlikely that in nature any larvæ of this species can reach maturity the first season, and probably all the larvæ hibernated in their early stages.

My trip to Colorado, in company with Mr. Bruce, in 1894, was expressly for the purpose of getting eggs of the Papilios *Bairdii* and *Oregonia*, and of Chionobas *Œno*. We were successful with the Papilios, as I have elsewhere related; and Mr. Bruce undertook to get the *Œno* eggs. He left Glenwood Springs for Webster and Hall Valley, July 14th, and wrote from the latter place, 16th: "Reached Webster at 2.15, — delightful ride from Leadville. On making inquiries at Webster, found that all the former inhabitants of Hall Valley had left; the Klines, who kept the public house at which I used to stay, gone to Cripple Creek; all the mines on the top closed; one family alone at the Valley. I shouldered my wallet and went off. It had rained every morning for two weeks, — everything very backward: Mts. Bullion and Hayden with more snow than I had seen before at this time. I hurried, trying to make the Valley before the storm came on; it came, however, when I was about half a mile from my goal, — a grand display of electricity, rather too close to be pleasant, but awfully sublime, a constant crackling! and the lightning! Then came a big hailstorm ending in rain. I reached Tracy's cabin at four, having made the five miles in one and a half hours, without a dry rag on me. This morning I am rather stiff and rheumatism is around a little. My old cabin on Bullion is there still; Mrs. Tracy will lend me two or three blankets, and I will take them and some grub this P. M., and go to the top, where I will stay till I get what I want, as the rain and snow has made it bad traveling. The flowers are more beautiful than I ever saw there; you have seen no penstemons yet! I may be a week here; don't know till I have been on the top."

From Mr. Bruce's diary I copy a few lines respecting the next days: "July 17th. I started early this morning, intending to get to the top of the range before the daily storm set in. The sun was shining brightly, and I took many species of butterflies as I walked through the timber, — Anthocharis *Julia*, Pieris *Oleracea*, Colias *Alexandra* and C. *Scudderii*, Argynnis *Eurynome*, A. *Freya*, A. *Triclaris*, and A. *Helena*. Just before I reached timber line, I found that the precipitation, that had been rain in the Valley for the last week, had here been snow. By nine o'clock the sun became obscured, and I hurried over the immense snow-field that covered the north sides of Bullion and Hayden to reach the cabin just in time. The mists gradually crept up from the Valley, and vast clouds

came rolling over the mountain-tops, when suddenly a dense storm of hail with a mighty wind. The temperature quickly dropped to freezing point, but I lighted a good fire and was pretty comfortable. The cabin was substantially built over the entrance to an old silver mine, and was about 13,000 feet above sea level, — the peaks near by rising about a thousand feet higher.

"July 20th. No change for the better; clear in the morning for about two hours, but not warm enough for any butterfly to be on the wing. I have been on the top twice, and have found several females *Œno* in crevices of rocks, but had to hurry down when the storm commenced, as the whole top was enveloped in clouds too dense to allow me to see more than six feet away.

"July 21st. A cold, stormy night ushered in a miserable day, the sun not visible at all. Indeed, it snowed hard all the day up to six o'clock. The mountain birds took shelter in the outer shed of my cabin; three white-tailed Ptarmigans were as tame as chickens. Pipits more shy, and running about like mice. The beautiful rosy Finches (Lewcosticte) were very tame and hungry, and in great variety of plumage. A large number of Says Chipmunk, or striped squirrel, invaded my room, eating everything they could find. At last I turned the tables on these fellows, and, by a dead-fall baited with oatmeal, I caught nineteen of them. I skinned and stewed the bodies, and found them an agreeable change from the hard salt ham I had been living on the last five days.

"Hall Valley, July 22d: I came down from the top of the Range last night; it was useless staying there any longer; the weather was simply abominable. I have taken a bad cold, for everything was wet and miserable. A long tramp yesterday till 2 P. M. gave me not even one *Smintheus*, or Colias *Meadii*, or E. *Callias*, where in ordinary years the three species abound. At 2 it began to rain, by 4 a furious snowstorm set in, at 6 it cleared up, and I started down to this valley, which I reached at dark. A cold, frosty night, followed by a bright morning with a cold wind. I shall to-day take another walk above timber. I have six females *Œno* in bags, and I see a lot of eggs on one and five or six in another." Mr. Bruce told me, when we next met, that he took the females *Œno* with his fingers off the rocks on the leeward side, in a torpid state; and when he brought them to Tracy's, bagged them over tin cans in which roots of grass had been placed. In his absence Mrs. Tracy kindly looked after them, keeping them in the sun and having one eye on the house cat.

"Hall Valley, July 23d. I enclose eggs of *Œno*. I shall go down to-morrow, for I can't walk very far this A. M. Have taken cold, I suppose, and am not surprised; everything — clothes, bedding, etc. — damp and mouldy. Everything sadly altered here; after being a busy camp, to see no one about makes it a lonesome place in bad weather. I walked up yesterday above timber to Gibson

Gulch to try for *Callias* and *Magdalena*. At 10 A. M. it began to cloud up, and by 11, it snowed so fast I could n't see a yard in front of me. I squeezed myself into a hole and stayed there an hour, when the storm subsided and I came down, gathering flowers by the way. All the butterflies I took were a couple of Anthocharis *Julia*, a few *Chryxus* and *Epipsodea*, and one pair of Colias *Meadii*, in copulation. This morning it is very bright after a bitter cold night." I have given Mr. Bruce's words, written on the spot, to make it clear what the difficulties are in the way of getting eggs from these alpine butterflies, and what sort of a climate the insects are subject to. It is evident that they must be in torpid state during three fourths their short lives, all the nights and fully half the days. The larvæ of *Œno* subject to the same conditions certainly cannot reach maturity the same season in which the eggs are laid.

In a letter respecting these females *Œno*, written some months after, Mr. Bruce says: "The amount of cold these insects will stand is surprising; as soon as the sun is shining they are on the wing, if the ground is not covered with snow. Even in the worst weather, the mornings are generally fine for an hour or two, and all the mountain-top species of butterflies are ready to take advantage of this brief interval to copulate and lay their eggs. At the best, two hours of sunshine was all they got during my visit in 1894. Directly the clouds came over the Range, into the clefts and hollows of the rocks went *Œno* and *Magdalena;* into the bottom of the tufts of herbage went Chionobas *Brucei* and *Chryxus* and P. *Smintheus;* while, sheltered under the flower-heads of Compositæ, were hidden A. *Eurynome* and Melitæa *Anicia;* and there they would stick as long as the storm lasted, whether it was for hours or for days. The fact that all eggs obtained by me from these torpid or semi-torpid females *Œno* were fertile proves, I think, that these females had been on the wing a few hours before."

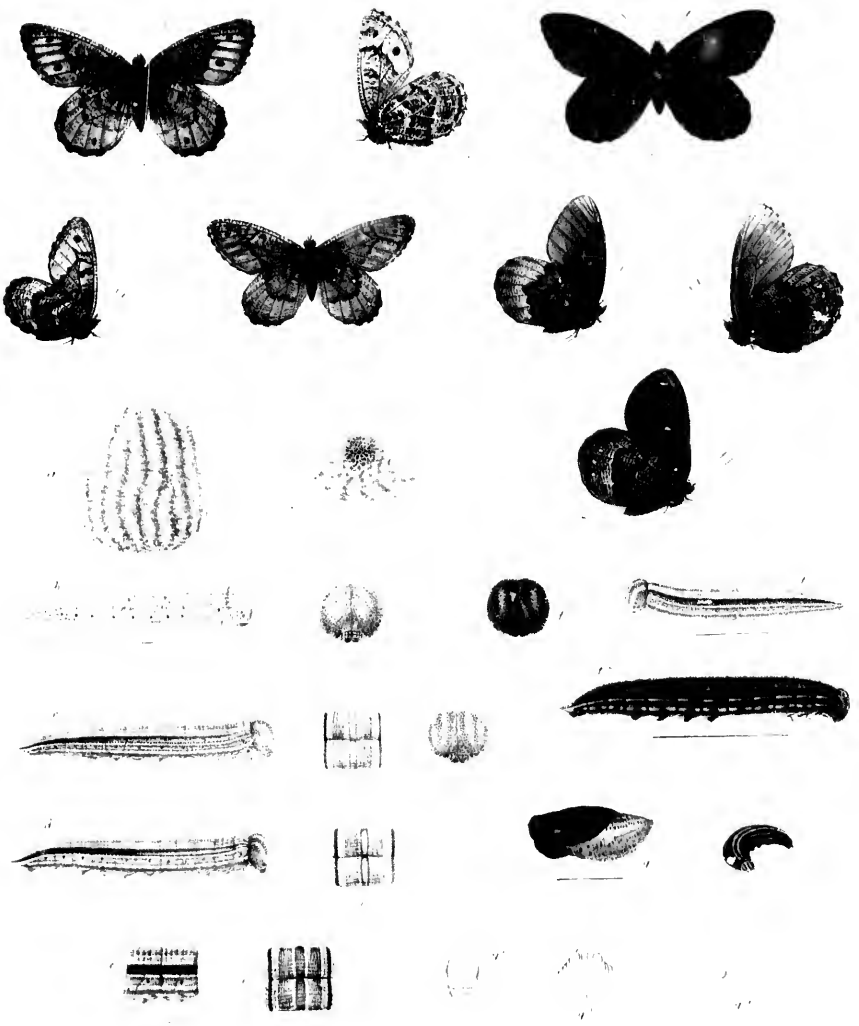
Many lepidopterists regard the Nymphalidæ as the highest of all butterflies, and the Satyrinæ, one of its sub-families, as in the advance, with the genus Chionobas leading. Starting with the proposition that a butterfly with six serviceable legs is a vulgar, low-down creature, it follows that one which can stand on four legs must be something superior. It has six, indeed, but the front pair are atrophied and useless as legs. Atrophy being the test, naturally Chionobas and the allied genera, which exhibit that deformity in an extreme degree, are held to be most advanced of all; and such feeble and half-alive species as *Semidea* and *Œno* are perched on the topmost twig of the butterfly-tree, — which to me is absurd. *Œno* has lived on the high peaks of Colorado, it may be, ten thousand years, or perhaps fifty thousand; its total butterfly existence limited to three or four weeks, and out of that all the nights and three fourths or more of the days

have been passed in a state of torpidity by reason of the cold, for water would freeze every night of summer at fourteen thousand feet. There is no chance for climbing up under these conditions, and *Œno* or *Semidea* to-day must be what they were when their life on the peaks was beginning, unless they have retrograded, which is probable. Common sense teaches that, when a path leads to an insurmountable obstruction, there is nothing for it but to retreat and seek some other outlet. It seems to me that no system of classification is of value which does not take into consideration many organs and characters of the imago, and also all three of the earlier stages. So far as my observation goes, the eggs of butterflies discover, at the least, generic characters, often specific, — the larvæ, generic and very generally specific; and pupæ, generic and often specific. Through the pupæ, Chionobas, Neominois, and Hipparchia are allied to certain of the Hesperidæ, as, for example, Eudamus; and through the larvæ, with certain families of the Heterocera, for example, the Noctuidæ. There is a marked difference at all four stages between many genera of the Satyrinæ which have suspended pupæ, and the genera which have naked pupæ, and I believe these last should be entirely separated from the others, and ranked in the scale next above the Hesperidæ.

EXPLANATION OF THE PLATE.

ŒNO, 2, ♀.

i, EGG ; i^2, micropyle.
j, YOUNG LARVA ; j^2, j^3, last segments ; j^4, head.
k, Larva at 1st moult ; k^2, head.
l, Larva at 2d moult.
m, Larva at 3d moult ; m^2, section of dorsum, segments 7 and 8.
n, Larva at 4th moult ; n^2, section of.
n^3, Adult Larva ; n^4, head.
o, o^2, CHRYSALIS ; o^3, o^4, cremaster.



ALBERTA. 1 2 3 4 5 6

a. 1ª Egg. *magnified.* 2ª *adult. nat. size.* 3. *magnified.*
b. 4. *Larva.* 5 *moult.* 6ª *chrysalis.*

PEARTIÆ. 5 6 3 7 8 9

CHIONOBAS XIV.

CHIONOBAS ALBERTA, 1–4.

Chionobas Alberta, Elwes, ♂, Transactions Entomological Society, London, 1893, p. 467.

Male. — Expands 1.4 to 1.6 inch.

Upper side gray-brown, often with a yellow, and sometimes a russet tint; primaries have the costal margin next base white flecked with dark brown or black; some examples have a pale sub-marginal band, on which, in the upper discoidal interspace, is a small black ocellus with minute white pupil; occasionally a smaller blind ocellus is seen in the lower median interspace; on secondaries the mesial band of under side reappears more or less distinctly; sometimes the whole wing is more or less covered by fine abbreviated transverse brown streaks, but often there is nothing of this; a sub-marginal narrow dusky stripe, often macular; and sometimes a minute blind ocellus in the second median interspace; fringes dusky at the tips of the nervules, elsewhere yellowish.

Under side of primaries gray-brown, lighter or darker according to the hue of the upper surface, and often yellow-tinted; the costa gray-white marked with black; the apical area gray-white, thickly covered with dusky scales, as is often the marginal area, this last showing a dark macular sub-marginal line on the middle interspaces; a mesial band from costa to sub-median nervure lightly edged with black, the outer border running obliquely back from costa and prolonged acutely along the upper median nervure, after which the course is straight, a little crenated in each interspace; the inner part of this band more or less streaked brown, and the whole cell; often the inner outline of the band is wanting; in many cases there is an absence of the brown streaks over the outer limb, as well as between the cell and inner margin; between the extremes there is every degree of variation.

Secondaries vary in color from dark, much streaked, to pale yellow-white, with very few light streaks; the band varies in width and considerably in outline; in some examples the margins are nearly parallel, the outer one rather evenly cre-

nated throughout; sometimes the inner one is deeply incised in the cell, next median, while the outer is nearly circular, there being a small incision at second branch of sub-costal, and occasionally this outline is much produced opposite cell; in the paler examples, the interior of the band is but little streaked.

Body dusky above, in the lighter examples gray or yellow-brown, beneath black with gray hairs, often so many as to make the general hue gray; femora black, the other leg joints red-brown; palpi black, in the light examples gray-white, the front hairs black; antennæ reddish next base, dusky in the middle, the club reddish on upper side, and together with the antennæ cretaceous beneath. (Figs. 1, 2.)

Female. — Expands from 1.4 to 1.8 inch.

Upper side much as in the male, but generally paler; primaries show from one to three ocelli, and occasionally a minute fourth; on secondaries a single ocellus, but often there is none. (Figs. 3, 4.) The variation in color and markings, in both sexes, is so considerable that a dozen figures would be needed to represent them. Unfortunately I have not been able to spare the space for more than a single pair, and have selected the insects that show an excess of markings, and the darkest hue.

Egg. — Sub-conic, the breadth to the height as 1 to 1.14; the base flattened, rounded; the sides rounded, broadest at about one third from base, narrowing upwards; marked by nineteen and twenty vertical ribs, some straight, others sinuous, occasionally one branching either near the bottom or top; these ribs are narrow at their summits, and rounded, the depressions rather deep, the slopes excavated closely as in *Jutta;* the micropyle is in the centre of a rosette of five-sided cells, outside of which are three or four rows of similar, less regular, larger ones; beyond these are shallow rounded cells, after which they run together forming low valleys, which are separated by flat irregular ridges; some of the last being broken up make knobs; color gray-white. (Figs. a, a^2.) Duration of this stage from ten to twelve days.

Young Larva. — Length, at twenty-four hours from the egg, .09 inch; shape of *Brucei* and *Semidea;* the tubercles and processes the same in number and position as in those species; ending in two slight conical projections; color of body grayish white, the lines or stripes pale brown; the basal ridge white; under side, feet and legs white, translucent; head pale yellow-green, with a tint of brown, sub-globose, broadest below, slightly depressed at the suture; the surface covered with shallow indentations among which are a few tubercles and processes like those on the body. (Figs. b, b^2.) Duration of this stage ten to thirteen days.

After first moult: length at twenty hours, .18 inch; shape as before; surface thickly covered with fine conical tubercles, each bearing a short, cylindrical clubbed process; color pale gray-green; the dorsal stripe green edged on either side by a brown line, outside of which is a narrow whitish stripe; the dorsal area finely streaked brown; the sub-dorsal line brown; the lateral band pale green, edged by a brown line on either side, and the posterior third obscured by vinous-black; below this a whitish line; the basal ridge yellow-white, and under it a brown line; under side, feet and legs translucent white; head shaped as before, greenish, with a brown tint, the vertical stripes as in the genus, pale brown. (Figs. *c*, c^2, c^3.) Duration of this stage seven to eight days.

After second moult: length at eighteen hours, .3 inch; shape as at second stage; same tubercles and processes; color and stripes same; head same. (Figs. *d*, d^2.) Duration of this stage six to eight days.

After third moult: length at twenty-four hours, .44 inch; same shape; color darker; the lateral stripe black except on the three anterior segments, these green; basal ridge yellowish; head as at last previous stage. (Figs. *e*, e^2.) To next moult six to seven days.

After fourth moult: length at one day, .56 inch (Fig. *f*); in about eight days was full-grown.

Mature Larva. — Length one inch; stout, obese, thick in the middle, tapering rapidly from 4 to head and from 9 to 13; ending in two short, blunt tails, the intervening space rounded; surface thickly covered with fine conical tubercles of irregular sizes, each bearing a cylindrical, slender, bent process; color dark brown; the dorsal stripe black, narrowly edged by yellow-white; the lateral band black on green ground, and under it a pale brown line; the spiracular band green, much specked with black; basal ridge brown; under side and prolegs bluish green, feet white; head small, sub-globose, broadest below, narrowing upwards, slightly depressed at top; the surface thickly covered (as in the genus) with shallow indentations, between some of which are tubercles with processes like those on the body; color brownish green, the vertical stripes (as in the genus) broad, dark. (Figs. f^4, natural size; f^2, enlarged; f^3, head.) From fourth moult to pupation twenty-one days.

Chrysalis. — Length .5 inch; breadth at mesonotum .2, at abdomen .23 inch; cylindrical; head case truncated, and closely as in *Jutta*, the top produced and

dome-shaped, the sides excavated; the mesonotum prominent, rising to a narrow, rounded ridge, the sides flat, or perhaps a little convex; the depression rather deep, angular; the wing cases elevated, beveled down to abdomen on the margins; the abdomen sub-conical, tumid; cremaster much as in *Jutta*, naked, without hooks or bristles; color of anterior parts greenish gray, the mesonotum darker, and having, across the summit, four blackish dots in row, two on either side; wing cases dark olive-green, the neuration distinct in lighter color; abdomen yellow-brown, marked by blackish dashes and dots in longitudinal rows; the dorsal and sub-dorsal rows dashes, two to each segment; the lateral row dots, two to the segment, placed obliquely; the spiracular and ventral rows alternate dash and dot on each segment in straight rows. (Figs. g^2, natural size; g, enlarged; g^3, g^4, cremaster.) Duration of this stage eight days. From laying of egg to imago from sixty-eight to seventy-eight days.

ALBERTA was described from three males which Mr. Elwes found in the collection of Mr. F. H. Wolley Dod at Calgary, Alberta, Canada, in 1893. Nothing was said of localities or habits. In June, 1894, Mr. Dod obtained eggs of *Alberta* by confining the female over grass, and sent forty-five to Mrs. Peart, who reared the larvæ to imagos. I was absent in Colorado during July and part of August, but returned in time to see the later larval stages. The first pupa was obtained 17th August, and gave a male butterfly on 24th; the second September 5th. These formed lying in the sod, head down, ventral side up. Several of the adult larvæ lingered through the fall, apparently ready to pupate, motionless, close to the earth, in a small sod, but during November these died.

As to the habits of this species, Mr. Dod has given me the following account: "ALBERTA has a marked preference for dry, stony hillsides, where the grass is stunted in growth; just such places, in fact, where the large anemone, which is common in this region, grows. Not that the flower has any attraction for the butterfly, for I have never observed *Alberta* to settle on flowers, but where the anemone abounds, there in all probability the butterfly abounds also. At the same time it is often abundant where there are no anemones. I have seen numbers on the wing on sunny days as early as 7 A. M., and a few may be started up within half an hour of sunset. This species has a rather quick but uncertain flight. Unless pursued or carried by the wind it seldom flies for more than ten or fifteen yards at a time, generally settling on bare ground; and when at rest it is very difficult to detect. It is very shy to approach on a bright, sunny day, and when it rises may easily be mistaken for one of the Orthoptera which are common here at the same season, and which, when on the wing, *Alberta* closely resembles in color."

CHIONOBAS XIV.

CHIONOBAS PEARTIÆ, 5–8.

Chionobas Peartiæ, new species.

MALE. — Expands 1.8 inch.

The wings semi-diaphanous.

Upper side smoky-black; immaculate; fringes concolored.

Under side of primaries pale brown-black; no markings; of secondaries pale brown, crossed by fine abbreviated streaks of darker color; beyond the band grayish; both edges of the band distinctly defined, black, the interior black-brown; the outer edge has a sharp elbow on the upper median interspace, the angle being about seventy degrees; from this to the inner margin straight, with a rounded crenation in each interspace; to costal margin straight, with a double serrated incision; the inner edge has an angular incision corresponding to the angular prominence without, and posteriorly the course is parallel to that of the outer edge without decided crenations; anteriorly is a large rectangular projection, the apex lying on the sub-costal nervure, and a smaller one, the apex of which touches the costal margin; immaculate.

Body blackish; legs, palpi, antennæ, and club, all black. (Figs. 5, 6.)

Another male is like the above, except that the band is similar to that of the female, Figure 8.

FEMALE. — Expands 2 inches.

Somewhat diaphanous, less so than the male.

Upper side smoky golden brown, uniform; immaculate, except that the submarginal dots of the under side are repeated in yellow-white. Under side of primaries golden bronze; of secondaries yellow-white, streaked with dark brown; the base dark brown, though next the band anteriorly the ground is whitish; the band bent as in the male, and crenated and serrated in same manner; half way between the band and hind margin is a row of small rounded, or partly angular whitish spots, from two to six in number, one to an interspace. (Fig. 7.)

Another female is colored on upper side like the male, smoky black; under side of primaries dark brown; of secondaries dark brown next base and over the marginal area; grayish next the band; the band darker brown within, the edges black; the outer margin in this example is bent on the upper discoidal interspace, and from the angle to inner margin the crenations are greatly flattened. (Fig. 8.)

Many years ago, more than thirty, the male here described and figured was sent me from the British Museum, by the trustees, as *Subhyalina*, Curtis, and it was not till I had occasion to investigate the history and character of *Subhyalina*, in 1894, that I became satisfied that the present species was still undescribed. I take pleasure in naming it for my associate, Mrs. Mary Peart, without whose coöperation from the beginning these volumes would not have been in existence. Fully twenty-five hundred drawings, plain and colored, have been made by Mrs. Peart for my plates, the beauty and precision of which it has not been possible to copy on the lithographic stones. Besides this labor, my friend has reared multitudes of larvæ in order to get the drawings of the several stages, and has made careful observations of every species.

I wrote Mr. A. G. Butler, early in 1895, asking him to examine the individuals of this species now in the Museum collection, and tell me how they compared with my male, of which I sent him a colored figure done by Mrs. Peart. He replied, 14th February: "We have one male closely resembling your figure in coloring and pattern; also three females from same habitat, none of which are quite like the male, the elbow of the band being less prominent, and the area beyond the band more or less varied with gray streaks. One of these females has the upper side smoky black, one is smoky yellow-brown, the third is intermediate in color. Beneath, the primaries of the first" (my figure 8) "are smoky black; of the second" (my figure 7) "is golden bronze; and the third is intermediate. The darkest one, which most nearly resembles the male in color of both surfaces, is least like it in the form of the band, whilst the yellow-brown one has the band almost exactly as in the male."

Mr. Butler further said that all these specimens were obtained by Captain Collinson, of H. M. S. Enterprise, at Winter Cove, Cambridge Bay, Victoria Land, lat. 69°, long. 106°. Under Mr. Butler's supervision, Mr. H. Knight made colored drawings of the two females which have been copied for the Plate. The upper side I was unable to present for want of space.

EXPLANATION OF THE PLATE.

ALBERTA, 1, 2, ♂, 3, 4, ♀.

a, EGG ; a^2, micropyle.

b, Young Larva ; b^2, head.

c, c^2, Larva at 1st moult ; c^3, head.

d, d^2, Larva at 2d moult.

e, e^2, Larva at 3d moult ; segments 7 and 8.

f, Larva at 4th moult.

f^4, ADULT LARVA, natural size ; f^2, same, enlarged ; f^3, head.

g^2, CHRYSALIS, natural size ; *g*, same, enlarged ; g^3, g^4, front and side view of cremaster.

PEARTIÆ, 5, 6, ♂ ; 7, 8, ♀, in vars.

PAPILIO IV.

PAPILIO BRUCEI (NO PLATE).

Papilio Brucei, Edwards, Canadian Entomologist, Vol. XXVII., p. 239. 1895.

THIS species is the result of the union of *P. Oregonia* and *P. Bairdii*, both figured in Volume II of this work. It originated therefore as a hybrid, but to-day is a fixed form, and is certainly entitled to a specific name. In Volume XXV., Can. Ent., p. 253, 1892, I published a paper, "Notes on a Polymorphic Papilio," in which it was stated that Mr. David Bruce, for two or three years past, in southwest Colorado, had been taking *P. Bairdii* in company with *P. Oregonia*, and also with a form which I had described as *P. Hollandii*, Can. Ent., Vol. XXIV., p. 50, 1892, which in general is like *Bairdii*, but has the abdomen either with a broad lateral band of yellow or almost completely yellow, instead of black, with rows of yellow spots as in *Bairdii* and all the *Asterias* sub-group. In other words, while the wings are those of *Bairdii*, the body is that of *Oregonia* and the *Machaon* sub-group. From what he had seen on the ground, Mr. Bruce had become satisfied that all these forms, in the locality specified, were members of one species. In 1892, he obtained eggs from a *Bairdii* ♀ confined over Artemisia dracunculoides, which he had discovered accidentally was the food plant of the larva. The larvæ from these eggs were brought to Mr. Bruce's house, at Brockport, N. Y., and from them were obtained five healthy pupæ, three of which gave *P. Bairdii*, in the spring of 1893, and two *Oregonia*. In 1893, Mr. Bruce was again upon the ground, and sent me eggs which he had obtained from a female *Oregonia*, and the outcome of them was six *Bairdii*.

In 1894, I accompanied Mr. Bruce to Colorado, and to Glenwood Springs, on the Grand River, which is one of the headwaters of the Colorado River, with the purpose of investigating this case of hybridism carefully, and on a considerable scale. We reached the Springs June 29th. On 3d of July, Mr. Bruce brought in a female of the so-called *Oregonia*, which he bagged over Artemisia, and which, within the next two days, laid eighty-one eggs. Another female,

taken on 10th, laid seventy eggs. On 6th, two *Bairdii* were found to have laid seventy-six and one hundred and seventeen eggs respectively; and another, confined on the 9th, laid seventy. In all, by the 11th, we had two lots of the so-called *Oregonia* eggs, and four of *Bairdii*. When the females were bagged, Mr. Bruce and I were in all cases together, and both examined the plants to see if perchance a stray egg had been previously laid on them. When the bags were opened, I attended to the eggs myself, clipped them off the stems, and put each lot in a box by itself. Thenceforward all the eggs and larvæ were in my room at the hotel, and were attended to solely by myself. So that there was nowhere a chance for error, or of mixing eggs or larvæ. The bits of stem which bore the eggs were placed in glass tumblers, labelled, and, when the larvæ hatched, fresh stems were given, and these were changed daily. As the larvæ grew, they were shifted to tin cans covered with cloth and overlaid by squares of heavy glass, to prevent escape, as well as to afford light. Treated in this way there was but a very small percentage of loss.

On 15th July, Mr. Bruce left me for Denver and the high peaks of the front range, and, some days after, I divided the larvæ and sent him, at Denver, one brood of the so-called *Oregonia* and two of *Bairdii*. He returned to Glenwood Springs on 28th July, but I had no more to do with his share of the larvæ. On 10th August, we left the Springs for Denver and home. My larvæ were now nearly full grown, and a few had suspended for pupation. I put the three lots into three boxes with fresh Artemisia for such larvæ as were still feeding; and I had a large tin box made and filled it with the plant. I kept the boxes by me throughout the journey to Coalburgh, W. Va. When there, after the Artemisia failed, carrot and fennel were substituted, but many of the larvæ died from this unaccustomed food.

The imagos began to come forth at eleven and more days from pupation, but many pupæ hibernated, some to give imagos in April, 1895, and an occasional one in May and June, while several went over to 1896.

The results in fall of 1894 were: —

1. From *Oregonia* eggs, 3 *Oregonia:* 1 ♂, 2 ♀.
   8 *Bairdii:* 7 ♂, 1 ♀.
2. From *Bairdii* eggs, 1st lot, 20 *Bairdii:* 18 ♂, 2 ♀.
   No *Oregonia.*
   From *Bairdii* eggs, 2d lot, 2 *Bairdii:* 1 ♂, 1 ♀.
   No *Oregonia.*

The results in spring of 1895 were: —

1. From *Oregonia* eggs, 5 *Oregonia:* 3 ♂, 2 ♀.
   4 *Bairdii:* 2 ♂, 2 ♀.

2. From *Bairdii* eggs, 1st lot, 11 *Bairdii:* 8 ♂, 3 ♀.
1 *Oregonia:* 1 ♂.
From *Bairdii* eggs, 2d lot, 3 *Bairdii:* 2 ♂, 1 ♀.
1 *Oregonia:* 1 ♂.

Result in fall and spring: —

1. From *Oregonia* eggs, 8 *Oregonia:* 4 ♂, 4 ♀.
12 *Bairdii:* 9 ♂, 3 ♀.
2. From *Bairdii* eggs, both lots, 36 *Bairdii:* 29 ♂, 7 ♀.
2 *Oregonia:* 2 ♂.

In all, 10 *Oregonia:* 6 ♂, 4 ♀.)
48 *Bairdii:* 38 ♂, 10 ♀.)

The proportion of *Oregonia* to *Bairdii* nearly as 1 to 5.

On the 8th of July, 1895, there were nineteen living pupæ left, 5 *Oregonia*, 14 *Bairdii*. These mostly died before the spring of 1896, but in March and April of that year there emerged 1 ♂, 3 ♀ *Bairdii*, all from eggs of *Bairdii*. Of the entire number of pupæ (77), forty per cent. gave butterflies in the fall of 1894, thirty-two per cent. in the spring of 1895, and twenty-eight per cent. went towards 1896, though very few survived the winter. In natural state no doubt many of these pupæ live through two winters, and the same is true in the case of other Pacific Papilios, *Rutulus*, *Daunus*, and *Zolicaon*, as I know from having bred all of them.

Mr. Bruce sent me a statement of the results obtained in 1894 and 1895 from the pupæ he brought home from Colorado. Thus: —

1. *Oregonia* pupæ gave —

1. In fall of 1894, 5 *Bairdii:* 4 ♂, 1 ♀.
2 *Oregonia:* 1 ♂, 1 ♀.
2. In spring of 1895, 9 *Bairdii:* 6 ♂, 3 ♀.
7 *Oregonia:* 4 ♂, 3 ♀.

2. *Bairdii*, first brood —

1. In fall of 1894, 7 *Bairdii:* 5 ♂, 2 ♀.
2 *Oregonia:* 2 ♀.
2. In spring of 1895, 8 *Bairdii:* 6 ♂, 2 ♀.
4 *Oregonia:* 4 ♀.

3. *Bairdii*, second brood —

1. In fall of 1894, 3 *Bairdii:* 3 ♀.
1 *Oregonia:* 1 ♂.
1. In spring of 1895, 5 *Bairdii:* 3 ♂, 2 ♀.
4 *Oregonia:* 2 ♂, 2 ♀.

From *Oregonia*, fall and spring: 9 *Oregonia*, 14 *Bairdii*.
From *Bairdii*, fall and spring: 11 *Oregonia*, 23 *Bairdii*.
Total: *Oregonia*, 20; *Bairdii*, 37. *Oregonia* being to *Bairdii* as 1 to 1.85. More *Oregonia* in proportion than came from the three broods I had.

It appears that each of the six broods described, 2 of *Oregonia*, 4 of *Bairdii*, gave examples of imago of its own form, and also of the other form.

Some of the examples taken at Glenwood Springs were typical *Bairdii*; that is, they cannot be distinguished from examples taken in Arizona, where there are no *Oregonia* and can be no intermixture. But most differ in varying degree from the type, no two being quite alike; they are gayer, and especially so beneath, running off to *Hollandii*, which seems to be the extreme of variation.

Scarcely any of the so-called *Oregonia* taken or bred agree fully with the type, which flies where there are no *Bairdii*, in Washington and British Columbia. They are modified in the direction of *Bairdii* in several particulars. The typical male *Oregonia*, on the upper side, *has the basal area of the fore wings thickly dusted with yellow scales. The submarginal black band on both wings also much dusted yellow.* Beneath, *the base of cell on fore wings is always gray-yellow; the nerves and branches of both wings are lightly edged with black; the submarginal band is largely covered with yellow scales, and the blue on hind wings is azure. The abdomen on ventral side is yellow, with a thin ventral line;* another such line, subventral, on the last three or four segments; *the ventral line forks as it nears the thorax, leaving a yellow space between the forks.*

The female has the base of fore wing as thickly dusted, perhaps more so; the submarginal band more dusted. Beneath, like the male; the cell nearly solid yellow, there being two black bars, one about middle, the other half way between this and the arc. The ventral side of abdomen is either marked by two fine black lines, or these are wholly wanting; on the side a narrow stripe.

1. A male, so-called *Oregonia*, bred from eggs laid by a female *Bairdii*, *is very black above*, a thin dusting of yellow scales at base of fore wing scarcely detracting from the general blackness; and the submarginal band is free from yellow scales. On the under side *the cell from arc to base is black, except for a narrow transverse bar just inside the arc*, and another at two fifths the distance from arc to base. *The nervures on both wings heavily edged with black; the blue not azure, but dark* (*as in Bairdii*). *The lines of black on abdomen are stripes rather*, and *next the thorax are diffused, making a broad black area.*

2. A male, so-called *Oregonia*, bred from egg laid by a female of same type. This is blacker than No. 1, the yellow dusting more scanty. *On under side the cell solid black*, excepting the two yellow crossbars at and near the arc; *the nerves and branches heavily edged with black;* the *blue dark;* the *black stripes of abdomen confluent next thorax.*

In a female corresponding to No. 2, the ventral side of the abdomen is nearly solid black; in one corresponding to No. 1, the four stripes are heavy, but not quite confluent.

The above description answers for all the examples of so-called *Oregonia* which I have bred from either same type of female or from *Bairdii*. But I have a female nearer the true type *Oregonia* that Mr. Bruce bred from egg laid by *Bairdii*, 1892, and which came out of pupa in March, 1893; spoken of in Can. Ent., XXV., 254. This has the base of fore wing and the submarginal band much dusted yellow; the base of cell beneath, gray-yellow, ending near middle of the cell in rays, and altogether as in typical *Oregonia;* the nerves and branches lightly edged black; the submarginal band on fore wings densely dusted, making it a yellow band rather; and the blue is azure. This is the nearest example to true *Oregonia* of all the bred hybrids which I have seen.

From what has been said, it must be evident that the so-called *Oregonia* of Glenwood Springs is not the true *Oregonia*. It is more black, less dusted yellow (on both sides); the cell of under fore wings black (an important character); the veins beneath all more heavily edged with black; the blue, dark instead of azure; the abdomen rather black than yellow on the ventral side. That is not *Oregonia*, but a distinct type of butterfly, which, if it had been brought in from Arizona by the Wheeler Expedition, would have been pronounced a species. It may be supposed that it originated in the mating of true *Oregonia* with true *Bairdii*, at some period in the past. Whether these two species, pure type, now mingle in that region, I cannot say, because I have not seen a pure *Oregonia* which was taken there. As to *Bairdii*, it varies so much, even where no *Oregonias* fly, and where there is no suggestion of intermixture, that we cannot say what the pure form is. These butterflies, as they now appear at Glenwood Springs, may have begun their career as hybrids fifty, or one hundred and fifty, or five hundred years ago, — no one can guess when; there has been evolved a distinct form, allied to *Oregonia*. This form, so far as appears a permanent one, I called BRUCEI. The so-called *Bairdii* are not true *Bairdii*, but at present it is impossible to fix upon their type, because, as before said, no two of them have been found alike.

The larvæ from eggs of the *Bairdii*, as well as those from eggs of the *Brucei*, were of the *Asterias* pattern; in the first three stages black, or brown-black, with white saddle-patch on 7, 8, 9, and dots and small spots of white irregularly placed on dorsum or upper part of side, no two individuals being quite alike in this respect. After third moult, green, with a black band across the middle of each segment, in which are set rounded yellow or orange spots; the junctions of the segments also black. The green of *Brucei* after fourth moult was bright yellow-green, the black bands narrow, the spots a rich chrome. Of *Bairdii*, a much darker green, the black bands wider, the spots pale yellow. Yet, on looking over a large number of the larvæ of each form, some of the *Bairdii* were

as brilliant as the others, and in all points were like them. This might be expected of hybrid larvæ. As to the pupæ I could see no difference in shape, and all were in general as in the *Asterias* group.

Eggs of *Brucei* laid 5th July, hatched 10th. The first moult was passed 14th and 15th; the second, 19th and 20th; the first to pass third was on 23d; to pass fourth, 30th July; the first pupa, 9th August; the first imago, 22d August

Length of the egg stage, 5 days.
Length of first larval stage, 4 days.
Length of second larval stage, 5 days.
Length of third larval stage, 4 days.
Length of fourth larval stage, 7 days.
Length of pupa stage, 13 days.
From laying of egg to imago, 38 days.

Eggs of *Bairdii* laid 8th July, hatched 12th. The first moult was passed 17th; the second, 23d; the third, 27th; the fourth, August 2d; pupation, 12th August. The first imago, 31st August.

Length of egg stage, 4 days.
Length of first larval stage, 5 days.
Length of second larval stage, 6 days.
Length of third larval stage, 4 days.
Length of fourth larval stage, 6 days.
Length of pupa stage, 19 days.
From laying of egg to imago, 44 days.

It becomes of importance to know the distribution of *P. Bairdii* and *Oregonia*, as well as *P. Brucei*. I have never seen an *Oregonia* from Arizona, but have received many *Bairdii* from that Territory; some from the Wheeler expeditions, some from Mr. Morrison's catch. On the other hand, *Oregonia* flies in British Columbia, east of the Cascade Range, and perhaps in other districts.

The only locality that I have been able by correspondence to discover, where *Bairdii* and *Oregonia* have both been found, is in Squaw Cañon, Sioux County, Nebraska. Professor H. G. Barber, of the University of Nebraska, at Lincoln, wrote me that an *Oregonia* was taken in Squaw Cañon in 1893, and an example of *Bairdii* in July, 1892; in different years it will be noticed. Another specimen of *Oregonia*, Mr. Barber says, was taken on Lodge Pole Creek, in S. E. Wyoming, in 1893, but no *Bairdii*. Professor C. V. Piper, of the Washington Agri-

cultural College, at Pullman, Wash., sent me several typical *Oregonia* taken there and in the near-by district in Idaho; but he had seen no *Bairdii*.

We were exceedingly desirous of obtaining eggs from the female of *Hollandii*, that the position of this form might be established. Mr. Bruce brought in one female on 3d July, but it laid no eggs, and died in confinement. No other example was taken, and only two males. Therefore we learned nothing respecting *Hollandii*, and it may be a hybrid, or it may be a species. Many years ago, I received a female of it from southern Arizona by one of the Wheeler expeditions, but no duplicate of it or male of it was thereafter seen until Mr. Bruce's explorations in Colorado. Although *Oregonia* does not fly in southern Arizona, *Zolicaon* does, and *Hollandii* may be the result of hybridism between that species and *Bairdii*. I hope that Mr. Bruce may yet determine as to this.

PAPILIO V.

PAPILIO AJAX (NO PLATE).

Papilio Ajax, Linnæus. Forms: *Walshii*, Edwards; *Telamonides*, Felder; *Marcellus*, Boisduval.

IN Volume I, I gave all the history of AJAX and its forms, at that time, 1872, known to me. During the years that have followed, I have repeatedly bred the larvæ from eggs laid by the females in confinement over the food plant, and now give some of the observations thus made; also a statement of the effect which has been produced on the emerging butterflies by subjecting the chrysalids to a low temperature.

The summing up of the observations of 1871 was, that WALSHII produced all three forms the same year; that TELAMONIDES produced *Marcellus* the same season; that MARCELLUS produced successive broods of *Marcellus* the same season, and occasionally *Telamonides*, and that its latest eggs produced *Walshii* and *Telamonides* in the following spring; and that, whenever any chrysalids of either of the broods of *Marcellus* pass the winter, they produce the other two forms, and probably sometimes *Marcellus*.

I would now modify this statement as follows: WALSHII produces *Marcellus* the same season, and *Walshii* and *Telamonides* the next; TELAMONIDES produces *Marcellus* the same season, and *Walshii* and *Telamonides* the next; and the over-wintering chrysalids of *Marcellus* produce both the other forms, and sometimes its own form.

Marcellus appears in the early days of June, but in some years fresh individuals are to be seen in numbers the entire month. I consider the first brood, therefore, to embrace all the June butterflies of this form. Those of the first part of the month are the direct descendants of the early *Walshii* butterflies, those of the later part of the month have come from the late *Walshii* and the early *Telamonides*, and are of mixed parentage. The second brood of *Marcellus* butterflies begin to appear about the middle of July, and fresh examples are coming from chrysalis up to the end of the first week in August. It is in direct

descent from the later *Telamonides* and the first individuals of the first brood of *Marcellus*, and is of mixed descent. The third brood of *Marcellus* appears in September, and the first one directly descended from *Marcellus*. It is greatly restricted in number, because, as the season progresses, a larger part of the chrysalids hibernate. So it is that a typical *Marcellus* is comparatively rare, and is reached by successive gradations from *Telamonides*.

MARCELLUS, of all broods, produces *Marcellus* the same season, but occasionally a typical *Telamonides* has been taken (never bred) in the fall, and must have come from *Marcellus*. One instance only is recorded of *Walshii* having produced its own form the same year, and one only of *Walshii* having so produced a *Telamonides*. But eight *Marcellus* are recorded as having in the spring emerged from hibernated chrysalids. One typical *Marcellus* was taken on the wing in April. *Walshii*, whether sprung from its own form, or from either of the other forms, is (1) true to its type, — the tips of the tails squarely white, with other points; (2) the tips and a little way up the sides white, after the manner of *Telamonides*, other points between *Walshii* and *Telamonides*, but nearest the former. The typical *Walshii*, therefore, passes by one grade into *Telamonides*. TELAMONIDES, from whatever parents, is rather more true to its type than is *Walshii*. The early MARCELLUS, from *Walshii* and *Telamonides*, are smaller than the later, less melanic, and are nearer to *Telamonides*. The typical *Marcellus* comes from its own form. There is a regular gradation therefore from typical *Walshii* to typical *Marcellus*.

As to periods of flight, the earliest and latest dates, in a course of years, at which the several forms have been observed at Coalburgh, W. Va., are: —

1. WALSHII. From 1872 to 1893, with the exception of three years, the first appearance was recorded; in many years, the last individual seen was made record of.

EARLIEST.	LATEST.
1871	May 14th.
1872, April 11th.	May 19th.
1873, April 8th.	
1874, April 27th.	
1875, April 7th.	
1877, March 23d.	May 15th.
1878, February 28th.	May 15th.
1880, early in March.	May 30th.
1881, April 19th.	May 21st.
1882, April 2d.	
1883, April 20th.	
1885, April 28th.	
1886, April 9th.	

1887, April 9th.	
1888, April 4th.	May 3d.
1889	May 15th.
1890, early in April.	
1891, April 13th.	
1892	May 6th.
1893, April 7th.	

2. TELAMONIDES.

EARLIEST.	LATEST.
1871, May 24th.	June 9th.
1872, April 29th.	May 30th.
1874, May 14th.	June 6th.
1875, May 27th.	
1877, May 18th.	
1878, May 3d.	
1880, May 19th.	
1886, April 29th.	
1887, April 23d.	
1889	June 14th.
1893, April 26th.	

3. MARCELLUS.

EARLIEST.
1871, June 1st.
1872, June 5th.
1874, June 6th.
1880, May 30th.
1881, June 7th.
1893, June 2d.

Therefore *Walshii*, during about twenty years, has been seen on the wing as early as 28th February, and as late as 30th May; *Telamonides*, as early as 23d April, and as late as 14th June. In one case there has been a range of ninety-one days, in the other of fifty-two. The first appearance of *Walshii* depends altogether on the state of the weather. If a few fine days come in March, some individuals will surely appear; but these early comers are almost invariably cut off by the severe weather, cold, with snow or rain, which follows. The food plant, Anona triloba, Pawpaw, does not put forth the first flower or leaf-bud before the last of April. The flower precedes the leaf, and, though I have never observed that the larvæ eat the flower, eggs are sometimes to be found on it, and even on the woody stems of the plant, before the opening of the leaf-buds.

TELAMONIDES emerges from chrysalis after the weather is comparatively set-

tled, and, though its extreme period has been fifty-two days, in any one year it has not been more than a month. The *Walshii* brood laps over on the *Telamonides*, and the latter on the *Marcellus*. But the abundance or otherwise of *Marcellus* butterflies in June depends on what proportion of the chrysalids of the other forms hibernate. In 1893, out of forty-five chrysalids from eggs laid by *Walshii* in April, forty went over to the next year. Out-of-doors the proportion must have been much the same, because there were almost no *Marcellus* in June. But, as will presently appear, often nearly all the chrysalids of the early forms give butterflies.

While naturally *Walshii* precedes *Telamonides*, it has been, and continues to be, a puzzling fact that, from hibernated chrysalids of the three forms, *Telamonides* butterfly emerges nearly, and often quite, as early as *Walshii*. For several years I was in the habit of keeping all chrysalids during winter in a cool room in the house; but as it seemed possible that the air of the house might exercise a forcing influence on them, I tried keeping the chrysalids out-of-doors. But the result was the same, and the fact remains unexplained. I give the outcome of a lot of chrysalids in 1884, bred from eggs laid by *Walshii* in April, 1883: —

Emerged March 11th, 3 *Walshii* ♂.	
Emerged March 13th, 1 *Walshii* ♂.	
Emerged March 17th,	1 *Telamonides* ♂.
Emerged March 20th,	1 *Telamonides* ♂.
Emerged March 21st,	1 *Telamonides* ♂.
Emerged March 24th,	1 *Telamonides* ♂, 1 ♀.
Emerged March 25th,	1 ♀.

Result: 10 butterflies, 4 *Walshii* ♂; 4 *Telamonides* ♂, 2 ♀.

From a lot of chrysalids in 1892, bred from eggs of *Walshii* laid in April, 1891, emerged, —

March 25th, 1 *Walshii* ♂.	
March 26th, 1 *Walshii* ♂.	
March 27th, 2 *Walshii* ♂.	
March 28th, 1 *Walshii* ♂.	
March 29th, 1 *Walshii* ♀.	
April 3d,	1 *Telamonides* ♀.
April 11th,	1 *Telamonides* ♀.

Result: 6 *Walshii*, 5 ♂, 1 ♀; 2 *Telamonides* ♀.

From a lot of chrysalids in 1882, bred from eggs of *Telamonides* laid 22d May, 1881, emerged, —

April 6th, 1 *Walshii* ♂.	
April 7th, 1 *Walshii* ♀.	1 *Telamonides* ♀.

April 8th, 1 *Walshii* ♀.	
April 9th, 2 *Walshii* ♀.	
April 10th,	1 *Telamonides* ♂.
April 13th,	1 *Telamonides* ♂.
April 14th, 1 *Walshii* ♂.	
April 15th,	2 *Telamonides* ♀.
April 17th,	1 *Telamonides* ♂.
April 18th,	1 *Telamonides* ♂, 4 ♀.
April 19th,	1 *Telamonides* ♂, 1 ♀.
April 22d,	1 *Telamonides* ♂.
April 24th,	2 *Telamonides* ♀.

Result: 22 butterflies, *Walshii*, 2 ♂, 4 ♀; 16 *Telamonides*, 6 ♂, 10 ♀.

From a lot of chrysalids in 1889, bred from eggs laid by *Telamonides*, 28th May, 1886, emerged, —

April 9th, 1 *Walshii* ♂.	
April 10th,	3 *Telamonides* ♀.
April 11th, 1 *Walshii* ♀.	1 *Telamonides* ♀.
April 15th,	1 *Telamonides* ♂.
April 19th,	1 *Telamonides* ♀.
April 22d,	1 *Telamonides* ♀.

Result, 9 butterflies: 2 *Walshii*, 1 ♂, 1 ♀; 7 *Telamonides*, 1 ♂, 6 ♂.

Many observations have established the fact that as a rule, with bred chrysalids, the *Walshii* butterflies emerge first, and the *Telamonides* last; but there are exceptions, and an occasional *Telamonides* will appear between two *Walshii*.

As to the forms of the butterfly produced by hibernated chrysalids: —

1. WALSHII chrysalids, —

Of 1871, produced in 1872, no *Walshii*, 13 *Telamonides*, 2 *Marcellus*.
Of 1886, produced in 1887, 11 *Walshii*, 6 *Telamonides*.
Of 1887, produced in 1888, 12 *Walshii*, 3 *Telamonides*.
Of 1891, produced in 1892, 6 *Walshii*, 2 *Telamonides*.
Of 1893, produced in 1894, 15 *Walshii*, 20 *Telamonides*.

2. TELAMONIDES chrysalids, —

Of 1870, produced in 1871, no *Walshii*, 16 *Telamonides*.
Of 1880, produced in 1881, 1 *Walshii*, 6 *Telamonides*.
Of 1881, produced in 1882, 6 *Walshii*, 16 *Telamonides*.
Of 1888, produced in 1889, 2 *Walshii*, 11 *Telamonides*.
Of 1889, produced in 1890, 1 *Walshii*, 36 *Telamonides*.

3. MARCELLUS chrysalids, —

Of 1871, produced in 1872, no *Walshii*, 36 *Telamonides*, 3 *Marcellus*.
Of 1885, produced in 1886, 1 *Walshii*, 2 *Telamonides*.
Of 1887, produced in 1888, 16 *Walshii*, 32 *Telamonides*.

Therefore five lots of *Walshii* chrysalids have produced 44 *Walshii*, 44 *Telamonides*, 2 *Marcellus*.

Five lots of *Telamonides* chrysalids have produced 29 *Walshii*, 24 *Telamonides*, 2 *Marcellus*.

Three lots of *Marcellus* have produced 17 *Walshii*, 70 *Telamonides*, 3 *Marcellus*.

The two united forms tend to produce their own forms, and this is more decided in *Telamonides* than in *Walshii*. And *Marcellus* tends to produce *Telamonides*.

As to the proportions of the several broods that hibernate: —

1. WALSHII: —

Of 70 chrysalids from eggs laid April, 1871, 62 gave butterflies the same year, 1 died, 7 hibernated.
Of 31 chrysalids from eggs laid May 23, 1871, 17 gave butterflies the same year, 14 hibernated.
Of 20 chrysalids from eggs laid April 22, 1883, 6 gave butterflies the same year, 14 hibernated.
Of 27 chrysalids from eggs laid April 20, 1891, 12 gave butterflies the same year, 15 hibernated.
Of 45 chrysalids from eggs laid April 26, 1893, 5 gave butterflies the same year, 40 hibernated.

2. TELAMONIDES: —

Of 6 chrysalids from eggs laid May 16, 1870, 6 gave butterflies the same year.
Of 23 chrysalids from eggs laid June 2, 1870, 22 gave butterflies the same year, 1 hibernated.
Of 17 chrysalids from eggs laid May 27, 1871, 7 gave butterflies the same year, 10 hibernated.
Of 10 chrysalids from eggs laid May 28, 1871, 4 gave butterflies the same year, 6 hibernated.
Of 26 chrysalids from eggs laid May —, 1881, 4 gave butterflies the same year, 22 hibernated.
Of 15 chrysalids from eggs laid May 29, 1887, 14 gave butterflies the same year, 1 hibernated.
Of 12 chrysalids from eggs laid May 22, 1888, 2 gave butterflies the same year, 10 hibernated.
Of 38 chrysalids from eggs laid June 7, 1889, 1 gave butterfly the same year, 37 hibernated.
Of 24 chrysalids from eggs laid June 14, 1891, 9 gave butterflies the same year, 15 hibernated.

3. MARCELLUS. 1. First brood.

Of 76 chrysalids from eggs laid June 1 to June 4, 1871, 36 gave butterflies the same year, 40 hibernated.
Of 5 chrysalids from eggs laid June 7, 1870, 4 gave butterflies the same year, 1 hibernated.
Of 14 chrysalids from eggs laid July 1, 1870, 8 gave butterflies the same year, 6 hibernated.
Of 32 chrysalids from eggs laid June —, 1886, 1 gave butterfly the same year, 31 hibernated.
Of 50 chrysalids from eggs laid June —, 1887, 4 gave butterflies the same year, 46 hibernated.

2. Second brood.

Of 19 chrysalids from eggs laid early in July, 1887, 6 gave butterflies the same year, 13 hibernated.
Of 42 chrysalids from eggs laid July 29, 1871, 13 gave butterflies the same year, 29 hibernated.
Of 2 chrysalids from eggs laid early in August, 1870, 1 gave butterfly the same year, 1 hibernated.

3. Third brood.

Of 57 chrysalids from eggs laid in September, 1885, 57 hibernated.

Therefore, of chrysalids of *Walshii* in several years, 102 gave butterflies the same year, 90 hibernated. Of chrysalids of *Telamonides*, 69 gave butterflies the same year, 102 hibernated.

Of chrysalids of *Marcellus* of first brood, 17 gave butterflies the same year, 84 hibernated; of second brood 20 gave butterflies the same year, 43 hibernated; of third brood, all (57) hibernated.

The foregoing statement explains why, in some years, *Marcellus* abounds in June, and why, in others, few examples are to be seen. In 1893, *Walshii* was unusually abundant during the last three weeks of April, and resorted to the lilacs and wild-plum trees, all which were in full bloom. On 26th, I took eight females, and 28th, nine more, and confined them all for eggs. Most of them were killed, however, by a two days' cold rainstorm; but about threescore eggs in all were laid, from which in time came 45 chrysalids. From these chrysalids only five butterflies came that year. Out-of-doors there were scarcely any *Marcellus* to be seen during June, and the wild pupæ of the early forms must nearly all have hibernated. Of course this state of things restricted the number of *Marcellus* flying later in the year.

As to color of chrysalids of the different forms: —

1. Walshii.

Of 36 chrysalids 3 were green, 33 brown.
Of 15 chrysalids 5 were green, 10 brown.
Of 31 chrysalids 4 were green, 27 brown.
Of 20 chrysalids 7 were green, 13 brown.
Of 14 chrysalids 6 were green, 8 brown.
Of 46 chrysalids 12 were green, 34 brown.

Therefore, of 162 chrysalids 37 were green, 125 brown; or 23 per cent. were green, 77 per cent. brown.

2. Telamonides.

Of 13 chrysalids 7 were green, 6 brown.
Of 19 chrysalids 2 were green, 17 brown.
Of 38 chrysalids 2 were green, 36 brown.
Of 14 chrysalids 6 were green, 8 brown.

Therefore, of 84 chrysalids 17, or 20 per cent., were green; 67 or 80 per cent., brown.

3. MARCELLUS, —

Of 50 chrysalids 3 were green, 6 per cent.; and 47, or 94 per cent., brown.

When the winter forms emerge from chrysalis, the eggs are unformed in the ovaries. On the other hand, when *Marcellus* emerges in June and later months, the eggs are fully formed, though not hard, and in a very few days are ripe for laying. The females are paired almost at once on escaping from chrysalis, and while the wings are yet limp. In every instance where I have taken a pair in copulation, the male has been old and worn. During the period of emergence, the males may be seen in numbers coursing up and down in the thickets close to ground, in search of the females, and several males may be seen fluttering about one female. The young males stand no chance at all in competition with the older ones. The former are for some hours limp of wing and weak, and before their wings are dry the eager crowd of elderly suitors have carried off the prize. It must result that many males never have the opportunity of pairing, and these live after the rest of their generation have disappeared.

I have in several years made experiments on the effect of cold applied to the chrysalids of AJAX, originally led thereto by Dr. August Weismann's observations on seasonal dimorphism in his Studien zur Descendenz-Theorie, 1875. My observations were published in the Canadian Entomologist, Vols. VII., 1875, and IX., 1877; also in Psyche, Vol. III., 1880. Mr. Raphael Meldola, in his translation of Dr. Weismann's work, London, 1880, Part I., Appendix 2, has recited so much of these as were found in the Can. Ent. As many readers of the Butterflies of North America have seen neither the papers spoken of nor Mr. Meldola's book, I will give here the substance of the observations made.

In June, 1875, 122 chrysalids were obtained from eggs laid by *Telamonides* females late in May. These, as fast as formed, were placed on ice in the refrigerator in a wooden box, and were so kept till 20th July. I then had to leave home for a few weeks, and sent the box to the ice-house with directions to place it on the surface of the ice. This it seems was not done, but it was set on straw near the ice, with the result that the chrysalids were subjected to a less degree of cold than was desirable. I returned 20th August, and learned that the ice in the house had just failed. The chrysalids had been subjected to a low degree of cold in the refrigerator for three or four weeks, and in the ice-house to a lesser degree, and which must have been daily diminishing as the volume of ice decreased. That the severity of the cold had not been sufficient to prevent the emerging of the butterflies was apparent when I opened the box, for there were discovered a number of dead ones, which had died as soon as they had come out, the wings being unexpanded. But one butterfly was alive, just out of its chrysa-

lis, and this proved to be a typical *Telamonides*. The remaining chrysalids were brought in-doors, and the next day three *Telamonides* emerged. By 4th September, fourteen of the same form had appeared. After that date a few *Telamonides* came at intervals up to 20th September; but, out of twenty-six butterflies between 4th and 15th, twelve were intermediate between *Telamonides* and *Marcellus* (that is, they were incompletely changed by the cold), some approaching one, some the other, more nearly. On 4th September, the first example wholly *Marcellus* appeared, and one such followed on each day, the 6th, 8th, 13th, and 15th; a single example between *Telamonides* and *Walshii* appeared 3d September, the tails squarely white-tipped, but in size and other points a *Telamonides*. From 15th September to 3d October, ten *Marcellus* appeared, and two which were between that form and *Telamonides*. The last emergence was on the 16th October. So that the whole period of emerging after the box was brought from the ice-house was fifty-seven days, and it had commenced some time before that occurred, as was evident by the dead butterflies. The natural period of the chrysalids of such examples of *Ajax* as emerge the first season is about eleven days, save that occasionally, but very rarely, a butterfly has been known to come out after a period of from four to six weeks. In the present case the cold had produced great irregularity in the duration of the stage. In all, fifty butterflies emerged between the 20th of August and 16th October, as follows: —

	Telamonides, typical,	22
Between	*Telamonides* and *Walshii*,	1
Between	*Telamonides* and *Marcellus*, — nearest the former,	7
Between	*Telamonides* and *Marcellus*, — nearest the latter,	9
	Marcellus,	11

Great uniformity was observable in the size of all these butterflies, their average being that of the usual *Telamonides*. The *Marcellus*, in addition to the somewhat reduced size, had almost invariably shorter and narrower tails than in the type; and, instead of the single crimson anal spot, nearly all had two spots, often large. Most of the chrysalids which survived the season died during the winter (and that was due to the cold they had been subjected to, for chrysalids of this species do not die in the winter), and there was but one emergence in the next spring, a male *Walshii*, on 2d March.

It seemed a proper conclusion from this experiment that the butterflies which emerged from the chrysalids subjected to cold would have done so in their natural state, and that the effect of cold was not to precipitate the emerging of any which would have slept till the next spring. And, as all which would naturally have emerged the first season would have taken the form *Marcellus*, the cold had changed a large part of them to *Telamonides*, that is, to a spring form. The

intermediate examples were probably from chrysalids which had experienced a lesser degree of cold; and several chrysalids experienced cold enough to retard their emergence of the butterfly, though not enough to change the form.

In May, 1878, I placed many chrysalids from eggs laid by *Walshii* in the ice-box, temperature about 33° Far. The youngest were but ten to fifteen minutes from pupation and were still soft; others were added at intervals up to twenty-four hours from pupation; and others at two and three days, and so on to eight days. (The chrysalis in this species becomes hard at about twelve hours.) All were removed from the box at the same time. The exposure had been from five days to nineteen days. I wished to determine if possible whether, in order to effect any change, it was necessary that cold should be applied immediately after pupation, or if one or several days might intervene between pupation and icing. Inasmuch as no color begins to show itself in the imago till a few hours, or at most but a day or two, before emergence, I thought it possible that cold applied shortly before that time might be quite as effective as if applied earlier, and particularly very soon after pupation. The result was that more than half the younger chrysalids died; one which had been exposed at ten minutes, two at one hour, one at two, two at three hours. On the other hand, one exposed at fifteen minutes, one at two hours, and one at twelve hours, gave butterflies. On the fourteenth day after removing the chrysalids, a *Telamonides* emerged from a chrysalis placed in the ice-box three days after pupation and exposed sixteen days. On the 19th day, emerged one *Telamonides* near to *Walshii* from a chrysalis placed in the box twelve hours from pupation and kept there eleven days. On the 19th day, also emerged a *Walshii* out of a chrysalis two hours old, on the ice eleven days. All the rest emerged unchanged *Marcellus*, but at periods prolonged in a surprising way: —

One on 43d day, exposed at 15 minutes.
One on 46th day, exposed at 2 hours.
One on 53d day, exposed at 24 hours.
One on 62d day, exposed at 6 days.
One on 63d day, exposed at 4 days.
One on 66th day, exposed at 7 days.
One on 77th day, exposed at 4 days.
One on 81st day, exposed at 12 hours.
One on 91st day, exposed at 5 days.
One on 96th day, exposed at 19 hours.
Five chrysalids hibernated, and all produced *Telamonides* the next spring.

In June, 1879, I obtained eggs of *Marcellus*, and in due time had one hundred and four chrysalids. Of these, thirty-five were placed in the ice-box at from twelve to twenty-four hours after pupation, dividing them into three lots, — first, nine chrysalids, which were kept on the ice fourteen days; second, twelve kept on ice twenty days; third, eleven on ice twenty-five days. Of the sixty-nine not exposed to cold, thirty-four gave butterflies at from eleven to fourteen days from pupation; and one only had the stage protracted, and that to about twenty-two days beyond the usual period. I reserved these chrysalids in order to compare the butterflies that might come from them with the butterflies from the iced ones. From the first lot emerged four females at eight and one half to nine and one half days after removal from the ice, and five chrysalids hibernated. Two of these females were clearly *Marcellus;* one was intermediate between that form and *Telamonides;* the fourth was a cripple, unexpanded, and was rejected. From the second lot came one male and five females at eight to nine days, another female at forty days, and five chrysalids hibernated. Three of these butterflies were *Telamonides*, one *Marcellus*, two intermediate. From the third lot, exposed twenty-five days, came four females at from nine to twelve days, another male at fifty-four days, and six chrysalids were killed. Two of these butterflies were typical *Telamonides* in everything but shape, and that was *Marcellus;* two were cripples.

In shape all the butterflies of the three lots were *Marcellus*, the wings produced, the tails long. It appeared that the chrysalids exposed twenty-five days gave butterflies that were fully changed; of those exposed twenty days, three were fully changed, two partly, one not at all. At fourteen days, one was partly changed, two not at all. Comparing the butterflies from the iced chrysalids with those which came the same season from chrysalids not iced, the former had the colors more intense, the black deeper, the light more decidedly green, the black bands narrower, the green bands wider; the marginal green lunules on the hind wings larger; the crimson spot generally large, double, and confluent, and sometimes edged on the basal side by white. All these changes were in the direction of the winter forms, and especially of *Telamonides*.

That the effect of cold was not simply to precipitate the emergence of the winter forms, making the butterflies which in natural state would have left their chrysalids in the succeeding spring to emerge in the first season, is evident from the fact that the shape was always that of the summer form, or *Marcellus*, while the markings and coloration were of the winter forms. On the other hand, those iced chrysalids which hibernated gave butterflies of the winter form, as if they had not been subjected to cold, one *Walshii*, six *Telamonides*. The longer the exposure under a low temperature the more decided was the change, but twenty-

five or thirty days proved sufficient in many cases. Changes were produced at twenty, sixteen, and eleven days, but none where the exposure was less than eleven. But exposure at eight days and less tended to prolong the chrysalis period in some cases. The longest interval between pupation and exposure to the cold when any change resulted was three days; in all instances beyond that time there was no change. The shortest interval when any change resulted was two hours, and in this one case the butterfly came out *Walshii*, which is a change more extreme than to *Telamonides*. Most chrysalids exposed so early, however, were killed; but after about twelve hours, at which time the chrysalis has become hardened, and up to twenty-four hours, seems to be the best time for application of cold.

NEOPHASIA I.

NEOPHASIA MENAPIA, Felder (no plate).

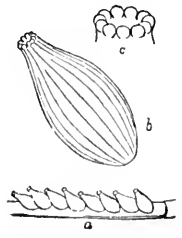
Edwards, Butt. N. A., ♂, Vol. I., p. 27, pl. 8. 1871; ♀, id., Suppl. Notes. 1872; Henry Edwards, Proc. Cal. Acad. Nat. Sci., Vol. V., p. 165. 1873; Mead, Report Wheeler Expedn., Vol. V., p. 743. 1875; Stretch, Papilio, Vol. II., p. 103. 1882; Hagen, Proc. Boston Soc. Nat. Hist., Vol. XXII., p. 134. 1882; Fletcher, Rep. Agric., Canada, 1895, p. 126.

This butterfly, through its larvæ, infests the pine woods of the Pacific Slope, and is found in small numbers as far east as the eastern or front range of the Rocky Mountains. Mr. Stretch observed the species in July, 1882, in Washington Territory, near Spokane Falls, finding the larvæ and the pupæ "on the trunks of pine-trees in immense numbers, say not less than from two to three hundred within six feet of the ground." A few days later he discovered in another locality that the butterflies were emerging from chrysalis. "I took probably seventy specimens in a few minutes, and over one hundred and fifty in course of the day, and it would have been easy to make the number fifteen hundred." At Brown's "the air was alive [illegible] butterflies." The area visited by the party of which Mr. Stretch was a member extends about twenty-five miles north and south, and in this region all the yellow pines have been nearly or totally stripped of their foliage, as well as many of the smaller species of coniferæ." It looked as if "fire had scorched the tops of the trees, so brown and withered did they look," etc. "The butterfly, when just out of chrysalis, is one of the most beautiful of its race, and fragile in the extreme, soon losing its freshness. Copulation takes place almost directly after emergence, often before the wings are dry. A female found in copula in the morning was imprisoned about two o'clock on a pine fascicle, and by six o'clock had laid sixteen eggs in a continuous row. These were pale green, ovate, with a small white coronet or raised circular ridge at the top." Mr. Stretch was assured that the butterflies seen by him were the earliest of the year, but whether there was a second brood or not he could not tell.

Mr. W. G. Wright, in 1891, observed *Menapia* in northeastern California, and sent me eggs which were laid on 29th August. In the regions described by both these gentlemen there must be two annual broods. The eggs are laid on the pine leaves from a few to as high a number as thirty-two (according to Mr. Stretch).

Mr. James Fletcher, in his Report, says that he encountered *Menapia* on or about the 21st July, 1895, in southern British Columbia, the caterpillar feeding on the foliage of Pinus ponderosa. He remarks that on Vancouver's Island the species is equally abundant, and more injurious apparently on the Douglass Fir, Pseudotsuga Douglasii. In the Okanagan Valley these butterflies were seen in countless numbers flying around the Douglass firs. The caterpillars let themselves down from the tops of tall trees by means of silken threads, some of which must have been of the length of one hundred feet or more. The chrysalids were found on the undergrowth, ferns, shrubs, etc., in large numbers. Fortunately, a parasitic ichneumon fly, Theronia fulvescens, was seen depredating on the larvæ.

Mr. Wright sent me many eggs of *Menapia* which were laid 29th August. I supposed that, as in the case of all the Pierid eggs I had made the acquaintance of, they would hatch presently; but as they did not, after some weeks had passed, I put them out-of-doors for the winter. They were brought into the house 24th of March next, and certainly were then alive. The larvæ in a few days could be seen through the now transparent shells, but every one died without chipping the egg. I had better success with the eggs which Mr. Fletcher sent me, and which he wrote were laid 29th July. They were exposed to the weather, under an open shed, and hatched April 5th to 7th, 1896. I gave the larvæ Scotch pine. They fed in clusters, as many as could lie close together encircling the leaf, their heads making a ring of black beads; and others were clustering close below. They eat the fleshy part of the leaf, leaving the fibre or core. After the first moult the entire leaf was eaten. This gregarious habit holds to the last stage.



Egg. — Flask-shaped, with rounded bottom; the height to the breadth nearly as 1 to 2; thickest a little below the middle, the bottom very slightly flattened; sloping evenly to the top, which is narrow, depressed; marked by from twenty to twenty-two slight, thin, vertical ribs, running from the top to about one sixth the distance from the bottom, and there disappearing; around the top is a circle of porcelain-white bead-like knobs, varying in number from eight to eleven; color emerald green. (Cut *a*, eggs as laid on leaf; *b*, egg enlarged; *c*, knobs at top.)

YOUNG LARVA. — Length, at one day from the egg, .12 inch; cylindrical, the anterior segments thickened, and tapering much from 2 to 5, after which slightly to 12, then rapidly to 13, which is somewhat flattened and ends roundly; on 2 an olive, chitinous, slightly corrugated patch, cut in two on the mid-dorsal line; each half irregularly trapezoidal; the anterior side longest; on each of the halves three tubercles and hairs in triangle, two to the front, the other at the extreme rear; on 3 and 4, on middle of each, a cross row of four tubercles and hairs, dorsal and sub-dorsal; lower down, two lateral tubercles on 3 (as there were also on 2), but only one on 4; after 4 the tubercles are placed in triangles, the dorsal one near the front of the segment, the sub-dorsal near the rear, the lateral midway between the other two; below the spiracles, a row of smaller tubercles, and finer, shorter hairs, one on 2 in line with the two laterals, one on 3 and 4 each, lower down, and in middle of the segment; this line is continued to 13, but after 4 there is a second tubercle back of the other and higher up; over each foot one minute hair, and on 13 three such at base of the anal leg; all the body tubercles black, conical, the hairs from them tapering, black; around each tubercle an outer circle of olive color, slightly raised above the surface; color of body yellow-green, with a tint of brown; head considerably broader than 2, rather high in proportion to its width, obovoid, with tubercles and hairs similar to those on body, seven on each lobe; color black, shining.

Mrs. Peart writes of the young larva: "It has a larger head in proportion to the body than any Pierid I have seen; the hairs in number and arrangement same as in Anthocharis *Genutia*. The tubercles, however, are smaller at base than in that species; the hairs taper to the tip, where there is a slight broadening, making a blunt ending." Duration of this stage, about eight days.

After first moult: length at one day, .15 inch; nearly same shape; all the body thickly covered with fine tubercles and hairs; 13 ending in two short, blunt projections, the space between deeply incurved (this form of 13 holds to the last stage); color yellowish with a tint of brown; feet black; head honey-yellow, clouded black on the upper half. Duration of this stage, about six days.

After second moult: length at eighteen hours, .26 inch; same shape; same tubercles and hairs; color yellow-green; traces appear of a white sub-dorsal stripe and basal band; under side paler green; feet black; at base of each proleg a black patch; head shaped as before, brown-green or yellow-green. Duration of this stage, about six days.

After third moult: length at one day, .4 inch; same shape; 13 now ends in

two short, blunt tails, the space between a little incurved; color yellow-green; the basal band broad, white; the sub-dorsal half as broad, also white; head yellow-green. Duration of this stage five and six days.

After fourth moult: length, .75 inch; shape as before. In about seven days was fully grown.

Mature Larva. — Length, one inch; head breadth of 2; body cylindrical, the last segments curving to 13, which ends in two short, blunt tails, the space between incurved; color dark green, with a narrow sub-dorsal and a broad lateral white band; under side nearly as dark green; feet black; pro-legs yellow-green, a small black, chitinous, rounded spot outside each; head obovoid, somewhat elongated, and is pushed forward below when the larva is at rest; color yellow green, sometimes a blackish patch on either lobe near vertex. From fourth moult to pupation, about eleven days.

Chrysalis. — Length, .7 inch; greatest breadth, .07; depth, .07 inch; cylindrical, slender, the head case prolonged into a straight, slender, conical spur; the eyes prominent; mesonotum low, rounded, and carinated, followed by a slight depression; abdomen slender, conical; wing cases prominent and rounded down to the abdomen; color dark green, striped white; a dorsal narrow stripe from posterior base of mesonotum the length of the abdomen; near it a sub-dorsal stripe, a little broader, from end to end; a lateral twice as broad as the sub-dorsal from wing to end, sending a narrow spur up and along the dorsal edge of the wing case. To imago eleven days. This chrysalis more resembles that of a Colias than any other Pierid known to me, but is much more slender than Colias.

All the pupæ obtained were green; but several which Mr. Stretch sent me in alcohol were brown, striped like the green ones. In his paper he says that the normal color of the pupa was pale green. "All those pupating on the needles of the young pines or shrubby plants in the underbrush were of this color, a close search failing to reveal an exception, while the larger proportion on the bark of the large trees were blackish brown. An examination of a number of these makes it probable that they are all diseased." Mr. Stretch notices that pupæ were found suspended on their threads, — that is, that pupation had taken place in midair, — the larval skin shrivelled up around the last segment of the pupa.

COLIAS III.

COLIAS EURYTHEME, FORM ERIPHYLE (NO PLATE).

Colias Eurytheme, form Eriphyle (E-riph'-y-le).
Eriphyle, Edwards, Can. Ent., Vol. XIX., p. 218. 1887; id., Trans. Am. Ent. Soc., Vol. V., p. 202. 1876; Hayden Bulletin, Vol. IV., p. 514. 1878. *Hagenii*, Edw., Papilio, Vol. III., p. 160. 1883; id., Can. Ent., Vol. XIX., p. 170. 1887. Var. *Autumnalis*, Cockerell, West Am. Scientist, Vol. IV., p. 42. 1888.

SUMMER FORM. — MALE. — Expands from 1.5 to 2 inches.

Upper side either canary-yellow or sulphur yellow, not unfrequently with an orange tint; the marginal borders and discal spots as in *Eurytheme*. Under side either pale yellow or deep yellow, marked as in *Eurytheme*.

FEMALE. — Expands from 1.6 to 2 inches.

Upper side greenish yellow, often more or less orange-tinted; the marginal borders as in female *Eurytheme*, that is, broad on primaries and enclosing a series of well-defined yellow spots; on secondaries the border extends from the outer angle two thirds the way to inner angle, and is usually broad enough to partially enclose a series of yellow spots.

VAR. AUTUMNALIS. — "Smaller, with narrower borders and the hind wings more grayish green." Cockerell. This form flies in the fall and also in the spring, in Colorado, and corresponds to the *Ariadne* form of the orange *Eurytheme*.

In the Trans. Am. Ent. Soc. cited, ERIPHYLE was described from thirty individuals of both sexes, taken at Lake Lahache, B. C., by Mr. G. R. Crotch. I considered them near to *Philodice*, but differing in some important particulars, and except in color, as being close to *Eurytheme*. It was stated that Mr. T. L. Mead, in 1871, had brought a Colias from Colorado, like this *Eriphyle* except in color, the latter being canary-yellow, the others sulphur, and that examples like the Coloradan had come from Montana.

Later *Hagenii* was described to include the Rocky Mountain form. Except in being yellow it was said to be like *Eurytheme*.

Through Mr. H. W. Nash, of Pueblo, Colorado, I was able to obtain eggs of this yellow butterfly, laid by females in confinement, with results as follows (published in Can. Ent., Vol. XIX., p. 171):—

1. On May 11, 1884, received eggs of the first brood of butterflies of the year. From these came, between June 8th and 15th, 14 butterflies, 10 ♂, 4 ♀; all yellow.

2. June 7, 1884, received eggs of the second brood of the year. From these, between 6th and 9th July, 15 butterflies, all *Eurytheme* (orange), 11 ♂, 4 ♀; three of the females being albinos.

3. June 7, 1884, received eggs. Result 12 butterflies, 8 of them *Eriphyle*, 3 ♂, 5 ♀; 4 *Eurytheme* ♀.

4. August 29 and September 3, 1884, received eggs. Result, 1st to 3d October, 5 *Eriphyle*, 2 ♂, 3 ♀.

5. June 27th, received eggs of the orange *Eurytheme*. Result, 9 butterflies, 6 being *Eurytheme*, 3 ♂, 3 ♀; 3 *Eriphyle*, 2 ♂, 1 ♀.

6. May 18, 1885, received eggs of the first brood of butterflies of the year. Result, 13th to 18th June, 35 butterflies, all *Eriphyle*, 20 ♂, 15 ♀. These females were very large and most of them deep yellow, approaching orange.

7. July 31, 1886, received eggs of *Eriphyle*. Result, 28th to 30th August, 3 ♂, 2 ♀, all *Eriphyle*, of the form *autumnalis*.

8. May 11, 1887, received eggs of the first brood of *Eriphyle* or *autumnalis*. Result, 9th to 14th June, 22 *Eriphyle*, 15 ♂, 7 ♀.

9. June 24, 1887, received eggs of *Eriphyle*, of the second brood of the year. Result, July 16th to 22d, 16 butterflies, 3 ♂, 13 ♀, all *Eriphyle*.

10. July 5, 1887, received eggs of *Eriphyle*, of the second brood of the year. Result, July 27th to 29th, 18 butterflies, 17 being *Eriphyle*, 14 ♂; 3 ♀; 1 *Eurytheme* ♀.

I therefore bred nine broods of butterflies from eggs of *Eriphyle*, and one brood from eggs of *Eurytheme*, and the result was sometimes unmixed, all the progeny being of the same form as the mother, at other times mixed, partly yellow, partly orange. The species *Eurytheme* theretofore known as tri-morphic (see Plate IV. of Colias, Volume II.), became tetra-morphic, *Eriphyle* being the fourth form.

The synonymy is as follows:—

Colias Eurytheme,

1. Winter form Ariadne
2. Winter form Keewaydin } orange.
3. Summer form Eurytheme

4. Winter form AUTUMNALIS } yellow.
5. Summer form ERIPHYLE }

I spent the month of July and part of June and August, 1894, in Colorado, and during most of the time was at Glenwood Springs, on the Grand River, in the west. *Eriphyle* was not uncommon there, especially about the alfalfa fields, but I never saw an orange *Eurytheme*. Nor have I seen any of the orange forms alive. Mr. Bruce says that the orange is certainly much scarcer than it was six or seven years ago, when he first went to Colorado. "It is seldom seen now, where formerly the yellow form was the exception." He accounts for the change by the spread of alfalfa, this having taken the place of the indigenous food plants.

The form *Keewaydin* was figured on Plate IV. of Colias, Volume I., 1869, and Figure 7 on that Plate represents a male *Eriphyle*. In the text it is stated that Mr. Henry Edwards, then living at San Francisco, had observed that the males of Keewaydin varied in color from "deep orange to lemon-yellow," and that "the male is constantly subject to run into this lemon-yellow variety." This is the first notice of the yellow form by any observer. Mr. Edwards afterwards came to be of the opinion that these yellow examples of Keewaydin were not connected with the Eurytheme species, but were what he had described as C. *Harfordii*. In that he was wrong. C. *Harfordii* is figured in the present volume, and belongs to a different sub-group of the genus from *Eurytheme*.

In the text of C. *Philodice*, in Volume II., Plate III. of Colias, there is described and figured an orange male which was taken in copulation with a yellow female, supposed to be a *Philodice*, in Illinois. Other instances of orange examples of one or both sexes, supposed to be *Philodice*, were mentioned in the same paper, or have been reported in the entomological journals.

Nearly all cases of albinism in the genus Colias are confined to the female sex, and exceedingly few albino males have been reported. But a fine albino male of *Philodice* was sent me by Mr. H. E. Wilford, of Batavia, New York, in 1891, and was mentioned in the Canadian Entomologist for March, 1892, Vol. XXIV., p. 49.

SUPPLEMENTARY NOTES.

PAPILIO DAUNUS. — This is a very widespread species, flying from Mexico to British Columbia, and from the Pacific through the Rockies of Colorado. I found it common at Glenwood Springs, Colorado. Twice have I bred it from egg, in one case the egg having been sent me by Professor Arthur J. Snyder at Park City, Utah, 1893, 10th July; in the other by Mr. Charles De Blois Green, at Osoyoos, B. C. In general the larval stages are like those of *Rutulus*, but the two eye-spots on segment 4 are more like those of *Turnus*.

ADULT LARVA. — Length, 1.6 inch; shape of *Turnus* and *Rutulus;* color uniform yellow-green; the eye-spot on 4 has the shape of a truncated pyramid (divided crossways into two), surmounting a circular spot, within which is a small circle; all the parts edged finely with black; and the whole spot is yellowish-green; segment 5 is edged posteriorly and narrowly with yellow, and the front of 6 as narrowly by black. The chrysalis is of same general form as in the two species named. The single image obtained emerged the second year. I formerly received a pupa of *Daunus* from Mr. Doll, bred in south Arizona, and this also lived through two years.

PAPILIO INDRA. — I received seven eggs of *Indra* from Mr. Bruce, 1893, at Denver; deposited on Artemisia dracunculoides. The species was abundant on Clear Creek and in the Platte Cañon. The egg is similar to that of *Asterias*, and the larvæ in their several stages follow that species closely. One pupa was obtained, 26th July, from which came a butterfly ten days later. Mr. Bruce wrote that in Platte Cañon every bit of wild parsley had larvæ of all sizes of *Asterias* on it; but that *Indra* could not be coaxed to lay on carrot or other umbelliferous plant, and that its sole plant was the Artemisia. On this last both *Bairdii* and *Oregonia* lay their eggs.

PIERIS VIRGINIENSIS. — In the North, New York to Canada, this is the early form of *Oleracea*, but in West Virginia I believe it to be the sole representative

of the species. It has been taken repeatedly at Coalburgh, in April and May, pure type; but no later examples, and no *Oleracea*, have been taken. Unfortunately, I have never been able to get a female since I learned how to make butterfly females lay their eggs. If there were a second brood, surely either myself, or other lepidopterists who have collected here, must have seen and taken examples of it. For all that appears, *Virginiensis*, in the South, is a species. At any rate, I have so catalogued it to call attention to it.

Anthocharis Reakirtii and Sara. — On March 31, 1888, I received eggs and larvæ (hatched on the way) of *Reakirtii*, from California, laid 22d. One larva passed the first moult, 2d April, second moult, 4th, fourth moult, 8th April, and pupated, 13th. This gave a true *Reakirtii* the next year, 1889, 12th April. Mr. Koebele wrote that *Sara*, of May and June, proceeds from eggs laid by *Reakirtii* in March, but that some pupæ went over the winter to produce *Reakirtii* in the early spring; also that the product of *Sara* was *Reakirtii* of the next spring. The pupæ of Anthocharis have the habit of passing two winters in some cases. Mr. Koebele wrote me, in 1888, that he then had pupæ of *Sara* and *Cethura* (*Cooperi*), which formed in 1886, and he sent one of the former. This, soon after I received it, gave an imago, *Reakirtii*. A pupa of A. *Genutia*, bred at Coalburgh, 1890, gave imago in 1892.

Anthocharis Ausonoides. — I received a larva from Mr. Cockerell, in Colorado, 10th June, 1888, and reared it to pupa and imago. This last appeared, 3d March, 1890, and was true to type. Another pupa from Mr. Koebele, sent in 1888, as *Ausonoides*, gave a female of that form, 30th March, 1889. There is no evidence that this species is dimorphic.

Anthocharis Olympia. — I took a female of this species at Coalburgh, W. Va., 21st April, 1890, on Sisymbrium, engaged in ovipositing. This egg was shape of *Genutia*, red. The larva hatched, 27th April; passed the first moult, 30th; the second, 6th May; the third, 9th; the fourth, on 12th. I then sent it to Professor Riley for a drawing, and on its return it died while changing to pupa. The adult larva is shaped and tuberculated as in *Genutia*, and is striped longitudinally with pale slate-color and bright yellow; a broad mid-dorsal band of the former, a sub-dorsal yellow stripe and a paler one along base; the side between these stripes still paler slate, running into white along the spiracles; the under side, feet and legs gray-green; head gray-green, with many fine tubercles and hairs. A figure of the adult larva of *Ausonoides* made about the same date by the same artist, Miss Sullivan, and greatly enlarged (as was *Olympia*), shows

a close resemblance in coloration; the slaty stripes are much deeper in hue, and the whole lower side is much darker than in *Olympia*. Judging by the larvæ, these two species belong to a different sub-group from *Genutia* and *Reakirtii*.

Colias Alexandra. — I have several times received eggs of this species from different localities in Colorado. The larvæ hibernate after the third moult. The eggs were laid on Astragalus and Thermopsis. I will give the particulars of one lot of larvæ received 18th August, 1886, the eggs sent by Professor G. H. French, from Central City, and hatched *en route*. They began to pass the first moult, 25th August; the second moult was overlooked; but before the third moult, all had gone into hibernation, and were sent to New York, to a refrigerating house, — six larvæ. They came back alive, 4th March, 1884, and were placed on white clover. On 7th April, one passed the third moult, and it passed the fourth on 13th, and pupated 26th April. The imago came out, 6th May, a female of type *Edwardsii*. The second larva pupated 5th May, and gave a female *Alexandra* — with no borders whatever — on 14th May.

Apparently there are two broods of *Alexandra* in the year, but Mr. Bruce is of the opinion that there is really but one. In June, the butterflies from the lower elevations first come from pupæ; in July, those from higher elevations, and in August, the highest of all; a constant stream of fresh butterflies being kept up from higher to lower elevations. Mr. Bruce says: "The species is a powerful flyer and takes very long flights; in the narrow cañons, will fly along the side of the trail or stream downhill for miles. It is found at various elevations from 6,000 to 10,000 feet."

The adult larva is shape of *Philodice*, 1.1 inch long; color uniform yellow-green; along base a white band with broken red-orange dashes running through it; head yellow-green. The chrysalis measures .8 inch; shape of *Philodice;* color yellow-green, the dorsal side darkest; on ventral side of the abdomen, next wings, three small reddish spots in line.

Colias Christina. — This species was described and figured in Volume I., from a few examples collected at the far north by Mrs. Ross. Colias *Astræa* was described from a single male brought in by the Hayden Expedition from the Yellowstone. The validity of *Astræa* was denied on general principles by Dr. Hazen, in a paper on "The Genus Colias" in the Trans. Bost. Nat. Hist. Soc., 1882; and he guessed it to belong to the same species as *Alexandra* and *Edwardsii*. As to *Christina*, he decided it to be neither more nor less than *Edwardsii*. *Christina*, since the opening of the Canadian Pacific Railway, has been taken by thousands on the plains of Manitoba and Alberta, and varies more

than any other American Colias in both sexes. I could fill three of my plates with distinct variations. One of its forms is certainly *Astræa*, and the orange form has been taken in Montana. But no connection appears between *Christina* and *Alexandra*, *Edwardsii*, or *Emilia*.

I received from Mr. Thomas E. Bean, at Laggan, Alberta, 1891, 20th May, a dozen larvæ past their first moult; on 6th June, twelve were feeding on white clover, all but one or two past third moult. One passed the fourth, 7th June; three more on 8th. In all I obtained five pupæ. On 19th, a male, *Astræa* type, came from pupa; on 21st, a female same; on 24th, a male, *Christina* type.

The adult larva is shape of *Philodice;* length, 1.4 inch; color dark yellow-green, a white basal stripe, a short red dash through it, behind each spiracle. The pupa is like that of *Philodice;* length, .78 inch; color yellow-green, a broad yellow stripe from wing cases to end on the ventral side; on the abdomen, below this stripe, a dash of red-brown crosses the three segments next wings. Some of the larvæ hibernated after the first moult, but they died during the winter.

Colias Elis. — This species was described by Mr. Strecker, 1885, from a single female taken in Canada. Mr. Bean, in the Canadian Entomologist, Vol. XXII., 1890, gives a very interesting account of the region about Laggan, Alberta, where *Elis* is taken on the peaks, as well as of this form itself. He gives reasons why *Elis* should be held a good species, and disconnected with *C. Meadii*, which it very closely resembles.

I received from Mr. Bean several just-hatched larvæ, 23d July, 1889; several passed their first moult 28th. Of the larva at this stage Mrs. Peart wrote me: "I see no difference in form, color, or number and arrangement of processes, between it and *Meadii*." The larvæ began to pass the second moult, 1st August; the third moult, 12th; length at third, .24 inch; color yellow-green; covered with fine, short black hairs from black tubercles, giving a darker appearance than characterizes any of our species reared by me except *Meadii*, and it was just as in that; a narrow whitish sub-dorsal stripe, under which, on segments 3 to 12, a small black spot to each; but some examples were without the black, and some without the white, or either; the basal ridge narrow, yellowish; head bright yellow-green, with many black hairs. Shortly after the third moult the larvæ slept, and were sent to New York. I received them again, 2d April, 1890, but only two were alive. One of them passed its fourth moult on 13th, the other on 17th April, and this last pupated 4th May. The pupa was figured by Mrs. Peart, but was lost in the mail in its return to me.

ADULT LARVA. — Length, .7 inch; color dark yellow-green, the dorsum a shade lighter than the sides; densely covered with short black hairs from black tubercles, each of which is encircled by a narrow whitish ring; a sub-dorsal white stripe, as broad as the basal, from 2 to 13; under this, on each segment, a small black spot, often, however, more or less wanting; the basal stripe white; head light yellow-green. The larva was in all respects, at all stages, like *Meadii*. The pupa was also like *Meadii*, and I refer to the description of this last. From some hibernated larvæ sent by Mr. Bean, and received 1891, May 24th, were obtained three pupæ and three imagos, namely, a male, 30th June, from pupa of 23d; a female, 28th June, from pupa of 20th; and a female, 29th June, from pupa of 20th.

I cannot see any noticeable difference between *Elis* and *Meadii*. If any example of either sex of the former shows any peculiarity, the same may be found in *Meadii*. I believe what Mr. Bean calls *Elis* type flies with *Meadii* in Colorado, and I have one such male, taken by Mr. Gillette. Many of the *Meadii* at Hall Valley have the dingy orange hue characteristic of the arctic species, C. *Hecla;* and the females have the faded orange, passing into sordid-yellowish, seen in females *Hecla*. I sent a pair of this type to Mr. A. G. Butler, London, and asked him to submit it to Mr. McLachlan, giving no information except that these specimens were taken in America. With the butterflies went a sealed envelope, not to be opened till these gentlemen had expressed their opinion as to the name of the species, and in it I told whence the insects came. Both pronounced the species to be *Hecla*, but they noticed the mealy spot on the shoulder of the male, a feature which appears to be unobserved in *Hecla*. These pale examples of *Meadii* were fresh, not worn at all, and were taken on the tops of the highest peaks in September.

COLIAS MEADII. — Mr. Bruce says that the proper habitat of *Meadii* is from 11,000 to 12,000 feet elevation in Colorado, but they will follow the narrow valleys down to 9,000 feet. Mr. Mead first took it on the divide between the Arkansas and Platte valleys, at about 12,000 feet, and saw none lower than 10,000. The larva is at all points like that of *Elis*, as above described. The pupa is about .66 inch in length, and shaped as in *Philodice;* color green-yellow, all the ventral side being brighter than the dorsal, and the projection or beak at head quite yellow; a mid-dorsal darker line, and a faint sub-dorsal one; all the dorsal side, and the ventral side of the abdomen, dotted and mottled with whitish; the wing cases and ventral side to head finely granulated. This description answers, word for word, for *Elis*.

SUPPLEMENTARY NOTES.

COLIAS SCUDDERI. — I received several eggs, August 1, 1890, from Mr. Bruce, at Hall Valley, Colorado, laid on a species of Vaccinium. He saw two females each lay an egg on this plant, and caught and confined them on it. He had seen females laying on willow also. I put the larvæ on weeping-willow leaves. Some of these reached the third moult and then hibernated, but they died during the winter. The larva up to third moult is closely like *Elis* and *Meadii*.

COLIAS BEHRII. — The habitat of this species was unknown until recent years, when Mr. H. G. Dyar was guided to it by the late John B. Lembert, on the high meadows, at 7,000 feet elevation, among the mountains of Yosemite.

LIMENITIS WEIDEMEYERII. — Mr. Bruce sent me fifteen eggs from Hall Valley, which were received, 24th August, 1891. He wrote: "I saw the female evidently trying to lay her eggs; caught her and tied on a small cottonwood close to my window. It rained for three days, and during this time she remained motionless on the under side of a leaf. By noon on the fourth day the weather had become fine and warm. On the fifth day she laid the eggs. I have before confined several females of this species without effect, and was not a little pleased at seeing the beautiful eggs." The eggs were of same form and character as those of the eastern species of the genus; and the young larva at birth looked just like a young *Disippus* or *Eros*, — the color light brown. It made a perch in exactly the same way. The successive moults showed the larva as being close to *Disippus*. The mature larva measured 1.2 inch, and four days after maturity it pupated. The pupa was .9 inch long, shape of *Disippus;* color of the head case, and of ventral side, and of the wing cases, blackish-brown, as was also the thoracic process; abdomen light buff with a pink tint mottled with olive-green; dorsal side of head case and the mesonotum pale brown, the head case obscurely silvered. I got but one pupa that season, as but one larva passed all its stages; the rest, after second moult, making cases of the leaves, as the allied species do. On 27th March, 1892, two of the larvæ came out of their hibernacula; on 2d April, one passed its third moult, on 6th, its fourth. The most advanced of the two I sent to Mrs. Peart; the other was discovered, on 7th April, to be making a new case, into which it retired on 8th. The next day a great change in the weather took place, the mercury falling to 37°, with flurries of snow. On the 14th, I discovered that this larva was dead. I have had no other instance of a Limenitis larva making a second case after it had come out of the first one in the spring.

LIMENITIS LORQUINI. — I received four eggs from Mr. W. G. Wright at San Bernardino, California, 24th April, 1892. These were of same form and pecul-

iarities as in *Weidemeyerii* and *Eros*. The first larva hatched, 25th; passed the first moult, 29th; the second moult, 2d May; the third moult, 4th; the fourth moult, on 7th; and pupated, 12th May. The first imago came out, 22d May. These eggs were laid on the tips of willow leaves and the larvæ fed on willow. They constructed perches, just as do the other species of the genus. At all stages the larvæ resembled *Arthemis* more than either of the other species; and the chrysalis was most like *Arthemis*. None of the larvæ made hibernacula.

Chionobas Ivallda. — I received eggs from Mr. Wright at Truckee, California, laid 8th July. These began to hatch on 20th; the young larva not different from *Chryxus*. The first moult was passed, 3d August; the second, on 13th; the third, August 26th; but the only larva which got past third moult died 28th. At all stages the form and coloration was as in *Chryxus*. *Ivallda* had been known only from the vicinity of Truckee, but the late John B. Lembert sent me several examples which he said he took along the Tuolumne River.

Lycæna Lygdamas. — On 25th May, 1891, I received four larvæ of this species from Professor A. D. Hopkins, of the W. Va. Agr. Station. He had found them on Vicia Carolina. "The larvæ when young feed on the tender leaves, flower-heads, and flowers; as they grow older, on the leaves and stems." The adult larva was very like *Pseudargiolus* in form. Length, .34 inch; breadth and height, each .05 inch; shape long oval, the sides along base nearly parallel, the two ends equally rounded; the dorsum high, and sloping fore and aft from the middle; the last segments flattened; segment 2 entirely conceals the head when the larva is at rest; the tuberculous processes that surmount the ridge as in *Pseudargiolus*: color very pale green; the sides of the ridge and body marked by two whitish oblique bars, the front pointing toward the dorsum, each bar crossing two segments. On 11 was a dorsal slit, and on 12 two cylindrical tubes, as in *Pseudargiolus*. These tubes I saw thrust out frequently, the tentacles fully ope... None of the larvæ reached pupæ, they not liking the food I gave them.

Lycæna Violacea. — In Volume II., I suggested that part of the *Violacea* butterflies of the spring came from *Violacea* eggs of the previous year. Of late years, I have found this to be the case. The chrysalids from *Violacea* eggs, in part, disclose *Neglecta* in the succeeding June, but most of them hibernate, and, so far as appears, produce *Violacea* the next spring.

Erebia Epipsodea. — There was error in my description of the egg of this species, I having given it thirty odd ribs, whereas it has about twenty-two.

The error was overlooked in proof-reading. The figure showed, however, that the number was about twenty-two.

EREBIA DISCOIDALIS. — This species has of late years been taken as far south as Calgary and Olds, which is about forty miles from Calgary. I received four eggs of it from Mr. Fletcher, part of seventeen sent him from Olds. The egg is of the shape of *Epipsodea* and *Magdalena*, and the ribs are as numerous as in the latter species, or rather more so, forty to forty-two against thirty-six in *Magdalena*. Mr. F. H. Wolley Dod sent eggs to Mrs. Peart, 28th May, 1895. He says: "This is the most sluggish flyer of any butterfly that I know, particularly the females. It flies principally in places where the grass is of a rich growth, and where the ground is covered with stunted sallows bushes. It may generally be found in considerable numbers in the shallow grass-covered ravines which are a notable feature of this country. It prefers low-lying ground. I do not mean that *Discoidalis* flies at a low altitude, for that of Calgary is 3,200 feet above sea level. In the very slightest breeze the species is helpless, and it never flies except during sunshine, and then not far. I first obtained it, 4th May; on 13th, it was locally abundant and in good condition. After three days of rain, 15th to 17th, the males were almost passée. Before the end of May, it disappeared almost entirely." The larvæ received by me were reared to third moult, when they seemed full-grown and hibernated; but none survived the winter.

PAPILIO PILUMNUS. — After the paper on this species was published in the present Volume, I had correspondence with Mr. William Schaus, the well-known lepidopterist, who gave the papers spoken of on page 7 to Mr. Henry Edwards. Mr. Schaus assures me that he was familiar with the species in Mexico, and has the larva to pupa, so discovering that *Pilumnus* belongs to the *Troilus* and *Calchas* group instead of that of *Turnus*.

DATE OF ISSUE OF PARTS 1-17.

Part 1. — January 9, 1887. — Containing Colias Eurydice, Argynnis Nitocris, A. Lais.

Part 2. — April 20, 1887. — Containing Colias Harfordii, Argynnis Coronis, Neonympha Gemma.

Part 3. — September 12, 1887. — Containing Melitæa Baroni, Argynnis Liliana, A. Egleis.

Part 4. — January 22, 1888. — Containing Colias Chrysomelas, Argynnis Nausicaa, Cœnonympha Galactinus.

Part 5. — May 28, 1888. — Containing Melitæa Rubicunda, Erebia Magdalena, Debis Portlandia.

Part 6. — December 14, 1888. — Containing Papilio Nitra, Anthocharis Genutia, Neonympha Areolatus.

Part 7. — March 11, 1889. — Containing Anthocharis Pima, Erebia Fasciata, Geirocheilus Tritonia.

Part 8. — June 2, 1889. — Containing Papilio Pilumnus, Grapta Interrogationis, Argynnis Cybele, and var. Carpenterii.

Part 9. — February 5, 1890. — Containing Argynnis Nevadensis, Satyrus Pegala, Erebia Epipsodea.

Part 10. — October 1, 1890. — Containing Argynnis Alcestis. A. Adiante, Satyrodes Canthus.

Part 11. — April 17, 1891. — Containing Apatura Flora, Satyrus Meadii, Chionobas Chryxus.

Part 12. — January 4, 1892. — Containing Papilio Americus, Chionobas Uhleri, C. Varuna.

Part 13. — December 10, 1892. — Containing Chionobas Chryxus, var. Calais, C. Jutta, C. Brucei, C. Crambis.

Part 14. — November 17, 1893. — Containing Neominois Ridingsii, Chionobas Œno, C. Macounii.

DATE OF ISSUE OF PARTS 1–17.

Part 15. — July 17, 1894. — Containing Argynnis Astarte, A. Alberta, Chionobas Subhyalina, C. Norna, C. Semidea.

Part 16. — October 5, 1895. — Containing Parnassius Smintheus, Satyrus Charon, Chionobas Gigas.

Part 17. — March 1, 1897. — Containing Chionobas Iduna, C. Californica, C Alberta, C. Peartiæ, C. Œno, C. Varuna.

GENERAL INDEX.