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NOTE.—Owing to the absence of the Editor from New York, it was impossible to produce the May number in proper time. It is hoped that the contents of this double number will compensate for the delay. (Issued July 10, 1883.)

ON THE POLYMORPHISM OF LYCÆNA PSEUDARGIOLUS. *BOIS.*

BY W. H. EDWARDS.

This paper, nearly in its present form, was read at the Montreal meeting of the Am. Assn. in 1882. Some additions and alterations have been rendered necessary by the receipt of Mr. Morrison's collections of 1881, and by further information respecting *L. Piasus*. Coalburgh, W. Va., April 1, 1883.

L. Pseudargiolus received its specific name in 1833, but Abbot had figured it in 1797, Ins. Ga., as *Argiolus*, mistaking it for the European species of that name. In 1862, I described as *Neglecta* what has since been found to be a co-form with *Pseudargiolus*, in W. Va., and the usual northern type of the summer generation. I also described *L. Violacea*, from W. Va., in 1866. At that time, very little was known of the polymorphism of butterflies, seasonal or other, and, moreover, that was a phenomenon which was only discoverable by breeding from the egg, and nothing whatever was known of the preparatory stages of any one of these supposed species.

Kirby had described *L. Lucia*, in Fauna Boreali Americana, in 1837, and, fortunately, had given a well executed and colored figure of it. His description does not agree with his figure, varying in several important particulars; but as he says that only one specimen was taken by the Expedition, I apprehend that the careful figure should be our guide, rather than the less careful description, especially as the figure really represents a common boreal form of the butterfly. The description says: "Wings above silvery-blue; the secondaries are *brown* underneath and *spotted with black and white*; towards the posterior margin the white spots are arranged in a transverse band parallel with it, and, as in the primaries, the wing terminates in several obsolete eyelets." The synopsis of character which precedes the description differs

from the latter, thus: "Secondaries underneath *brownish-ash color*, spotted with black and white." One says "brown," the other "brownish-ash color."

The colored figure shows the basal area of secondaries to be whitey-brown, and there is a conspicuous blackish, triangular patch on the disk at the origin of the median nervules, of which the text is silent; the extra discal area is scarcely whiter than the basal, and is not composed of white spots, as would be understood by the description. It is merely the uninterrupted white ground of that part of the wing. Also, the margins by no means represent obsolete eyelets, as stated, but heavy dark confluent crenations.

I believe the typical *Lucia*, as our collectors understand it, has a more or less conspicuous black discal patch, as indicated in Kirby's figure, and a heavy black border. As witness to this, Mr. Scudder, Can. Ent., VIII., 62, describes *Lucia* as having the spots of the under hind wing "very large, usually completely confluent, and often suffusing nearly the whole base of the wing; and the marginal markings tend to form a broad band, etc." This agrees well with the figure, whereas the description might pass for *Violacea* of a silver-blue shade, and on which the white scales of under side had been partially denuded, so as to disclose the brown sub-color, thereby leaving the white area somewhat macular. The fringes are white and black alternately.

The typical *Violacea* is violet-blue above, light grayish-white beneath, and all of one shade, there being nothing macular in it, with dark points across the disks, and pale dusky crenations in outline on the margins. But while, in W. Va., violet is a prevailing color, many are lavender-blue, or silvery, and some, especially females, are metallic blue. The range of color embraces all the shades which are to be found in the northern corresponding forms. The fringes are either white and black as in *Lucia*, or on the hind wing white altogether. At the extreme north, the under side of *Violacea* is not so white and pure as in the type, the brown sub-color appearing more or less. The southern *Violacea* considerably approaches *Neglecta* in color of both sides.

Now, in addition to the above-named and described forms, which stand at the extremes of the series, there is another midway between *Lucia* and *Violacea*, and distinctly characterized. The males are silvery-blue and as often violet-blue, the females almost always metallic blue, of the shade spoken of as sometimes seen in the Virginian *Violacea*. The fringes white and black, as in *Lucia*. The ground color of secondaries underneath is whitish, and continuous, and the marginal crenations are very heavy, confluent, black, making a conspicuous band. There is no discal patch, and therein it differs from *Lucia*; the marginal band separates it from *Violacea*. This form is as unknown in Virginia as is *Lucia*,

but seems to prevail in New York, New England, and Quebec, at least in the region about Montreal. I call this *Marginata*. It has passed sometimes as *Lucia*, sometimes as *Violacea*, but by separating it we shall get a clearer idea of the species. Of course, these three forms, distinct as they are generally, all vary, and one approaches the other, or glides into the other, by intermediate examples, but I should say that forty-nine out of fifty individuals, no matter where found, would range under one of these names. They all belong to the same species. *Lucia* without the black patch is *Marginata*, and *Marginata*, without the black and heavy border, is *Violacea*. They are three phases of the winter form of the species, and whether we call them trimorphic forms, or three varieties, makes no difference in the result. At any rate the two extremes, *Lucia* and *Violacea*, differ materially.

In W. Va., *Violacea* is the sole representative of these forms, there being no examples so far known approaching *Lucia*, and very few indeed approaching *Marginata*, even by a slight deepening of color in the marginal band. And it has acquired a melanic male not before observed. Mr. Morrison took the same melanic male together with both *Violacea* and *Neglecta* in south Colorado.

In many seasons, the blue males swarm in my neighborhood, and assemblies of scores and hundreds may be met with along the water courses, early in April, or in the last days of March. The first generation vastly outnumbers its apparent second one, which is made up of *Pseudargiolus*, flying in May, and *Neglecta*, in June, and is now very abundant. Sometimes, with the early butterflies, a few individuals are taken which combine the features of both *Violacea* and *Pseudargiolus*, the males having the upper surface colored as in the latter, but the under marked like the other, and often more emphatically than in the type. I have such a mixed example from south Colorado also.

Precisely at what line *Lucia* and *Marginata* are suppressed, or where the melanic form comes in, I am not able to state. Dr. Jno. Hamilton, of Allegheny, and Rev. W. J. Holland, of Pittsburgh, both assure me that the black male has never been seen by them in Pennsylvania. To the west, Dr. H. S. Jewett, at Dayton, Ohio, has never seen the black male, though blue *Violacea* flies there. Mr. H. K. Morrison tells me that in western North Carolina both the black and blue forms are found. Mr. E. M. Aaron, now of Philadelphia, but formerly of eastern Tennessee, says that all the West Virginia forms of the species are found in Tennessee, North Carolina and Georgia. Abbot, in the *Insects of Georgia*, figured *Pseudargiolus* as *Argiolus* (of Europe) and its larva and chrysalis.

The typical *Pseudargiolus* is large, sometimes expanding 1.4 inch, and from that down to one inch. *Neglecta* expands from .8 to 1 inch. As a rule, the disk of forewing in *Pseudargiolus* ♀ is whiter than in *Neglecta*, and the under side of both sexes is

purser white, with fewer and less distinct marks; and the disk of hind wings of *Neglecta* is pale, with a deep blue marginal border, while in *Pseudargiolus* both wings are of one hue. The northern summer form is *Neglecta*; in the south, *Pseudargiolus* flies in May and *Neglecta* in June, and, as I shall show, have not a direct relationship with each other notwithstanding the resemblance.

We have therefore *Pseudargiolus*, *Neglecta*, *Marginata*, *Violacea* and the melanic male (originally supposed to be the female) of the latter, all going to make one polymorphic species. I propose to show what is known of the inter-relationship of these forms.

1. In the high boreal regions both *Lucia* and *Violacea* fly.

I have *Violacea* from St. Michael's, Alaska; also from Anticosti. And *Lucia* from Anticosti and Lake Winnipeg. Kirby's *Lucia* was taken in lat 54°, or about as far north as the upper end of Winnipeg. Mr. Couper, who collected for two seasons on Anticosti, is confident that no butterfly can be double-brooded on that island, by reason of the short and cold summer. Probably at St. Michael's all species are monogoneutic also. As only two examples were received from this locality, both of which were *Violacea*, we cannot tell whether *Lucia* flies there or not. Very probably it does, and, if so, these two forms in Alaska as well as on Anticosti equally represent the species. Being single-brooded, they together stand for the parent species. They are the primary or winter generation. As the species has extended to the south, where a second generation was permitted, *Neglecta* is derived directly from it.

2. In a belt of latitude covering part of Canada and British America, and southward to Long Island at the east, and Racine, Wisconsin, at the west, we have *Lucia*, *Marginata*, *Violacea* and *Neglecta*. The three forms of the winter generation appear, in the territories they all inhabit, at the same period of the year. Neither precedes the other in time.

I give a table of localities of both the winter and summer generations, as they manifest themselves; also adding *Piasus* to bring the entire sub-group into one view.

Now as to the three members of the winter form appearing at the same time of the year. At my request, several gentlemen undertook very kindly to pay special attention to this point, the present year. Unfortunately, in most localities, this has been the most wretched conceivable season for butterflies, and Mr. Hulst is the only person who has met with the species we are considering in any numbers.

1. Dr. E. C. Howe, Yonkers, N. Y., says: "All these forms do really occur here, and at the same time."

2. Rev. George D. Hulst, of Brooklyn, N. Y., between 17 April and 19 May, took 118 ♂ 31 ♀. The first example was a ♂

TABLE OF LOCALITIES—WINTER AND SUMMER GENERATIONS.

LUCIA.	MARGINATA	VIOLACEA.	SAME. BLACK MALE.	VIOLACEA CINEREA.	NEGLECTA.	PSEUDARG.	PIASUS.
Anticosti. Winnipeg. Montreal.	Montreal.	St. Michaels Anticosti. Winnipeg. Montreal.			Montreal.		
Orono, Me. Boston.	London, Ont Orono.	Orono. Boston.			London. Orono. Boston.		
Albany, N.Y. Yonkers, " L. Island. Racine, Wis.	Yonkers. L. Island. Racine.	Albany. Yonkers. L. Island. Racine.			Albany. Yonkers. L. Island. Racine.	Racine.	
		C'lb'h, W.V. Dayton, O. Carb'ale, Ill. W. N. Car. Georgia. E. Tenn. Montana.	Coalburgh. W. N. Car. Georgia. E. Tenn.		Coalburgh. W. N. Car. Georgia. E. Tenn.	Coalburgh. W. N. Car. Georgia. E. Tenn. Montana. Nevada.	
North Colo.	Montana.	S. Colorado.	S. Colorado.	S. Arizona.	N. Colorado. S. Colorado.	S. Arizona.	
		Mt. H'd Or.			S. California	Arizona.	Arizona. California.

Marginata 17th April; on the 19th, 1 ♂ same and 1 ♂ 1 ♀ *Volacea*; on 22d, 3 *Lucia*, two of which displayed very large patches on hind wings, 7 *Marginata*, and 4 *Violacea*; on 24th, 2 *Lucia*, 11 *Marginata*, 7 *Violacea*; on 1st May, 6 *Lucia*, 22 *Marginata*, 23 *Violacea*; on 8th May 11 *Lucia*, 18 *Marginata*, 14 *Violacea*; May 16, 4 *Lucia*, 7 *Marginata*, 3 *Violacea*. I would have been glad of many other statements, and should have received them had the season been propitious, but this one, made by an experienced and careful observer, and extending through several weeks, tells the story as completely as if a dozen had been sent me. Mr. Hulst further informs me that he happened to have a lot of these butterflies caught one day in the spring of 1881, 41 specimens in all. That of them 8 are *Lucia*, all but three having the patch of large size, 24 are *Marginata*, and 9 *Violacea*; and speaking in general of these forms as they appear at Brooklyn, he says that *Lucia* is common, *Marginata* takes in the bulk of the specimens, and *Violacea* is not unfrequent.

3. Rev. Thos. W. Fyles, of Cowansville, P. Q., sends a table of his captures:

On 22nd May, 3 *Marginata*.

" 27th " 2 "

" 31st " 1 "

" 2nd June, 4 " and 2 *Lucia*.

" 12th " 1 "

3. Eggs laid by *Violacea*, in April or early in May, in W.Va., produce *Neglecta*, in June, so far as known, but most of the

chrysalids hibernate. The eggs are laid on Dogwood, *Cornus*, in April. This was ascertained in 1878 only. On tying a female over the end of a branch, about 40 eggs were obtained within a few hours, laid among the flowrets. This was 14th April. The duration of the egg stage was 5 days, of the larval, 24 days, and the first pupation took place on the 13th May; on 6th June, or 24 days after pupation, there emerged a *Neglecta* ♀. The whole period, therefore, from egg to butterfly, was 53 days, and observations in successive years show that the duration of the egg and larval stages is just about the same as in the case stated; that is, 29 or 30 days. I have never had a butterfly from *Violacea* chrysalis except in this one instance. Some of the chrysalids of 1878 were alive late in the summer, and the presumption is, would have successfully hibernated, if I had had the skill to manage them properly. But about middle of September all were found to be dead. And in subsequent years, I have lost them without getting a butterfly. They either dry up or mould. In nature, these larvæ fall to the ground when full grown, and no doubt conceal themselves under sticks and stones for pupation. I made my plans for the present season (1882) to breed from *Violacea* and *Pseudargiolus* largely, with the hope of clearing up any yet obscure parts of their history, and received advice from Mr. William Buckler, of England, who has had great experience in rearing lepidopterous larvæ, as to the way of preserving a just medium between dryness and too great dampness with the chrysalids, but have been able to do nothing, getting neither eggs nor larvæ. Inasmuch as *Violacea* is so excessively abundant in April, it is not possible that the few late females of *Pseudargiolus*, which lay eggs in September, can be the parents of all this host, and I infer, in consideration of the fact that the hibernating chrysalids of the May generation (*Pseudargiolus*) produce their own form of butterfly only so far as yet known, and also that the larger part of the chrysalids of *Violacea* appear to hibernate, that nearly all the butterflies of the first generation must come in direct descent from their own form of the year before.

4. Eggs laid by *Pseudargiolus* produce the same form the same year in very small numbers, but most of the chrysalids hibernate to produce the same form the next spring. The few butterflies which emerge the same summer are sometimes as large as the parent female, but usually are smaller. I have never actually carried one of the chrysalids over the winter to imago in the spring, but there can be no doubt that *Pseudargiolus* of May come from hibernating chrysalids, and I will make it clear that any other assumption is impossible. The food plant of *Pseudargiolus* is Rattle-weed, or otherwise called black snake-root, *Cimicifuga racemosa*. That the females laid their eggs on this was only ascertained in 1877, and early in July, I had got about 30 chrysalids by raising the larvæ. (The duration of the several stages are as fol-

lows: egg, 4 days; larva, 19 at the least, or 23 days from laying of egg to pupation. From that to 28 days.) On 19th August, 1 ♂ *Pseudargiolus* came forth from chrysalis; 1 ♀ 1st September, and 1 ♀ between 3rd and 20th September, while I was absent from home. The other chrysalids were alive at the beginning of winter, but 19th February, 1878, were found, on examination, to be dead. I opened their wing cases, and most had the full color of *Pseudargiolus*, a few showing no color at all. It is well known that the color of a butterfly's wing begins to set but a short time before the imago is to issue from chrysalis, and when the color is complete the insect is ready to burst the shell. Most of my chrysalids then, at some date in the winter, had been fully ready to give *Pseudargiolus* butterflies, but just at that point they had died.

In 1878, I had a great number of larvæ. On one day, 19 June, I found 50. On 13th July, emerged 1 ♀; on 4th August, 1 ♂; on 10th August, 2 ♀; and no more issued. I had tried to keep these chrysalids damp on moss sprinkled with water, but on 12th September found that all were dead with mould.

In 1879, I carried upwards of 20 chrysalids, obtained in July, through the summer and fall, with no emergence except on 14th September, when a ♀ *Pseudargiolus* came out. The rest were alive in early winter, but were found to be dead 19th January.

In 1881, I had 3 chrysalids that certainly were alive 20th February, 1882, and that day they were removed from the house to the open air, the weather becoming moderately warm. This was with the hope that the butterflies would soon begin to come forth. But some time in March I found all of them dead. On opening the wing cases they proved to be 2 ♂ 1 ♀ *Pseudargiolus* in full color.

This season, 1882, I could get but two chrysalids, one of which formed 3d July, and gave a full-sized female 15th July, or after 12 days. The other, on 27th July, gave a medium-sized ♀ after but ten days pupation.

In corroboration of the observations based on the chrysalids, I will give others upon the appearance of the butterflies in the field, and these can have no other interpretation than that *Pseudargiolus* of May must come altogether from hibernating chrysalids. I recall the facts before stated, that the duration of the egg and larval stage in the first generation (or *Violacea*) is about 30 days, and that the only butterfly known to emerge from chrysalis proceeding from *Violacea* was *Neglecta*, after a period of 24 days from pupation, making 63 days from egg to butterfly. The egg was laid 14th April, and the *Neglecta* came out 6th June. Now it will be seen that year after year the first appearance of *Neglecta* has been in the early days of June, while *Pseudargiolus* has been on the wing, in fresh examples, at the time that *Violacea* eggs were being laid. In fact, *Pseudargiolus* is always plenty before the

larvæ from *Violacea* eggs have reached chrysalis, and has totally disappeared when *Neglecta* begins to come on the stage.

1865, 22d May, took 3 *Pseudargiolus*; on 15th June, 3 ♂ *Neglecta*, the first seen.

1866, on 13th and 14th June, took 30 ♂ *Neglecta*; on 1st July, 1 ♀, the first seen.

1867, 11th May, took 6 ♂ *Pseudargiolus*.

1868, 1st " " 1 ♀ " the first example seen.

" 14th " " 14 ♂ ♀ "

1869, 29th " " 15 ♂ "

" 6th June " 1 ♀ " on 20th June took several *Neglecta*.

1870, 15th May, took 5 ♂ *Pseudargiolus*.

1877, 29th " " 3 ♀ "

" 2d June " several ♂ "

1878, 13th to 17th April, found the first eggs and nearly hatched larvæ of *Violacea*. On 19th, 20th, 21st April, took each day a fresh ♂ *Pseudargiolus*. On 1st May 5 ♂, and 3d May, recorded that the species was abundant. On 6th June, a *Neglecta* (before mentioned) came from chrysalis from *Violacea*. On 9th June, took several *Neglecta*, and recorded that no more *Pseudargiolus* were to be seen.

1879, 1st to 6th May, was daily finding eggs and larvæ of *Violacea*; 9th May, took 1 ♂ *Pseudargiolus*.

" 11th " " 1 ♀ "

1880, 2d May, took 2 ♂ *Pseudargiolus*: On 30th May, took 23 ♂ *Neglecta*.

1881, 8th May, found the first larva of *Violacea* of the season; same day, saw first *Pseudargiolus* flying. 16th they were plenty; On 7th June, *Neglecta* were flying, fresh from chrysalis; took 5 ♂; on 22 June, they were plenty.

1882, April 6, took several fresh ♂ *Violacea* in a cluster on the ground, and with them were two ♂ *Pseudargiolus*, earlier by a month nearly than I had ever seen them.

The observations on the chrysalids and those on the appearance of the butterflies in the field therefore agree, and together show that *Pseudargiolus* of May cannot proceed from *Violacea* butterflies of that year, but must come from hibernating chrysalids. The later butterflies, *Neglecta*, which follow closely the others, and begin their flight about June 1, and are not in large numbers, as a rule, must come from *Violacea* butterflies of the same year. A small percentage of the chrysalids from *Violacea* give butterflies at fifty and more days from the eggs laid in April, which brings the emergence into June, and the result is *Neglecta*; while nearly all the chrysalids hibernate, as before said, to give *Violacea* the next spring.

In a paper in Can. Ent. Vol. X., p. 1, 1878. I stated my

belief that *Pseudargiolus* proceeded directly from *Violacea*, and accounted for *Neglecta* by effect of climate, scarcity of larval food, etc. But later observations and a careful reading of my journals have led me to reject that theory.

Therefore, what is apparently the second generation is really but partially so. It is made up from two distinct sources, and the true second generation of the year in descent is *Neglecta*, proceeding, as it does, directly from the first generation, or *Violacea*. *Pseudargiolus* is an interpolated and distinct generation, the first in the year of its series. It has no direct connection with the winter forms, but an indirect one through the few individuals which spring from it late in the season, as I shall show.

I am not able to state what is the behavior of *Neglecta*, when it lays its eggs, or upon what plant. Inasmuch as, later in the year, only an occasional individual of the species is flying, and which can be accounted for as the product of *Pseudargiolus*, it seems to me highly probable that all the chrysalids from *Neglecta*, which would be formed in July, go over the winter, to swell the hosts of *Violacea* in April.*

5. The few late females sprung from *Pseudargiolus*, and which emerge from chrysalis irregularly in August and September, lay eggs, and the chrysalids thereupon hybernate and produce *Violacea* in the following spring.

In September, 1873, Mr. T. L. Mead, then at Coalburgh, noticed a female laying eggs on flowers of *Actinomeris squarrosa*. From these two chrysalids were obtained, but they died during the winter. In September, 1874, I found a few larvæ on same plant, and got from them three chrysalids, from which emerged 13th February, 1875, three butterflies, 1 ♂ 2 ♀ *Violacea* (as related Can. Ent., VII., p. 82.)

In 1877, so late as 13 October, I found several larvæ on *Actinomeris*, and sent them to Dr. Hagen for observations on the honey-tubes. 1878, 11 September, I had 3 larvæ from same plant, but find no mention of the chrysalids later. 1881, 30 August, I found 2 larvæ on same plant, and obtained from them two chrysalids. These gave two females *Violacea*, on 2nd and 15th March,

* While correcting the proof of this paper, 30th June, I am able to add something to the history of *Neglecta*. From *Violacea* eggs, in April of this year, I obtained six chrysalids, which formed 19 May, and within one or two days after. To the present date, or at 39 to 41 days from pupation, no chrysalis has given butterfly, though *Neglecta* butterflies have come and nearly gone. *Pseudargiolus* was so scarce that I saw but one example, a female, which I caught while it was ovipositing on Rattle weed, on 5th June. From this, tied in bag, I got eggs, and this very day 3 of the larvæ therefrom have pupated, 1 on 28th, or at 23 to 25 days from laying the eggs. On the Rattle weed, previous to 16th June, I found a few eggs and larvæ of *Pseudargiolus*, from which I have 12 chrysalids. On 9th June, the first example of *Neglecta* butterfly was seen, a fresh male, and within a week there were many. And they have nearly disappeared, and examples taken since 25th have been worn. But at this date, 30th June, the Rattle weed is still abundant, and bids fair to continue in flower two weeks longer (or long enough for all larvæ now on it to mature), and I find plenty of young larvæ, which undoubtedly are from *Neglecta*. Since 16th June, I have found both fresh eggs and newly hatched larvæ. I observe that the chrysalids from eggs of *Pseudargiolus* are nearly twice as large as those of *Violacea*, averaging, length, .336 in., breadth of abdomen, .157 in.; while *Violacea* averages, length, .26 in and breadth .125. What the chrysalids from *Neglecta* measure I will ascertain in due time. But the little chrysalids of *Violacea* will not produce the large butterfly *Pseudargiolus*, and the large chrysalis of the latter will not produce the little butterfly *Violacea*.

1882. So that certainly some *Violacea* come from the chrysalids of the late *Pseudargiolus* of preceding year. But, as before said, all cannot so originate. *A. squarrosa* has furnished very few larvæ, two and three in a season, in one case ten; but if all, or any large part, of the spring butterflies came from September larvæ, the plants would swarm with the latter.

This is the history of the species in W. Va. At the north, very little seems to have become known respecting any of the preparatory stages. But 8th June, 1878, I received from Prof. J. H. Comstock several larvæ, on *Viburnum acerifolium*, supposed to be from eggs laid by *Neglecta*. None of the chrysalids therefrom gave butterfly the same season, and all were dead by 12th December. I conclude that these chrysalids would, under natural conditions, have hibernated.

On the other hand, Mr. William Saunders, in *Can. Ent.*, Vol. I., p. 100, relates that he found larvæ nearly full grown 12 July, on *Cornus*; and in Vol. VII., page 83, he further says, that of that lot of larvæ, 5 soon after pupation produced *Neglecta* butterflies. It is to be inferred that no chrysalids lingered, as no mention is made of such. Mr. Saunders says, that in his locality, London, Ont., there are two broods of *Neglecta*, one in May and June, the other in July and later. And the date of his captures, in several years, run from 14th May to 4th June; a much beaten specimen on 25th June. And fresh individuals had been taken 2d and 5th July, indicating a second brood. Mr. Saunders is confident that the winter forms of the species are not to be found in that region, not having been taken or seen, though there are many collectors at hand. At various points from W. Va. to Maine the winter forms and the flowering of *Cornus* come together, so that except for Mr. Saunders' confidence in the absence of these forms, I should infer that the eggs which produced these larvæ were laid by one of the winter forms. If that had been so, the second generation, *Neglecta*, would have followed the first in direct succession, with many of the complications seen in W. Va.

In *Can. Ent.*, X., p. 129, Dr. E. C. Howe states, that at Yonkers, N. Y., (which is about two degrees to the south of London, Ont., and being on the seaboard, has a very much milder climate), he saw several pairs of *Lucia* in copulation April 19, and females *Lucia* were ovipositing on *Cornus* April 30 and May 4, 1878, and he saw *Neglecta* males flying on April 19 and 22 that year. That single mention raises a curious point. It is plain that these *Neglecta*, flying with *Lucia*, must have come from hibernating chrysalids, as truly as did the *Lucia*. The history of these *Neglecta* would appear to be identical with the history of *Pseudargiolus* in W. Va., and they represent the southern form, and are interpolated in the series just as *Pseudargiolus* is. In fact, these early *Neglecta* would be very small *Pseudargiolus*, though perhaps undistinguishable from the examples of *Neglecta* which

come in direct descent from *Lucia* and appear later. Mr. Lintner's observations lead to the same conclusion, though confined almost wholly to *Neglecta*. He has found this form between May 12 and middle of June, in successive years. On June 9 observed four pairs in copulation. His only *Violacea* recorded appeared May 12 and 19, and same year *Neglecta* was flying from May 16 on, so that the two forms were contemporary in part of their periods. As above stated, Mr. Saunders shows two broods of *Neglecta*, the later one flying in July and August. I have taken *Neglecta*, at Hunter in the Catskills, September 8. There was no general flight, but here and there a butterfly. It is much to be hoped that further observations may be made by some of our northern lepidopterists on these forms.

As stated, I have received from Montana males of *Violacea* and *Marginata*, and both sexes of *Neglecta*; from northern Colorado, *Lucia* and *Neglecta*; from southern Colorado, *Violacea* and its black male, and both sexes of *Neglecta*; from Nevada *Pseudargiolus*, from Arizona a form slightly differing from *Violacea*, which I have called *Cinerea*; from southern California, *Neglecta* ♂ ♀; from Mt. Hood, Oregon, a female very near *Neglecta*.

[But nearly all the Pacific examples, and many from Arizona, are what Dr. Boisduval names *Piasus*. They expand from 1 inch to 1.3; in color, the males are violet-blue, the under side not quite white, but color of *Neglecta* of the Atlantic slope, and the markings are as in that form, pale but distinct. But the females are not often like those of *Neglecta*. The blue of the disk is duller than in the males, and there is no white as in the two forms named; the black border is confined to the hind margin, as in many *Lucia* and *Violacea*. The costal margin is blue in many examples; others have a fuscous wash over costal margin, and both these winter variations are found in the eastern winter forms, but not in *Neglecta*. The under side is usually more like *Neglecta* than *Violacea*. But with 12 ♀♀ sent me by Mr. W. G. Wright, came 1 ♀ closely approaching *Neglecta*, in the black borders to both margins, and to *Violacea* in the indistinct markings of under side. The upper side is deep blue, with no trace of white on disk, and therein also it differs from *Neglecta*. The female before spoken of, from Mt. Hood, is much the same as this from south California. *Piasus* evidently stands between *Violacea* and *Neglecta*. Some males in the shade of blue cannot be separated from *Neglecta*, nor can they in the appearance of the under surface, and therefore I have tabulated this form as found in California. *Piasus* first appears at San Francisco, according to Mr. Henry Edwards, "about the end of March or the beginning of April, as soon as the peach and cherry trees are in blossom." It is his opinion that in that locality there is but one annual brood of the larva. He says that there is absolutely no green vegetation in the lowlands of California after July, and there would be nothing

for larvæ later than this to feed upon. Mr. Wright, at my request, has watched the appearance of *Piasus* the present season, 1883, at San Bernardino, southern California, and has sent me many examples (35 ♂ 12 ♀). Evidently, there, there are two distinct broods. The first examples were taken in February and March, the last from 18th April to 2d May. All of a sudden the species became abundant from 18th April, after an interval of several weeks, during which none were seen. I find no perceptible difference between the ♂ ♀ of the two broods, except that in the earlier one appears the female before spoken of, which resembles *Neglecta* instead of *Violacea*; of the males, there are several individuals, which, if taken in W. Va., I should consider *Neglecta*. As I look at the matter, *Piasus* is probably an offshoot of *Neglecta* or *Pseudargiolus*, and occasionally there is a reversion to *Violacea* in some characters.]

Summing up the facts as related, with such inferences as the best observations at command will justify, the history of the species treated of will take shape as follows:

1. The winter generation, in its most northern localities, is one-brooded, and at same time dimorphic; *Lucia* and *Violacea*.
2. At a certain line, moving southward, say at or about lat. 45°, on the Atlantic, a second generation, *Neglecta*, appears; and the first, or winter, generation has become trimorphic: *Lucia*, *Marginata*, *Violacea*.
3. At another line, say at or about lat. 38°, on the Atlantic, two of the forms of the first generation are suppressed, viz.: *Lucia* and *Marginata*; and an entirely new form comes in, restricted to one sex: viz., the black male of *Violacea*.
3. But in lat. 40°, at the west, in Colorado, at high elevation, the original dimorphism prevails, *Lucia* and *Violacea*; though the latter has acquired the black male, identical with that of the east.
5. At another line, say about lat. 33°, in Arizona, *Violacea* is replaced by a modified form, *Cinerea*, and the black male apparently has disappeared.
6. On the Atlantic, from about lat. 40° or 39° and south, a second summer form is interpolated: viz., *Pseudargiolus*, from which proceeds a partial generation only the same year.
7. This partial generation produces chrysalids, which hybernate, and in the spring disclose a part of the butterflies of the first generation, or *Violacea*.
8. But most of the butterflies of the first generation are directly descended from the first generation of the year before.
9. The first generation produces a partial second the same year: viz., *Neglecta*, and this probably produces chrysalids which hybernate to give butterflies of the first generation in the spring. The first generation is therefore made up from two and, probably, three distinct sources.
10. The interpolated summer form, *Pseudargiolus*, is very

much independent of the first generation, and the latter is very much independent of its second generation, as well as of *Pseudargiolus*; and, therefore, if at any point, either was suppressed, the other could exist, and would solely represent the species. Which accounts for the form *Piasus* on the Pacific, or for the single form *Neglecta* at London, Ont.

NOTE.—Prof. Lintner, Can. Ent., VII., p. 122, 1875, stated that *Lucia* had never to his knowledge been taken in the vicinity of Albany, N. Y., or in that well-worked region, Centre, N. Y.; but that, at the latter locality, in some seasons *Neglecta* swarms in myriads: “the air has seemed blue” with them. On the next page, in a foot-note, it is said: “Since the publication of the above, L. *Lucia* has made its appearance for the first time at Centre. Examples of it were captured by Mr. W. W. Hill on the 16th May, 1876, at this locality, where it was also captured on the 13th, 20th, 26th May (5 specimens).”

In a letter to me of 22d July, 1882, Prof. Lintner says: “*Lucia* is increasing here. A young collector showed me an example taken this spring on the other side of the Hudson. He says he saw several more.” Mr. Lintner also sends me a ♀ *Violacea* taken in the Heldeberg Mountains, which are west of and near Albany.

It is plain therefore that *Violacea* and *Lucia* do fly in that region, but just as plain that the flight must be a very insignificant one, and that it cannot possibly be the parent of the vast swarms of *Neglecta* described. The latter must come almost wholly from *Neglecta* chrysalids of the year before.

In Butterflies of N. A., Part XII., to be issued this season, I shall devote two plates to the species here treated of, with all its forms and many variations; also with full larval of history.

THE LEAF-ROLLERS OF ILLINOIS.

BY D. W. COQUILLETT.

The following leaf-rollers were bred by me while living at my old home near Woodstock, Ill.; they all have sixteen legs and belong to the families *Tortricidæ*, *Tineidæ* and *Pyralidæ*. The Tortricids were determined for me by Prof. Fernald; the Tineids by Prof. Fernald and Lord Walsingham, and the Pyralids by Mr. Grote, and I would hereby acknowledge my indebtedness to these gentlemen for aiding me in this direction. I have appended to each description the initial letter of the person who determined the imago for me.

DEPRESSARIA PULVIPENELLA. Clem.

Body green, sometimes a darker dorsal line and sub-dorsal stripe; piliferous spots green; cervical shield green with a black



Edwards, William H. 1883. "On the polymorphism of *Lycaena pseudargiolus*." *Papilio* 3(5-6), 85–97.

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