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## PSYCHE.

### PROBLEMS IN THE GENUS BASILARCHIA. PLATES I-III.

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#### I. INTRODUCTION.

Among the representatives of the genus *Basilarchia* occurring in the north-eastern United States are certain remarkable forms which seem in a measure to bridge the gaps between the three types to which specific rank has been generally accorded. Some of these intermediate forms have been figured and described as probable hybrids, others as aberrant or dimorphic forms; several others are known to which no distinct names have been given. This paper is the result of an effort to summarize the existing knowledge of these forms, in order to prepare the way for methodical investigation.

#### II. THE THREE GENERALLY RECOGNIZED SPECIES.

No attempt will be made here to present detailed descriptions of these familiar butterflies, which are treated in all the leading works on North American lepidoptera. It will suffice to point out certain pertinent facts.

1. *B. arthemis* Drury (Plate I., fig. 5, ♂; Plate II., fig. 4, ♂), the common white-banded species of the mountain districts, ranges very widely through Canada, and in the United States frequents northern New England, the Adirondack and Catskill regions, and a belt of country extending westward to Minnesota. About Boston it is very rare, but has been taken by Harris, Clapp, Miss Guild, Morse, F. H. Sprague, P. S. Sprague, Zerrahn and others. Reported instances of its capture south of the latitude of Boston are so scarce as to emphasize its almost complete restriction to the hilly country of the north. The species is reported from most stations either as single-brooded or as having a partial second brood. The larvae feed upon poplar and willow.

2. *B. astyanax* Fab. (Plate I., fig. 1, ♂; fig. 2, ♀), the blue-black species without white band, is absent from Canada with the exception of southern Ontario, and even in the United States encroaches very little upon the territory of *arthemis*. In general it may be said that *astyanax* seldom appears north of latitude  $43^{\circ}$ , but that south of latitude  $42^{\circ}$  it replaces *arthemis*. It is found as far west as the



Mississippi. About Boston it is much more common than *arthemis*. The larvae feed upon apple, willow, poplar, and wild cherry.

*Astyanax* is generally double-brooded, though at some points near its northern limit the second brood is only a partial one. This species is extremely variable both in size and markings. Very large examples, rivalling *Semnopsyche diana* in size, occur from New York city southward; and mingling with these are found specimens scarcely larger than the average *arthemis*. Both sexes attain to both extremes of size, though the larger specimens are usually females.

3. *B. archippus* Cramer, "the Viceroy" (Plate II., fig. 1, ♂; Plate I, fig. 6, ♀), is the most famous example of mimicry among North American butterflies. The mimicked species is *Anosia plexippus*, the Monarch or Milkweed butterfly. *Archippus* has, instead of the deep brown or blue-black ground color characteristic of the *Basilarchias*, the orange coloring of *Anosia*. Unlike its allies, but like *Anosia*, it frequents sunny open fields, and in such situations may be found throughout the eastern United States. It is triple-brooded throughout almost its entire range. The larvae feed upon several species of willow, and sometimes on poplar.

*Archippus* is extremely variable in size, like *astyanax*. The depth of the ground color also varies somewhat, and the mesial black line of the secondaries is often (more frequently in females) indistinct or incomplete. The incomplete condition is to be seen in the female here figured.<sup>1</sup>

### III. THE PROBLEMATIC FORMS.

1. *Basilarchia proserpina* Edwards, the first of the problematic forms to attract attention, was described in 1865 from two males taken in the Catskill mountains, and redescribed later (Edwards '67, '69) when the same region yielded more material. The following is quoted from the notes accompanying the second ('67) description:

On the same days I took about fifty *Arthemis*, all except two or three being males, and just from chrysalis. I have never known *Arthemis* so abundant in that locality. The variation among so many was remarkable, particularly in the width of the white band and the size of the russet spots above and below; in half the specimens these spots were wanting above, in others there were two or three and from that up to a complete series of large rounded spots; the color of under side ran through all shades, from blackish to brown, cinnamon and russet.

Notwithstanding his observations upon these intergrading forms, all of which he referred to *arthemis*, Edwards for some time believed *proserpina* to be a distinct

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<sup>1</sup> Strecker ('78) has described a variety, *pseudodorippus*, which altogether lacks the mesial line.



species. Scudder ('72) treated it as a variety of *astyanax*, and in criticising this view Edwards ('73) suggested that it might be a dimorphic form of *arthemis*. The discovery of "other varieties of *proserpina*" led Scudder ('75) to adopt this view tentatively, though he suggested that *proserpina* might prove to be a hybrid between *arthemis* and *astyanax*. Two years later Edwards ('77) announced the rearing of larvae from eggs laid by a captured *proserpina*; <sup>1</sup> four came to maturity, giving three typical *arthemis* (or form *lamina*, as he then designated it) and one *proserpina* closely resembling *astyanax*.<sup>2</sup> After another space of two years, Edwards ('79) published a full account of his studies of *proserpina*, including an exhaustive list of localities in which it had been taken, and a history of the breeding experiments. On the plate accompanying this was figured a "variety" of *proserpina*, the oft-quoted specimen from Mr. Mead's collection.<sup>3</sup> This will be referred to later.

One of the most noteworthy features of *proserpina* is its distribution, which is almost wholly confined to the narrow zone in which the ranges of *arthemis* and *astyanax* overlap.

2. *B. arthechippus* Scudder, (Plate II., figs. 2, 3), generally regarded as a hybrid between *arthemis* and *archippus*, was described from a specimen taken at Chateauguay Basin, Quebec, in 1879, by Mr. J. G. Jack.<sup>4</sup>

The specimens here figured were taken in Alstead, N. H., by the Field brothers, in 1895 and 1896; still another was seen on the wing in the same locality in 1902, but not captured. The three above mentioned are now in the Museum of Comparative Zoology.

*Arthechippus* exhibits a very thorough mingling of the characters of its supposed parents, and the three specimens preserved are almost exactly alike in appearance. All three are males; whether females ever occur remains to be seen.

3. An unnamed *Basilarchia*, apparently a hybrid between *astyanax* and *archippus*, is represented by fig. 4 on Plate I. This specimen was obtained by Mr. A. P. Morse from Sherborn, Mass., and is a male. The ground color is mahogany brown; the spots of the inner row are deep orange, those of the outer row somewhat paler. There are no blue markings.

Mr. Jacob Doll has a similar specimen which was taken on Long Island, and one or two others have been reported.

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<sup>1</sup> The male which had impregnated this female was of course unknown.

<sup>2</sup> *Basilarchia astyanax* = *ursula* Fab. Edwards employs the latter name.

<sup>3</sup> This "variety" has also been figured by Scudder ('89) and Holland ('99), the latter failing to mention the fact that it is not a typical *proserpina*. The specimen reproduced herewith as fig. 6 on Plate III. resembles it closely, but lacks some of the red markings.

<sup>4</sup> Scudder ('89) refers to a second specimen, described by Edwards. This is an error; both Edwards and Scudder had seen the same specimen.



## IV. THE "VARIETIES" OF PROSERPINA.

*Proserpina* is the only one of the problematic *Basilarchias* here listed which by its variability is susceptible of subdivision. That *proserpina* as heretofore treated comprises several well-marked forms I believe to be clearly apparent from the data already accumulated. Yet *arthemis* is credited in all our catalogues with being dimorphic only, and *proserpina* is given as the alternate form. To attempt a complete list of the proper subdivisions at this time would be premature; but it seems desirable to point out four of them, as follows:

(a) The typical *proserpina*, described by Edwards in 1865. The size is that of an average *arthemis*; ground color black or very dark brown; the mesial white band shows faintly as a broken row of dots on the primaries above, and somewhat more distinctly below. On the secondaries there is no mesial band, and the blue spots are very small. The female of this form was described by Edwards in 1868 as "similar" to the male. Figures 1 and 2 on Plate III. show two males of this form taken in Alstead, N. H.; the second specimen was reversed to show the under surface. Fig. 3 on Plate I. shows an example from Andes, N. Y.

(b) A larger form, with mesial band developed on primaries to about one-third of its area in typical *arthemis*, and broadest at the costa. Ground color dark as in the preceding, and blue spots restricted. On Plate III., fig. 3 shows a female from Sullivan County, N. Y., and fig. 4 a male from Alstead, N. H.

(c) A large form, with distinctly brown ground color; the mesial band appears on both pairs of wings, but is narrow and irregular as compared with the band on typical *arthemis*. Red spots appear on upper surface of secondaries as in most specimens of *arthemis*. Figured (Plate III., fig. 5) from a male taken in Temple, N. H.

(d) A form resembling *astyanax* (*ursula*) in many ways, yet having the white band well developed on all the wings. The blue scales on the upper surface of secondaries are abundant and brilliant. This form is called by some collectors a "white-banded *ursula*." A small specimen of this form, reared at Sharon, Mass., from a hibernating larva by Mr. A. C. Sampson, is figured as fig. 6 on Plate III.<sup>1</sup> Very large specimens, taken on Long Island, are in the collections of Messrs. Jacob Doll and H. H. Newcomb. There are two specimens in the Museum of Comparative Zoology; one of these is from Deerfield, Mass., and the other bears no locality label. The specimen from the Mead collection is similar to these, but shows more red on the upper surface.

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<sup>1</sup> This specimen is now in Mr. Newcomb's collection.



## V. PROSERPINA CONSIDERED AS A POSSIBLE HYBRID.

Scudder ('89) treats *proserpina* as a hybrid produced by the crossing of *arthemis* and *astyanax*. The principal facts upon which he bases his theory are:

1. The occurrence of apparent hybrids *arthemis-archippus* and *astyanax-archippus*.

2. *Proserpina* resembles *astyanax* even more closely than *arthemis*, to which latter species Edwards has proved it to be in some way related.

3. In structure of genitalia *proserpina* and *astyanax* are precisely alike.

4. *Proserpina* is more variable than either of the supposed parents.

5. *Proserpina* occurs only in a narrow belt where the ranges of its supposed parents overlap.

6. "*Proserpina* is known at so many points in this belt, that it presumably occurs wherever *arthemis* and *astyanax* are brought into contact."

7. No dimorphic species is known of which one of the forms appears only along one edge of the territory occupied by the species.

## VI. THE FACTS SUMMARIZED.

The three recognized species, *Basilarchia arthemis*, *B. astyanax* and *B. archippus*, all occur together in a narrow zone running westward from the Atlantic coast to the Mississippi river; north of that zone, *arthemis* and *archippus* occur together; south of it, *astyanax* and *archippus* occur together.

With these three species we may effect three different combinations of two species each, viz.: *arthemis-archippus*, *arthemis-astyanax*, *archippus-astyanax*.

Each of these three combinations is actually represented by an intermediate form.

Two of these intermediate forms, *arthemis-archippus* and *archippus-astyanax*, are generally believed to be hybrids, but their hybrid nature is as yet undemonstrated.

The third, *arthemis-astyanax*, is really a group of several interblending forms, assembled under the name *proserpina*.

The *proserpina* forms are either the results of the intercrossing of *arthemis* and *astyanax*, or polymorphic forms of *arthemis*.<sup>1</sup> They are found in the narrow zone above mentioned.

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<sup>1</sup>Grey ('79) has suggested that the three supposed species are polymorphic forms of one species. The statement here given does not necessarily preclude the view that *astyanax* and *arthemis* may both be forms of a single polymorphic species. Mr. H. H. Newcomb has suggested this to the Cambridge Entomological Club.



## VII. CONCLUSION.

The futility of speculation and the importance of actual experiment are well shown in the cases presented. [The problems involved in the inter-relations of these butterflies are of interest to all biologists. They can only be solved by careful and long-continued investigation.]

At the Alstead laboratory the effort will be made during the coming summer to breed hybrid *Basilarchias* in a large enclosure, with growing trees on which the larvae may feed. Quantitative studies of variation in this genus are now under way. It is hoped that before the close of the summer new light may be had upon the questions here discussed.]

I am indebted to Messrs. A. P. Morse, H. H. Newcomb and A. C. Sampson for the loan of specimens from their collections.

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