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Polymorphism in Reared Broods of *Heliconius* Butterflies from Surinam and Trinidad[1]

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Plates I-VI

[This paper is one of a series emanating from the tropical Field Station of the New York Zoological Society at Simla, Arima Valley, Trinidad, British West Indies. This station was founded in 1950 by the Zoological Society's Department of Tropical Research, under the direction of Dr. William Beebe. It comprises 200 acres in the middle of the Northern Range, which includes large stretches of undisturbed government forest reserves. The laboratory of the station is intended for research in tropical ecology and in animal behavior. The altitude of the research area is 500 to 1,800 feet, with an annual rainfall of more than 100 inches.

[The present paper is chiefly concerned with the results of an eighteen-day trip to Surinam, which was undertaken in mid-April, 1954. Headquarters, as on a previous visit in 1953, were at the Moengo mine of the Surinaamsche Bauxite Maatschappij, where we were the guests of Mr. and Mrs. H. Meijer. The trip was made possible by the generous gifts of Mr. C. R. Vose, and by the cooperation of the Alcoa Steamship Company.

[The major part of the actual collecting of living *Heliconius* material in 1954 was undertaken by Henry Fleming, and the painstaking care of the eggs, larvae, pupae and ultimate emergence of the imagos was borne by Jocelyn Crane and Rosemary Kenedy. Future papers will deal with immature stages and rearing methods. For details of keeping and maintaining adult heliconids, see "Construction and Operation of Butterfly Insectaries in the Tropics," Crane & Fleming (Zoologica, 1953, Vol. 38, No. 14, pp. 161-172.)]

Forty years ago two able entomologists, J. J. Joicey and W. J. Kaye, made a thorough study of a collection of butterflies from French Guiana. The three paragraphs below are from their paper (1916):

"The following account is concerning a collection made during the months July, August and September, 1915, between the places St. Jean and St. Laurent on the Maroni River in French Guiana. The distance between the two places is about twelve miles or rather less, and the distance of St. Laurent (the nearer place) from the coast is about twenty miles. The collection, which contained numbers of specimens of other families, was, however, chiefly remarkable for the vast numbers and variety of forms of *Heliconius melpomene* and *Heliconius erato*. A few other species of *Heliconius* were obtained, but only a very few specimens of each.

"As it is, there are 731 specimens, which show a most wonderful range of variation. Many forms are new, and others graduate completely into these as well as to all the other known forms that have ever come from French Guiana.

"In comparison with the very large numbers of *melpomene* specimens the number of *erato* forms is small, being only 155 against 731 *melpomene*."

The object of these quotations is to emphasize several facts. First, the closeness of the locality to that in which we collected. The Moengo Mine Road is 30 miles in length, running east and west, beginning at Moengo and ending on the bank of the Marowyne (=Maroni) River at Albina, directly opposite St. Laurent on the French side. Our collecting was all done along the central 10 miles of the Moengo-Albina Road. The two collecting areas are thus only a few miles apart, separated by merely a change in direction and the width of the Marowyne River.

Secondly, the identification of the insects by Joicey & Kaye, insects with such a bewildering maze of colors and patterns, was necessarily based on individuals of unknown parentage or inter-relationship. The result of this was a plethora of bi- and trinomial names divided into

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various categories, such as species, subspecies, variety, form, type, stage and aberration.

From our studies of *Heliconius* behavior in insectaries, we came to this aspect of extreme variation convinced that the final solution depended on one method of approach. This was actually to breed the butterflies, and to determine the composition and possible variation in breeds from individually-known parents, both if possible, but at least the females.

In 1953 our first attempt at breeding Surinam heliconids failed, and only a single butterfly lived to reach the laboratory at Simla, where she survived only an hour. The elaborate notes we made on the behavior and other phases of ecology of these easily tamed butterflies more than compensated for the one set-back.

In 1954, eleven days were spent in field work in Surinam. In a few days we had 53 butterflies in captivity, feeding and in health. Twelve of these were females. Day by day, as they flourished, they began to lay eggs, and we were ultimately rewarded with 54. Every one of these was correlated with an individual female, and we knew even the sequence of deposition.

In the course of our experience we learned many niceties of butterfly preferences and requirements. They did not favor low-growing egg-plants, but more readily accepted those at higher levels. We found that by following them around with small passion vines growing in pots, they would often desist from their lantana flower feeding and give their whole attention to alighting on a tendril and depositing an egg. They had a preferred time schedule, and 12 to 12:30 PM was the period most likely to produce results (cf. Seitz, 1913, p. 377). An excess number of individuals or a superabundance of flower food were distinct deterrents to oviposition.

Obtaining a supply of new-laid fertilized butterfly eggs was one thing. Transporting them to Simla, Trinidad, was quite another. One batch was taken on board Alcoa's river steamer, and cared for throughout the three days' trip to Port-of-Spain. The second lot was flown direct from Paramaribo to Trinidad, via the Dutch airline. The latter had the best of it, for the flight lasted only four hours. On the vessel which carried some of us and our heavy luggage the eggs began to hatch in our cabins on the first day out.

Forty-five larvae were reared from six broods. They are discussed in detail below.

Brood A

(Plate I)

Female Parent: *H. erato* (Field No. 7); Surinam. This individual bears a close resemblance to the 13 offspring of Surinam male No. 20 crossed with Trinidad female No. 45 (see below). It shares characters of *androdaixa*, *andremona* and *amazona* (Seitz, plate 78d). Wing spread 72 mm.

Offspring: One of the eggs of this female hatched into a larva which was reared. This proved also to be a female, but details of the caterpillar made it certain that both parent and offspring are *erato* and not *melpomene*.

The single offspring approximates *leda* (Seitz, plate 78d). The general color is not Scarlet-Red but Flame-Scarlet (Ridgway). The pale forewing markings are pale lemon yellow. They differ not only from Seitz's illustration but, when examined minutely, vary on the right and left wings, and still more so on the underside of the wings. Wing spread 65 mm.

Eight *leda*-like individuals taken in the same locality on the expeditions were all different from one another in minor details, as well as in number and size of the various spots.

Brood B

(Plate II)

Parents: Male: *H. erato* (Field No. 20); Surinam. Female: *H. erato* (Field No. 45); Trinidad. The Surinam male parent (No. 20), approximates *H. amazona* (Seitz, plate 78d) both in general pattern and color. In the single, pale, mid-forewing spot, and in the apparent perforation of two of the hindwing markings, it resembles *andremona* (plate 78d). It possesses five instead of six radii. The color of the light forewing spots is Pale Green-Yellow (Ridgway) instead of Light Lemon Yellow. Wing spread 75 mm.

The character most consistently different from Seitz's figures, and present in both male parent and all the offspring, is the large size and spindle shape of the two outmost forewing spots. These point toward and are closest to the mid outer margin of the wing, and show little variation in shape and position. They are decidedly unlike the corresponding spots in Seitz's *androdaixa*, *andremona* and *amazona*.

The Trinidad female parent (No. 45) is a typical *Heliconius erato hydara* Hewitson. In Seitz it is closest to *viculata* (plate 78b), except that the red band is solid, with the veins almost obliterated. The shape of the various components of the scarlet mosaic is similar to that of *colombina*. Wing spread 61 mm.

Offspring: The caterpillars of all 13 offspring were typical *erato*. The imagos have all wing markings entirely scarlet, lacking yellow. In pattern they closely approximate their male parent, and although each show minor distinguishing characters, in pattern they come closest

to *andremona* (Seitz, plate 78d). For example, 8 out of the 13 have the mid-forewing spot with a trace of a double, and in 8 there are 6 instead of five radii.

The wing spread varies from 55 to 69 mm., with an average of 63 mm. The forewing spots which are Pale Green-Yellow in the male parent are, on the underside of the forewing of the offspring, varying shades of pale pink.

Brood C
(Plate III)

Female Parent: *H. erato* (Field No. 30); Surinam. This is a black-hindwing, subsequently proved *erato,* as close to *H. viculata* as anything in Seitz (plate 78b), sharing minor characters of the red band with *colombina* and *erythrea* (plate 78b and c). Wing spread 72 mm.

Offspring: Four caterpillar offspring were typically *erato,* and the imagos reared from these are divided sharply into two and two. The first two are identical, black-hindwinged *erato,* and the remaining two are rayed-hindwinged, but differing strongly from each other. Offspring One, Two and Four are females, while Three is a definite *erato* male, confirming the identification of the female parent.

One and Two are identical with their female parent, closer in fact, even in minute differences of the red wing-band, than to any Seitz's figures. The wing spreads are, respectively, 63 and 68 mm.

Imago Three is closest to *H. udalrica* (Seitz, plate 78c), but with the forewing pattern less pronounced and more scattered. The color is Scarlet instead of Apricot Orange. The basal, under aspect of the hindwings shows the four proximal scarlet dots as distinct, and forming heads for four of the six hindwing radii. The wing spread is 73 mm.

Offspring Four is smaller than Three, 60 as compared with 73 mm. in wing extent, but the red forewing pattern is much the same. The most striking difference is in the presence of three white spots which occupy the center of the three proximal spots in the wing pattern. The one along the costal margin of the wing is linear; the next below, in the discal area, is crescentic, and the third is a long oblong, occuyping the central two-thirds of the spot on the midwing.

On the underside of the forewing the red is subordinated and the white is dominant. As in Offspring Three the basal scarlet spots are nearly or quite separate.

Brood D
(Plate IV)

Female Parent: *H. erato* (Field No. 41); Surinam. A large, black-hindwinged *erato,* closest, in red band outline, to *erythrea* (Seitz, plate 78c). Identical with *erato* female parent No. 30. Identified as *erato* both by larvae and by male offspring. Wing spread 80 mm.

Offspring: Thirteen out of 15 larvae reared, with an average wing spread of 65 mm. These offspring divide sharply into two groups, 8 black-hindwings and 5 rayed-hindwings. In the ratio of males to females, the blackwings show 5 to 3, the rayed wings 3 to 2. The order of egg deposition reveals the following succession of black and rayed individuals: R,R,B,R,R,B,B,R, B,B,B,B,B,.

Considering the red wing band in the eight black-hindwing offspring, no two are exactly alike. As a whole they roughly divide into two divisions. The first group consists of three individuals with forewing spots so tightly joined that the veins are obliterated, exactly as in their female parent. In the remaining five the band is very broad, irregular as to outline, and loose and open in the joints, revealing the veins to a less or greater extent.

In the case of the five rayed-hindwing offspring, the same general distinction holds, two butterflies, like their maternal parent, showing close-knit units of the red band, and three presenting varying stages of disorganization and dissolution of the vein-separated spots. None of these can be correlated with any of Seitz's plates.

Brood E
(Plate V)

Female Parent: *H. erato* (Field No. 51); Surinam. A black-hindwinged *erato,* 82 mm. wing spread, with red spot identical with that of female parent No. 30.

Offspring: Four offspring, all black-hindwinged, consisting of two males and two females, are very close to their female parent and to one another. The average wing spread is 67 mm.

Brood F
(Plate VI)

Female Parent: *H. melpomene* (Field No. 49); Surinam. On April 17 a black-hindwinged, female heliconid was taken at Moengo. It was large, with a wing spread of 82 mm. The scarlet wing band was unusually broad, and irregular along the distal margin.

Offspring: Ten were successfully reared to maturity. The larvae showed the color distinction of *melpomene,* not *erato,* and all, in black-hindwing and general characters, resemble their maternal parent. Eight of the offspring are males, and two females. The male imagos confirm the larval identification of *melpomene.*

Offspring Numbers One to Five were reared on Surinam passiflora, and showed an average wing spread of 77.4 mm. The larvae of Numbers Six to Ten were fed on passiflora from Simla, Trinidad, and are uniformly smaller, showing an average wing spread of 63.4 mm. This dissimilarity in size bears no relation to variation in relative shape or size of the scarlet band. Were the 10 individuals not members of the same brood, 4 of their band variations would be considered worthy of some degree of recognition.

Major characteristics of the six broods may be summarized as follows, omitting lesser details of color and pattern:

Heliconius erato group

Brood A: Female parent: red radiations on fore- and hindwings; broken forewing red band. Male unknown.

Offspring: 1 is rayed like parent; forewing band represented by small, scattered, whitish spots.

Brood B: Male parent (Surinam): red radiations on fore- and hindwings; forewing band represented by a broken area of large, scattered, creamy spots.

Female parent: (Trinidad): red forewing band only.

Offspring: 13 with red radiations on fore- and hindwings; broken, red, forewing band.

Brood C: Female parent: red forewing band only. Male unknown.

Offspring: 2 like parent.

1 with broken, red, forewing band; red radiations on fore- and hindwing.

1 with broken, red, forewing band with whitish spots; red radiations on fore- and hindwing.

Brood D: Female parent: red forewing band only. Male unknown.

Offspring: 8 like female parent; red forewing band varying from solid to broken.

5 with red variations on fore- and hindwings; red forewing band varying from solid to broken.

Brood E: Female parent: red forewing band only. Male unknown.

Offspring: 4 like female parent.

Heliconius melpomene group

Brood F: Female parent: red forewing band only. Male unknown.

Offspring: 10 like female parent, with much variation in red band.

Summary

Six broods of heliconid butterflies were reared from parents taken at Moengo, Surinam. The one exception was a brood of 13, with the following parents: a male Surinam *Heliconius erato amazona,* mated to a female Trinidad *Heliconius erato hydara.*

Four broods of 1, 4, 4 and 13, had typically black-hindwinged, *Heliconius erato,* Surinam, female parents. The sixth brood of 10 had a *Heliconius melpomene,* Surinam, female parent.

The distinction between *Heliconius erato* and *melpomene* was established by means of differences in the larvae, as well as by the scent scales of the male offspring.

The offspring frequently differed radically both from the parent and from one another. These differences were tentatively correlated with illustrations in A. Seitz, "Macrolepidoptera of the World," Vol. 5, plates: "The American Rhopalocera," plate 78. New sibling relationships were therefore established for types of individual patterns and colors, to which have heretofore been applied terms such as species, subspecies, variations, forms, types, stages and aberrations.

Further data and interpretations are anticipated in cross-breeding future broods, resulting in F_2 generations.

References

Joicey, J. J. & W. J. Kaye

1916. On a collection of Heliconine forms from French Guiana. Trans. Ent. Soc. London, 412-531.

Ridgway, R.

1912. Color standards and color nomenclature. Publ. by the author. Washington, D. C.

Seitz, A.

1913. Heliconiinae. Macrolepidoptera of the World, Stuttgart, 5: 375-395; pl. 78.

EXPLANATION OF THE PLATES

The light wing markings on the figures of all the plates are red or scarlet, with the following exceptions:

Plate I. Lower Figure: Pale spots on forewing are Light Lemon Yellow (Ridgway).

Plate II. Upper Left Figure: Forewing spots are Pale Green-Yellow (Ridgway).

Plate III. Lower Right Figure: The three pairs of light spots on forewing are white.

PLATE I

Brood A. *Heliconius erato* group

UPPER FIGURE. Female parent.
LOWER FIGURE. Single offspring.

PLATE II

Brood B. *Heliconius erato* group

UPPER LEFT FIGURE. Male parent.
UPPER RIGHT FIGURE. Female parent.
LOWER FIGURES. Thirteen offspring.

PLATE III.

Brood C. *Heliconius erato* group

UPPER FIGURE. Female parent.
LOWER FIGURES. Four offspring.

PLATE IV

Brood D. *Heliconius erato* group

UPPER FIGURE. Female parent.
LOWER FIGURES. Thirteen offspring.

PLATE V

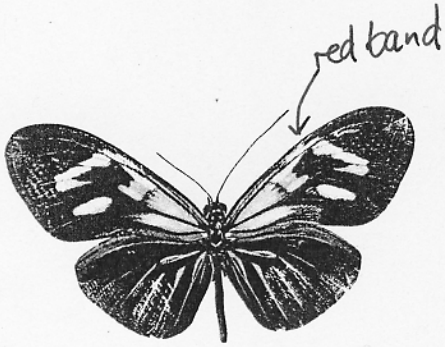
Brood E. *Heliconius erato* group

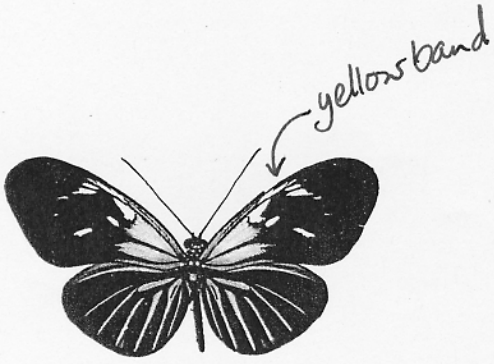
UPPER FIGURE. Female parent.
LOWER FIGURES. Four offspring.

PLATE VI

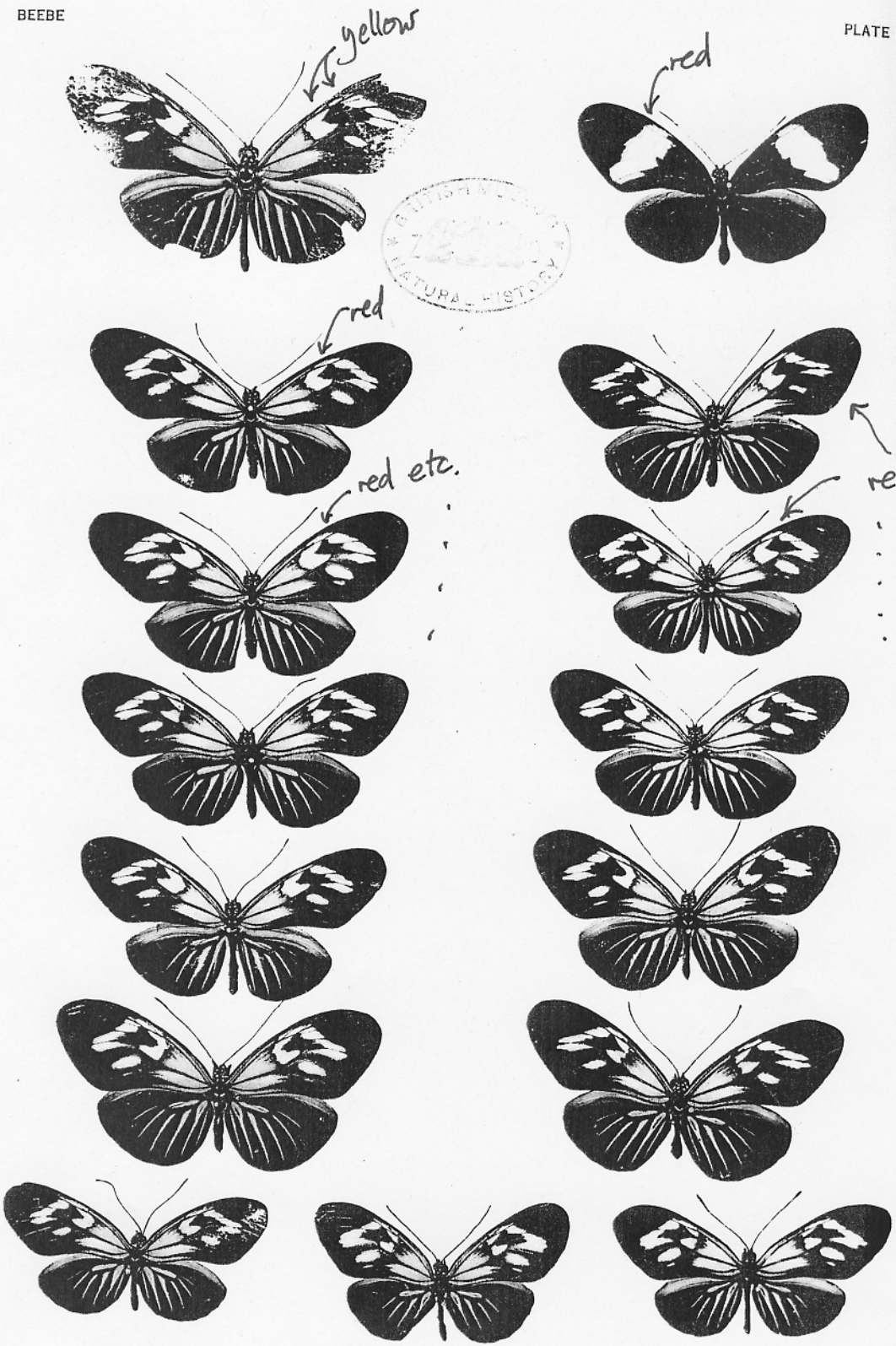
Brood F. *Heliconius melpomene* group

UPPER FIGURE. Female parent.
LOWER FIGURES. Ten offspring.





POLYMORPHISM IN REARED BROODS OF HELICONIUS BUTTERFLIES
FROM SURINAM AND TRINIDAD



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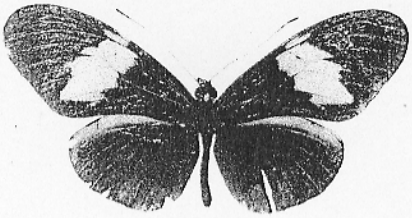

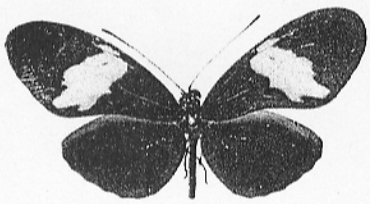

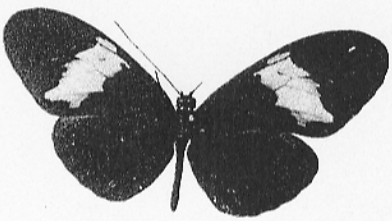

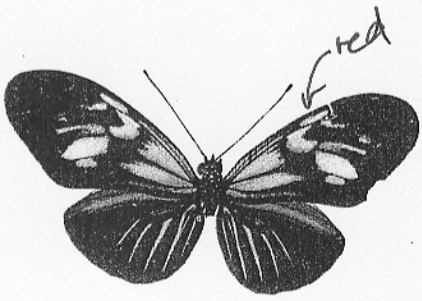

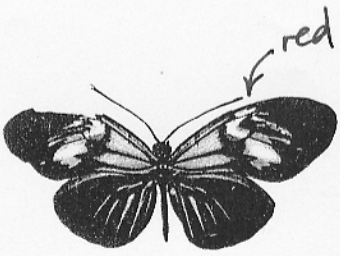

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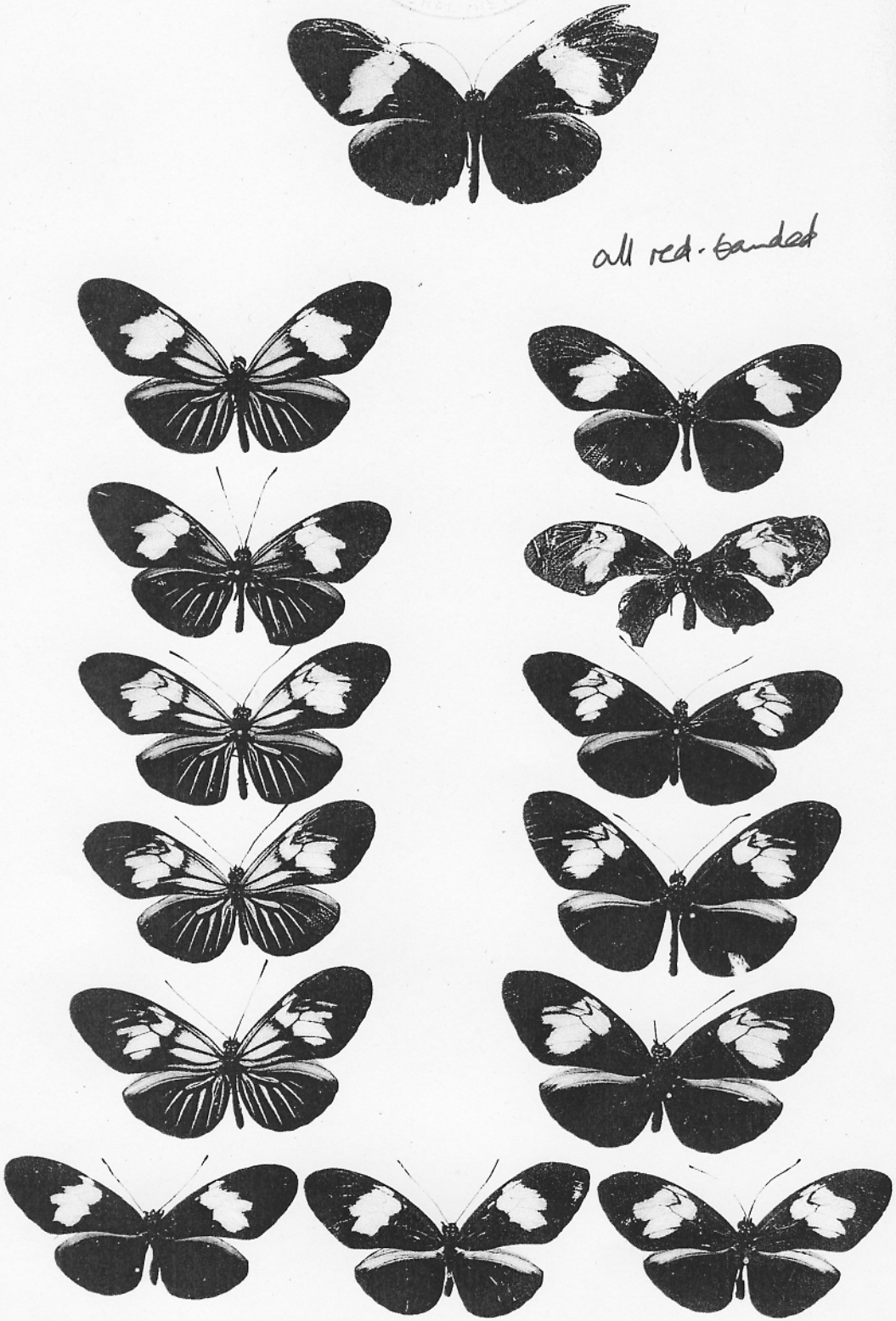

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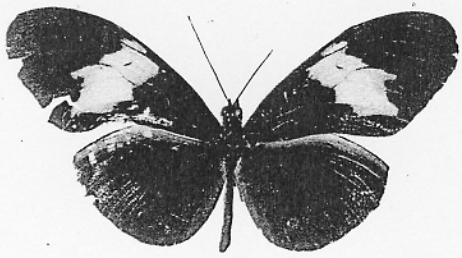

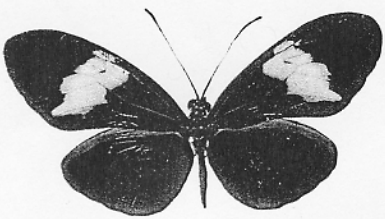

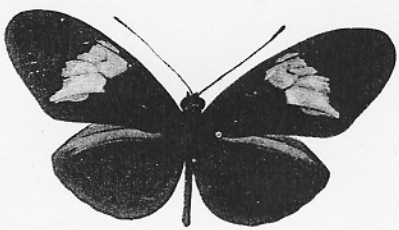

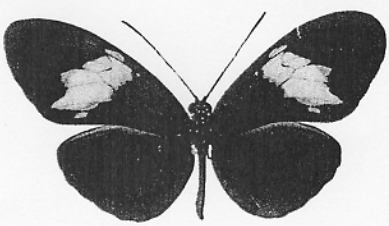

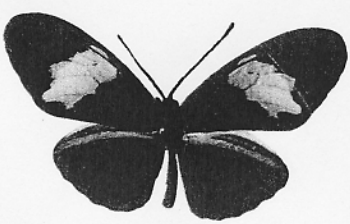

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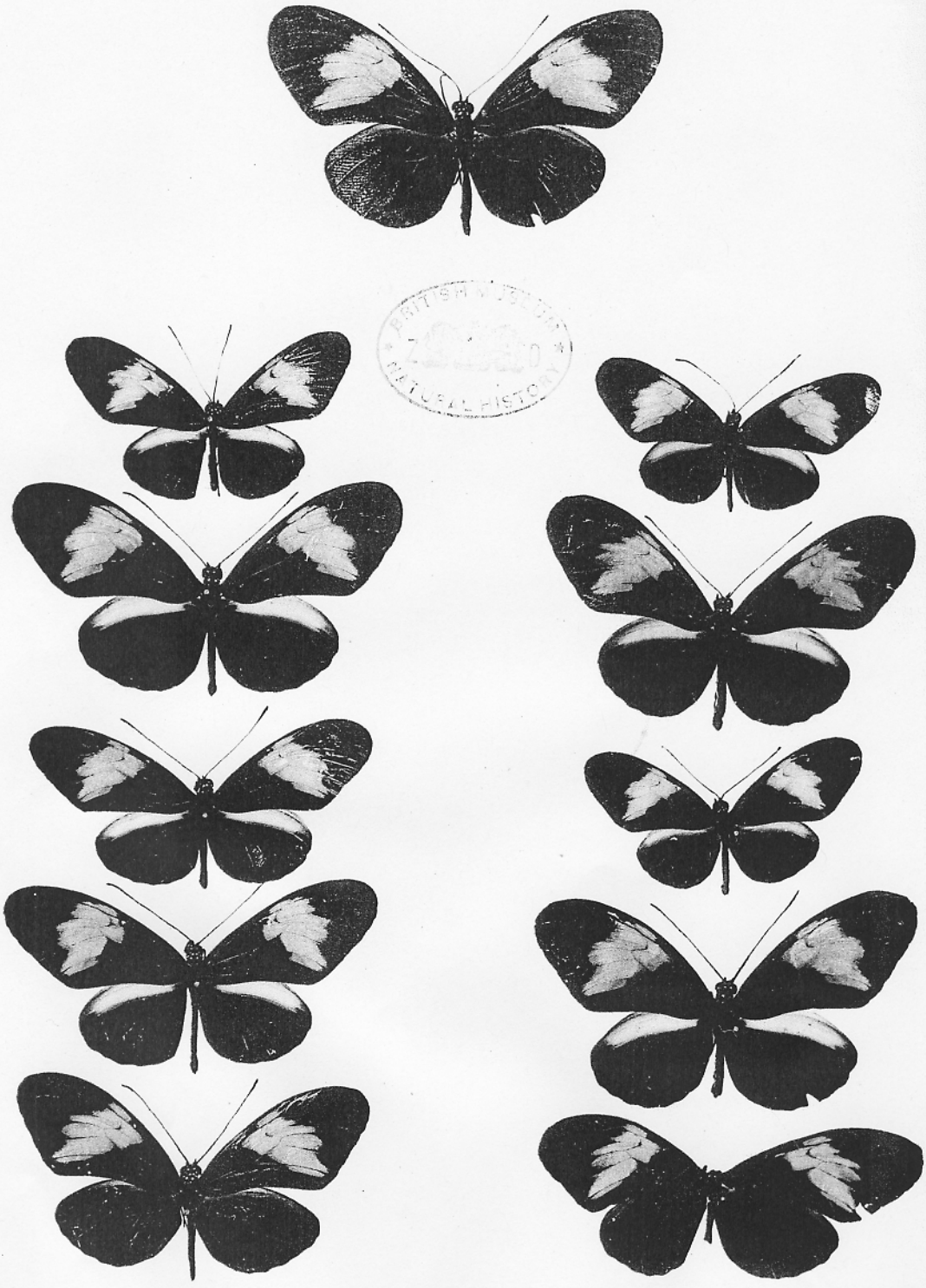

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