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Prof. Huxley with the  
author's kind regards

XXXII. *Contributions to an Insect Fauna of the Amazon Valley.* LEPIDOPTERA :  
HELICONIDÆ. By HENRY WALTER BATES, Esq. (Communicated by the Secretary.)\*

Read November 21st, 1861.

“Die wissenschaftliche Untersuchung der Natur strebt in den Einzelheiten das Allgemeine zu erkennen, um endlich dem Grunde aller Dinge näher zu kommen. Für diese Art Untersuchungen, die immer das Ziel der Naturforschung sein sollte, bietet wohl keine Thierklasse so reichen Stoff als die Insecten.”—Karl Ernst von Baer, Address on the Opening of the Russian Entomological Society, St. Petersburg, May 1860.

THE family *Heliconidæ* was established by Mr. E. Doubleday in 1847, in Doubleday and Hewitson's 'Genera of Diurnal Lepidoptera.' It was founded on a number of Butterflies, remarkable for the elongated shape of their wings, and peculiar (with the exception of one genus, *Hamadryas*, which the author placed provisionally in the family, *op. cit.* p. 98) to the intertropical and subtropical zones of America. Many of them had been described by the older authors under *Heliconia*, *Mechanitis*, and several other ill-defined genera. They had been previously (in 1836) united in a tribe, *Heliconiides*, by Dr. Boisduval in his 'Spécies Général des Lépidoptères;' but this comprehended also the group *Leræidæ*, which Doubleday excluded from the family. Linnæus treated them as a section of the genus *Papilio*, under the name of *Heliconii*. The nearest allies of the *Heliconidæ* are the *Leræidæ* just mentioned and the *Danoidæ*: all are distinguished from the true *Nymphalidæ* by the discoidal cell of the hind wings being always closed by perfect tubular nervules. Mr. Doubleday, placing more reliance on the shape of the antennæ and the abdominal border of the hind wings than on the far more important character above named, was led to exclude the genus *Eueides* from the family: this rendered the definition of the two groups very difficult, if not impossible, *Eueides* having the wing-cells closed in the same way as the *Heliconidæ*. Excepting that I re-admit *Eueides*, and exclude *Hamadryas*, which does not enter into the series of the American *Heliconidæ*, the family will be treated of in the present memoir as defined in the work above quoted.

The position of the *Heliconidæ* in the order Lepidoptera may be understood when I state that in a natural system the group would stand at the head of the whole series of families of which the order is composed. At least, this should be its place according to the view now taken of the order by many systematists, who arrange the families of *Rhopalocera*, or Butterflies, according to their degree of dissimilarity to the *Heterocera*, or Moths—in other words, according as their structure shows a lower or a higher stage in an ascending scale of organization. For, as the lower families of Moths are allied to other orders of insects, the further a group recedes from them in structure, the higher is the grade of perfection of the Lepidopterous type which it exhibits. The families show their degree of affinity to Moths by many characters, the principal of which is the

\* The materials on which this memoir is founded were collected by the author during eleven years' research on the banks of the Amazons.

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structure of the anterior legs in the adult state of the insects. The *Heterocera* have always six perfect legs: most of the families of *Rhopalocera* have the anterior pair in a more or less rudimentary condition; and as the atrophy seems to have reached its furthest stage in the *Heliconiidae*, this group must be considered as occupying the highest rank in the order. Other characters accompany the one derived from the structure of the legs, which it is unnecessary here to enumerate. It will be seen from these remarks that the order Lepidoptera is one of those groups in the Animal Kingdom which show, beyond the many collateral branches of development that always exist, a clear linear advancement of organization.

The *Heliconiidae*, *Danaidae*, and *Acraeidae* are related to each other in a different way from that which appears in the received classifications. A few remarks on their mutual affinities are necessary, in order to exhibit the true relations of the *Heliconiidae* to the allied groups of the Old World tropics. It has escaped the notice of all authors, that the *Heliconiidae* are composed of two groups, which differ very considerably in important points of structure; in fact, the majority of the genera of which the family is composed ought to be withdrawn from it, and placed with the *Danaidae*. The very great superficial resemblance between the two sets of genera has led to their being united by all authors, and prevented inquiry into their real relationship. To avoid innovation, I will retain the family as it stands, and call the group which is allied to the *Danaidae*, DANAOID HELICONIDE, and the other, which approximates somewhat to the *Acraeidae*, ACRAEOID HELICONIDE. The Acraeoid group comprehends the genera *Heliconius* and *Eueides*; the Danaoid, the whole of the remaining *Heliconiidae*. The following are the distinguishing characters of the two groups:—

*Acraeoid Heliconiidae*. The hind wing-cell is very small, and the nervures are so arranged that the upper and lower radials\* (discoidal nervures of Doubleday) appear to be branch and sub-branch of the subcostal nervure, the discocellulars being short and continuous with them; the costal nervure is prolonged to the apex of the wing. The larvæ are similar to those of *Acraea* and *Argynnis* (*Nymphalidae*), being beset with hispid spines†. The head is broad, the palpi thick.

*Danaoid Heliconiidae*. The hind wing-cell is very large, and irregular in shape; the two radials never appear as branches of the subcostal, but are very uncertain in position, owing to the very vacillating length and direction of the discocellulars: the costal nervure is short, and terminates on the costa, not reaching the apex of the wing. The larvæ (only one species is known) are smooth, like those of the *Danaidae*, but are furnished with tubercles, instead of long fleshy threads. Head small, orbicular; palpi slender‡.

\* I have adopted the terminology of Doubleday (Doubl., Hewitts., and Westwood's Genera of Diurnal Lepidoptera) with regard to the neuration or veining of the wings, excepting that I call the "nervures" of the subcostal and median nervures "branches," and the "discoidal nervures" "radials," these alterations appearing necessary to prevent the verbal confusion of nervule with nervure, and discoidal with discocellular.

† The early states of these insects were not known to Doubleday. I reared, myself, *Heliconius Erato* (and *Doris*) and *Eueides Lybia*. We are acquainted, through other sources, with the larvæ of *H. Melpomene*, *H. Ricini*, and *Mechanitis Polymnia*.

‡ Since the above memoir was read, Dr. C. Felder of Vienna, in an article entitled, "Specimen Faune Lepidopterologicae riparum Negro superioris in Brasilia septentrionali," 'Wiener Entomologische Monatschrift,' March 1862,



There is a very wide dissimilarity in minor points and in general appearance between the Asiatic set of forms and the American: the only Old World genus which at all approaches the New World group is *Hamadryas*; but the shape, colours, and neuration of the wings show that it has no close affinity with them. The two sets of forms seem to agree, however, in habits, and apparently occupy the same sphere in the economy of nature in their respective countries. Mr. Wallace, who has had the good fortune to observe both in their native abodes, says, the habits of the South Asian *Euplœæ* (the most numerous genus) are precisely those of the *Heliconidæ*. The Asiatic *Danaidæ* are mostly above the middle size, and include some of the largest Butterflies known; their American equivalents are in general below the middle size. Both are extremely prolific or abundant in individuals, and are amongst the most characteristic productions of their respective countries. Each set, also, are the objects of numerous mimetic resemblances on the part of other Lepidopterous insects of their own region belonging to different families,—the Asiatic mimickers being modelled after the Asiatic *Danaidæ*, and the American after the American members of the same family. The entire dissimilarity of the two sets of forms would seem to teach us that there can have been no land communication east and west between the tropical parts of Asia and America since they first came into existence, and therefore that the great continents must have remained separate in those quarters from a very remote epoch to allow for such an extensive independent development of forms. They are both strictly confined to the hottest parts of their respective hemispheres. In America they are not found beyond the northern tropic, nor much further south than 30° S. lat. They are not known to occur so far from the equator as either tropic in the Old World, but are limited to the south-eastern parts of Asia and the islands of the New Guinea group. The genus *Danaüs*, with which we have seen both groups are connected, ranges as far north as 41° in Europe, and 45° in North America. It is interesting thus to find that the only genus which is common to the three tropical regions is the sole one of the family that occurs in high latitudes. The only means of communication between the intertropical lands of America and Asia seems to have been a circuitous route by the north (or south); and the essentially tropical forms do not appear to have passed along it. The fact of the peculiar equatorial Asiatic *Danaidæ* not reaching Africa is explicable on the same grounds as their entire distinctness from the American ones, namely, the non-existence of an equatorial connexion of land of a nature suitable for their transit between the two continents since the remote date when the first forms of the group came into being.

The habits of the *Heliconidæ* have been described by various travellers,—Lacordaire having given a complete account of the Cayenne species, and Dyson and Gosse some interesting notes on those of Venezuela and Jamaica. The total number of species described is 284, namely, 233 belonging to the Danaoid, and 51 to the Aæræoid group. They are peculiarly creatures of the forests, and, like the Platyrhine Monkeys, the arboreal

stomoses with the median a short distance from its origin. In the systematic part of the present memoir I shall follow Dr. Felder in this altered classification. The two groups which composed the family *Heliconidæ* are, it must be repeated, completely and widely distinct. Yet the analogical resemblance between them is so great, that some species of the one might easily be confounded (if not closely examined) with species of the other.

*Gallinæ* (*Penelopidæ* and *Crocidæ*), and other groups of the same region, point to the gradual adaptation of the fauna, during an immense lapse of time, to a forest-clad country.

I found on the banks of the Amazons 94 species (besides many local varieties, considered by some authors as species) of the two groups (67 Danaoid and 27 Acreoid), representing all the genera of the family but three. They are most numerous in those parts of the country where the forests are most extensive and the climate most sultry and humid. I found the number of species to increase in travelling from east to west, from the Lower Amazons towards the eastern slopes of the Andes. They were rare in the somewhat drier tract of country which borders the Lower Amazons about the middle of its course. I found in this large district only 26 species, namely, 10 belonging to the Danaoid and 16 to the Acreoid group. Within an area of about the same dimensions, in the moist region of the Upper Amazons, I collected 64 species, of which 42 were Danaoid and 22 Acreoid *Heliconidæ*. I should judge, from the collections received in England from those parts, that the hot Andean valleys near Bogota, or in Ecuador, contain a still larger number of species than the plains of the Upper Amazons. In the dry forests which clothe a great part of the banks of the Tapajos I found exceedingly few: at one locality, where I collected four months, and which was rich in other families of Lepidoptera, I saw only one species of the Danaoid and four of the Acreoid group. According to Dyson, many species (*Ithomia*) of the lowlands in Venezuela have a vertical range of 2000 feet, and some genera (*Hymenitis* [*H. Dercetis*], *Olyras*, *Entresis*), which do not inhabit the Amazon region, occur at an elevation of 8000 feet. The species are exceedingly abundant in individuals wherever they occur: they show every sign of flourishing existence, although of slow flight, feeble structure, unfurnished with apparent means of defence, and living in places which are incessantly haunted by swarms of insectivorous birds. The pathways in the forest near towns are quite enlivened by the multitudes which fly about amongst the lower trees, in their bright dresses of orange, blue, and yellow, and red and black.

The mode of flight of the members of the two groups is somewhat different. The *Heliconii* and *Ereides* move along in a sailing manner, often circling round for a considerable time, with their wings horizontally extended. The species of the Danaoid group, for the most part, keep near the ground, and have a very slow irregular flight, settling frequently. They are all of social or gregarious habits. Not only do individuals of the same species congregate in masses, but the set of closely allied species which people a district keep together in one or more compact flocks. I noticed in four districts rich in Danaoid *Heliconidæ*, where I collected, that about half the species of *Ithomia* flew together in one circumscribed area of the forest, and the other half in a second similar locality, the rest of the tolerably uniform wooded country, in each case, being nearly untenanted by them. The larger species (*Heliconii*, *Lycoræa*) frequent flowers, probing the nectaries with their proboscides; but the smaller kinds (*Ithomia*), and the members of the Danaoid group generally, are very rarely found thus occupied: I noticed them sometimes imbibing drops of moisture from leaves and twigs. The fine showy *Heliconii* often assemble in small parties, or by twos and threes, apparently to sport together or

perform a kind of dance. I believe the parties are composed chiefly of males. The sport begins generally between a single pair: they advance, retire, glide right and left in face of each other, wheel round to a considerable distance, again approach, and so on: a third joins in, then a fourth, or more. They never touch: when too many are congregated, a general flutter takes place, and they all fly off, to fall in again by pairs shortly afterwards. The species which I have seen most frequently employed in this way is the *Heliconius Rhea*, a glossy blue-black species, with bright yellow belts across its wings.

The larvæ of the two or three species whose transformations I observed feed together in clusters on the leaves of trees of moderate elevation, near the places where the adult insects are found.

The majority of the species have very limited ranges. I was surprised, when travelling on the Upper Amazons from east to west, to find the greater part of the species of *Ilhomiæ* changed from one locality to another, not further removed than 100 to 200 miles. For instance, there were 11 of these *Ilhomiæ* at a place called Fonte Boa, and 9 at St. Paulo, 180 miles distant; but only two of the total number (20) were found in both localities. This is remarkable when we consider that the whole of the country of the Upper Amazons is a nearly level plain, uniformly covered with forest, and offering no perceptible difference in soil or other physical conditions. Five only out of the 20 species have been met with in any other part of South America. The areas of distribution of most of the remaining 15 must be, in each case, a very limited tract of country. The species which inhabit other parts of Tropical America must have similarly contracted ranges, if we may judge from the collections received in England from different districts.

Now, many of these local species have the appearance of being geographical varieties; I could not help suspecting them to be such when I met with them in nature, the differences between the forms of one and those of another locality relating in many cases simply to the colours and colour-patterns of the wings. The marks of distinction, however, are in the majority so well defined, so ordinarily common to all the individuals concerned, and there is so generally an absence of connecting links, that they are held on all hands to be good and true species. Moreover, in those cases already mentioned, where a number of very closely allied species fly together, they keep themselves perfectly distinct; there are no hybrid forms (I am speaking of the *Ilhomiæ* and allied genera), and on observing individuals *in copula*, I almost always\* found the pair to be precisely the same in colours and markings. In the multiplicity, apparent distinctness, and restricted ranges of the species, this group much resembles the family of Humming-birds of the same regions.

I believe, nevertheless, that the suspicion of many of the species being nothing more than local modifications of other forms has proved to be well founded. Amongst the great number of perfectly distinct and well-marked species, a few occurred which showed great variability: these, I think, afford a key to the explanation of the origin of the rest. The details of variation will be given under the head of each species:

\* The exception was in the case of *Mechanitis Polyanna*, which, as will be seen, on referring to the account of it in its place, is a polymorphic species, whose local varieties are in an imperfect state of segregation.

those which supply the most decisive results are *Mechanitis Polymnia*, *Ithomia Orolina* and *Illinissa*, *Ceratonia Ninonia*, and the *Lycoreæ*. The varieties of these present all the different grades between simple individual differences and well-marked local varieties or races, which latter cannot be distinguished from true species, when two or more of them are found coexisting in the same locality without intercrossing, as takes place in *Ithomia Illinissa* and its allies, and probably in *Mechanitis Nesæa* and *Lysinnia*. A striking case of the production of a local variety now spread over a wide area, and undistinguishable from a true species, is afforded in *Heliconius Thelciope*, to the details of which, given in the systematic part of this memoir, I must refer the reader.

These species, when carefully studied, seem to me conclusively to show that many of the now distinct species of *Heliconiæ* have arisen from local varieties, segregated from the variations of preexisting widely disseminated species; for these distinct forms or species do not essentially differ from the undoubted varieties of the species cited. The genera show different degrees of susceptibility of change under altered local conditions. Thus, many species of *Heliconius* (*H. Rhea*, *Clytia*, *Ricini*, *Vesta*, *Thelciope*, *Antiocha*, &c.) are unchanged over the whole of the wide country which includes the areas of several successive local races of many *Ithomiæ* and *Napeogenes*\*.

The process of the creation of a new species I believe to be accelerated in the *Ithomiæ* and allied genera by the strong tendency of the insects, when pairing, to select none but their exact counterparts: this also enables a number of very closely allied ones to exist together, or the representative forms to live side by side on the confines of their areas, without amalgamating.

The course followed by Nature in the formation of these numerous local species, I think, is clearly exhibited in *Mechanitis Polymnia*, to the details of which, given in its place, I must beg the reader to refer. We see here the manufacture, as it were, in process. The species is widely disseminated and variable. The external conditions in certain localities are more favourable to one or more of the varieties there existing than to the others; those favoured ones, therefore, prevail over the others. We find, in this most instructive case, all the stages of the process, from the commencement of the formation of a local variety (var. *Egænsis*) to the perfect segregation of one (var. *Lysinnia*, considered by all authors as a true species). In this species, most of the local varieties are connected with their parent form by individuals exhibiting all the shades of variation; and it is on this account only that we know them to be varieties. In the species allied to *Ithomia Flora*, the forms are in a complete state of segregation (with the exception of *I. Illinissa*, which throws light on the rest), and therefore they are considered as species; they are, in fact, perfectly good species, like all other forms considered as such in natural history. It is only by the study of variable species that we can obtain a clue to the explanation of the rest. But such species must be studied in nature, and with

\* These are *Ithomia Flora*, an inhabitant of the whole Lower Amazon region (from the Atlantic to the Rio Negro), which is represented by *I. Hippotalania* in Cayenne, and *I. Omega*, *Illinissa*, *Gualla*, *Priscilla*, *Herdona*, in different areas on the Upper Amazon; *Napeogenes Cyriannassa*, which becomes *N. adolphe* on the banks of the Cupari (Tapajós), and *N. Tucantina* on the north bank of the Upper Amazons; *N. Luachua*, which is changed to *N. sulphurina* at Bahia, and to *N. Ercilla*, *N. Corena* and *N. Pharo* in different areas on the Upper Amazon. Other species might be added in confirmation. Most of the species of *Heliconius* quoted are found unchanged over the collective areas of all these forms of *Ithomia* and *Napeogenes*.

strict reference to the *geographical relations* of their varieties. Many closet naturalists, who receive disconnectedly the different varieties in any group, treat them all as independent species: by such a proceeding, it is no wonder that they have faith in the absolute distinctness and immutability of species.

The sexes in the *Heliconidæ* very rarely differ in colours. Secondary sexual characters of another description occur, however, very generally in the Danaoid group. The males, in all the genera but two (*Lycorea* and *Itina*) of this section, are furnished with a pencil or fringe of long hairs near the costal edge of the hind wings on the upper surface. It sometimes arises from the bottom of a shallow horny cup situated between the costal and subcostal nervures; the hairs are long, soft, and adpressed. I was unable to discover any use in this structure; it seemed not to be under the control of the insect. There is no movement in flight, or position in repose, peculiar to the male sex, which might require an instrument to hold the wings together—a function which the position of the hairs, in the place where the fore wing overlaps the hind wing, suggests to the mind. I believe the appendage must be considered as an outgrowth of the male organization, which is not in this case applied to any especial purpose: it may be taken to be of the same nature as the pencil of hairs on the breast of the male Turkey. Growths of one kind or other, on the surface of the wings, peculiar to the male sex, are frequent in Butterflies: in *Danais* the males have a small horny excrescence on the disk of the hind wings, which, considering the near relationship proved to exist between the two groups, I take to be homologically the same as the pencil of hairs in the *Danaoid Heliconidæ*. In the genus *Paronia*, belonging to the family *Brassolidæ*, the males in some species have a fringe of hairs near the abdominal border; in others, a long pencil of the same on the disk; and, again, in others, instead of these appendages, a thickened plate on the inner margin of the hind wings.

The most interesting part of the natural history of the *Heliconidæ* is the mimetic analogies of which a great many of the species are the objects. Mimetic analogies, it is scarcely necessary to observe, are resemblances in external appearance, shape, and colours between members of widely distinct families: an idea of what is meant may be formed by supposing a Pigeon to exist with the general figure and plumage of a Hawk. Most modern authors who have written on the group have mentioned the striking instances of this kind of resemblances exhibited with reference to the *Heliconidæ*; but no attempt has been made to describe them fully, nor to explain them. I will give a short account of the leading facts, and then mention some circumstances which seem to throw light on their true nature and origin.

A large number of the species are accompanied in the districts they inhabit by other species which counterfeit them in the way described. The imitators belong to the following groups:—*Papilio*, *Pieris*, *Euterpe*, and *Leptalis* (fam. *Papilionidæ*), *Protogonius* (*Nymphalidæ*), *Thomeis* (*Erycinidæ*), *Castnia* (*Castniadæ*), *Dioptis*, *Pericopis*, *Hyelosis*, and other genera (*Bombycidæ* Moths)\*. I conclude that the *Heliconidæ* are the *objects imitated*, because they all have the same family facies, whilst the analogous species are dissimilar to their nearest allies—perverted, as it were, to produce the resemblance, from

\* The accompanying Table, in which a number of the most striking of these are arranged in parallel columns, will give some idea of the extent to which this system of imitation prevails.



SPECIES OF MACHILID ANALOGUES IN THE LEPIDOPTERA OF TROPICAL AMERICA, ESPECIALLY BETWEEN THE DOMINANT FAMILY HELIOIDAE AND DIFFERENT OTHER FAMILIES.

Danaid Helioidea	Agaridae	Papilionae	Porinae	Erycinidae	Castniidae	Bombycidae
Laycoeca Avergensis Machonia Psioidi { Huma Phenacota } P. Thomae* Dicerama Epiketo Tithorea Bomplandi Medinaa Egina M. Parulidis* M. Lucifer M. Messias M. (?) Hezi M. Mnasius* M. Niomiina Ceratima Niomiina M. Niomiina Mechanitis Egeonhis M. Nesiata—N. progenes Xanthomer* M. Lysiomiina Callithomiina Alexirhoe*—Ceratima Niomiina Ethomiina Flora { I. Cymo } Napoegenes Thre* I. Blunsi I. Bessii I. Napoegenes Eretila* and allies I. Chrysoniina I. S. Coregia* and allies I. Herdini Ceratima Niomiina Ethomiina Omega I. Virginia I. Primula—Napoegenes Pflaro, I. Paritica—N. sulphurina, I. Puriocodia I. Calenia—Napoegenes Tolosa, Ceratima viulala—N. Apollia	Heliconius Heautuba* H. Selyeni H. Parulidius* H. Aurora H. Ismenius H. Zuleika H. Niomata H. Enoima, var. H. Ethios H. Eurota	Papilio Z greus* Eutempis Eurytele* Leptalis Opise* L. Egeona L. Astyoche L. Thomeo* L. Lysimo, var.* L. Erythra* var. of Thomeo, L. Leucome* var. of Thomeo, L. Melaroe* var. of Thomeo, L. Argophloe*, var. of Thomeo, L. Eumelia, L. Siboe*, P. Pansanius*, P. Zeyathus P. Limos P. Bolivar ♀	L. Thomeo* Ithomeis satellites* L. Lysimo, var.* I. aurantiaca* I. minima* I. Helconina* L. Argophloe*, var. of Thomeo, L. Eumelia, L. Siboe*, Stalactis Callippe	Castaia Lanus* Diopsis Cyma. D. diaplana. D. Allana. D. sp.* Diopsis L.   Periop- leridina*   ps, sp.* Diopsis, sp.* Diopsis Omega. P. moeris, sp.* P. Isco*, C. Aerodolis* C. sp.*	Pericopsis angulata, P. sp. Hyclosia Throsia, Pericopsis turbida*	

\* I have used this name for \* have been ascertained by and found to be very much fewer in individuals than the species which they imitate.

the normal facies of the genus or family to which they severally belong\*. The resemblance is so close, that it is only after long practice that the true can be distinguished from the counterfeit, when on the wing in their native forests. I was never able to distinguish the *Leptalides* from the species they imitated, although they belong to a family totally different in structure and metamorphosis from the *Heliconiidae*, without examining them closely after capture. They fly in the same parts of the forest, and generally in company with the species they mimic.

I have already given an account of the local modifications to which the *Heliconiidae* are subject. It is a most curious circumstance, that corresponding races or species of counterfeiting groups accompany these local forms. In some cases I found proof that such species are modified from place to place to suit the peculiar forms of *Heliconiidae* there stationed. As this is an important point, and one which throws light on the origin of mimetic species, I must ask the reader's careful attention to the details, referring to the plates.

Plate LV. fig. 1 *a* (*Ithomia Flora*) and fig. 1 (*Leptalis Theonoe*) represent a *Heliconide* and its imitator, both of which inhabit the banks of the Cupari, a river belonging to the Amazon system, in 55° W. long. Neither of these is found on the Upper Amazons (60° to 70° W. long.), where I made the remaining part of my observations on these insects. At Ega, on this upper river, in 65° W. long., two species of *Ithomia* occurred, which I consider to be local varieties or races of *I. Flora*, namely, *I. Omega* (Pl. LV. fig. 2 *a*) and *I. Illinissa* (Pl. LV. fig. 6 *a*). It is immaterial to the question in hand whether these be considered absolutely distinct species or races; the *Leptalis* which was found in their company was the form called *L. Lysiuoe* (Pl. LV. fig. 3), with its admitted varieties (figs. 4, 5, 6, and 8). Only one of these varieties of *Leptalis* mimics an *Ithomia*; this is our fig. 6, which evidently counterfeits *Ithomia Illinissa* (fig. 6 *a*). The prevailing form of *Leptalis*, the *L. Lysiuoe* (fig. 3), has no resemblance to any *Ithomia* of Ega, but is, when flying, a wonderful imitation of the *Stalactis Duralii* (Pl. LV. fig. 3 *a*), a common insect belonging to a genus (family *Erycinidae*) equally flourishing and abundant in individuals with the members of the family *Heliconiidae*. I think there will be no doubt in the mind of any one that the Ega *Leptalides* are local varieties of the Cupari *L. Theonoe* (fig. 1), when all the connecting links between them are studied in the figures given on our two plates. It is highly probable, therefore, that this species has been by some means modified with especial reference to the changed *Ithomia*, or other insects, of the locality. The varieties, figs. 4, 5, and 8, were excessively rare: they have the appearance of *sports*, and show how variable the species has been in this district.

The same takes place at St. Paulo, in 69° W. long. Here we find the *Ithomia* again changed. Neither the *I. Flora* of the Cupari and Lower Amazons nor the *I. Illinissa* of Ega occurs; but the second Ega species, *I. Omega*, inhabits the district, and several other species not found in other places, amongst them *I. Ilerdina* (Pl. LVI. fig. 4 *a*), *I. Chrysonomia* (Pl. LVI. fig. 3 *a*), and *I. Virginia* (Pl. LVI. fig. 6 *a*). The prevailing species of

\* This may be seen from the figures given of *Leptalis*,—fig. 5, Pl. LVI. being *L. Nephemia*, a species exhibiting the usual form of the family *Pieridae*, to which the genus *Leptalis* belongs; whilst all the other *Leptalides* figured are mimetic species, totally unlike, as far as facies is concerned, this normal form.

*Ithomia* of the locality being thus changed, how stands it with the *Leptotides*? They are changed also, and again with close reference to the *Ithomia*. I found a number of different varieties, which I could not doubt were local forms of the same species as that found on the Cuparí and at Ega. Thus, there was one (Pl. LV, fig. 2) closely resembling *L. Theonöe* (fig. 1), but modified to produce a nearer imitation of the *Ithomia Omega* (Pl. LV, fig. 2*a*), which I believe to be a local form of *L. Flora*. Another (Pl. LVI, fig. 3) resembled *Ithomia Chrysdonia* (Pl. LVI, fig. 3*a*); but the imitation is not fixed or exact in all the specimens taken, as may be seen by comparing figs. 1, 2, 3, of the same Plate. We here detect nature, as it were, *striving* after a correct imitation: the explanation of this will be attempted further on. A third form of *Leptalis* found at St. Paulo is the one figured Pl. LVI, fig. 6, which mimics the *Ithomia Virginia* (Pl. LVI, fig. 6*a*). Besides these, a few varieties occurred which did not closely counterfeit any *Ithomia*; they were very much rarer than the others. I figure two of these (Pl. LV, figs. 7, 9), to show how they connect the other more strongly modified varieties with the Ega forms.

The *Ithomias* concerned in these imitations have the character of true species, being distinct and constant, with the exception of *L. Chrysdonia*, whose varieties are detailed under the head of the species, which is variable, and throws light on the origin of the rest. They are all excessively numerous in individuals, swarms of each kind being found in the localities they inhabit. The *Leptotides* are exceedingly rare; they cannot be more than as 1 to 1000 with regard to the *Ithomia*. It may be asked, how can we know they are all varieties (using the term as meaning forms descended from others) of one species? I must refer to the figures given, which, although they do not include all the connecting varieties that were collected, show how nearly all the forms are linked together. The most distinct amongst them are those figured Pl. LVI, figs. 4 and 6. The feature which distinguishes fig. 4 is the white colour of the disk of the hind wings, and the veins which traverse it. This character is shown to be due to variation, from the facts that *Ithomia Oncidia*, an undoubted variety of *L. Chrysdonia* (or *Orolina*), exhibits a commencement of this milky shade of the wings, and that many individuals of *L. Herdina* (Pl. LVI, fig. 4*a*) display steps of modification in the colours of the veins. The variety figured Pl. LVI, fig. 6, appears distinct, from the single pale spot near the tips of the wings; an approximation to this is seen in the variety figured Pl. LV, fig. 9, which is an undoubted modification of *L. Lysinoë* (Pl. LV, fig. 3). The remarkable variety figured Pl. LV, fig. 4 has been described by the only author who has treated on these insects (Mr. Hewitson) as a variety of *L. Lysinoë*. In a polymorphic form, like this *Leptalis*, none of the varieties can be taken from the rest and denominated species, (using the term as meaning forms which cannot have descended from other closely allied ones), without exercising the art of species-making in the most arbitrary manner. For if we allow so great a latitude to variation as that from figs. 3 to 4, 5, 6, 7, 8, and 9, Pl. LV., how can we venture to say that natural modification, having gone so far, was incompetent to go further, so as to produce figs. 4 and 6, Pl. LVI., and that those forms must have arisen by some unknown agency? It is true, they have not arisen by simple variation, or *sports*, in one generation, but, as we shall presently see, by an external agency accumulating the modifications of many generations in two diverging directions. As

the connecting links have not all been found, they may be called species: the word is of little importance. The habits of all are the same. When I had collected only two or three of the most distinct, I considered them separate species; but intermediate forms successively occurred, every capture tending to link the whole more closely together. The explanation that the whole are the result of hybridization from a few originally distinct species cannot at all apply in this case, because the distinct forms whose intercrossing would be required to produce the hybrids are confined to districts situated many hundred miles apart.

None of these *Leptalides* have been found in any other district or country than those inhabited by the *Ithomiæ* which they counterfeit. A species very closely allied to *L. Lysinoë*, var. *Argochloë* (Pl. LVI. fig. 6), has been received from Mexico (*L. Atherize*); but an *Ithomia*, of nearly the same colours (*I. Nero*) also inhabits Mexico. Many other species of *Leptalis*, of much larger size than the one here discussed, also mimic *Heliconidæ*, the objects of imitation not being *Ithomiæ*, but other genera of the family. Two of these are figured on Pl. LVI. *L. Oriso* (Pl. LVI. fig. 8) is a remarkably exact counterfeit of *Methona Psilii* (fig. 8 a), the resemblance being carried to minutiae, such as the colour of the antennæ and the spotting of the abdomen. *L. Amphione*, var. *Egaëna* (Pl. LVI. fig. 7), is very curious, as being a satellite of *Mechanitis Polymnia*, var. *Egaënsis* (fig. 7 a), both peculiar to the district of Ega,—the typical *L. Amphione* being found at Surinam, in company with the typical *M. Polymnia*, which it resembles—local varieties or sister species of *Leptalis Amphione* accompanying local varieties of *Mechanitis Polymnia* in other parts of tropical America.

Several species of *Dioptis*, a genus of Moths, and *Ithomeis*, a genus of *Erycinidæ*, also accompany these species or distinct local forms of *Ithomia*. A few of the Moths are figured on Pl. LV. figs. 10, 11, 12, 13. The imitations may not appear very exact from the figures; but when the insects are seen on the wing in their native woods, they deceive the most experienced eye.

A similar series of mimetic analogies occurs in the Old World, between the Asiatic and African *Danaidæ*, or representatives of the *Heliconidæ*, and species of other families of Butterflies and Moths. No instance is known in these families of a tropical species of one hemisphere counterfeiting a form belonging to the other. A most remarkable case of mimicry has been recorded by Mr. Trimen\* in a *Papilio* of Southern Africa, *P. Ceneæ*, whose male wears to deception the livery of one species of *Danais*, namely, *D. Echeria*, whilst the female resembles a quite different one, *D. Chrysippus*,—both African. Mimetic analogies, however, are not confined to the Lepidoptera; most orders of insects supply them; but they are displayed only by certain families. Many instances are known where parasitic Bees and two-winged Flies mimic in dress various industrious or nest-building Bees, at whose expense they live in the manner of the Cuckoo. I found on the banks of the Amazons many of these Cuckoo Bees and Flies, which all wore the livery of working Bees peculiar to the country.

The instances of this kind of analogy most familiar to European entomologists are those of the European species of *Trochilium* (a genus of Moths), which strangely mimic various

\* 'Rhopalocera Africæ Australis,' p. 21. Cape Town.

Bees, Wasps, and other Hymenopterous and Dipterous insects. The parallelism between these several forms and their geographical relations have not yet, I believe, been investigated. The resemblances seem to be more closely specific in tropical countries than in Europe; and I think it likely that the counterfeits in high latitudes may not always be found in company with their models. It is possible the geographical relations between the species concerned may have been disturbed by the great climatal and geological changes which have occurred in this part of the world since the date when they first came into existence.

Not only, however, are *Heliconidæ* the objects selected for imitation; some of them are themselves the imitators; in other words, they counterfeit each other, and this to a considerable extent. Species belonging to distinct genera have been confounded, owing to their being almost identical in colours and markings; in fact, many of them can scarcely be distinguished except by their generic characters. It is a most strange circumstance connected with this family, that its two sections, or subfamilies, have been mingled together by all authors, owing to the very close resemblance of many of their species. Analogies between the two subfamilies have been mistaken for affinities. It is sometimes difficult to understand in these cases which is the imitator and which the imitated. We have, however, generally a sure test in the one set exhibiting a departure from the normal style of colouring of their congeners, whilst the other are conformable to their generic types. The species of *Napeogenes* are, by this criterion, evidently all imitators of *Athonia*; they are also rare insects, like the *Leptalides*. The mimetic species of *Heliconius* must be, for the same reason, imitators.

These imitative resemblances, of which hundreds of instances could be cited, are full of interest, and fill us with the greater astonishment the closer we investigate them; for some show a minute and palpably intentional likeness which is perfectly staggering. I have found that those features of the portrait are most attended to by nature which produce the most effective deception when the insects are seen in nature. The faithfulness of the resemblance, in many cases, is not so striking when they are seen in the cabinet. Although I had daily practice in insect-collecting for many years, and was always on my guard, I was constantly being deceived by them when in the woods. It may be asked, why are mimetic analogies so numerous and amazingly exact in insects, whilst so rare and vague in the higher animals\*? The only answer that I can suggest is, that insects have perhaps attained a higher degree of specialization, after their type, than most other classes: this seems to be shown by the perfection of their adaptive structures and instincts. Their being more numerous and striking in tropical than in temperate countries is perhaps attributable to the more active competitive life, and the more rapid succession of their generations, in hot than in cold countries.

It is not difficult to divine the meaning or final cause of these analogies. When we

\* Two instances of mimicry in birds, quite as wonderful as those between *Leptalis* and *Athonia*, have just been communicated to me by my old travelling companion, Mr. A. R. Wallace. He has observed two species of *Oriolidae* (perverted from the normal facies of the family) attendant on two species of *Meliphagidae*, and mimicking them in the most curiously minute way in colours and in general figure. The associated pairs inhabit separate islands, as follows:—I. Bourou, *Mimeta* (*Oriolidae*) *Bourouensis*, *Tropidorhynchus* (*Meliphagidae*), n. sp.; I. Ceram, *Mimeta* *Forstni*, *Tropidorhynchus subcarinatus*.

see a species of Moth which frequents flowers in the daytime wearing the appearance of a Wasp, we feel compelled to infer that the imitation is intended to protect the otherwise defenceless insect by deceiving insectivorous animals, which persecute the Moth, but avoid the Wasp. May not the Heliconide dress serve the same purpose to the *Leptalis*? Is it not probable, seeing the excessive abundance of the one species and the fewness of individuals of the other, that the Heliconide is free from the persecution to which the *Leptalis* is subjected?

I think it clear that the mutual resemblance in this and other cases cannot be entirely due to similarity of habits or the coincident adaptation of the two analogues to similar physical conditions. This is a very abstruse part of our subject; for I think the facts of similar variation in two already nearly allied forms do sometimes show that they have been affected in a similar way by physical conditions. A great number of insects are modified in one direction by a seaside habitat. I found, also, the general colours of many widely different species affected in a uniform way in the interior of the South American continent. But this does not produce the specific imitation of one species by another; it only prepares the way for it.

It is perhaps true that the causes (to be discussed presently) which produce a close or mimetic analogy cannot operate on forms which have not already a general resemblance, owing to similarity of habits, external conditions, or accidental coincidence. Species or groups which have this kind of resemblance to each other have been called by Dr. Collingwood recurrent animal forms. The English Bee-Moths owe the narrow and pointed shapes of their wings, which already approximate them to Bees, to their blood-relationship to the Hawk-Moth family. Their Bee-like size, form, and flight doubtless arise from their Bee-like habits. A close specific analogy between any one of these and a Bee, such as exists between the insects discussed in this memoir, could scarcely be due to an accidental resemblance like that between the Hawk-Moth and a Bee, or to similarity of habits. It would mean an adaptation of the Moth with especial reference to the Bee.

I believe, therefore, that the specific mimetic analogies exhibited in connexion with the *Heliconidae* are adaptations—phenomena of precisely the same nature as those in which insects and other beings are assimilated in superficial appearance to the vegetable or inorganic substance on which, or amongst which, they live. The likeness of a Beetle or a Lizard to the bark of the tree on which it crawls cannot be explained as an identical result produced by a common cause acting on the tree and the animal.

Some of the imitations by insects of inanimate and living objects are very singular, and may be mentioned in this place. Many caterpillars of Moths, but sometimes the cases only which are manufactured and inhabited by the caterpillars, have a most deceptive likeness to dry twigs and other objects. Moths themselves very frequently resemble the bark on which they are found, or have wings coloured and veined like the fallen leaves on which they lie motionless. The accidental general resemblance between the shape of Moths' wings and leaves here gives nature the ground-work for much mimetic analogy. It has been pointed out by Rössler\* that the Bull-tip Moth, when at rest, is intended to represent a broken piece of lichen-covered branch,

\* In an article on resemblances between insects and vegetable substances (Wiener Entomol. Monatschrift, 1861,

—the coloured tips of these wings, when they are closed, resembling a section of the wood. Other Moths are deceptively like the excrement of birds on leaves. I met with a species of Phytophagous Beetle (*Chlamys pilula*) on the Amazons, which was undistinguishable by the eye from the dung of Caterpillars on foliage. These two latter cases of imitation should be carefully considered by those who would be inclined to think that the object of mimetic analogies in nature was simply variety, beauty, or ornament: nevertheless these are certainly attendants on the phenomena; some South-American *Cassidae* resemble glittering drops of dew on the tips of leaves, owing to their burnished pearly gold colour. Some species of Longicorn Coleoptera (*Ougheocerus scorpio* and *concentricus*) have precisely the colour and sculpture of the bark of the particular species of tree on which each is found. It is remarkable that other species of the same small group of *Longicornes* (*Phacelocera Buquetii*, *Cyclopeplus Batesii*) counterfeit, not inanimate objects, like their near kindred just cited, but other insects, in the same way as the *Leptalides* do the *Heliconidae*.

Amongst the living objects mimicked by insects are the predacious species from which it is the interest of the mimickers to be concealed. Thus, the species of *Scaphura* (a genus of Crickets) in South America resemble in a wonderful manner different Sand Wasps of large size, which are constantly on the search for Crickets to provision their nests with. Another pretty Cricket, which I observed, was a good imitation of a Tiger Beetle\*, and was always found on trees frequented by the Beetles (*Odonotocheila*). There are endless instances of predacious insects being disguised by having similar shapes and colours to those of their prey; many Spiders are thus endowed: but some hunting Spiders mimic flower-buds, and station themselves motionless in the axils of leaves and other parts of plants to wait for their victims.

The most extraordinary instance of imitation I ever met with was that of a very large Caterpillar, which stretched itself from amidst the foliage of a tree which I was one day examining, and startled me by its resemblance to a small Snake. The first three segments behind the head were dilatable at the will of the insect, and had on each side a large black pupillated spot, which resembled the eye of the reptile: it was a poisonous or viperine species mimicked, and not an innocuous or colubrine Snake; this was proved by the imitation of keeled scales on the crown, which was produced by the recumbent feet, as the Caterpillar threw itself backwards. The Rev. Joseph Greene, to whom I gave a description, supposes the insect to have belonged to the family *Nolodoutidae*, many of which have the habit of thus bending themselves. I carried off the Caterpillar, and alarmed every one in the village where I was then living, to whom I showed it. It unfortunately died before reaching the adult state.

p. 164). The author enumerates many very singular cases of mimicry; he also states his belief that the mimicry is intended to protect the insects from their enemies.

There is an interesting note, by the Rev. Joseph Greene, in the 'Zoologist,' 1856, p. 5073, on the autumn and winter Moths of England, whose colours are shown by the author to be adapted to the prevailing tints of nature in the season in which the species appear.

\* A remarkable instance of deceptive analogy relating to a Cricket and a species of *Crematula* is described by Westwood in Trans. Lin. Soc. vol. xviii. p. 119. In this memoir, Mr. Westwood has enumerated many curious cases of mimetic analogy.

I think it will be conceded that all these various kinds of imitative resemblances belong to the same class of phenomena, and are subject to the same explanation. The fact of one species mimicking an inanimate object, and another of an allied genus a living insect of another family, sufficiently proves this. I do not see how they differ from the adaptations of organs or instincts to the functions or objects they relate to. All are adaptations, either of the whole outward dress or of special parts, having in view the welfare of the creatures that possess them.

Every species in nature may be looked upon as maintaining its existence by virtue of some endowment enabling it to withstand the host of adverse circumstances by which it is surrounded. The means are of endless diversity. Some are provided with special organs of offence, others have passive means of holding their own in the battle of life. Great fecundity is generally of much avail, added to capabilities, active or passive, of wide dispersion; so that when the species is extirpated in one part of its area of distribution, the place is refilled by migration of individuals from another part. A great number have means of concealment from their enemies, of one sort or other. Many are enabled to escape extermination, or obtain subsistence, by disguises of various kinds: amongst these must be reckoned the adaptive resemblance of an otherwise defenceless species to one whose flourishing race shows that it enjoys peculiar advantages.

What advantages the *Heliconidae* possess to make them so flourishing a group, and consequently the objects of so much mimetic resemblance, it is not easy to discover. There is nothing apparent in their structure or habits which could render them safe from persecution by the numerous insectivorous animals which are constantly on the watch in the same parts of the forest which they inhabit. It is probable they are unpalatable to insect enemies. Some of them (*Lycorca*, *Iluna*) have exsertible glands near the anus, which are protruded when the insects are roughly handled; it is well known that similar organs in other families (*Carabidae*, *Staphylinidae*) secrete fetid liquids or gases, and serve as a protection to the species. I have noticed also that recently killed specimens of Danaoid *Heliconidae*, when set out to dry, were always less subject than other insects to be devoured by vermin. They have all a peculiar smell\*. I never saw the flocks of slow-flying *Heliconidae* in the woods persecuted by birds or Dragon-flies, to which they would have been easy prey; nor, when at rest on leaves, did they appear to be molested by Lizards or the predacious Flies of the family *Asilidae*, which were very often seen pouncing on Butterflies of other families. If they owe their flourishing existence to this cause, it would be intelligible why the *Leptalidae*, whose scanty number of individuals reveals a less protected condition, should be disguised in their dress, and thus share their immunity.

This explanation, however, would not apply to the imitation of Danaoid *Heliconidae* by other species of the same subfamily. Moreover, there are several genera of other groups (*e. g.*, *Heliconius*, *Papilio*) which contain mimetic species side by side with species that are the objects of mimicry by members of other families, as will be seen by reference to the Table at p. 503. There is no reason to conclude that some of these possess the peculiar means of defence of the Danaoid *Heliconidae*, whilst their near kindred are de-

\* Mr. Wallace tells me the *Euploea* of the Eastern Archipelago have also this peculiar smell.



prived of them. It is not unreasonable to suppose that some species are taken by insectivorous animals, whilst others flying in company with them are avoided. I could not, from their excessive scarcity, ascertain on the spot that the *Leptalides* were thus picked out. I noticed, however, that other genera of their family (*Pieridæ*) were much persecuted. We have proof, in the case of Sand-Wasps, which provision their nests with insects, that a single species is very generally selected out of numbers, even of the same genus, existing in the same locality. I was quite convinced in the case of *Cerceris binodis* of South America, which destroys numbers of a *Megalostomis* (family *Clythridæ*), that the great rarity of the Beetle was owing to its serving as prey to the *Cerceris*. We cannot point out all the conditions of life of each species concerned in these mimetic analogies. All that we can say is, that some species show, by their great abundance in the adult state, that during this period, before they propagate their kind, they enjoy by some means immunity from effective persecution, and that it is therefore an advantage to others not so fortunate, and otherwise unprovided for, if they are so like as to be mistaken for them.

The process by which a mimetic analogy is brought about in nature is a problem which involves that of the origin of all species and all adaptations. What I have previously said regarding the variation of species, and the segregation of local races from variations, the change of species of *Heliconidæ* from one locality to another, and the probable vital necessity of their counterfeits which accompany them keeping to the exact imitation in each locality, has prepared the way to the explanation I have to give. In the cases of local variation of the *Heliconidæ*, there was nothing, as before remarked, very apparent in the conditions of the localities to show why one or more of the varieties should prevail in each over their kindred varieties. There was nothing to show plainly that any cause of the formation of local varieties existed, other than the direct action of physical conditions on the individuals, although this might be seen to be clearly incompetent to explain the occurrence of several varieties of the same species in one locality. We could only conclude, from the way in which the varieties occur in nature, as described in the case of *Mechanitis Polynnia*, that the local conditions favoured the increase of one or more varieties in a district at the expense of the others—the selected ones being different in different districts. What these conditions were, or have been, was not revealed by the facts. With the mimetic species *Leptalis Theonoe* the case is different. We see here a similar segregation of local forms to that of *Mechanitis Polynnia*; but we believe we know the conditions of life of the species, and find that they vary from one locality to another. The existence of the species, in each locality, is seen to depend on its form and colours, or *dress*, being assimilated to those of the *Ithomiæ* of the same district, which *Ithomiæ* are changed from place to place, such assimilation being apparently its only means of escaping extermination by insectivorous animals. Thus we have here the reason why local races are formed out of the natural variations of a species: the question then remains, how is this brought about?

The explanation of this seems to be quite clear on the theory of natural selection, as recently expounded by Mr. Darwin in the ‘Origin of Species.’ The local varieties or races cannot be supposed to have been formed by the direct action of physical conditions

on the individuals, because, in limited districts where these conditions are the same, the most widely contrasted varieties are found existing together, and it is inexplicable how they could have produced the nice adaptations which these diverse varieties exhibit. All the varieties figured on Pl. LV. figs. 2, 7, 9, and on Pl. LVI. figs. 1, 2, 3, 4, 6, are found at St. Paulo, within a mile of each other, in the same humid forest. Neither can these adapted races, as before remarked, have originated in one generation by *sports* or a single act of variation in each case. It is clear, therefore, that some other active principle must be here at work to draw out, as it were, steadily in certain directions the suitable variations which arise, generation after generation, until forms have resulted which, like our races of *Leptalis Theonoë*, are considerably different from their parent as well as their sister forms. This principle can be no other than natural selection, the selecting agents being insectivorous animals, which gradually destroy those sports or varieties that are not sufficiently like *Ithomia* to deceive them. It would seem as though our *Leptalis* naturally produced simple varieties of a nature to resemble *Ithomia*; it is not always so, as is proved by many of them figured in the places above quoted. There is some general resemblance, it is true; and this is not purely accidental; for it is quite natural that the parent *Leptalis* should produce offspring varying in the direction of *Ithomia*, being itself similar to an *Ithomia*, and having inherited the property of varying in this manner through a long line of ancestors. We cannot ascertain, in this case, whether changed physical conditions have had any effect, quantitative or qualitative, on the variability of the species after migrating to a new district. At any rate, the existing varieties of our *Leptalis* show that the variations of *Leptalis* and *Ithomia* are not quite coincident, and that the agency of natural selection is required to bring the slowly forming race of one to resemble the other. I do not forget that at each step of selection the forms of *Leptalis* must have had sufficient resemblance to an *Ithomia* to lead to their preservation, or, at least, to prevent their complete extinction: as, however, the two analogues so much resemble each other at the commencement of the process, these steps would not be numerous. In many cases of mimetic resemblance, the mimicry is not so exact as in the *Leptalides*. This would show either that the imitator has only inherited its form from remote ancestors who were actively persecuted, the persecution having ceased during the career of its immediate ancestors; or it would show that the persecutor is not keen or rigid in its selection; a moderate degree of resemblance suffices to deceive it, and therefore the process halts at that point. I leave out of consideration all resemblances which can only be accidental, or which are resemblances of affinity.

If a mimetic species varies, some of its varieties must be more and some less faithful imitations of the object mimicked. According, therefore, to the closeness of its persecution by enemies, who seek the imitator, but avoid the imitated, will be its tendency to become an exact counterfeit,—the less perfect degrees of resemblance being, generation after generation, eliminated, and only the others left to propagate their kind. The actual state of *Leptalis Theonoë* is not the same in all of its three districts. A few varieties, or *sports*, are seen at Ega (65° W. long.) and St. Paulo (69° W. long.), namely, those figured Pl. LV. figs. 4, 5, 7, 8, and 9, which have an indeterminate resemblance. On the Cupari

(55 W. long.) the resemblance is perfect (Pl. LV. fig. 1); and this is the only form of the *Leptalis* known in the locality. The varieties figured Pl. LVI, figs. 1, 2, 3, show different degrees of resemblance to *Ithomia Chrysodonia* (fig. 3 a); these, therefore, exhibit the selection in process. Thus, although we are unable to watch the process of formation of a new race as it occurs in time, we can see it, as it were, at one glance, by tracing the changes a species is simultaneously undergoing in different parts of the area of its distribution.

The fact of one of the forms of *Leptalis Theonoë*, namely *L. Lysinoë*, mimicking at Ega, not an *Ithomia*, but a flourishing species of another quite distinct family (*Stalactis Duvalii*), shows that the object of the mimetic tendencies of the species is simply disguise, and that, the simple individual differences in that locality being originally in the direction, not of an *Ithomia*, but of another object equally well answering the purpose, selection operated in the direction of that other object. This point is well illustrated by the species of a small group of Longicorn Beetles already cited, some of which mimic a piece of bark, and others insects of another family—and by hunting Spiders, many of which wear the form of insects, and many that of inanimate objects amongst which they seek their prey.

When the persecution of a variable local form of our *Leptalis* is close or long continued, the indeterminate variations naturally become extinct; nothing then remains in that locality but the one exact counterfeit, whose exactness, it must be added, is henceforward kept up to the mark by the insect pairing necessarily with its exact counterpart, or breeding *in and in*. This is the condition of *Leptalis Theonoë* (Pl. LV. fig. 1) in its district; and it is the condition of all those numerous species of different orders which now appear fixed and distinct. When (as happens at St. Paulo, where a greater abundance of individuals and species, both of *Ithomia* and *Leptalis*, exists than in the locality of the last-named) many species have been in course of formation out of the varieties of one only, occasional intercrossing may have taken place; this would retard the process of segregation of the species, and, in fact, aid in producing the state of things (varieties and half-formed species) which I have already described as there existing.

In what way our *Leptalis* originally acquired the general form and colours of *Ithomia* I must leave undiscussed. We may conclude (if we are to reason at all from existing facts) that, as the antecedent forms of our races of *Leptalis* which are still undergoing change were themselves similar to *Ithomia*, the form has been inherited through a long line of ancestors, which have been more or less subjected to similar conditions. The instance of one of our forms leaving the *Ithomia* to mimic a species of another family may show us how a new line of mimetic analogy and gradual modification may have been originally opened.

Such, I conceive, is the only way in which the origin of mimetic species can be explained. I believe the case offers a most beautiful proof of the truth of the theory of natural selection. It also shows that a new adaptation, or the formation of a new species, is not effected by great and sudden change, but by numerous small steps of natural variation and selection. Some of the mutual resemblances of the *Heliconidae* already mentioned seem not to be due to the adaptation of the one to the other, but rather, as they

have a real affinity, the genera to which they belong being throughout very similar in colours and markings, and all equally flourishing, to the similar adaptation of all to the same local, probably inorganic, conditions. The selecting agent, which acts in each locality by destroying the variations unsuitable to the locality, would not in these cases be the same as in *Leptalis*; it may act, for anything we know, on the larvæ; in other respects, however, the same law of nature appears, namely, the selection of one or more distinct varieties by the elimination of intermediate gradations\*. The conditions of life of these creatures are different in each locality where one or more separate local forms prevail, and those conditions are the selecting agents. With regard to the *Leptalides*, I believe we may be said to know these conditions. To exist at all in a given locality, our *Leptalis Theonœ* must wear a certain dress, and those of its varieties which do not come up to the mark are rigidly sacrificed. Our three sets of *Leptalides* may be compared to a variable flowering plant in the hands of a number of floriculturists, whose aims are different, each requiring a different colour of flower, and attaining his end by "roguing" or destroying all variations which depart from the standard.

It may be remarked that a mimetic species need not always be a rare one, although this is very generally the case; it may be highly prolific, or its persecution may be intermitted when the disguise is complete.

The operation of selecting agents, gradually and steadily bringing about the deceptive resemblance of a species to some other definite object, produces the impression of there being some innate principle in species which causes an advance of organization in a special direction. It seems as though the proper variation always arose in the species, and the mimicry were a predestined goal. This suggested the only other explanations that I have heard of, namely, that there may be an innate tendency in the organization to become modified in a given direction—or that the parent insect, being powerfully affected by the desire of concealment from the enemies of its race, may transmit peculiarities to its offspring that help it to become modified, and thus, in the course of many generations, the species becomes gradually assimilated to other forms or objects. On examination, however, these explanations are found to be untenable, and the appearances which suggest them illusory. Those who earnestly desire a rational explanation, must, I think, arrive at the conclusion that these apparently miraculous, but always

\* Some of the close resemblances amongst the *Heliconida* themselves seem to be kept up by their varying in a precisely similar way. There is a very singular instance in three species of three different genera, *Melinæa*, *Mechanitis* (*Mothone*), and *Heliconius*, which are all, in East Peru, orange and black in colour, and in New Granada orange, black, and yellow. This seems to be a case of coincident, simple variation; for if three forms are quite alike in colours, it is conceivable that they may vary alike when placed under new conditions by migration. Our *Leptalides* have been shown not to vary precisely like their models; and therefore the case just quoted does not throw any difficulty in the way of the explanation I have given; but it is a very extraordinary one.

I have not thought it necessary to mention cases of close resemblances in insects which are only accidental, or which are explicable by the blood-relationship or affinity existing between the species which display them. Some orders of insects contain an almost infinite variety of forms, and it will not be wonderful, therefore, if species here and there be found to resemble each other, although inhabiting opposite parts of the earth, and belonging to widely different families. Such analogies are accidental, and can have nothing at all to do with the evidently intentional system of resemblances, carried on from place to place, which I have discussed. Some cosmopolitan families present very similar species in all parts of the earth; it can scarcely be necessary to say that close resemblances between New and Old World forms in these cases are resemblances of affinity, and not mimetic analogies.

beautiful and wonderful, mimetic resemblances, and therefore probably every other kind of adaptation in beings, are brought about by agencies similar to those we have here discussed.

### HELICONIDÆ.

I have mentioned, in a note at p. 496, that I should follow the example of Dr. Felder in separating the Danaoid *Heliconidæ* from the remainder of the family, and combining them with the *Danaidæ*. I shall, however, consider these groups as sub-families, instead of families. The modifications in the classification thus introduced will be seen by the following synopsis of the section Rhopalocera.

#### Order LEPIDOPTERA.

##### Section RHOPALOCERA.

Family 1. HESPERIDÆ. Six perfect legs in ♂ ♀; hind tibiæ, with few exceptions, having two pair of spurs. Larva inhabiting a rolled-up leaf; pupa secured by many threads, or enclosed in a slight cocoon. (These characters approximate the family to the Moths, or Heterocera).

Family 2. PAPILIONIDÆ. Six perfect legs in ♂ ♀. Wing-cells (at least, of the hind wings) closed by perfect tubular nervules. Hind tibiæ with one pair of spurs. Pupa secured by the tail and a girdle across the middle in an upright position. (The *Papiliones* have a leaf-like appendage to the fore tibiæ, as pointed out recently by Dr. Adolf Speyer; the character approximates the family to the Hesperidæ and Moths.)

Family 3. LYCENIDÆ. Six perfect legs in ♀; four in ♂; the fore tarsi wanting the tarsal claws, but densely spined beneath. Wing-cells (except in *Eumeus*) not closed by perfect nervules. Pupa secured by the tail and a girdle across the middle.

Family 4. ERYCINIDÆ. Six perfect legs in ♀; four in ♂; the fore tarsi consisting only of one or two joints, and spinless.

Subfam. 1. ERYCININÆ. Pupa recumbent, flattened beneath, secured by the tail and a girdle across the middle.

Subfam. 2. STALACTINÆ. Pupa not flattened beneath, secured rigidly by the tail in an inclined position, without girdle.

Subfam. 3. LIDYTHELINÆ. Pupa suspended freely by the tail.

Family 5. NYMPHALIDÆ. Fore legs imperfect in both sexes; in the ♀ wanting the tarsal claws; in the ♂ the fore tarsi aborted, consisting of one or two joints. Pupa suspended freely by the tail.

a. Lower disco-cellular nervule, especially of the hind wing, more or less atrophied.

Subfam. 1. NYMPHALINÆ (*Nymphalidæ*, *Ageronidæ*, *Eurytelidæ*, and *Morphidæ*, part, of authors).

b. Lower disco-cellular nervule perfect.

Subfam. 2. HELICONINÆ.

Subfam. 3. ACRÆINÆ.

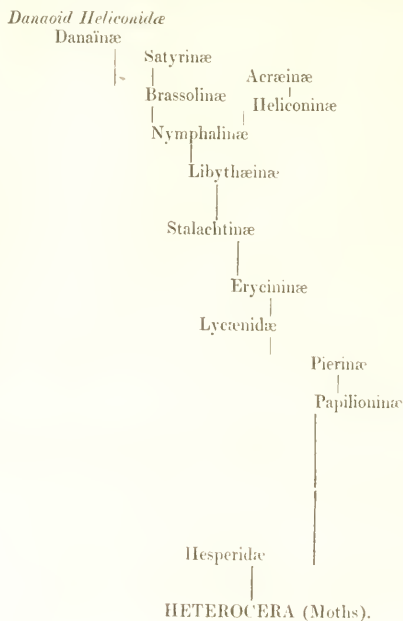
Subfam. 4. BRASSOLINÆ.

Subfam. 5. SATYRINÆ.

Subfam. 6. DANAÏNÆ.

The *Danaoid Heliconidæ*, as before mentioned, are considered to stand at the head of

the order Lepidoptera, as being the perfection of the Lepidopterous type. This position might be disputed with them by the *Satyrinae* on account of the degree of atrophy of the fore legs, which is perhaps as great in some species of *Satyrinae* as it is in the most advanced genera of Danaoid *Heliconidae*. The order of affinities does not range in a line; there are branches; and so it may happen that two groups may be nearly equal in their grade of perfection through each standing at the head of its branch. The true relationships of the groups of Rhopalocera may be therefore better explained by a diagram.



#### Subfamily DANAINÆ.

##### A. DANAINÆ proper (*Danaïde* of authors).

##### Genus DANAIS, Latreille.

###### 1. DANAIS ERIPPUS, Cramer.

*Papilio Erippus*, Cram. Pap. Exot. t. 3. f. A, B.

A common and well-known insect. It is found in waste grounds and open places everywhere throughout the region of the Lower Amazon. Its larva feeds on *Asclepias Curassavica*.

###### 2. DANAIS GILIPPUS, Cramer.

*Papilio Gilippus*, Cram. Pap. Exot. t. 26. f. C, D.

This is a rarer species than the foregoing. It is found in similar situations at Pará.

3. *DANAIS ERESIMUS*, Cramer.

*Papilio Eresimus*, Cram. Pap. Exot. t. 175. f. G, H.

This is the common species in the interior of the country. It is very abundant at Ega, on the Upper Amazons, where *D. Eriippus* did not occur.

## B. DANAID HELICONIDE

(*Heliconide*, part, of authors).

Genus *LYCOREA*, Doubleday.

Doubleday and Hewitson, Gen. Diurn. Lepid. p. 107.

The six described species of this genus differ from each other by such slight characters (small differences in colours, and in the arrangement of the pattern on the wings, being the only points which distinguish them), that they might fairly be considered as varieties of one only. I have not yet seen specimens, however, which connect all the forms together, and these are mostly the products of different geographical areas; it will be more convenient therefore to treat them independently, than to combine them under the head of one polymorphic species. A good collection of specimens from all parts of the area of distribution of the genus would here be very instructive. We should then be able to ascertain the metropolis and probable area of origination of each of the various forms. I have seen only *L. Halia* in collections from S.E. Brazil. *L. atergalis* is peculiar to Columbia and the Upper Amazon region; but a striking variety of it prevails over the type in this last-mentioned district, and another, *L. Pales* (Felder), occurs on the Rio Negro. *L. Cleobaea* (which is scarcely more different from *L. atergalis* than the just-mentioned *L. atergalis*, var. is from its type) is reputed to occur in the West India Islands. At Pará three forms, including *L. Halia*, are found together; and here some intermediate varieties occur, making it probable that the segregation of the quasi-species is not in that district complete.

1. *LYCOREA CERES*, Cramer.

*Papilio Ceres*, Cramer, Pap. Exot. t. 90. f. A.

This species occurs in the Amazon region at Pará, and on the banks of the Tapajós. It is also an inhabitant of Surinam. Cramer's figure is made from an example rather aberrant in the markings of the hind wings; otherwise it agrees very well with the specimens I have before me. I have a variety from Pará which connects this form with *L. Halia*.

2. *LYCOREA PASINUNTIA*, Cramer.

*Papilio Pasinuntia*, Cram. Pap. Exot. t. 316, A, B, C.

This form occurs throughout the whole of the Amazon region, from 18° to 70° W. long. The extreme western examples, found at St. Paulo on the Upper Amazons, show a change of colour in the yellow irregular belt of the fore wing, which has acquired the same orange-tawny shade as the rest of the wing. The same substitution of colour

occurs in several other species of Heliconidæ, found in that locality—a curious result of peculiar local conditions. Cramer figures a slight variety as the ♂ of the species (fig. A).

### 3. LYCOREA HALIA, Hübner.

*Eueides Halia*, Hübner, Exot. Schmett.

Found in company with *L. Ceres* and *L. Pasinuntia* at Pará. As I have before remarked, this is the form of *Lycorea* which prevails in S.E. Brazil. A variety, found also at Pará, connects it with *L. Ceres*, the chief Guianian form, and suggests the conclusion that both the extreme local races or species were one and the same at not a very distant period of time.

### 4. LYCOREA ATERGATIS, Doubleday.

*L. atergatis*, Doubled. and Hewits. Gen. Diurn. Lep. pl. 16. f. 1.

The figure here quoted was made from a Venezuelan specimen. I did not find the species on the Lower Amazons; but it was the most abundant form of the genus at Ega, on the upper river. Many of the individuals there occurring, however, form a strongly marked variety, in which the ground-colour is dark brown, suffused more or less with blackish. Further to the west of Ega, this variety is the prevailing form.

### Genus ITUNA, Doubleday.

Doubled. and Hewits. Gen. Diurn. Lep. p. 113.

The species of this genus, like those of *Lycorea*, seem to be all geographical forms of one only. But in this instance the segregation of races is complete, whilst in *Lycorea* we have seen it to be in many of the forms only in process. Three *Itunæ* are known: one, *I. Lamyra*, Latr., occurs in New Granada; the second, *I. Ilione*, Cram., inhabits Guiana and, I believe, Brazil, along the Atlantic coast; the third, *I. Phenarete*, Dbld., is peculiar to Bolivia and the Upper Amazons. All three are tolerably distinct in colours and markings.

### ITUNA PHENARETE, Doubleday.

*I. Phenarete*, Dbld. and Hewits. Gen. Diurn. Lepid. pl. 17. f. 1.

I met with one example only, at Tabatinga, Upper Amazons.

### Genus METHONA, Doubleday.

Dbld. and Hewits. Gen. Diurn. Lep. p. 115.

This genus, which is so closely allied to the following (*Thyridia*) that the species of both have always been confounded, is distinguished from it by structural characters, viz. the neuration of the hind wings and the form of the male fore legs, which are of great systematic importance in another part of this family, but here can scarcely be considered even of generic value. The internal (abdominal) nervure of the hind wing is long, and



terminates on the outer margin; the lower disco-cellular is placed at a right angle with the median, is much longer than the middle disco-cellular (which is straight), and strongly angulated. The fore legs of the male have the tibiae and tarsi linear in shape, although much shorter than the femur; they differ in length in individuals of the same species, but are never so far aborted as to form a mere round knob at the tip of the femur, as in *Thyridia*. In *Thyridia* the lower disco-cellular is short and straight, and placed at an obtuse angle with the median, whilst the middle disco-cellular is very long and angulated; and the internal (abdominal) nervure is short, terminating on the abdominal border.

1. METHONA THEMISTO, Hübner.

*Thyridia Themisto*, Hübn. Zuträg. f. 163-1.

I found this species at Pará, where it was associated with *M. Psidii*. Like the other species of the genus, its flight is somewhat slow and heavy. It frequents thinned parts of the virgin forest, moving about the lower trees and underwood. It differs from *M. Psidii*, principally, in the absence of a black belt across the disk of the hind wings. It is probably a modification of it.

2. METHONA PSIDII, Linnaeus (Pl. LVI. fig. 8 a).

*Papilio Psidii*, Linnaeus, sec. Cramer.

— — —, Cram. Pap. Exot. t. 257, f. F.

Mr. Doubleday and all subsequent authors have considered the *P. Psidii* of Linnaeus and Cramer to be a *Thyridia*. I cannot imagine how their mistake has arisen, all the numerous examples of the insect represented by Cramer as *P. Psidii* which I have examined having the wing-neuration and male fore legs of *Methona*. It is an exceedingly common insect throughout the Amazon region. The figure of Cramer is accurate: the small, rounded shape of the hyaline area near the tip of the hind wing, crossed by two nervures only, and the opaque black colour of the basal part of the hind margin of the fore wing reaching the median nervure (both good specific characters), are well given. The colour of the thorax varies in almost every specimen. In all there is a round grey spot on the wing-lappets; but in some examples the edges of these organs are also grey, and in others the surface of the thorax is much variegated with grey colour.

Genus THYRIDIA (Hübner), Doubleday.

Doubl. and Hewits. Gen. Diurn. Lep. p. 117.

THYRIDIA LEO, Felder.

*Thyridio Leo*, Feld. Wien. Ent. Monatschr. 1862, p. 75.

I found this species at Villa Nova, on the Lower Amazons, in company with *Methona Psidii*. Dr. Felder's specimens came from the Upper Rio Negro. It is distinguishable from *M. Psidii* at once by its structural generic characters, as will be seen from the description above given of the genus *Methona*; but in size and colours the two resemble

each other so much, that I could not distinguish them when on the wing. It is replaced in South-East Brazil by the *Th. Pytho* of Felder, which I consider a local form of the same species.

Genus DIRCENNA, Doubleday.

Doubl. and Hewits. Gen. Diurn. Lep. p. 119.

In this genus the hind-wing venuration resembles that of *Methona*, inasmuch as the lower disco-cellular is strongly angulated, and emits a recurrent nervule; but the middle disco-cellular in the ♂ is bent, and directed towards the apex of the wing. The internal nervule is very short, terminating on the abdominal edge. In the fore wing the first median branch is thrown off at a moderate distance from the base of the wing, terminating on the hind margin, close to the posterior angle, the cell being much broader than in *Methona* and *Thyridia*. The body is slender; the antennæ moderately elongated, and thickened towards the tip into an elongate club. The palpi are clothed in front with long porrect hairs, their third joint being long and pointed. The male fore tibiæ and tarsi are aborted, being reduced to a small knob at the apex of the femur.

Doubleday left the list of species referable to this genus in an unsatisfactory state. The following are all at present known\* :—

1. *D. Klugii*, Hüb. Zutr. f. 801, 802.—Mexico.
2. *D. Jemima*, Hüb. ib. f. 807, 808.—Venezuela and New Granada.  
*D. Ianbe*, Doubled. and Hewits. Gen. Diurn. Lep. pl. xvii. f. 2.
3. *D. Devo*, Hüb. Zutr. f. 243, 244.—South-East Brazil, Bahia.
4. *D. Rhoëo*, Felder, Lepidop. Fragment., p. 40.—South-East Brazil, Pará, and Amazons.
5. *D. Xantho*, ib. p. 40.—South-East Brazil, Bahia.
6. *D. Zelia*, Guér. Icon. Règne Animal, text, p. 470.—Bolivia.
7. *D. Epidero* (Boisduval, MS.), n. sp.—Amazons.
8. *D. Lenæa*, Cram. † t. 231, f. D. ♂.  
*D. Melanida*, Cram. t. 231, f. F. ♀.  
*D. Zælo*, Boisduval, MS.

1. DIRCENNA RHOËO, Felder.

*D. rhoëo*, Felder, Lepidop. Fragment., p. 40.

This form differs from the *D. Devo* of Hübner only in the greater breadth and irregularity of the dusky-black border of the hind wing, especially in the ♀, and in the

\* *Dircenna Daillia*, Hewits. Trans. Ent. Soc. vol. ii. N.S., pl. xxiii. f. 3, is a *Hymenitis*.

† This species is imperfectly known. Cramer's figures are very unsatisfactory. In Cayenne examples, the wings are clearer hyaline than represented by him; the basal half of the fore wing, the anal quadrate patch of the hind wing, and the nervures are suffused with bright fulvous. The nervures near the apex of the fore wing are bright yellow. It appears to be a rare species. In Dr. Boisduval's collection, typical examples stand under the MS. name of *D. Zælo*. I am indebted to Dr. Boisduval for the present of a fine example. I believe, however, that *D. Lenæa* (Guiana), *D. Epidero* (Amazons), *D. Zelia* (Bolivia), and *D. Xantho* (Bahia) might be all treated as geographical forms of one and the same species.

nervures which traverse the disk of the same wing being of a yellowish colour instead of black. In the ♀ the disco-cellulars and the terminal parts of the median branches are accompanied by dusky streaks. It cannot be considered, however, otherwise than as a local variety of *D. Dero*, which has the hyaline disks of the wings always clearer, and the black borders more sharply defined than *D. Rhoëo*. *D. Dero* is peculiar to South-East Brazil, and is not found in the Amazon region, where the local form *D. Rhoëo* takes its place. I have seen specimens of *D. Rhoëo* also from the neighbourhood of Bogotá, New Granada. It flies in thinned parts of the forest in Ygapó, or flooded districts, in the dry season. The species is always accompanied by the following, *D. Epidero*, to which it has so close a general resemblance, that I always found it difficult to distinguish one from the other when on the wing. The two forms, however, have no very close real relationship, there being points of difference in their structure, namely, in the shape and venuration of the hind wings in the males. The constant companionship of the two species can only be explained by the social and gregarious instincts of the *Heliconiide*.

## 2. DIRCENNA EPIDERO (Boisduval MS.), n. sp.

Expanse 2" 5". ♂. Wings hyaline, a patch of bright yellow across the middle and apical regions of the fore wing and the basal half of the hind wing. *Fore wing: above*, with the margins blackish, a triangular spot on the hind part of the cell, near the base, and a narrow belt across the disco-cellulars, extending down the second median branch (and partly down the third) to the hind margin, also blackish, the dark colour on the posterior margin extending quite to the median nervure and its first branch. *Beneath*, the same, except that there are two or three white specks at the tip of the wing. *Hind wing: above*, with the margins blackish, the portion between the second median branch and the abdominal edge very much broader; a narrow dusky belt from the costa across the disco-cellulars to the hind margin, most frequently interrupted in the middle, also blackish; the nervures across the basal part clear light yellow. *Beneath*, the same, except that the base of the costa has a stripe of orange-colour, and that the tip has two, and the hind margin near the anal angle four, white specks.

The hind wing is short and subquadrate, the apex being sharply truncated; the lower disco-cellular is angulated (with a recurrent nervure) close to the junction of the lower radial. The species varies in the broad black border, near the anal angle of the hind wing, having a reddish streak in the middle, through which shine the white marginal specks of the under surface.

♀. Very variable in colours. The following are the chief variations:—

1. Same as the ♂, except that the broad anal black border of the hind wing is of a clear orange-red colour in the middle.
2. The wing much suffused with blackish, leaving two broad belts across the fore wing, the basal part and a subapical spot of the hind wing alone hyaline; the apical belt of the fore wing has a patch of light yellow, and the nervures traversing the basal part of the hind wing are reddish.

Generally distributed throughout the Amazon region, in thinned parts of the forest,

invariably associated with *D. Rhoöo*. Both have a weak, slow flight, and are generally seen in company with *Ithomia* of various species.

Genus CALLITHOMIA, nov. genus.

*Generic Characters.*—Head, palpi, and antennæ same as in *Dircenna*; the long hairy palpi, and their long pointed third joint, being characters which distinguish both from *Ithomia* and its allied genera. Hind wing in the ♂ short, subquadrate, in the ♀ elliptical; in both sexes with the lower disco-cellular straight, rather long, placed at an obtuse angle with the median; the middle disco-cellular angulated (with a recurrent nervule), in the ♂ very long, bent, and directed outwards towards the apex of the wing. Fore tibiæ and tarsi in the ♂ rudimentary, reduced to a small knob at the tip of the femur; tarsi in the ♀ slender, filiform, the joints not being contracted and crowded at the tip.

The shape of the wings, structure of the head, antennæ, and palpi give this genus very much the aspect of *Dircenna*, from which the neuration of the hind wing amply distinguishes it. In this latter respect, it bears a similar relation to *Dircenna* that *Thyridia* does to *Methona*. In the hind-wing neuration it resembles also the genus *Olyras*, but differs from it in the palpi and male fore legs. In colours it differs from *Dircenna*, the wings being rendered opaque by fulvous-coloured scales, instead of being naked and hyaline. The species are very rare, and seem to be confined to the far interior of Equatorial America: none have yet been noticed by authors.

1. CALLITHOMIA ALEXIRRHÖË, n. sp.

Expanse, ♂, 2<sup>u</sup> 2<sup>m</sup>; ♀, 2<sup>u</sup> 7<sup>m</sup>. ♂. *Fore wing*: above, with a large opaque orange-tawny spot occupying the basal third of the wing—a round spot in the middle of the cell, and a line running along the apical part of the first median branch being black; to this succeeds an irregular belt of light yellow, semitransparent on its outer edge—the rest of the wing from the end of the cell being black, with a row of five large, yellowish, semitransparent spots, of which the fourth is placed out of line, near to the outer margin. In the ♀ the apical part of the outer margin has a row of three or four pale spots. *Beneath*, the same, except that there is a marginal row of six large subtriangular silvery-white spots.

*Hind wing*: above, subopaque orange-tawny, with a row of four large subrounded black spots along the wing behind the cell, of which the outermost is very small in the ♂, and a marginal series of six subtriangular black spots, through which, on the edge, shine the white marginal spots of the under side. *Beneath*, the same, except that there is a long, subcostal, black stripe and a row of seven silvery-white marginal spots. Body black, beneath yellow; collar with two small yellow spots; wing-lappets each with one large spot of the same colour. Antennæ pale fulvous, the basal part black.

I found two or three examples of this very elegant insect in the forest at St. Paulo, on the Upper Amazons, flying in company with the *Ithomia* and *Ceratinie* of the locality.

2. *CALLITHOMIA ZETUXIPPE*, n. sp.

♀. Expanse 2" 6". Very similar to the preceding. It differs in having the fore wing, the base of the costa, and the posterior margin broadly blackish; the apical part of the wing is brown, the margins of the nervures, at the end of the cell, being reddish; the row of pale spots across this part is reduced in number to three. *Beneath*, the marginal row of pale spots in both wings is clear yellow, instead of silvery white as in *C. Alexirrhoe*. The neuration of the hind wing is slightly different from that of *Alexirrhoe*, inasmuch as the upper radial is brought much nearer the subcostal, and the upper disco-cellular is very minute.

One example taken on the banks of the Cuparí, an affluent of the Tapajos.

3. *CALLITHOMIA THORNAX*, n. sp.

♀. Expanse 2" 10". Wings elongate, orange-tawny. *Fore wing: above*, with a large, rounded spot in the middle of the cell, the base of the costa, and the whole of the hind margin black; the apical third is also blackish, leaving a submarginal row of six triangular spots and the edges of the nervures at the end of the cell orange-tawny; there is also a subapical row of four elongate, semihyaline spots. *Beneath*, the same, except that the submarginal row of fulvous spots is expanded into an irregular belt, and that there is an interrupted row of minute yellowish spots on the extreme outer margin.

*Hind wing: above*, with a row of four subquadrate spots along the wing, close behind the cell; the margins are spotless. *Beneath*, the same, except that there is a broad subcostal black stripe, and a fifth spot added to the central series; the black stripe curves at the end, so as to meet the line of spots; the hind margin, towards the anal angle, has a row of four whitish spots.

Body and antennæ the same as in the two preceding species. The neuration of the hind wing is different from that of the preceding, inasmuch as the upper radial appears as a branch of the subcostal after the cell.

A single example taken at Tabatinga, on the frontier of Peru.

Genus *CERATINIA* (Hübner), Doubleday.

Doubl. and Hewitts. Gen. Diurn. Lepid. p. 127.

This genus, which Doubleday thought most convenient to treat as a section of *Ithomia*, forms part of a group of genera or subgenera (comprising *Ceratinia*, *Napeogenes*, *Oleria*, *Mechanitis*, *Sais*, *Ithomia*, *Hymenitis*) which agree in their palpi being destitute of hairs in front, in their terminal joint being short, very slender, pointed, and projecting from the forehead, and in the antennæ being somewhat elongate, only slightly and very gradually thickened towards their tips. These genera or subgenera, however (at least, such of them as I think it will be advantageous, for the sake of clearness, to adopt), differ from each other greatly in the neuration of the hind wings.

*Ceratinia* has the hind wing elongated in both sexes. In the male, the lower disco-cellular forms a very obtuse angle with the median, is angulated, and emits a recurrent nervule near or close to the junction of the lower radial, the middle disco-cellular being

long and straight, directed outwards, and the upper straight, nearly reaching the apex of the wing. In the female, the lower disco-cellular forms a less obtuse angle with the median; the recurrent nervule is emitted either close to the junction of the lower radial or from the middle disco-cellular; the latter is directed across the wing, joining the subcostal; the upper radial, is either emitted close to this junction, or is situated as a branch of the subcostal, after the cell. The male fore tibiæ and tarsi are reduced to a small knob; the femur is not notably abbreviated. The female fore tarsi have the joints slender and filiform.

This genus is interesting as exhibiting the wing-neruation in a vacillating state. Not only do the sexes show an important difference in the position of the angle and recurrent nervule of the hind wing disco-cellulars, but individuals of the same species vary in the position of certain nervures. Those parts of structure which form fixed generic characters in other groups are here variable in the sexes and in individuals of the same sex. *Ceratinia* is nearly allied to *Mechanitis* (as defined in this memoir), on the one hand, and to *Ithomia*, through such species as *I. Iphianassa*, on the other.

#### 1. CERATINIA NINONIA, Hübner.

*Ceratinia Ninonia*, Hübn. Exot. Schmett.

Hübner's figures represent an insect with rather broad fore and hind wings, and with two large yellow spots across the middle of the fore wing, besides a crooked yellow belt across the black apical part. I found a species extremely common at different stations on the Amazons, which was evidently the same as *Ninonia*, but very variable in shape and colours, and presenting very few examples which agreed exactly with Hübner's figures. The species, however, evidently varies in different ways in different localities; yet the local varieties are not definite, the segregation of the races is not complete; so that it is embarrassing to decide whether to treat the form as one polymorphic species, including the variations under one and the same definition, or to describe separately the type and the local varieties. Besides these incomplete local modifications, easily traceable to the type, there are, as often happens in the case of prolific, widely distributed, and variable species, a number of other forms rather more strongly marked and better defined, which inhabit regions rather more distant from the locality of the type than those which the mere varieties inhabit. These are admitted on all hands to be distinct species; but I think it would be difficult to prove that these were not also varieties of *C. Ninonia*, which have become more completely segregated from the parent form. Such are, amongst others, *C. Theo* (Hewits.), Rio Negro; *C. Leprieurii* (Feisthamel), Cayenne; *C. Fenestella* (Hewits.), Venezuela; *C. Melphis* (Hübner.), S.E. Brazil; and *C. Finbria* (Hewits.), New Granada.

The following are the chief varieties of *Ceratinia Ninonia* occurring in the Amazon region.

Var. 1. *C. Borii* (Boisduval's Coll.).

Expause 2" 1<sup>m</sup> to 2" 3<sup>m</sup>. Hind wings in both sexes much narrower than in the type;

the two yellow spots across the middle of the fore wing are pale and semitransparent : the basal area of the hind wing is also semitransparent.

This variety occurs in company with the typical *C. Niionia* at Cametá, on the Tocantins, in much greater abundance than its type. I met with it also on the banks of the Tapajos, but there without the true *C. Niionia*. It is found also at Cayenne, in company with *C. Leprieurii*, a form which I did not meet with in the Amazon region.

Var. 2. Expanse 2"-5". Much larger than var. 1. The yellow spots across the middle of the fore wing are entirely wanting, there being only a crooked yellow belt across the black apical part. Both wings are much broader than in var. 1; and the hind wing is strongly angulated about the middle of outer margin.

This variety occurs much further to the west. It is found, to the exclusion of var. 1. at Ohydos, on the Guiana side of the Lower Amazons, and, again, on the Upper Amazons, at all the stations I examined, from the mouth of the Rio Negro to Peru. With it are found many individuals agreeing in colours with var. 1, although not in shape; others occur intermediate between vars. 1 and 2.

## 2. CERATINIA THEA, Hewitson.

*Ithomia Thea*, Hewits. Exot. Butt. *Ithomia*, fig. 11.

I consider this a well-marked and fixed local variety or race of *C. Niionia*. It has not been found hitherto elsewhere than on the banks of the Rio Negro, whose climate, soil, and forests are different from those of the main Amazons.

## 3. CERATINIA XANTHOSTOLA, n. sp.

♂. Expanse 2" 5". In colours resembling *C. Thea*; the wings very different in shape. The fore wing is long and narrow, very much longer than the hind wing (as in fig. 1. *Ithomia*, pl. 2. Hewits. Exot. Butt.). Opaque orange-tawny; costal edge and a faint spot in the centre of the cell blackish; apical third (or more) black, crossed by a curved yellow belt, which reaches only the second median branch; margin with a row of seven large rounded yellow spots.

Hind wing semioval, the costal and subcostal nervures rigid and straight, reaching the apex, which forms a sharp angle: *above*, opaque orange-tawny, with a broad, somewhat regular dusky margin, in which is a row of seven rounded yellow spots. *Beneath*, the same, except that the base of the costa is yellow, that there is a stripe of dusky colour along the costal nervures, and a central dusky stripe along the wing, passing close behind the cell.

This insect has the appearance of an aberration or extraordinary variety of *C. Niionia*, in company with which and its varieties it is found. Many individuals, however, occurred; and I think it is a form whose peculiarities are probably hereditary.

## 4. CERATINIA VALLONIA, Hewitson.

*Ithomia Vallonia*, Hewits. Exot. Butt. *Ithomia*, fig. 13.

This beautiful species was very rare at Pará. In colours it resembles much *Xapogenes Cyrianassa*.

## 5. CERATINIA FLUONIA, Hewitson.

*Ithomia Fluonia*, Hewits. Exot. Butt. *Ithomia*, fig. 26.

In this species the hind-wing upper radial nervure in the female is always connected with the cell by means of an upper disco-cellular. It is a distinct, well-marked form, closely allied, however, to *C. Ninonia*, and appears to be confined in its range to the region of the Upper Amazons.

## 6. CERATINIA ANASTASIA, n. sp.

♂ ♀. Expanse 2" 9". A very large broad-winged species, having very much the appearance of *Mechanitis Mæclus*, Hewits. Exot. Butt. *Mechanitis*, fig. 9. Dark orange-tawny. *Fore wing* broad, rounded at the apex: *above*, with a transverse zigzag belt after the end of the cell, from the costal to the second median branch, and a submarginal row of seven large, rounded spots, bright yellow; it has the following spots and marks of black colour:—a streak along the base of the costa, a large triangular spot within the base and a double spot at the apex of the cell, two large spots between the 1st and 2nd median branches, and a broad stripe on the hind margin, not reaching the median nervure or the hind angle: the transverse belt and the submarginal spots are also margined with black. *Beneath*, the same.

*Hind wing* nearly oval in shape: *above*, with a broad stripe crossing the hind part of the cell, the apical margin, and a row of large elongate marginal spots black; the marginal spots towards the apex are small, the others blend more or less with the central stripe. *Beneath*, the same, except that there is a broad black subcostal stripe and two small marginal yellow spots near the apex.

This very large and remarkable species is found only on the Upper Amazons, at Ega and St. Paulo, where it flies in company with *Melinæa* (or *Mechanitis*) *Mæclus*, to which it is assimilated in colour. Both inhabit the shades of the lofty and humid forest, and are slow flyers.

## 7. CERATINIA MANAOS, n. sp.

♂. Expanse 2" 5". Resembles much in shape and colours *C. Rowena* (Hewitson, Exot. Butt. *Ithomia*, fig. 123). It differs in the yellow transverse belt extending over the terminal part of the cell. The hind wing has a central black stripe composed of five subquadrate spots passing behind the cell, and a marginal row of six semicircular dull black spots. *Beneath*, all the wings have a submarginal row of white spots, and the hind wing has the usual black subcostal stripe.

This species, together with *C. Rowena*, cited above, have the appearance of small examples of *Mechanitis Polymnia*; their neuration, however, shows that they belong to *Ceratinia*. *C. Manaos* was taken on the banks of the Rio Negro, at the Barra.



## Genus SAIS, Doubleday (part).

Doubld. and Hewits, Gen. Diurn. Lepid. p. 131.

The type of Doubleday's genus *Sais* is the *Papilio Rosalia* of Cramer, a species which differs in the structure of the fore legs of the male and in the hind-wing venuration from the allied forms of Heliconiidae. Doubleday, however, made the definition of his genus impossible, by placing in it a series of species (*S. Cyriaussa* and others) which have no resemblance to *S. Rosalia* in the features mentioned. *S. Cyriaussa* and its allies form a distinct group, which I have named *Xapeogenes*. *Sais* may be known by the following characters.

The hind-wing lower disco-cellular in the ♂ runs in a line with the median nervure; the middle disco-cellular also runs nearly in the same straight direction, but it is angular, and emits a recurrent nervule; the upper disco-cellular is short, and placed near the apex of the wing. In the ♀ the position of the lower and middle disco-cellulars is the same; but the upper disco-cellular is wanting, the upper radial being placed as a branch of the subcostal. The costal and subcostal nervures amalgamate for nearly the whole course of the costal, as in the genus *Mechanitis*. The fore legs of the ♂ are quite rudimentary; not only are the tibiae and tarsi reduced to a small knob, but the femur also is greatly abbreviated. In the ♀ they are much elongated, and the tarsi are filiform. The head is very small; the antennae are very long and slender.

In this genus the elongation of the hind-wing cell and the alteration of the radial venuration within the domain of the median, reach their extreme point. In this sense, *Sais* may be considered to be the highest development of the Heliconioid or Danaid type on the American continent, in the sense of receding farthest from *Danaüs* and the Nymphalidae. The group *Hypacitis* exhibits probably its greatest deviation from the Nymphalideous type as *Sais*, but in *Hypacitis* this deviation runs in a different and nearly opposite direction.

## SAIS ROSALIA, Cramer.

*Papilio Rosalia*, Cram. Pap. Exot. t. 216, f. B.

Cramer's figure, made from a Surinam specimen, represents the apex of the fore wing of the same orange-tawny colour as the rest of the surface. I did not meet with any examples coloured in this manner. The species varies much according to locality, as is usual with the Heliconiidae; but the variations do not embrace all the individuals in each locality; in other words, the segregation of race is not complete.

Var. 1. Pale orange-tawny; apical part of the fore wing clear black.

All the examples met with in the Pará and Tapajós districts were conformable to this type. I did not find it at all on the Upper Amazons.

Var. 2. Dark orange-tawny; apical part of the fore wing black, hind wing having a series of blackish stripes extending from the central macular vitta to the marginal lunules.

Examples of this occurred at Ega, in company with the following:—

Var. 3. Pale orange-tawny; apical part of the fore wing dusky, with a large irregular fulvous spot in the centre.

Ega.

Var. 4. Dark orange-tawny; apical part of the fore wing black, with a series of short narrow isabella-coloured stripes accompanying the nervures; hind wing having a series of blackish stripes extending from the central macular vitta to the marginal lunules.

Ega and St. Paulo. At St. Paulo this was the prevailing form of the species. These dark varieties certainly do not inhabit the region of the Lower Amazons.

GENUS *MECHANITIS* (Fab.), Doubleday.

Double. & Hewits. Gen. Diurn. Lepid. p. 130.

After a careful examination of nearly all the species, I find that two widely distinct generic types were comprised by Doubleday under *Mechanitis*. One of these (which comprehends his section 1, including, however, *M. Polymnia*, placed in his section 2) is closely allied to *Ceratinia*, *Sais*, *Napeogenes*, and *Ithomia*, agreeing with them in the shape and position of the palpi and the rudimentary condition of the fore legs of the ♂; the other (in which the fore tibiae and tarsi of the ♂ are nearly of the same shape as in *Danais*, being only a little shortened, more or less, according to the species, and the terminal joint of the palpi does not project in front of the forehead) approaches *Olyras*, *Tilborca*, and *Eutresis*. This group (Doubleday's sect. 2, in part) I shall name *Melinaea*; the other (sect. 1) will retain the name of *Mechanitis*. We have here an illustration on a smaller scale of the same deceptive analogy which has led to the junction of the Heliconinae with the *Heliconia*-like Danainae. There is, in truth, a very wide difference in structure between *Mechanitis* and *Melinaea*; but the great similarity in dress of the respective species, in great part pair by pair, has led to their being grouped in one genus. The distinguishing characters of *Mechanitis* are the following:—

Head small; palpi thinly clothed with scales, terminal joint pointed, projecting. Antennae moderately long, thickened into a distinct club at the apex. Hind-wing lower discocellular nearly in a line with the median, rather short; middle discocellular at right angles with the lower, angulated, and emitting a recurrent nervule in the middle in both sexes; upper discocellular in the ♂ inclined towards the base, joining the subcostal not far from the middle of its course, in the ♀ very short or entirely wanting, in the latter case the upper radial being as a branch of the subcostal beyond the cell. Costal nervule amalgamated with the subcostal for nearly half the length of the wing in the ♀. Fore legs of the ♂ with the femur short, tibiae and tarsi reduced to a small knob; in the ♀ slender, the tarsi filiform, the spines minute.

The genus, as thus defined, comprises two groups of species of very different general appearance,—one containing *M. Polymnia* and its allies, distinguished by their large size, opaque wings, and varied coloration—the other including *M. Phyllodoce* of Hübner, and several nearly related species, remarkable for their much smaller size and pale, semi-

transparent wings. These latter may retain as sectional distinction the name *Oleria*, as proposed by Hübner.

Section 1. *Oleria*, Hübner.

Hübner, Verzeichniß bekannter Schmetterlinge, p. 9.

1. *MECHANITIS (OLERIA) THEAPIHA*, n. sp.

Very similar in size, shape, and general appearance to *Mechanitis* or *Ithomia ethica* (Hewits. Exot. Butt. *Ithomia*, fig. 110).

♂ ♀. Expanse 1" 2'''–1" 8'''. Wings pale sulphur-white, semitransparent. Fore wing with a wide border, and a broad oblique band extending from the costa across the end of the cell to the outer margin near the hind angle, black; a submarginal row of round white spots in the outer black border, not reaching the hind angle. Beneath, the same.

Hind wing with a black border, narrow on the costa, and broad along the outer margin, the latter having a submarginal row of rounded white spots. Beneath, the same.

Body and antennæ black. Head and thorax with some whitish markings.

Found on the banks of the Cupari, a branch of the Tapajós, and also at St. Paulo, on the Upper Amazons. At St. Paulo the individuals were larger and more vividly coloured than on the borders of the Cupari.

Section 2. *Mechanitis* proper.

2. *MECHANITIS POLYMNIA* (Linn.), Cramer, Pap. Exot. t. 191. f. E.

This species, like many others of the Heliconiæ, is subject to remarkable local variation. The varieties, taken in connexion with their geographical distribution, are a most interesting study. The species is extremely abundant wherever it is found, and the different varieties are copiously represented in collections. It is slow in flight, and inhabits thinned parts of the forest, or neglected and shady plantations near settlements. The caterpillar (figured in Sepp, Papill. de Surinam, pl. 2.) has a smooth integument. The head is round, and the body has a row of small pointed tubercles on each side. It is grey, with black spots, and ringed with yellow. It feeds on *Solanum aculeatissimum*, and is gregarious. The chrysalis is smooth.

The typical form of the perfect insect, as figured by Cramer, prevails at Pará and throughout the Lower Amazon region. All the examples collected at the different stations in those parts resemble each other pretty closely in colours and markings. At Ega, on the Upper Amazons, the species is very unstable; very few individuals were found conformable to the Cramerian type: it there varies, not only in general colour and pattern, but also very considerably in the shape of the wings, especially in the male sex. One variety seems, however, to predominate, to which I give the name of *M. Egaënsis*: I frequently found pairs of it *in copula*, and never observed it to mate with other varieties, from which I was inclined to conclude that the individuals preferred to pair with their exact counterparts, and therefore that the variety was in process of segregation from the type. All the intermediate forms between the typical *M. Polymnia* and *M. Egaënsis* occurred at Ega, but in fewer numbers. At St. Paulo, 260 miles

further to the west, the species was again extremely variable, but the varieties were quite different from those of Ega: individuals coming very near the type occurred, but not one was found quite conformable. *M. Egaënsis* was quite absent; but, on the other hand, a new variety abounded at St. Paulo, of which there was certainly no trace at Ega; this has been figured and described as a distinct species, viz. *M. Mazæus* (Hewits. Exot. Butt. *Mechanitis*, fig. 8). Two other remarkable varieties also occurred—one near *M. Menophilus* (Hewits. l.c. *Mechanitis*, figs. 2, 3), and the other with a structural modification in the shape of the wings, described below as *M. Olicencia*.

The way in which I found this species to vary, as just described, impressed me greatly, and helped much, in conjunction with other facts of a similar tendency, not only to destroy my belief in the constancy of species, but to teach how new ones may have originated. The complete set of connecting forms found showed that I had here to deal with one species only, disseminated over a large area, and modified in certain districts under peculiar conditions there obtaining. The varieties were of such a nature as to form and colours, that it was inconceivable they could have been hybrids produced by the intercrossing of two or more originally distinct species. The amount of local modification exhibited was not in accordance with obvious differences in the local conditions; for the species was totally changed from Ega to St. Paulo, 260 miles apart and very similar in soil, climate, &c., whilst very constant on the Lower Amazons, in districts 600 miles apart and very different in physical conditions. Since returning to England, I have learned that *M. Polymnia* again varies on the eastern slopes of the Andes, whilst a cluster of remarkable varieties or local forms (some of which have been described as species) are found in the Andean valleys. Some of these (*M. Macrinus*, *M. Menophilus*, &c.) are very clearly varieties of *M. Polymnia*, like the forms found at Ega and St. Paulo; but others (*M. Mothone*, *M. Menapis*) are more sharply defined, and have the appearance of true species. Now I think the conclusion is unavoidable, that these apparently distinct species are modifications, as well as the undoubted varieties are; for we have the species in all stages of modification—simple variation, local variety scarcely distinguishable from a mere variation, complete local variety, and well-marked race or species. The forms of *M. Polymnia* found in South Brazil confirm this view. At Rio Janeiro the well-marked race or species *M. Lysinnia* alone is found; at Bahia (travelling towards the home of the type, *M. Polymnia*), *M. Lysinnia* in company with *M. Nesaea*, a form exactly intermediate between *M. Polymnia* and *M. Lysinnia*; at Pernambuco (further northward) *M. Nesaea* alone occurs; at Pará this form is seen no more, and *M. Polymnia* in its typical dress monopolizes the field.

These facts seem to teach that, in this and similar cases, a new species originates in a local variety, formed in a certain area, where the conditions are more favourable to it than to the typical form, and that a large number of such are simultaneously in process of formation from one variable and widely distributed species. The new species cannot be proved to be established as such, unless it be found in company with a sister form which has had a similar origin, and maintaining itself perfectly distinct from it. Cases of two extreme varieties of a species being thus brought into contact by redistribution or migration, and not amalgamating, will be found to be numerous when the subject is

inquired into\*. I found no clear instance on the banks of the Amazons of two forms of *M. Polymnia* having this relationship; but, to judge from the collections received, it exists between *M. Lysimnia* and *M. Nesaea*, in the middle parts of the Brazilian coast-country, at Bahia.

Local var. *Mechanitis Egeensis* (Pl. LV1. fig. 7 a).

Expansion, ♂ 2" 2''-2" 7'', ♀ 2" 4''-3''. ♂. Fore wing similar in shape to that of *M. Polymnia*: *above*, dark orange-tawny or reddish brown; the basal part of the costa and a broad stripe along the hind margin, extending three-fourths the length of the wing, and touching the edge, black; there are, besides, six black spots, namely, a large quadrate one about the middle of the cell, a faintly marked one near the base, two (sometimes united) over the end of the cell, and two between the 1st and 2nd median branches. Across the wing, a little beyond the middle, is a very irregular bright-yellow belt, which begins on the costa and terminates about the middle of the outer margin: this band generally includes a quadrate spot lying within the end of the cell; its outer margin is deeply bisinuated, and broadly edged with black: in the middle of the brownish apical part of the wing, near the costa, is a large ill-defined yellowish spot. *Beneath*, the same, except that there is on the outer margin, near the apex, a series of five whitish spots, in some examples reduced in size and number, in others altogether wanting.

*Hind wing* short and quadrangular, the angularity most pronounced in small examples. *above*, same colour as the fore wing; there is a broad, black, zigzag stripe along the disk, behind the cell, and generally a series of marginal humules of the same colour. The marginal humules are wanting in some examples: in others they are large, and blended partly with the black discal stripe. *Beneath*, the same, the margin spotless: there is a yellow spot at the base of the costa.

♀. Similar to the ♂ in colours: the hind wing is not angular, but elliptical in shape, and has generally a trace of the marginal white spots on the under surface. Individuals occur much darker in colour, with the black marks spreading partly over the surface.

Extremely abundant all the year round at Ega, in thinned parts of the forest: but found in no other part of the Amazon region. It occurred in company with the typical *M. Polymnia* and numerous individuals exhibiting all the gradations between the two extreme forms. I add descriptions of some of these intermediate varieties.

\* I have given a case in the first paper published of this series, "On the Insect Fauna of the Amazon Valley," in 'Transactions of the Entomological Society of London,' n. s. vol. v. p. 354, *Papilio Vertumnus* and *P. Hierocles*. It seems to me that, as only those local varieties become species which maintain themselves distinct when brought by redistribution in contact with their sister-forms, natural selection comes here into play. It is an advantage to a form to have a sphere of life different from its allies: when two sister-forms keep themselves distinct in a locality, it is a sign they have acquired sufficient difference to fill two separate spheres; if they paired together, they would soon become one again. Nature may be said to place a premium on diversity: for she thus destroys the incompletely formed race, and preserves the completely formed one.

The case of *Mechanitis Polymnia* differs from that of *Leptalis Thymoe*, in exhibiting the production, generally, of only one local form in a district, instead of many. As far as my observations go, this seems to have been the most frequent course in nature. More than one new race would with difficulty be formed in a limited area, where the individuals live in close neighbourhood, except in such cases as our *Leptalis*, where rigid destruction of intermediate forms is going on, thus restricting the choice of mates to the surviving forms, or in such genera as *Uthomia*, where there is no doubt the insects carefully select their exact counterparts in pairing.

Var. 1. Same as *M. Polymnia*, Cram., except that the ground-colour is of a dark orange-brown, nearly as in *M. Egaënsis*.

This variety was numerously represented, and in both the sexes.

Var. 2. Between var. 1 and *M. Egaënsis*.

The wings are dark isabella-colour, or orange-brown; the black stripe along the hind margin of the fore wing touches the edge for great part of its length; and there is a large irregular yellow spot, bordered with tawny, in the centre of the black apical part. Hind wing of the ♂ more angular than in *M. Polymnia*, the apex being as if truncated.

Many examples of this variety occurred at Ega. Few were exactly alike; some approach *M. Egaënsis*, and others the var. 1 above described.

Local var. *Mechanitis Mazæus*, Hewitts. Exot. Butt. *Mechanitis*, fig. 8.

This form prevailed at St. Paulo, 260 miles to the west of Ega, in the same way as *M. Egaënsis* did in its locality. There is a wide contrast in colour between the two varieties, and at a first glance they would be pronounced distinct species. Examples occurred at St. Paulo, however, which connected *M. Mazæus* with *M. Polymnia* type. The other varieties found at the same locality are so numerous that they cannot conveniently be described in detail: some are intermediate between *Mazæus* and the var. 2 of *M. Egaënsis*; others are remarkable for their rich colouring of black, yellow, and orange-brown, the black spots at the end of the fore-wing cell forming a belt, which divides the yellow part into two simous belts. One (found paired with *Mazæus*) resembles *M. Menophilus* (Hewitts Exot. Butt. *Mechanitis*, fig. 3). All of these varieties, however, have the marginal row of white spots beneath; and none agree with the *M. Egaënsis*. The following merits a separate name and description, on account of the modified shape of its wings.

Local var. *Mechanitis Olivencia*.

♀. Expanse 2" 10<sup>m</sup>. Similar in colours to *M. Mazæus*. Fore wing much shorter, the apex being obtuse and the outer margin less oblique, so that the end of the cell is brought much nearer to the apex, reducing the extent of the dark-coloured part near the apex: orange-tawny; the costal margin near the base and a broad stripe along  $\frac{3}{4}$ ths of the posterior margin, touching the edge, black. There is a triangular spot in the basal part of the cell, a large quadrate one in the middle, and a large twin spot across the end of the cell, also black; beyond the twin spot there is a short undulated belt of a rather paler tawny than the ground-colour, which is yellow near the costa, and bordered exteriorly with black, the apical part of the wing beyond this belt being orange-tawny like the ground-colour: there is a black spot in the angle between the 1st and 2nd median branches, and a twin spot posterior to it, nearer the outer edge, of the same colour. *Beneath*, the same, except that there are three white marginal spots near the apex.

*Wing wing*: *above*, the same as in *M. Mazæus*; *beneath*, the same as above, except that the margin is destitute of white spots, or has only a slight indication of them. Body and antennæ the same as in *M. Polymnia* and all the varieties of it here described.

Found in company with the *M. Mazæus* at St. Paulo. It is a variety of *M. Polymnia*, which varies in an important part of structure.

## GENUS NAPEOGENES, nov. gen.

Head small; palpi thinly clothed with scales, not hairy, the terminal joint slender and projecting in front of the forehead. Antennæ moderately short, and distinctly thickened towards the apex, fore-wing median nervure emitting its first branch at a short distance from the root of the wing, hind-wing lower and middle disco-cellulars running at an obtuse angle with the median nervure; both of the same length, directed obliquely towards the costa near the apex (a little less oblique in the ♂ than in the ♀), straight or very slightly bent, and without recurrent nervules: upper disco-cellular in the ♀ rather long, joining the subcostal near its termination; in the ♂ short, joining the subcostal far from its termination. The costal and subcostal nervures of the hind wing, in both sexes, are free and wide apart. Fore tibiæ and tarsi in the ♂ aborted; femur not abbreviated: fore tarsi in the ♀ slender filiform.

The species of this genus, such as were then known, were included by Doubleday under his genus *Sais*; they are, however, perfectly distinct from *Sais* both in the wing-neuration and in the structure of the fore legs of the ♀. Most of the species mimic corresponding species of the allied genus *Ithomia*, in the same way as the *Leptolides* do. In every locality where *Ithomia* are found in abundance, species of *Napeogenes* are almost sure to be found also, mimicking one or more of them, the *Ithomia* being always abundant, whilst their imitators are very generally scarce in individuals. The resemblance between species of the two groups is so great that it is difficult to imagine it not to be one of real affinity; the neuration of the wings, however (a constant and important character), is a sure guide in distinguishing them. They are always represented with this feature carefully marked in the beautiful figures given by Mr. Hewitson in his 'Exotic Butterflies.'

♂ Collar and wing-lappets orange; antennal club less abruptly thickened.

## 1. NAPEOGENES CYRIANASSA, Doubleday.

*Sais Cyrianassa*, Doubl. and Hewits. Gen. Diurn. Lep. pl. 18, t. 1.

*Ithomia Cyrianassa*, Hewits. Exot. But. *Ithomia*, fig. 65.

Occurs at Pará, in humid parts of the forest, abundantly. It is distributed over a wide area in the Amazon valley, but in each locality it suffers modification. The amount of this modification is not in proportion to geographical distance. Thus, at Fonte Boa, 1500 miles to the west of Pará, it scarcely differs from the Pará type, having only the discal area of the hind wings less transparent; but on the banks of the Cupari, only 500 miles west of Pará (all these places are in the same latitude), it exists only under the form of a well-marked and constant local variety or race (our *N. Adelphæ*); a short distance (150 miles) to the west of Fonte Boa, it occurs again as a distinct local variety (our *N. Tanaulima*).

The species much resembles, when on the wing, *Ceratonia Nioonia*, var. *Borii*. It is a slow flier, and, although abundant in individuals, is confined to limited areas in the districts where it is found.

## 2. NAPEOGENES TUNANTINA.

♀. Size, shape, and general colour of *N. Cyrianassa*. Apical yellow spot of the fore wing oval in shape, rounded on its inner edge, sinuated in the middle, leaving the dusky crossbelt of undiminished thickness to the outer margin. Disk of the hind wing semi-opaque, fulvous. The rest as in *N. Cyrianassa*.

Found in the forest at Tunantins, north shore of the Upper Amazons. All the individuals seen were conformable to the above description.

## 3. NAPEOGENES ADELPHIE.

♀. Size, shape, and general colour of *N. Cyrianassa*. The wings are throughout more opaque. The apical yellow spot of the fore wing is oblong, of nearly uniform width; its inner margin has two slight sinuations: the black transverse belt between it and the disk commences at the subcostal nervure, and is gradually attenuated to its termination on the outer margin.

This constant local form differs from *N. Cyrianassa* more than *N. Tunantina* does. It is peculiar to the forests of the Cuparí, a branch river of the Tapajós. All the individuals found were constant to their type.

## 4. NAPEOGENES INACHIA, Hewitson.

*Ithomia Inachia*, Hewitson, Exot. Batt. *Ithomia*, fig. 66 (not 67)\*.

This species closely resembles *N. Cyrianassa* in form and colours. The basal part of the fore wing, however, has a rather larger extent of yellowish hyaline: the subapical spot is regularly oblong oval, and the black crossbelt is gradually narrowed, its edges being straight, from the costa to the outer margin. The antennæ are entirely black. The hind wing beneath wants the basal costal yellow spot which is so constant in *N. Cyrianassa* and its local varieties.

Found in company with *N. Cyrianassa* at Pará. Although the two species are so closely allied and fly together, they appear to maintain themselves perfectly distinct. Nothing resembling a hybrid example or connecting form ever occurred. I strongly suspect that we have here a case of mimetic adaptation: because most of the numerous local varieties of *N. Inachia* are modified to represent species of *Ithomia* occurring in the same localities.

## 5. NAPEOGENES PYROIS.

♀. Size, shape, and colour of antennæ of *N. Inachia*. The subapical yellow spot of the fore wing, and its accompanying black crossbelt, as well as the broad fulvous border of the hind wing, are also precisely the same. The ground-colour of the wings, however, is quite different. The basal area of the fore wing and the discal portion of the hind wing (with their nervures) are straw-coloured and semitransparent. The submarginal

\* Fig. 67 is given by Mr. Hewitson as a variety of *Inachia*. It differs only in colour, and is without a doubt a local variety of *Inachia*. It occurs abundantly at Bahia, where it seems to mimic *Ithomia Euritea* of that region. It should have a distinctive name for the sake of clearness; I propose that of *N. sulphurea*.



row of white spots on the fore wing is partly obsolete. Beneath, it wants (like *N. Inachia*) the yellow spot of the hind wing at the base of the costa.

Found, in company with *N. Adelpha*, on the banks of the Cuparí. It is evidently a local modification of *N. Inachia*, although having a strikingly different appearance through the change in its coloration. It is remarkable that the Cuparí form of *N. Cyriopossa* (*N. Adelpha*) should have changed so little, whilst *N. Pyrois*, the Cuparí form of *Inachia*, is so considerably modified from its type.

#### 6. NAPEOGENES PILARO, Felder.

*Ithomia Pharo*, Feld. Wien. Entomologische Monatschr. 1862, p. 76.

*Ithomia Inachia*, var., Hewitson, Exot. Butt. *Ithomia*, figs. 143, 144.

Tabatinga, near the frontier of Peru, Upper Amazons. I believe, with Mr. Hewitson, that it is a variety of *N. Inachia*, but is a well-marked one, the product of a distinct area, and constant in its differential characters; it merits, therefore, a separate name and mention. I did not meet with it in any other part of the Amazon region, except the locality mentioned above. Dr. Felder has received it from the Upper Rio Negro. It is similar in colours to the *N. sulphurina* (the race of *N. Inachia* peculiar to S. E. Brazil), but differs from it in the broader black borders and the much paler colour with semi-transparency of the discal areas of the wings.

#### 7. NAPEOGENES ERCILLA, Hewitson.

*Ithomia Ercilla*, Hewits. Exot. Butt. *Ithomia*, fig. 128.

Found only at Fonte Boa, on the Upper Amazons. It mimics very curiously in colours and markings a group of *Ithomia* which are peculiar to the same part of the country, viz., *I. Elia*, *I. Illiassa*, *I. Priscilla*, and *I. Guilla*. It agrees so nearly in all essential characters with *N. Inachia*, notwithstanding the totally different coloration, that I think there can be no doubt it is another local form of that species. In support of this view, I would adduce that it is the only form of the *N. Inachia*-group found in the locality, where some one or other might be expected to occur, from being found always in company with *Ithomia* where these latter exist abundantly. I found it flying amongst a crowd of the above-named species, within a limited area in the interior of the forest; it was much rarer than the *Ithomia*, and quite undistinguishable from them on the wing.

#### 8. NAPEOGENES ITHRA, Hewitson.

*Ithomia Ithra*, Hewits. Exot. Butt. *Ithomia*, fig. 74.

Agrees with *Inachia* in the colour of the body and antennæ, but differs from it totally in the colours of the wings. It has a remarkable and evidently mimetic resemblance to *Ithomia Cyta*. Both are peculiar to the neighbourhood of Para—the *Ithomia* being very abundant, whilst *N. Ithra* is an extremely rare species.

#### 9. NAPEOGENES CORENA, Hewitson.

*Ithomia Corena*, Hewits. Exot. Butt. *Ithomia*, fig. 112.

Found only at St. Paulo. Agrees with *Inachia* in the colour of the body and antennæ, but is totally different in the coloration of the wings from that and all the allied species

or varieties. It wears, in fact, the peculiar livery of a species of *Ithomia* characteristic of the locality in which it is found, in this respect being like the two preceding species.

\*\* *Collar and wing-lappets black ; antennal club more abruptly thickened.*

10. *NAPEOGENES PHERANTHES*, n. sp.

♂ ♀. Expanse 2". Wings narrow ; shape and position of the black parts same as in *N. Inachia*, except that the borders are wider. *Fore wing*: above, with the basal and apical hyaline areas faintly margined with purple, stained in the middle with light yellow, the black posterior border reaching and slightly passing the median nervure and its first branch ; outer margin spotless. *Beneath*, same as above, except that the marks which are black above are of a fulvous colour, and the apical margin has three white spots.

*hind wing*: above, with the discal hyaline area faintly margined with purple, yellow in the middle ; the hind border wide and orange-coloured, margined with black, as in *N. Inachia*. *Beneath*, the same, except that the costa has a long fulvous stripe, and the outer margin a series of five white spots.

Body black ; collar and wing-lappets spotted with white ; a central line on the mesothorax also white. Antennæ black ; club yellow.

Taken at Fonte Boa. Rare.

11. *NAPEOGENES CROCODES*, n. sp.

♂. Expanse 2". Colours above and beneath almost precisely as in *Napeogenes Pharo*, Hewits. (Exot. Butt. *Ithomia*, figs. 143, 144). The hyaline areas are rather paler straw-colour, the wings much narrower. Antennæ black ; club yellow.

Body black ; collar and wing-lappets spotted with white ; a central line on the mesothorax also white.

Taken at Tabatinga, in company with *N. Pharo*. It is evidently a local modification of *N. pheranthus*, modified in colours to mimic *N. Pharo*.

12. *NAPEOGENES DUESSA*, Hewitson.

*Ithomia Duessa*, Hewits. Exot. Butt. *Ithomia*, fig. 137.

I did not meet with this species myself. It was taken by M. de Gand at Nauta, on the Upper Amazons.

It will be useful to enumerate the rest of the described species which I consider to belong to this genus : I include a description of a new one in the list.

1. *N. TOLOSA*, Hewits. Exot. Butt. *Ithomia*, fig. 72.

Mexico.

2. *N. LARINA*, Ibid. *Ithomia*, fig. 90.

New Granada.

This is the mimetic analogue of *Ithomia Celemia*, Hewits. (l. c. *Ithomia*, fig. 22), found

in the same country. Mr. Hewitson, in the text, has called attention to the close resemblance, stating that he had been inclined to refer them to the same species.

3. *N. APULIA*, Hewits. l. c. *Ilhomia*, fig. 127.

New Granada. This species, different in style of coloration from any Heliconide found in the Amazon region, affords another instance of the strange adaptive resemblances existing in this genus. It mimics a small group of *Ceratonia* which are also peculiar to New Granada, namely, *C.* (or *Melinaea*?) *Villula* (Hewits. Exot. Butt. *Ilhomia*, fig. 126) and *C. Cæno* (*ib.* fig. 84).

4. *N. XANTHONE*, n. sp.

♂. Expanse 2". Belongs to our first section, and is probably another local form of *N. Inachia*. Wings elongate-narrow. *Fore wing*: *above*, with the black borders and crossbelt arranged as in *N. Inachia*, except that the crossbelt is much more oblique, commencing nearer the base of the wing; basal area opaque bright fulvous; the crossbelt very broad on the costa, then narrower, but continuing of equal breadth from the cell to the outer margin; subapical spot oblong-oval, bright clear yellow; outer margin spotless. *Beneath*, the same, except that there is a submarginal row of seven white spots.

*Hind wing*: *above*, with outer margin from before the end of the costa to the anal angle broadly black, enclosing an orange-coloured stripe; discal area bright clear yellow. *Beneath*, the same, except that the basal part of the costa is yellow, and that there is a black stripe along the subcostal nervure, and a submarginal row of six white spots.

Body dark grey; collar and wing-lappets orange-coloured. Antennæ black.

Bahia and S. E. Brazil. It somewhat resembles in its general colours *Mechanitis Vesca*, a prolific species peculiar also to the same part of Brazil.

5. *N. SULPHURINA*, nob. *Ilhomia Inachia*, var., Hewits. Exot. Butt. *Ilhomia*, fig. 67.

Bahia.

Genus *ITHOMIA*, Doubleday.

Doubl. and Hewits. Gen. Diurn. Lep. p. 122.

I propose to limit this genus to those species in which the hind-wing disco-cellular nervule is placed so as to form a right or acute angle with the median nervule, and is directed across the wing (instead of towards the apex) in both sexes. The head and palpi are constructed precisely as in *Ceratonia*, *Sais*, *Mechanitis*, and *Napeogenes*. The antennæ are long, and thickened towards the tips; sometimes they are excessively elongated and filiform. Even when thus limited, the genus contains a considerable diversity of forms, constituting groups which perhaps have an equal right with *Ceratonia* and *Napeogenes* to be called genera. The chief groups are the three following:—

1. *Ilhomia* proper.

The hind-wing lower radial is visible on the disk, and terminates on the hind margin, the median branches not being widely separated. There is a long middle disco-cellular nervule which is directed obliquely outwards. The arrangement of the upper radial and

upper disco-cellular is very variable, there being a gradation from those species which stand nearest to *Ceratonia*, which have an upper disco-cellular in both sexes, to those approaching *Hymenitis*, in which this nervule disappears, the upper radial being then as a branch of the subcostal (in the ♀) or totally wanting (in the ♂).

### 2. *Hymenitis*, part (Doubleday).

In this series of species the lower radial and upper disco-cellular exist in the ♂, although the lower radial is more or less aborted, whilst in the ♀ the upper radial becomes joined as a branch to the subcostal, its corresponding (the upper) disco-cellular being wanting. The lower radial is removed nearer the costa, terminating at the apex of the wing, the median branches being rather widely spread.

### 3. *Hymenitis*.

The hind-wing lower disco-cellular, in the extreme forms of the group, anastomoses immediately with the subcostal in both sexes; consequently both middle and upper disco-cellulars are entirely absent, the lower and upper radial being as branch and sub-branch of the subcostal. The median branches are very widely spread, and the wing-cell is thrown close to the fore margin of the wing. In the less extreme species, both disco-cellulars exist in the ♂; but they are very short, and the lower radial is always placed nearer the subcostal than in group 2.

The explanation of this diversity in the system of neururation of the hind wing in the genus *Ithomia* seems to be this:—The species exhibit from one end of the scale to the other the gradual determination of the nervures towards the costa. In *Napeogones*, in *Ceratonia*, in *Mechanitis*, and still further in *Sais*, we have seen the radial brought within the domain of the median nervure; in *Ithomia* they show the opposite tendency, namely, to connect themselves with the subcostal system of nervures—a tendency which progresses through our sections 1 (*Ithomia* proper) and 2, and culminates in *Hymenitis*. *Hymenitis*, therefore, exhibits the extreme development of a plan of wing-neururation totally unlike anything existing in the rest of the section Rhopalocera.

In this direction it may be said to display the type of the beautiful order Lepidoptera in its greatest perfection. It is a curious fact that none of the delicate species comprised in the subgenus *Hymenitis* are found in the Amazon plains: they seem to be confined to the more elevated valleys of the Andes, in Peru and New Granada, and to the higher tropical latitudes of Mexico and S. E. Brazil\*.

\* The following described species of *Ithomia* belong to the *Hymenitis* section:—

1. *I. diaphana*, Drury, ii. pl. 7.—Jamaica, St. Domingo.
2. *I. esula*, Hewits. Exot. Butt. *Ithomia*, fig. 83.—New Granada.
3. *I. Theodelinda*, Hewits. Exot. Butt. *Ithomia*, fig. 146.—New Granada.
4. *I. Daillia*, Hewits. Trans. Ent. Soc. n. s. vol. ii. pl. 23. fig. 3.—New Granada.
5. *I. Andromica*, Hewits. Exot. Butt. *Ithomia*, fig. 38.—Venezuela.
6. *I. Eruca*, Hewits. Exot. Butt. *Ithomia*, fig. 81.—Brazil, 30° S. lat.
7. *I. Morganæ*, Hubner, Zutrage, figs. 869, 870.—Mexico.
8. *I. Devecis*, Doubled. & Hewits. Gen. Diurn. Lep. pl. 18. fig. 6.—Venezuela.
9. *I. Nero*, Hewits. Exot. Butt. *Ithomia*, fig. 37.—Mexico.
10. *I. Oto*, Hewits. Exot. Butt. *Ithomia*, fig. 39.—Guatemala.

The species of *Ithomia* are very numerous; 107 have already been described, but many still exist unpublished in collections. They are most numerous in the equatorial parts of America, decreasing towards either tropic. One only is found in the West India Islands, and none, I believe, in extra-tropical North America. Two or three occur in 30° S. lat.; but the genus is unknown in Chili and to the south of the Rio de la Plata. Most of the species have curiously limited ranges: many of those inhabiting the banks of the Upper Amazons do not extend more than 100 or 200 miles, although there are no apparent physical barriers to their dissemination: and it is probable, from the number of new ones received in collections made in newly explored localities, that most of the Andean valleys have their peculiar species.

They are prolific insects, and gregarious in their habits, flocks of many different species associating together. Their flight is low and weak; and they affect only certain parts of the forest, generally shady hollows, where many hundreds may often be seen sporting together, although not an individual is found in any other part of the neighbourhood.

### 1. ITHOMIA EURIMEDIA, Cramer.

*Papilio Eurimedia*, Cram. Pap. Exot. t. 126. f. C, D.

— — *Egle*, Hübner, Samml. Ex. Schm.

A common species at Pará and throughout the Lower Amazon region. It is often found in company with *Leptalis Eumelia*, to which it has so great a resemblance that the two seem to be of the same species when on the wing. It is found also at Surinam (in company with the *Leptalis*); and I have examples from Bahia, in S. E. Brazil, where a variety of it also occurs which is widely disseminated over South and extra-tropical Brazil.

### 2. ITHOMIA NISE, Cramer.

*Papilio Nise*, Cram. Pap. Exot. t. 231. f. E.

— *Selene*, Cram. Pap. Exot. t. 315. f. F, G.

— *Neso*, Hübner, Samml. Ex. Schm.

Cramer's figures of this species are very bad; but I think they are recognizable with the assistance of the descriptions in the text, and that they represent the same species as that figured by Hübner under the name of *Neso*. It is an abundant species at Pará, but is not found anywhere else in the Amazon region. I have specimens of both sexes from Demerara, and find that they do not differ from Pará examples; at Cayenne, however, a local variety prevails in which both wings have above a submarginal row of pale spots, and the general colour is much paler. It is the only *Ithomia* known to me in which the sexes are strikingly different in appearance. The wings of the ♂ are more transparent, and much paler in colour than those of the ♀, especially the discal area of the hind wing. The peculiar texture of the surface of the wings is owing to the extreme fineness of the scales with which they are covered. I consider *I. Azara* (Hewitts, Exot. Butt. *Ithomia*, f. 23), which occurs on the banks of the Napo, a local modification of this species, several connecting forms being known. The very beautiful *Iolalia* (Hewitts, l. c. f. 97) of New Granada is probably also another local variety\*.

\* *I. Tutia*, Hewitts, Exot. Butt. *Ithomia*, ii. 6 (a species allied to *I. Nise*), is given as an Amazonian species erroneously. It is a native of Venezuela.

3. *ITHOMIA PECILA*, n. sp.

♂. Expanse 2" 2". Texture of the wings precisely as in *I. Nise*; but both wings are considerably narrower, as in *I. Azara*. *Fore wing: above*, semitransparent, with the basal half orange-tawny; the costal edge, the hind margin, a narrow triangular spot at the base of the cell, and two rounded ones placed obliquely at the end of the cell blackish; the apical third of the wing dusky black, the space between this part and the orange-tawny basal part occupied by a rather broad, oblique, light-yellow crossbelt; the inner edge of the black apical part has many indentations, and near the hind angle there is a narrow dusky streak running from the outer margin halfway along the second median branch. *Beneath*, the same, except that there is a row of 5-6 small white spots very near the outer margin, and a series of 4-5 fulvous spots across the dusky-black apical part.

*Hind wing* semitransparent: *above*, orange-tawny, with a straight macular stripe along the disk running behind the cell, composed of four semioval spots, which are connected together, and a marginal row of four or five nearly semicircular spots, all black. *Beneath*, the same, except that the costal edge is yellowish, and that there is a marginal row of six small white spots.

Body blackish; thorax spotted with greenish yellow; abdomen beneath wholly greenish yellow. (Antennae wanting).

My example of this species was received from Bogotá, New Granada. There is a specimen in the British Museum from Nauta, Upper Amazons.

4. *ITHOMIA SYNNOVA*, Hewitson.

*Ithomia Synnova*, Hewits. Exot. Butt. *Ithomia*, f. 136.

A distinct and beautiful species, found only in the forest at Tunantins, on the northern bank of the Upper Amazons. Its nearest relative is no doubt the following, *I. Gunilla*.

5. *ITHOMIA GUNILLA*, Hewitson.

*Ithomia Gunilla*, Hewits. Exot. Butt. *Ithomia*, f. 130.

Found at Fonte Boa, Upper Amazons, flying in company with the two following. All three stand in the closest relationship with each other; they are identical in colours, differing only in their arrangement or pattern. They all seem to keep themselves perfectly distinct.

6. *ITHOMIA PRISCILLA*, Hewitson.

*Ithomia Priscilla*, Hewits. Exot. Butt. *Ithomia*, f. 131.

Fonte Boa; equally abundant with the preceding and following.

7. *ITHOMIA ILLINISSA*, Hewitson. (Pl. LV. fig. 6 a).

*Ithomia Illinissa*, Hewits. Exot. Butt. *Ithomia*, f. 2 and 132 (aberration).

This species has a wider range than the two preceding, being found much further eastward, at Ega, and probably also westward in Peru. I found, at Fonte Boa, with the type, a few individuals of a variety which connects the species with *I. Priscilla*. I

am inclined to think that all three are modifications of one and the same species. They may have arisen in separate localities, and have been afterwards brought by altered distribution into contact; but it is not necessary to suppose this, as the *Ithomia* always pair with their exact counterparts, so that separation is probably not requisite to aid the segregation of races, when the variations have once arisen.

The flocks of Butterflies, all of the same colour, and undistinguishable from one another when on the wing, which fly together in the same dry hollows of the forest at Fonte Boa, comprise, besides the three preceding species, also a fourth *Ithomia* (*I. Elia*, belonging to a different section of the genus) and *Napeogenes Ercilla*. A *Leptalis* (Pl. LV. fig. 6), coloured in the same way, occurs in company with *I. Illiassa*, at Ega; and an *Ithomeis*\* (*I. aurantiaca*, belonging to the widely different family *Erycinidae*) flies

\* ITHOMEIS, nov. gen. (Family ERYCINIDÆ).

Allied to *Lynxus* and *Pheles*. Facies of *Ithomia*, having similar elongated fore wings and whitish spots near the apex, imitating the transparent ones usual in the species of that genus.

Head clothed with even, soft hair-scales; palpi extremely short, thick, thinly and smoothly clad with scales. Antennæ moderately slender, elongate, not pale-ringed; thickened towards the apex into an elongate, slender, compressed club. Fore wing elongate, apex more or less rounded; subcostal and median nervures straight; the former two-branched, emitting its first branch just before, its second much beyond, the end of the cell; upper disco-cellular very short; middle disco-cellular much longer, transverse; lower disco-cellular slanting outwards, nearly perfectly tubular, joining the median beyond its second branch. Hind wing suboval; upper radial appearing as a continuation of the subcostal, the terminal part of the subcostal placed as a branch of it; middle disco-cellular short, transverse; lower disco-cellular in the same relative position as in the fore wing. Legs thinly clad with scales, stout; fore legs of the ♂ densely hairy; fore legs of the ♀ long, thinly clad, claw-joint very large, oblong-oval, claws minute.

In the shape and clothing of the head, palpi, and antennæ, this genus is extremely similar to *Lynxus*, *Pheles*, *Zronia*, *Themone*, and the allied genera. Its nearest relationship is with *Pheles*, from which it differs in the second subcostal branch of the fore wing being emitted after, instead of before, the end of the cell. The species of *Pheles* have somewhat the aspect of *Ithomia* and *Stalactes*, but those of *Ithomeis* have a much closer resemblance to those genera.

1. ITHOMEIS AURANTIACA, n. sp.

♂. Expanse 1.9". Fore wing: above, black; a long triangular spot at the base of the cell, a smaller one just after the cell, a rounded one between the 1st and 2nd median branches, and a belt of three similar spots across the wing, between the radials and the 2nd and 3rd median branches, whitish; the costal margin at the base, a large spot between the median and postmedian nervures, and a narrow, somewhat regular, submarginal band beginning on the costa, running parallel to the outer margin, arched, and reaching the hind margin, orange. Beneath, the same.

Hind wing: above, orange, the whole margin narrowly, and a large triangular spot on the basal part of the disk, black. Beneath, the same, except that there are two white spots at the base of the wing.

Antennæ black. Body black; forehead silvery white; abdomen beneath orange.

Found at Caiçara, between Ega and Fonte Boa, in company with *Ithomia Elia*, which it very much resembled on the wing.

2. ITHOMEIS STALACTINA, n. sp.

♂. Expanse 1.8". Fore wing: above, black; the costal and hind margins near the base slightly tinged with tawny orange; a long stripe within the base, a speck beyond the cell, a spot between the 1st and 2nd median branches, and a short macular cross-belt, placed rather more than halfway between the cell and the apex, white. Beneath, the same, except that the tawny-orange marks near the base appear as distinct stripes, and that there is a short, narrow, obscure tawny belt parallel to the outer margin.

Hind wing: above, black; a broad tawny-orange stripe begins at the base, runs along the abdominal margin, bending before reaching the anal angle, and continues thence to the apex; there is also a dull tawny-orange spot in the middle of the costal margin. Beneath, the same, except that there are two white spots at the base.

Body and antennæ black; forehead silvery white; abdomen beneath orange.

with *Ithomia Aelia* in another locality. A species of Bombycine Moth (*Dioplis Aeliana*, Pl. LV, fig. 10) is also seen mingled with the crowd in the forests of Fonte Boa. None of these are found in any other part of the Amazon region, nor indeed in any other part of America, to my knowledge, than the places inhabited by their counterparts.

Found at Ega, in company with *Stalactis Duvalii* and *Ithomia Theonoi*, var. *Lysinœ*. I think there can be no doubt it is of the same stock as *Ithomeis aurantiaca*, and has become modified in colours by natural selection, like *Leptalis Lysinœ*, to adapt it to the prolific and flourishing *Stalactis Duvalii*.

3. *ITHOMEIS HELICONINA*, n. sp.

♂. Expanse 1" 2". *Fore wing*: above, black; a large triangular spot on the basal part of the disk, traversed by the median nerve and its first branch, a short crossbelt beyond the cell, traversed by the costal, upper and lower radials, and 3rd median branch, white; a narrow submarginal curved belt, beginning on the costa and ending near the hind margin, reddish. *Beneath*, the same.

*Hind wing*: above, black, with the disk (behind the cell), including the central part of the abdominal margin, greyish white, semitransparent; the nervures dusky; the broad black hind border has a narrow reddish-orange stripe in its middle. *Beneath*, the same, except that there is a white spot at the base.

Body and antennæ black; forehead silvery white; abdomen beneath orange.

Found at St. Paulo, flying in company with *Ithomia Herdina*, which it resembles when on the wing.

4. *ITHOMEIS MIMICA*, n. sp.

♂ ♀. Expanse 1" 3"–1" 9". *Fore wing*: above, dull black, with a reddish tinge on the margins near the base; a triangular spot traversed by the median nerve in the basal part of the disk, and an obscure spot between the 2nd and 3rd median branches, dull greyish white; a broad arched tawny-orange belt parallel to but distant from the outer margin, beginning on the costa, and not reaching the hind angle. *Beneath*, the same, except that the tawny-orange belt is yellower, and that there is a stripe of the same colour on the costal and hind margins, near the base.

*Hind wing*: above, dull black; the disk crossed behind the cell by an obscure, narrow, greyish stripe, traversed by the dusky nervures; a broad regular submarginal stripe along the hind margin and the abdominal edge orange-tawny. *Beneath*, the same, except that there is a whitish streak at the base of the costa.

Body and antennæ black; forehead silvery white; abdomen beneath orange.

This species is found at St. Paulo and at Ega. It has a great resemblance in colours (though much smaller in size) to *Stalactis Enterpe*, which inhabits in great numbers both localities.

5. *ITHOMEIS SATELLITES*, n. sp.

♂. Expanse 1" 8". *Fore wing*: above, black; a very large triangular spot, occupying the basal part of the disk, extending nearly to the end of the cell and to the hind angle, and a macular crossbelt consisting of six spots, half-way between the cell and outer margin, greyish white, slightly transparent; a submarginal belt, beginning on the costa and extending nearly to the hind margin, reddish orange. *Beneath*, the same.

*Hind wing*: above, with the whole disk grey, semitransparent; the costal edge black; a broad submarginal band, beginning on the costa and running parallel with the margin to the abdominal edge, reddish orange, bordered on each side with black. *Beneath*, the same, except that the red submarginal belt runs also along the costal margin to the base of the wing, which has also on its black costal edge a whitish stripe.

Body and antennæ black; forehead silvery white; abdomen beneath orange.

This species has the light-coloured portions of the wings much greater in extent, and much clearer in hue, than any of its kindred. It is found in the forests of the Upari, a branch of the Tapajós, in company with *Ithomia Flava*. It is in accordance with the rest of the facts of adaptive resemblances here recorded, that this *Ithomeis*, the *Leptalis* of the locality (*I. Theonoi*), and the *Ithomia* which they both mimic (*I. Flava*), are all much more transparent and clearer in colour than their allied forms of the Upper Amazons.

I believe that all the five species of *Ithomeis* here described belong to one stock. It is remarkable that the colours of the antennæ and body are identical in all five. This seems to show that the modifications have played only upon the colours of the wings, and this strictly in accordance with the *Ithomie* or *Stalactes* which abound in the locality they respectively inhabit. They are all excessively rare. I found but one specimen each of four of the species, during eleven years' research.



8. *ITHOMIA ILERDINA*, Hewitson. (Pl. LVI. fig. 4 a.)

*Ithomia Ilerdina*, Hewits. Exot. Butt. *Ithomia*, f. 129, 145.

This is closely allied to *I. Illinissa*. It entirely takes the place of that species at St. Paulo, differing from it only in the white disk of the hind wing and orange submarginal band of the fore wing. It is clearly only a local modification of the same, whose segregation from the original stock is complete. A variety of *Leptalis Lysinae* (*L. Leucanoe*, Pl. LVI. fig. 1) exists at St. Paulo in company with it, and presents precisely the same modifications of colour; also the Erycinide *Ithomis Heliconia*, and a species of Bombycide Moth (*Dioplis*, Pl. LV. fig. 11). The three mimicking species were very rare, whilst *I. Ilerdina* was extremely abundant. *I. Ilerdina* varies a little in the white nervures of the disk of the wings being partly black, showing the process of transition to the peculiar white hue which distinguishes it from the allied species.

9. *ITHOMIA ONEGA*, Hewitson. (Pl. LV. fig. 2 a.)

*Ithomia Onega*, Hewits. Exot. Butt. *Ithomia*, f. 1.

This handsome species is found in abundance throughout the Upper Amazon region, where it seems to take the place of *Ithomia Flora*, which is peculiar to the region nearer the Atlantic. I believe it to be a local modification of *I. Flora*. A *Leptalis* of similar colours (*L. Melanoë*, Pl. LV. fig. 2) and a Bombycide Moth (*Dioplis Onega*) accompany it. The *Leptalis* is undoubtedly a variety or descendant from the stock of *L. Theonoe*, which, we have seen, inhabits only those places where *Ithomia Flora* occurs. *Leptalis Melanoë* has been found nowhere but in company with *Ithomia Onega*.

10. *ITHOMIA FLORA*, Cramer. (Pl. LV. fig. 1 a.)

*Papilio Flora*, Cramer, Pap. Exot. t. 257. f. B, C (poor figure).

*Ithomia Flora*, Hewitson, Exot. Butt. *Ithomia*, f. 68, 69.

— *Egra*, *ibid.*, f. 1 (a slight aberration).

This species abounds in the forests of the Amazon Delta, and as far up the river as the banks of the Cuparí (a branch of the Tapajós), 120 miles above the mouth of that river. Unlike the *Ithomia* of the Upper Amazons, its wings have a very large portion of their surface clear of scales and transparent. *Leptalis Theonoe* (Pl. LV. fig. 1), *Napreogenes Ilera*, and the Bombycide Moth *Dioplis Cyana*, have a great resemblance to it, and are found only in the regions which it inhabits. *Dioplis Cyana*, however, is an exception; it has acquired a wider range, being found at Ega, where no clear-winged *Ithomia* are met with. The *Ithomia* increase in transparency in receding from the equator. They are numerous in Venezuela, South Brazil, and Mexico. The tendency to transparency reaches its acme in *Ithomia (Hypocætilis) diaphana* of Jamaica. Nearly all the species of the Upper Amazon region have opaque wings.

11. *ITHOMIA DOTO*, Hübner.

*Ithomia Doto*, Hübner, Samml. Exot. Schmett.

— *Sisera*, Hewits. Exot. Butt. *Ithomia*, f. 6.

Abundant on the banks of the Tocantins, at Baiao. Found also at Pará

12. *ITHOMIA ANTISAO*.

*Ithomia Sao*, Hewitson, Exot. Butt. *Ithomia*, f. 110, 111.

This form requires to be distinguished by a separate name from *I. Sao* of Hübner, although it be only a local variety of it, on account of its wings being less clear, the nervures tinged and bordered with reddish, and the hind-wing border having a reddish stripe within it. The true *Sao* of Hübner, of which I examined the typical example in Dr. Boisduval's collection, has very clear wings, sharply defined nervures, and the hind-wing border wholly dark brown. I did not find this in the Amazon region, the whole of the examples collected agreeing with the figs. 110, 111 of Hewitson. On the Upper Amazons it is an extremely abundant species.

With this species commences the tendency to determination of the hind-wing neuration towards the costa. In the  $\sigma$  the upper radial is placed as a branch of the subcostal near the apex, and consequently there is no upper disco-cellular nervule. In the  $\text{♀}$  the upper radial is connected with the cell by means of an upper disco-cellular, in the same way as in the typical *Ithomia I. Flora* and its allies.

13. *ITHOMIA TUCUNA*, n. sp.

$\sigma$   $\text{♀}$ . Expanse  $1'' 9'''$ – $2'' 4'''$ . Closely resembles in shape, markings, and neuration *Ithomia Zetina* (Hewitson, Exot. Butt. *Ithomia*, f. 94–96). Differs in colours. *Fore wing* hyaline: *above*, the entire margin evenly bordered with dark brown, which colour also forms a short oblique belt running from the costa across the end of the cell; the hyaline part brownish, with a large spot in the middle of the cell, a crossbelt beyond the cell, and a row of elongate spots between the nervures, near the margin, light yellow; the costal stigma, with the nervures crossing it, and the base of the upper radial light yellow. *Beneath*, the same, except that the outer margin, from the costal stigma to the hind angle, is orange-coloured, edged with black, and that there are two white spots at the apex.

*Hind wing*: *above*, more broadly margined with dark brown, except on the abdominal edge; the whole basal part of the disk, extending to the abdominal margin, with the nervures traversing it, light yellow; an elongate spot over the lower radial, also, same colour. *Beneath*, the same, except that the margin is orange, edged with black, and that there is a marginal row of five white spots set in black semicircles.

Body black; thorax spotted with white; abdomen yellow beneath. Antennae black; club orange-yellow.

Abundant in humid parts of the forest, at St. Paulo, Upper Amazons. The hind-wing upper radial is totally wanting in the  $\sigma$ .

14. *ITHOMIA SALAPIA*, Hewitson.

*Ithomia Salapia*, Hewits. Exot. Butt. *Ithomia*, f. 15.

The collar and wing-lappets are rufous, and the antennal club yellow; otherwise it very closely resembles *I. Primula*.

Banks of the Napo.

15. *ITHOMIA VESTILLA*, Hewitson.

*Ithomia Vestilla*, Hewits. Exot. Butt. *Ithomia*, f. 17.

Very abundant in the forests of the Upper Amazons. It is always seen in company with *I. Aulisao*; at Ega these two species seem to prefer each other's company to that of any of their kindred. At Fonte Boa there were two places in the forest peopled by *Ithomia*: one was tenanted only by *I. Illinissa* and its allies, as already described; the other by *I. Aulisao*, *I. Vestilla*, *I. Virginia*, and *I. Onega*. The same occurred at St. Paulo; their societies were there increased by the attendance of *I. Oriana*.

The hind-wing upper radial is deficient in the ♂, and is placed as a branch of the subcostal a short distance after the cell in the ♀. This is a further approximation towards *Hymenitis*.

16. *ITHOMIA PRIMULA*, n. sp.

♂ ♀. In size, shape, and markings, identical with *I. Vestilla*. It differs in colours. The hyaline parts of the wings in their centres are sulphur-yellow, as also the nervures which traverse them. In the fore wing there are two dusky lines, instead of one, extending from the short black stripe at the end of the cell, namely, one accompanying the 2nd, and the other the 3rd median branch. The dark border of the hind wing is much wider than it is in *I. Vestilla*.

These points of difference are constant in all the examples (many hundreds) which I examined. I believe, however, that *I. Primula* and *I. Vestilla* have descended from the same stock at no remote period. The grades of modification have not been found, and probably no longer exist; but allied species show, by their variations, a segregation in progress of two or more species from one stock not less dissimilar than the two species in question. The range of *I. Primula* does not coincide with that of *I. Vestilla*. It is not found at Ega, which seems to be the head-quarters of *I. Vestilla*, but makes its first appearance further west, at St. Paulo, where it is more abundant than its sister species.

The hind-wing upper radial is totally wanting in the ♂, and is placed, as a branch of the subcostal, a long distance beyond the end of the cell in the ♀.

17. *ITHOMIA ÆLIA*, Hewitson.

*Ithomia Ælia*, Hewits. Exot. Butt. *Ithomia*, fig. 7.

As before stated, this species flies in company with the similarly coloured *I. Illinissa*, *I. Guaita*, and *I. Priscilla*. It differs from them considerably in the venuration, the upper radial being placed as a branch of the subcostal after the cell in the ♀, although (unlike *I. Vestilla* and *I. Primula*) it is present in the ♂ and connected with the cell by means of an upper disco-cellular nerve.

It is found at Ega, and at various places in the forest thence to Fonte Boa.

18. *ITHOMIA OROLINA*, Hewitson.

*Ithomia Orolina*, Hewits. Exot. Butt. *Ithomia*, fig. 141, ♂.

Found abundantly at St. Paulo.

Expanse 1" 7". It is a very variable species; and one at least of the varieties appears

to have reached an advanced stage of segregation from the parental stock. They all fly together in the same places, and their differences are so slight and graduated that they cannot fittingly be treated as independent forms or species. They are as follows:—

Var. 1. *I. Aureola*.

♀. Size and general colours of *I. Orolina*. *Fore wing: above*, with a complete black border; the apical part has a large, broad, oblong, opaque orange spot occupying more than one-third of the wing; posteriorly the spot reaches only the 2nd median branch, but covers entirely the 3rd; interiorly it is bordered by the short dusky belt running across the end of the cell: rest of the wing clear, transparent. *Beneath*, the same, except that there are three greyish-white spots at the apex.

*Hind wing* clear, transparent, the nervures edged with blackish; costal and posterior margins widely bordered with blackish, the latter having a rufous line in the centre. *Beneath*, the margins are orange-coloured, bordered with blackish, the margin without spots.

Body and antennæ black; thorax with a few faint whitish marks.

Found in company with *I. Orolina*, whose ♀ usually does not differ in markings from the ♂. It is a mere variety of the ♀, but necessary to distinguish, as it connects together the extreme modifications of the species.

Var. 2. *I. Oncidia*.

♀. In size, shape, and markings, similar to *I. Orolina*. *Fore wing: above*, with a complete narrow dusky border; the apical part has an arcuated orange belt, which is indistinctly limited on the inner side, but reaches nearly the hind angle, and leaves both the 2nd and 3rd median branches visible for the greater part of their length; rest of the wing transparent: the cell in middle part is broadly fuliginous; there is a thick dusky belt across the end of the cell, and the median branches are edged with blackish; a spot over the end of the cell and two spots between the median branches milky white. *Beneath*, the same, except that the apical margin of the wing has a greyish-white stripe.

*Hind wing* broadly margined with blackish, the hind border having in the middle a narrow orange-coloured line; the whole of the discal portion, with its nervures, milky white. *Beneath*, the same, except that the margins have a broadish orange line, widely margined with dusky, and the apex has a short greyish-white stripe.

Body and antennæ black; head and thorax with a few faint whitish marks.

This variety of the ♀ is interesting, as furnishing proof of the variability in colour, from smoky hyaline to milky white, of the discal portions of the wings and their nervures.

We can understand from this how *Ithomia Herdina*, and its imitator *Leptalis Leuconœ*, may have originated.

Var. 3. *I. Chrysodonia*. (Pl. LVI. fig. 3 a.)

Very similar in colours and markings to *I. Orolina*, but much larger; the hind wings in the ♂ different in shape.

♂ ♀. Expanse 2' 1". *Fore wing* the same in colours and markings as *I. Orolina* (fig. *cit.*), the only differences being that the orange belt of the apical border is neatly margined with blackish on its inner side, between the 2nd and 3rd median branches, and

that it wants, beneath, the greyish-white marginal stripe at the apex, the upper disco-cellular is rather longer.

*Hind wing* with the costal edge much more dilated before the apex than in *I. Orolina*, and the apex itself in consequence is more broadly and transversely truncated; the two radials are much closer together, the upper partly atrophied, and the lower not visible on the disk; the third median branch is directed more towards the apex of the wing; the colours of the hind wing are the same as in *I. Orolina*, except that the dusky border is deeper in colour, more distinctly limited, and has an orange stripe running through the middle, which is most distinct towards the apex. *Beneath*, it wants the short grey-white macular marginal stripe at the apex.

Body and antennæ black; head and thorax with a few faint white markings. The elongate cup-like depression between the costal and subcostal nervures of the hind wing in the  $\sigma$ , connected with the pencil of hairs, is much larger in this form than in *I. Orolina*.

This is the most abundant form of the species, and should be properly taken as the type. *I. Orolina* being subordinated with the other forms as its varieties. I follow the usual practice in taking the first-described form as the type.

Var. 4. *I. Aureliana*.

In shape and markings this form comes between *I. Sarepta* (Hewitts. Exot. Butt. *Ithomia*, fig. 3.) and *I. Chrysodonia*.  $\sigma$ . Expanse  $2'' 2''$ . *Fore wing* much elongated, upper disco-cellular wanting; *above*, the subapical orange belt, as in *I. Sarepta*, is broadly margined along its entire inner edge with black; but it is much narrower, being broadest near the costa, narrowing gradually to the 3rd median branch, thence very narrow to the hind angle; it thus leaves between the upper radial and 1st median branch a series of four successively larger whitish transparent spots: the dusky belt across the apex of the cell is large; the transparent parts are whitish, and all the nervures are broadly bordered with blackish; the black apical margin has a row of four obscure whitish spots. *Beneath*, the same, except that the nervures around the end of the cell are orange-coloured, and the marginal spots near the apex are large and of a clear grey white.

*Hind wing* oblong, costal border broad, apex rounded; outer margin with a broad dusky border, in the middle of which runs a broad orange stripe; the hyaline disk is whitish, the nervures dusky. *Beneath*, the oblong pouch near the costa is much larger than in *I. Chrysodonia*; colours as above, except that there is near the apex a marginal row of four elongate greyish-white spots.

Body and antennæ black; head and thorax with a few faint white marks. The hind-wing lower radial ( $\sigma$ ) is not visible on the disk, and the upper radial is partially aborted.

Taken, in company with the four preceding, at St. Paulo.

19. *ITHOMIA SAREPTA*, Hewittson.

*Ithomia Sarepta*, Hewitts. Exot. Butt. *Ithomia*, fig. 3.

Found at Barra, on the Rio Negro, by myself; and at Guia, several hundred miles further up the same river, by Mr. Wallace. I did not find it at St. Paulo.

I treat this as an independent form, because it appears to have separated itself com-

pletely from the parental stock, *I. Orolina*, and inhabits a distinct area of country. *Ithomia Cidonia* (Hewitson, Exot. Butt. *Ithomia*, fig. 122), of New Granada, is another local race of the same stock. *I. Sarepta* comes nearest to *I. Aureliana*, and *I. Cidonia* to *I. Chrysonidia*. The five varieties found mingled together at St. Paulo cannot be thus separated, although they show, as we have seen, differences of structure as well as of colour and markings. They form a graduated series, and have not reached the stage of complete segregation. The differences in the veining of the wings are evidently the correlated result of the altered shape and increased or diminished size of the wings. I consider this *Orolina* group of *Ithomia* to be nearly equivalent to the *Illinissa* group; the difference between the present condition of the two is that in *Ithomia Orolina* and its allies the segregation of the forms is only partially complete, whilst in *I. Illinissa* and its kindred it is almost perfectly so.

A variety of *Leptalis Lysinoë* (*L. Erythroë*, Pl. LVI. figs. 1, 2, 3), a *Napeogenes* (*N. Corena*), and a Bombycine Moth (*Dioptis*, n. sp.), all assimilated in colours to *L. Orolina* and its varieties, occur in company with them at St. Paulo.

## 20. ITHOMIA ORIANA, Hewitson.

*Ithomia Oriana*, Hewits. Exot. Butt. *Ithomia*, fig. 134.

Abundant at St. Paulo, in the moister parts of the forests.

## 21. ITHOMIA VIRGINIA, Hewitson. (Pl. LVI. fig. 6 a.)

*Ithomia Virginia*, Hewits. Exot. Butt. *Ithomia*, fig. 18.

Banks of the Upper Amazons, from the mouth of the Rio Negro to St. Paulo. It is probably a local variety of *I. Cyano*. The upper radial is partly aborted in the ♂.

## 22. ITHOMIA CYMO, Hübner.

*Ithomia Cyano*, Hübn. Samml. Exot. Schm.

— *Galita*, Hewits. Exot. Butt. *Ithomia*, fig. 5.

Very abundant at Para, in company with *I. Florea*. The upper radial is totally wanting, and the lower disco-cellular partly aborted in the ♂.

## 23. ITHOMIA NEPHELE, n. sp.

♂ ♀. Expanse 2" 5". Hyaline, slightly fuliginous. *Fore wing* with a narrow black border, which is broadest along the hind margin; there is a short, broadish, oblique black belt across the end of the cell, and beyond this an oblique chalky-white belt, beginning on the costa, where it forms an opaque white stigma, and nearly reaching the middle of the 3rd median branch; the nervures which it traverses are also white; the 2nd and 3rd median branches, as well as the rest of the nervures, are black; there is also a series of obscure whitish spots between the nervures, near the outer border. *Beneath*, the black borders and belt are reddish orange.

*Hind wing* with a narrow, clearly defined black border, which beneath is reddish orange.

Body and antennæ black; head and thorax marked with white.

This species, which is the only *Ithomia* found in the Amazon region that might be considered a *Hypocritus*, is found only at Tabatinga, on the Peruvian frontier. It resembles much *I. Edessa* (Hewitson, Exot. Butt. *Ithomia*, fig. 12.), a native of S. E. Brazil; but it is a little larger, and differs considerably in the hind-wing venation of the ♀. In *I. Edessa* there is a middle and an upper disco-cellular nervule, and the upper radial is only partially aborted; indeed, the venation is identical with that of *I. Virginia* and *I. Oriana*; but in *Nephele* the approximation to *Hypocritus* is carried a step further; for the middle and upper disco-cellulars, as well as the upper radial, are all quite aborted, although the lower disco-cellular and radial are not attached to the subcostal. In the ♂ the middle disco-cellular joins the subcostal, and there is no trace of an upper radial.

#### Genus MELINÆA, nov. genus.

The species of this distinct group were placed by Doubleday in section 2 of the genus *Mechanitis*; but he failed to mention or misstated most of the principal characters of the section. The genus is nearest allied to *Olyras* and *Thyridia*; in fact, it approximates these much more closely than it does *Mechanitis*. From *Olyras* it differs in the fore legs of the ♂, in the palpi, and slightly in the wing-venation; from *Thyridia* also in the fore legs of the male, in the palpi, and in the antennæ. The following are its principal characters.

Palpi short, smoothly clothed with scales, and closely applied to the forehead; third joint not porrect as in *Mechanitis* and the allied genera. Antennæ very long and slender. Fore legs of the ♂ with the tibiæ and tarsi more or less abbreviated, but never reduced to a rounded knob; the tibia always shorter than the femur. Fore tarsi of the ♀ long, filiform, spines wide apart. Hind-wing costal widely separated from the subcostal in both sexes, in the ♂ long, reaching nearly the apex of the wing, in the ♀ very short, terminating on the costa; the lower disco-cellular in both sexes straight, nearly in a line with the median nervure; the median nervure, in fact, describes a gentle curve, the lower radial being placed as though it were a fourth median branch; the middle disco-cellular is at right angles with the lower, strongly angulated in its middle, and emitting a recurrent nervule; upper disco-cellular rather long, transverse, joining the subcostal at about one-half the length of the wing.

The great resemblance in colours and markings between the species of *Melinæa* and those of *Mechanitis* has led to the confounding of the two genera; in other words, a relation of analogy has been mistaken for one of affinity, just as in the case of the two subfamilies *Heliconiinae* and *Danaïinae*. There is, however, as will be seen on comparing the characters of the two genera, a wide structural difference in the palpi, fore legs of the male, and venation of the hind wings. Some species of *Melinæa* so nearly resemble species of *Mechanitis*, that they might easily be mistaken for them. The two analogous forms accompany each other; but I think I found proof that they are not adapted one to the other, in the fact that the species of the two genera do not coincide in any locality on the Amazons, but vary and segregate races without any mutual specific similarity. They are very frequently accompanied by a *Heliconius* assimilated to them in colours

and markings: in the case of this genus, adaptation seems to be intended. The following are all the cases of this complex association known to me:—

Nicaragua.	Upper Amazons.
Heliconius Zuleika.	Heliconius Pardalinus.
Melinæa Hezia.	Melinæa Pardalis.
Mechanitis, n. sp.	No Mechanitis.
	—————
New Granada.	Heliconius Aurora.
Heliconius Ismenius	Melinæa Lucifer.
Melinæa Messatis.	No Mechanitis.
No Mechanitis.	
	Pará.
Heliconius, n. sp.	Heliconius Sylvania.
Melinæa, n. sp.	Melinæa Egina.
Mechanitis Menophilus.	No Mechanitis.
	—————
East Peru and Bolivia.	Heliconius Numata.
Heliconius, n. sp.	Melinæa Mneme.
Melinæa, n. sp.	
Mechanitis Mithone	Pernambuco.
	Heliconius Ethra.
	Mechanitis Nesæa.
	No Melinæa.
	Rio Janeiro.
	Heliconius Euerate.
	Mechanitis Lysimnia.
	No Melinæa.

The new species mentioned are contained in the British Museum Collection.

#### 1. MELINÆA EGINA, Cramer.

*Popilio Egina*, Cram. Pap. Exot. t. 191. f. D.

— *Ludovica*, Cram. Pap. Exot. t. 297. f. E.

This is a common species throughout the Amazon region, and appears to be very constant in character throughout the whole area. The ♂ fore legs are in a more rudimentary condition than in other species of the genus, the tibiae and tarsi forming simply an elongate-conical point at the apex of the femur. It flies, in company with *Mechanitis Polymnia*, *Melinæa Mneme*, *Heliconius Sylvania*, and *H. Numata*, slowly, amongst the lower trees in thinned parts of the forest.

#### 2. MELINÆA MNEME, Linnaeus.

*Popilio Mneme*, Linn. Syst. Nat. ii. 756. n. 59.

— —, Cram. Pap. Exot. t. 190. f. C.

Also found at all stations throughout the Amazon region. It is constant in its specific characters, with the exception of a frequent aberration in the blending of the black



central and marginal stripes of the hind wing, which many *Heliconida* are subject to. The fore tibiae and tarsi of the ♂ are nearly as long as the femur.

### 3. MELIN EA EQUICOLA, Cramer.

*Papilio Equicola*, Cram. Pap. Exot. t. 297. f. F.

This species seems intermediate between *M. Maemo* and *M. Egiua*, not only in colours, but in the structure of the fore legs in the ♂. It is found at Ega. In my example the yellow belt across the end of the cell in the fore wing is less distinct than it is in Cramer's figure; the apical half of the wing is black, with two yellow macular belts, as in *M. Egiua*; there is a black spot in the angle formed by the first median nervure and its first branch; and the marginal row of pale spots is indistinctly marked.

### 4. MELIN EA LUCIFER, n. sp.

♀. Expanse 2<sup>u</sup> 9<sup>u</sup>. Similar in size and general appearance to *M. Maemo*; differs from it in the absence of the yellow crossbelt, and the presence of a very large subapical yellow spot on the fore wing. *Fore wing*: *above*, tawny orange; the costal margin near the base, a stripe along the middle of the hind margin, an irregular spot within the cell before the middle, a short oblique belt across the end of the cell touching the costa, a spot between the 1st and 2nd median branches near the median nervure, and the apical fourth of the wing black; the black apical part extends along the outer margin, and is connected with an oblong spot which ascends between the 1st and 2nd median branches; there is a yellow spot on the costa, at the end of the cell, and a very large oblong yellow spot in the middle of the apical part, crossed by three nervures; near the middle of the black outer border are two large orange-tawny submarginal spots. *Beneath*, the same; margin spotless.

*Hind wing*: *above*, tawny orange; a stripe along the costa from the base to the apex, and a very large rounded spot which occupies the anal half of the wing, black; there is also a small black spot between the two radial nervures. *Beneath*, the same; margin spotless.

Body and antennae precisely as in *M. Maemo* and *M. Egiua*. Fore tibiae and tarsi of the ♂ elongated, but much shorter than the femur.

St. Paulo; Upper Amazons. Its mimetic analogue, *Heliconius Aurora*, was found in its company.

### 5. MELIN EA MENIUS, Hewitson.

*Mechanitis Menius*, Hewits. Exot. Butt. *Mechanitis*, fig. 6.

This species was plentiful at Ega.

### 6. MELIN EA MYELUS, Hewitson.

*Mechanitis Myelus*, Hewits. Exot. Butt. *Mechanitis*, fig. 6. ♀.

— *Marsaus*, Hewits. l. c. fig. 10. ♂.

Also plentiful at Ega, in company with *M. Menius*. The two sexes are somewhat dissimilar in the colours of the wings.

## 7. MELINEA PARDALIS.

*Mechanitis Mælus* (part), Hewitson, Exot. Butt. *Mechanitis*, fig. 9.

Mr. Hewitson considered this form to be a variety of *M. Mælus*: both were very abundant at Ega, and I did not find them to intermingle; it will be better, therefore, to keep them apart. The two sexes are alike in colours, as in the vast majority of the *Heliconidae*. I did not meet with *M. Pardalis* at St. Paulo; but at Tabatinga, 80 miles further west, it again occurred, not however under precisely the same form as at Ega, but in a modified state, the yellow crossbelt and the spot at the hind angle of the fore wing having become of the same dark orange-brown hue as the rest of the wing. The same transformation of colour takes place in many species of *Heliconidae* in travelling from east to west, and I am inclined to think it is due to the direct action of the physical conditions of the localities on the early states of the insects.

## 8. MELINEA MNASIAS, Hewitson.

*Mechanitis Mnasias*, Hewits. Exot. Butt. *Mechanitis*, fig. 5.

Found at Pará, where it is rare. The species mimics most accurately in colours the *Cephalina Nivonia*, var. *Barii*.

## Genus TITHOREA, Doubleday.

Doubled. and Hewits. Gen. Diurn. Lep. p. 99.

## 1. TITHOREA HARMONIA, Cramer.

*Papilio Harmonia*, Cram. Pap. Exot. t. 190. f. C.

*Tithorea Megara*, Doubled. and Hewits. Gen. Diurn. Lep. pl. 14. fig. 2.

Cramer's figure was made from an aberrant example, in which, as frequently happens in the *Heliconidae*, the black central stripe of the hind wing is partially connected with the hind border; on this account Doubleday and other authors have passed it over, and given a new name to the species. The figure, however, is a very fair one, and recognizable by the tricuspid termination, on the outer border, of the fore-wing central yellow crossbelt, which distinguishes the species from all others. It is found pretty generally throughout the Amazon region, in the moister parts of the forest, and in company with *Melinae Mueme*, *Mechanitis Polymnia*, &c.

## 2. TITHOREA CUPARINA.

♂ ♀. Size, shape, and general coloration of *T. Harmonia*. *Fore wing*: above, with the basal half orange-tawny, the outer edge of this colour running very obliquely from the middle of the costa to the outer margin; this is followed by an irregular and oblique clear yellow belt which crosses the costal part of the end of the cell and terminates in an obtuse point in the middle of the outer margin; the apical part beyond the yellow belt is black, and is crossed in the middle by three yellow spots; the basal third of the costa, the median nervure to the 1st branch, and the whole of the hind margin are bordered with black, besides which there are three black spots on the disk of the wing, namely, a triangular one in the middle of the cell, one across the end of the cell, and one between

the 1st and 2nd median branches. *Beneath*, the same, except that there is (in some examples) a row of four white spots along the outer margin.

*Hind wing* precisely as in *T. Harmonia*, namely, tawny-orange, with a broad stripe along the fore margin not reaching the costa or the apex, an outer border, widening towards the anal angle, and a central stripe from the abdominal edge to the lower radial, crossing part of the cell, black. *Beneath*, the same, except that there is a row of fourteen silvery-white submarginal spots.

Common on the banks of the Cuparí (branch of the Tapajós), where it replaces *T. Harmonia*, of which it is a tolerably well-marked local variety. I found it only in the district just named; whilst *T. Harmonia* ranges, under its typical form, over a wide tract of country, from Surinam, Pará, and the Tocantins to the banks of the Upper Amazons.

### Subfamily HELICONINÆ\*.

#### Genus HELICONIUS.

*Heliconius*†, Felder, Wien. Entom. Monatsschr. 1862, p. 79.

*Heliconia* (Latr.), Doubled. and Hewits. Gen. Diurn. Lep. p. 101, and authors.

#### 1. HELICONIUS SYLVANA, Cramer.

*Papilio Sylvana*, Cramer, Pap. Exot. t. 361. f. C, D.

This species is common throughout the Amazon region, in company with *H. Numata*, *Melinæa Egina*, *Mechanitis Polymnia*, and other species of *Heliconidae*. I have found examples which almost link it to *H. Numata*; indeed the three forms *H. Numata*, *H. Sylvana*, and *H. Encoma* might be treated as so many varieties of one stock, being in an incomplete state of segregation.

#### 2. HELICONIUS NUMATA, Cramer.

*Papilio Numata*, Cram. Pap. Exot. t. 297. f. C, D.

This species is so variable that it is difficult to find two examples exactly alike. Cramer's figure represents a frequent aberration, in which the central stripe of the hind wing is connected by dark lines with the hind border; in the markings of the fore wings, however, it exhibits nearly the most common form of the species. It differs from *H. Sylvana* in the following points:—

1. The yellow crossbelt of the fore wing lies wholly beyond the cell; the black apical part is much smaller; and there is only one transverse row of spots, which are three in number and widely separated.
2. The black spot in the middle of the fore-wing cell is connected with a line of the same colour, which runs to the base.

\* Synonymous with our Aercoid *Heliconidae*, p. 496. The small nervule mentioned (in the note on that page) as one of the distinguishing characters of the Danaoid *Heliconidae*, was considered by Doubleday (who noticed it in the *Danaïde* proper) to be the internal nervure. It is connected with the *submedian* nervure, and not the *median*, as stated by inadvertence.

† Dr. Felder proposes this innovation of the masculine for the feminine termination, on the grounds that the name *Heliconia* clashes with that of a group of plants inhabiting the same region, and that Linnaeus first used the word in the masculine form, *Papilionus Heliconii*.

3. The black central stripe of the hind wing runs from the middle of the abdominal edge to the apex of the wing.

4. The pale submarginal spots of the upper surface are wanting.

It is curious that these points of difference between *H. Numata* and *H. Syltrana* are almost precisely the same as those which distinguish *Melinaea Mueme* from *M. Egina*. I judge from this that a mimetic resemblance is intended between the *Heliconii* and the *Melinaea*—*H. Numata* and *M. Mueme*, *H. Syltrana* and *M. Egina*,—the Heliconine insects being adapted to the Danaïne species. If we trace the species or races allied to *H. Numata* over the whole of Tropical America, we shall find that each one mimics a Danaïne species in its locality; and I think it probable that they are all of the same stock as *H. Numata*. Thus, in Eastern Brazil *H. Ethra* mimics *Mechanitis Nesæa*; and in the southern parts of the same country, *H. Eucrate* precisely imitates *Mechanitis Lysimnia*. I have already mentioned these and other cases occurring in New Granada, Nicaragua, Eastern Peru, and the Upper Amazons: the *Heliconii* are adapted sometimes to a *Mechanitis*, and sometimes to a *Melinaea*.

*H. Numata* varies in structure as well as in colours. The wings are sometimes broader, sometimes narrower; and their edges are simple in some examples, and festooned in others. The yellow crossbelt is sometimes blended with the ground-colour of the wing; in many examples which connect the species with *H. Eucoma* it is narrow, and in others very broad, as represented in Cramer's figure.

The central black stripe of the hind wing is often very broad, covering part of the cell; at other times it is very narrow, and passes much behind the cell.

The species is found abundantly throughout the Amazon region; it occurs in thinned parts of the forest, where it is seen sporting about by twos and threes in the sunlight, or floating lazily in the air. The following is a remarkable variety occurring only on the Upper Amazons.

Var. *H. Isabellinus*.

♂ similar in shape and in the position of the black markings to *H. Numata*. Pale orange-tawny; in the fore wing the two macular belts, which in *H. Numata* are distinct and of a yellow colour, are blended together and of the same pale orange-tawny hue as the rest of the wing; the nervures, at the point where the two belts touch, are margined with blackish; the apical part of the wing is black, as usual, and is crossed by a row of four pale spots.

Two examples occurred, one at St. Paulo, and one (much smaller) at Tumantins.

### 3. HELICONIUS EUCOMA, Hübner.

*Encides Eucoma*, Hübner, Zuträge, f. 577, 578.

This species differs from *H. Numata* in the yellow crossbelt of the fore wing being narrow and submacular, consisting of four or five more or less distinct elongate spots, and also by its being separated from the cell by a series of black spots, more or less joined together in the form of an oblique belt. It is, however, extremely variable. At St. Paulo and other stations on the Upper Amazons, many examples occurred of a very dark

orange-brown colour, more or less suffused with black; one variety is so distinct that it merits a distinctive name, as follows:—

Var. II. *Pardalius*.

♂. Similar in size and shape to *H. Numata* and *Eucoma*. *Fore wing*: *above*, rich orange-brown; the basal half of the costal margin, a broad stripe on the hind margin, broadest in the middle, and an irregular border along the outer margin black; an elongate spot within the cell touching the base, a quadrate spot at the end of the cell, and two rounded spots, one between the 1st and 2nd, the other between the 2nd and 3rd median branches, also black; beyond the cell is an oblique bright-yellow belt, consisting of five elongate spots, and between it and the apex is a second yellow belt of four smaller spots: the outer edge of the first belt, the nervures beyond it, and an irregular spot around its extremity are black. *Beneath*, the same.

*Hind wing*: *above*, rich orange-brown; a stripe along the costa, a broad central one, and a marginal series of very large connected angular spots black. *Beneath*, the same, except that there is on the hind margin, towards the anal angle, a series of ten short yellowish-white lines.

Body and antennæ as in *H. Numata*.

The rich orange-brown colour of the apical part of the wing, divided into spots by the dark lines which accompany the nervures, gives a distinct appearance to this form, which, however, in all essential points is very closely allied to *H. Eucoma*. It is found in company with *H. Eucoma* at St. Paulo. It very much resembles *Melinæa Pardalis* of the same neighbourhood.

I. *HELICONTUS AURORA*.

♂. Size and shape of *H. Numata*. *Fore wing*: *above*, clear tawny orange; the basal half of the costa, a broad stripe on the hind margin, touching the edge, but not reaching the hind angle, an elongate spot at the base of the cell, a stripe across the end of the cell, from the costa to the outer margin, consisting of two elongate spots which meet at the hind angle of the cell, and the apical fourth of the wing black: in the middle of the black apical portion is an elongate yellow spot, crossed by four nervures. *Beneath*, the same; margin spotless.

*Hind wing*: *above*, clear tawny orange; a subcostal stripe, bent before the apex towards the upper radial, and a very large rounded spot occupying more than the anal half of the wing, black. *Beneath*, the same; margin spotless.

Body and antennæ precisely the same as in *H. Numata* and the allied species and varieties.

This apparently distinct species occurred at St. Paulo; it has a striking resemblance to *Melinæa Lucifer* of the same locality. It agrees in all essential points with *H. Numata*, and is most likely a modification of that species; but the intermediate connecting forms are wanting.

5. *HELICONIUS ANTIOTCHA*, Linnæus.

*Papilio Antiocha*, Linn. Syst. Nat. ii. add. 1068. n. 12.

— —, Cramer, Pap. Exot. t. 38. f. E, F.

A widely distributed species; found in Venezuela, Guiana, and throughout the Amazon region, with the exception of the district near Pará.

6. *HELICONIUS CLYTIA*, Cramer.

*Papilio Clytia*, Cram. Pap. Exot. t. 66. f. C.

This species is very abundant at all the places I visited on the banks of the Amazons. In many places a variety occurs in company with the type, in which the first yellow belt of the fore wing is narrow, and similar in shape to the first white belt of *H. Antiocha*. The colour of the belts in Cramer's figures of *P. Clytia* is given as white, probably by error of the colourist.

7. *HELICONIUS RHEA*, Cramer.

*Papilio Rhea*, Cram. Pap. Exot. t. 51. f. C, D.

Also a generally distributed and abundant species throughout the Amazon region.

8. *HELICONIUS LEUCADIA*.

♂. Expanse 2" 6". Similar in size, shape, and general colours to *H. Rhea*; differs chiefly in having a series of eight large geminated whitish spots on the posterior margin of the hind wing. The first yellow belt of the fore wing is in the form of an oval spot, divided in two by the median nervure. The hind wing, beneath, is considerably different from the same part in *H. Rhea*; the red streaks and spots at the base are as follows:— there is an elongated streak along the basal part of the costa, a shorter one between the basal parts of the costal and subcostal nervures, a round spot within the base of the cell, another similar one at the base, between the median and post-median nervures, and a macular vitta running in a curve from the base of the abdominal edge to the third median branch. The marginal geminated spots of the upper surface are represented by large elongated white spots, one between each nervure.

One example, taken at St. Paulo.

9. *HELICONIUS HERMATHENA*, Hewitson.

*Heliconia Hermathena*, Hewits. Exot. Butt., *Heliconia*, fig. 5.

This very beautiful species was found only on the banks of the Tapajos, in scattered woods on the campos opposite Aveiros. It is not closely allied to any known species; as Mr. Hewitson observes, it partakes of the characters of *H. Phyllis* (of Rio Janeiro) and *H. Charitonia* (of the West India Islands), which are the two extreme forms of the genus.

## 10. HELICONIUS ERATO, Linnaeus.

*Papilio Erato*, Linn. Mus. Lud. Ulr. 231 (1761).

— *Anathusia*, Cram. Pap. Exot. t. 177. f. F. (1770).

— *Doris*, Linn. Mant. 536 (1771), var.

— —, Cram. Pap. Exot. t. 337. f. C. (1782).

— *Quirina*, Cram. l. c. t. 65. f. A, B. (1779).

The two forms, *Erato* and *Doris*, offer a striking contrast in their colours, one being red, the other blue, and were naturally considered two perfectly distinct species. I thought they were such myself, until I bred them from precisely similar larvae, which fed together in one cluster on the same tree. There are males and females in about equal numbers of both forms. I did not find, in the many hundreds of examples which I examined, any intermediate variety; the species, therefore, offers a case of dimorphism of which it is difficult to surmise the purpose. This case of variation in colour may, however, help to explain how the very diversified species of this genus have originated. *H. Erato* exists in both forms throughout the delta region of the Amazons, Guiana, and New Granada; but on the Upper Amazons, at St. Paulo, I found one of them absent, the blue one (*Doris*) only existing there; it occurred, however, in great numbers.

The larva has a series of moderately long hispid spines on each segment of the body; the head is bifid; in colour it is yellow, with narrow black bands. The chrysalis is smooth, without angles; the head, however, is prolonged to a point. It is suspended freely by the tail. The pupa-state lasts eight days.

## 11. HELICONIUS METHARME, Erichson.

*Heliconia Metharme*, Erichson in Schomburgk's Reise in Brit. Guiana, p. 595.

This species has very much the appearance of *H. Erato* (var. *Doris*), but it wants the patch of blue at the base of the hind wings above; it has, on the other hand, a series of short bluish lines near the hind margin, which are absent in *H. Erato*. It was rather a common insect at Ega and St. Paulo, but did not occur at all on the Lower Amazons. The species is found only in the interior of the forest, flying slowly, and delighting to settle on the scarlet blossoms of a climbing-plant; whilst *H. Erato* is seen only on the skirts of the woods and in damp waste places.

## 12. HELICONIUS MELPOMENE, Linnaeus.

*Papilio Melpomene*, Linn. Syst. Nat. ii. 758. n. 71.

— —, Cramer, Pap. Exot. t. 191. f. C.

Found only in the middle part of the Lower Amazon region, at Obydos and Santarem, where the dry, hilly country of Guiana from the north, and that of interior Brazil from the south, reach the banks of the river. The soil in this part of the banks of the Amazons is light and sandy; the dry and wet seasons are more strongly contrasted, and the forests thinner, than in the rest of the river valley. The species also occurs throughout Guiana, Venezuela, and in New Granada. It is quite absent, however, from the humid forests of the Amazons, both to the east and to the west of the places above mentioned.

An allied species, *H. Thelxiope* of Hübner, exists there in its stead, having very similar habits, and filling, as it were, the same sphere in the economy of nature. These two forms (*H. Melpomene* and *H. Thelxiope*) have all the appearance of two thoroughly distinct species; but they are connected together by an unbroken series of varieties, the principal of which occur, not in the places where the two species come in contact, but in two isolated limited areas—at Serpa (west of Obydos) and on the banks of the Tapajos (near Aveyros). These connecting links cannot be the hybrid progeny of two originally distinct species, on account of their geographical position; many of them (and others not met with on the Amazons) occur also in Surinam and Cayenne, where *H. Thelxiope* has not been found. I believe there can be no doubt that *H. Thelxiope* is descended from *H. Melpomene*, and that the intermediate varieties are remnants of the steps of modification. The following are the principal intermediate varieties; they are all very scarce, whilst the species they connect exist in great profusion:—

Var. 1. *H. Callycopis*, Cramer, Pap. Exot. t. 190. f. E, F.

Same as *H. Melpomene*, except that the red belt of the fore wing is either very broad and irregular, or is broken into a number of various-sized spots.

Surinam and Obydos, Lower Amazons, in company with *H. Melpomene*.

Var. 2. *H. Elimæa*, Erichson, in Schomburgk, Reise in Brit. Guiana, p. 595.

The same as *Callycopis*, except that, in addition to the irregularity of the red belt, the basal part of the fore wing has a large red patch.

Obydos, in company with *H. Melpomene*.

Var. 3. *H. Lucia*, Cramer, Pap. Exot. t. 350. f. E, F.

Same as *H. Melpomene*, except that the red crossbelt of the fore wing is narrow and curved outwards, and that there is a large quadrate yellow spot within the end of the cell. This is the commencement of the chain of variations which leads to *H. Thelxiope*. The *H. Lucia* of Cramer was found at Surinam. I have Amazonian examples, taken at Serpa and on the Tapajos, which differ in the yellow spot of the cell being scarcely perceptible.

Var. 4. The same as *H. Lucia*, except that the base of the fore wings has a large red spot, and that the base of the hind wing is also red.

Serpa, Lower Amazons; banks of the Tapajos, near Aveyros; Cayenne.

Var. 5. *H. Erythraea*, Cramer, Pap. Exot. t. 189. f. A.

Santarem, in company with *H. Melpomene*; Surinam.

Var. 6. *H. Andremoua*, Cramer, l. c. t. 297. f. A.

Surinam.



Var. 7. *H. Udubrica*, Cramer, l. c. t. 297. f. B.

“Pará” (Cramer). Taken probably somewhere on the banks of the Lower Amazons, as no trace of any of these forms exists at Pará.

These three varieties (5-7) seem to be intermediate between *H. Melpomene* and *H. Vesta*. I once took a ♀ *Erythraea* in copula with a ♂ *Melpomene*. *H. Vesta* would appear, from this, to be descended from the same stock as *H. Thelxiope*. It has, however, receded, as a form, further from the common parent than *H. Thelxiope*, and has acquired a much wider range.

Var. 8. *H. Tyche*, nob.

Fore wing as in var. 2, viz., black, with the basal third and a broad belt across the middle rosy red, leaving a narrow black intermediate space. The hind wing above and beneath is precisely as in *H. Thelxiope*.

Taken at Serpa.

Var. 9. *H. Hippolyte*, nob.

Fore wing black; the basal fourth and a narrow oblique belt crossing the wing beyond the cell, from the costa nearly to the hind angle, rosy red; there is also a yellow spot on the costa, on the inner side of the red belt, and another obscure one within the cell. Beneath, the same. Hind wing, above and beneath, as in *H. Thelxiope*.

Serpa and banks of the Tapajós.

The approximation towards *H. Thelxiope* in this and the preceding variety is very considerable.

Var. 10. *H. Cybele*, Cramer, Pap. Exot. t. 188. f. A.

Serpa. In this beautiful variety the fore wing has the arrangement of yellow spots very similar to that of *H. Thelxiope*; but the hind wing is black, as in *H. Melpomene*, with the exception that there is a red spot at the base.

### 13. HELICONIUS THELXIOPE, Hübner.

*Nereis festiva Thelxiope*, Hübn. Samml. Exot. Schmett.

Very abundant at Pará and on the banks of the Tocantins, also on the Upper Amazons, from the mouth of the Madeira to Peru. The geographical position of the complete chain of transition-forms just enumerated seems to show that *H. Thelxiope* originated in a variety of *H. Melpomene*, which was naturally selected out of the many that arose in the species on its descending into moist areas, as being better adapted to the humid forests of the Amazon plains than the parent form. It varies much in the shape and position of the yellow spots of the fore wing, but the most general form is that figured by Hübner. The following are the more important varieties.

Var. 1. *H. Aglaope*, Felder, Wiener Entomologische Monatschrift, 1862, p. 79.

Differs from *H. Thelxiope*, Hübner, in having simply a narrow, oblique, slightly curved, yellow macular belt, consisting of seven spots, which crosses the fore wing considerably beyond the cell.

Pará, and north coast of the island of Marajó. Dr. Felder describes it as a species, from specimens received from the Upper Rio Negro.

Var. 2. *II. Ticius*, Ménétrics, Cat. d. l. Coll. de l'Ac. Imp. de St. Pétersbourg, p. 114.

In this variety the yellow macular belt is placed close to the end of the cell; the spots are much elongated, and form, with the yellow spot within the end of the cell, a large compact macular patch.

Pará and Upper Amazons. Neither of these varieties shows a tendency to become local, or separate itself from the parent form.

#### 14. HELICONIUS ESTRELLA.

♂ ♀. Size, shape, and colour of *II. Thelxiope*: markings of the hind wing nearly the same as in *II. Vesta*. Fore wing: above, black, the basal third reddish carmine; the nervures bordered with black; a narrow macular belt, consisting of six light yellow spots, crosses the wing much beyond the end of the cell, nearly reaching the 2nd median branch. Beneath, the same, except that the red at the base of the wing is scarcely shown.

Hind wing: above, black; the centre of the cell and six narrow streaks radiating from the base, and running between the nervures, but not reaching the margin, reddish carmine; the second streak from the abdominal edge has a black mark near the base. Beneath, the same, except that the cell has simply two red streaks, that there is a round red spot between the median and abdominal nervures, and that the costa is yellow at the base.

Body differently marked from *II. Thelxiope*, the thorax being black, with six distinct rounded yellowish spots and two transverse lines behind.

This form seems to be intermediate between *II. Melpomene* and *II. Vesta*. It agrees with the latter in the design of the hind wings, but the shape and colour of the wings are different from it. In *II. Vesta* the shade of red is always inclining to orange, whilst in *II. Estrella* it is of the same crimson tint as in *II. Melpomene* and *Thelxiope*. This is most perceptible in living specimens. I look upon *II. Estrella* as a race, or a variety tending to become a race, equivalent to *II. Thelxiope* and *II. Vesta*, and to have segregated from the common stock, independently of the other forms.

I met with it only in the Delta lands of the Amazons; at Pará; and on the northern coast of the island of Marajó.

#### 15. HELICONIUS VESTA, Cramer.

*Papilio Vesta*, Cram. Pap. Exot. t. 119. f. A.

This species is very abundant, and widely distributed, being found at Surinam; Cayenne; along the whole course of the Amazons, up to the Andes; in Bolivia, and at Cuenca, to the west of the Cordillera. It is further removed than *II. Thelxiope* from *II. Melpomene*, differing from both in colour and in the shape of the hind wings, their outer margin being less rounded: the yellow marks of the thorax are the same as those of *II. Estrella*. The yellow spots of the fore wing vary in the same way as in *II. Thelxiope*.

The area of distribution of *H. Testa* embraces the lesser areas of *H. Melponene* and *H. Thelxiope*. As intermediate forms connect it with *H. Melponene*, there can be no doubt that it is descended from the same stock as that species; but having diverged more widely, it is not readily seen to be a modification of it, like *H. Thelxiope*. It may be the oldest-created of this cluster of imperfectly segregated species.

#### 16. HELICONIUS BURNEYI, Hübner.

*Migonitis Burneyi*, Hübner, Zuträge, f. 401, 402.

This fine, large, robust species belongs to the same group as *H. Melponene*, &c. It seems to be confined, like *H. Thelxiope*, to the forest plains of the Amazons; it is not, however, a common insect, but is restricted to certain localities. Its strong, bold flight distinguishes it from all other species of *Heliconius*, when on the wing. Many individuals of both sexes have the hind wings black, except a patch of red at the base.

#### 17. HELICONIUS EGERIA, Cramer.

*Papilio Egeria*, Cramer, Pap. Exot. t. 31. f. B. C.

This resembles much *H. Burneyi* in size and general appearance; it seems, however, to be a perfectly distinct species, recognizable by the glossy light-brown hue with paler streaks between the nervures, of the under surface of the wings. The hind wing beneath has a red streak near the abdominal edge, and there is a yellow spot on the costa at the base. It is a rare species: I took it at Para; it is found also at Cayenne, where *H. Burneyi* appears not to occur. My specimens differ from the one figured by Cramer, in the design of the upper surface of the hind wing, the red colour of the basal half being continued in a series of eight short, wedge-shaped streaks into the broad, black marginal half of the wing.

#### 18. HELICONIUS AÆDE, Hübner.

*Migonitis Aæde*, Hübner, Zuträge, f. 129, 130.

*Heliconia Astydania*, Erichson in Schomburgk's Reise in Brit. Guian. p. 595 (aberration).

The antennæ in this species are much shorter than in the *Heliconiæ* generally, and more thickly clavate. It appears to be confined to the Amazon region and Guiana. In Guiana (Demerara and Cayenne) a species is found\* which closely resembles it in shape and colours, but differs in having slender antennæ, like the typical *Heliconiæ*.

#### — HELICONIUS XANTHOCLES, n. s.

♂. 3<sup>rd</sup> 2<sup>nd</sup>. Fore wing: above, black, the basal third clear orange-red, a large quadrate spot within the cell at the end, and a belt of seven large spots close after the end of the cell, clear yellow; near the apex is a small oblong yellow spot, crossed by three nervures. Beneath, the same.

Hind wing very broad, nearly circular. Above, black, with two short red streaks at the base. Beneath, the same, except that there is a small yellow spot at the base of the costa, and four small red spots between the nervures at their origin. Body black; head with a few white marks; mesothorax with four small spots in front, in a transverse line, and two large ones in the middle, yellow. Scutellum and two spots on the metathorax also yellow. The abdomen has a series of narrow yellow bands, the tip of each segment being edged with yellow. Antennæ long and slender, black.

Demerara; Cayenne.

*II. Astylamia* of Erichson differs from the type in wanting the radiating lines of the hind wing. We have already seen that this is a common form of aberration in the *Heliconii* of this group.

19. HELICONTIUS RICINI, Linnæus.

*Papilio Ricini*, Linn. Syst. Nat. ii. 756. 63.

— —, Cramer, Pap. Exot. t. 378. f. A. B.

A common and well-known species. It appears to be distributed throughout the whole of the northern part of tropical America. It differs in habits from the other species of the genus, inasmuch as it frequents the skirts of woods, semicultivated grounds, and gardens. Its antennæ are short, and strongly clavate: in this feature, as well, indeed, as in size, shape, and habits, it approaches the genus *Eueides*.

Genus EUEIDES, Doubleday.

Doubled. & Hewits. Gen. Diurn. Lepid. p. 145.

1. EUEIDES ISABELLA, Cramer.

*Papilio Isabella*, Cram. Pap. Exot. t. 350. f. C, D.

*Papilio Isabella Nereis fulva Dianasa*, Hübner. Samml. Exot. Schm. (slight var.).

This is a common and abundant species throughout the Amazon region. It does not inhabit the forest, but frequents open bushy places on the skirts of woods, flying in the usual sailing manner of the *Heliconii*. Like the species of *Heliconide* which have the same style of coloration (*Heliconius Numata*, *Mechanitis Polymnia*, &c.), it is a variable insect on the Upper Amazon, although constant in its specific characters at Pará. *II. Dianasa* of Hübner is a slight variety.

2. EUEIDES HÜBNERI, Ménétrés.

*Eueides Hübneri*, Ménét. Cat. d. l. Coll. de l'Ac. Imp. de St. Petersburg, p. 116, pl. 8. f. 5.

Very rare. Although very closely allied to *Eu. Isabella*, this is a well-marked form, which probably maintains itself distinct from that species. It differs somewhat in the shape of the wings; the pale central crossbelt is divided into separate spots; the antennæ are black, with the club pale beneath. It is an approximation towards *Eu. Cleobaea* (Hübner) of Mexico.

3. EUEIDES LAMPETO, n. s.

♀ 3". *Fore wing* broader, the costa more arched than in *Eu. Isabella*: *above*, orange-tawny; a small portion at the apex, a narrow outer margin, and a broad stripe near the hind margin, extending from the base to near the hind angle, black; there are also four black spots on the disk, viz. a large wedge-shaped spot within the cell near the base, a small one over the disco-cellulars, a large rounded one between the 2nd and 3rd, and an indistinct one between the 1st and 2nd median branches; close to the apex are two whitish spots. *Beneath*, the same, except that there are three white apical spots.

*Hind wing*: *above*, orange-tawny; a line along the basal half of the subcostal nervure, a broad central stripe of six elongate spots behind the cell, and a broad hind border

black; a submarginal row of whitish spots, interrupted in the middle. *Beneath*, the same, except that the costal nervure is also black, and the submarginal spots are larger and of a clearer white, there being two between each nervure, except near the apex, where there is only one, instead of two.

Body brown; antennæ yellow, except the extreme base, which is black; forehead and two spots on the crown white; mesothorax with four large rounded orange-tawny spots, namely, two wide apart on the shoulders and two near together in the middle.

This fine large species is deceptively like *Stalachtis Calliope*. It appears to be very rare. I met with only one individual; at St. Paulo. *Stalachtis Calliope* is a very abundant species.

#### 4. EUEIDES MEREALI, Hübner.

*Colanis Mereali*, Hübner, *Zuträge*, t. 201, 202.

The sexes differ considerably in the colours and design of their wings. The ♂ is dark orange-tawny; the apical half of the fore wing is black, sometimes crossed by a short orange-tawny belt; the hind wing has a broad and rather well-defined black border. The ♀ is paler in hue, and has two or three large ochreous spots in the middle of the fore wing; the apical half is black, sometimes with an ochreous spot on the costa, half-way between the cell and the apex; the black border of the hind wing is ill defined, shading off gradually into the ground-colour of the wing.

I met with this species on the Tapajos and Upper Amazons. It is found within the forest, flying about the tops of low trees in sunny openings. It has no near ally in the Amazon region, to my knowledge.

#### 5. EUEIDES LYBIA, Fabricius.

*Papilio Lybia*, Fab. *Syst. Ent.* p. 460, n. 73.

— *Hypsipile*, Cramer, *Pap. Exot.* t. 177, f. C, D.

A very common species throughout the country. It flies in open sunny places on the skirts of the forest, or in semicultivated grounds. The caterpillar resembles in all essential points those of *Heliconius Eralo* and the species of *Argynnis*. Each abdominal segment is furnished with a row of rather long hispid spines; the head has two similar spines, longer than those of the abdomen; the colour is pale red; the spines black. The chrysalis is angular, and spinose on its dorsal surface. The pupa state lasts eight days.

#### 6. EUEIDES THALES, Cramer.

*Papilio Thales*, Cramer, *Pap. Exot.* t. 38, f. C, D.

*Eueides Thales*, Hewitson, *Journal of Entomology*, i, pl. 10, f. 3 (var.).

A common and generally-distributed species in equatorial America. It closely resembles *Heliconius Vesta*, in company with which it is frequently found.

#### 7. EUEIDES EANES, Hewitson.

*Eueides Eanes*, Hewitson, *Journ. of Entom.* i, pl. 10, f. 1.

This species also closely resembles *Heliconius Vesta*. It is found only on the Upper Amazons, at St. Paulo, flying over bushes on the skirts of the forest.

S. EUEIDES ALIPHERA, Godart.

*Papilio Aliphera*, Godt. Encyclopédie Méthodique, t. ix. p. 246.

A widely distributed species, being found over nearly the whole of tropical America. It seems to be constant throughout. I met with it at St. Paulo.

Subfamily ACRÆINÆ.

Genus ACRÆA, Fabricius.

1. ACRÆA THALIA, Linnaeus.

*Papilio Thalia*, Linn. Syst. Nat. ii. 757, n. 67.

— —, Cramer, Pap. Exot. t. 246. f. A.

I took (at Pará) only one individual of this sole species of *Acraea* found in the Amazon region.

#### EXPLANATION OF THE PLATES.

The Plates are designed to show a few examples out of a great number of mimetic analogies between various Lepidopterous insects and the Heliconidae. The insects figured belong to four families, very widely dissimilar in structure and metamorphosis: *Leptalis* (fam. Pieridae), *Dioplis* (Bombycidae, Moths), *Stalachtis* (fam. Erycinidae), *Ithomia*, *Mechanitis*, *Methona* (fam. Heliconidae). The figures also illustrate the process of the origination of a mimetic species through variation and natural selection. Reasons have been given (p. 501 *et seq.*) for considering the species of *Leptalis* and *Dioplis*, amongst others, as having been adapted by this process to the species of *Stalachtis* and the genera of Heliconidae—the colours being brought into exact resemblance by the successive preservation of such naturally arising variations as tended more and more to resemble. One species only, *Leptalis Theonoe*, furnishes a good example of the process, it being one which, by a rare chance, shows in its existing varieties the process in different stages of completion. The figures indicated by a simple numeral represent the *adapted* forms; those marked *a*, the species to which they are adapted.

#### PLATE LV.

Fig. 1. *Leptalis Theonoe* (Hewitson).—Inhabits Cupari, 55° W. long.

Fig. 1a. *Ithomia Flora* (Cramer).—Inhabits Cupari, 55° W. long.; also the mouth of the Amazons and Surinam.

Neither of these forms is found further westward on the Upper Amazons, where the following allied species and varieties alone occur.

Fig. 2. *Leptalis Theonoe*, var. *Melanoe*.—St. Paulo, Upper Amazons, 69° W. long.

Fig. 2a. *Ithomia Onega* (Hewitson).—Upper Amazons, from 58° to 70° W. long.

The specimen of *L. Theonoe* in the British Museum collection, which served Mr. Hewitson for his figure of the species, is very much larger than the one figured in this Plate. But the *Leptalides* are apt to vary very much in size.

Fig. 3. *Leptalis Theonoe*, var. *Lysanoe* (Hewitson).—Described by the author as a distinct species. The white fore part of the hind wing is merely a sexual character, and is hidden by the fore wing in the natural position of the wings!—Ega, Upper Amazons, 65 W. long.

Fig. 3a. *Stalachtis Phœlusa*, var. *Duruli* (Perty).—Ega, Upper Amazons, 65 W. long.

The resemblance between these two is very great, when flying in their native woods. The *Leptalis* is quite unlike any *Ithomia* found in the whole region, and is supposed to have been adapted to the *Stalachtis*, because its original variations were in the direction of *Stalachtis*, and this disguise equally well served the purpose of preservation with that of an *Ithomia*.

Fig. 4. *Leptalis Theonoe*, var.—Ega. Described by Hewitson as a variety of *L. Lysanoe*, Exot. Butt. *Leptalis*, fig. 13.

Fig. 5. *Leptalis Theonoe*, var.—Ega.

Fig. 6. *Leptalis Theonoe*, var.—Ega. This has considerable resemblance to *Ithomia Illuissa*, fig. 6a.

Fig. 7. *Leptalis Theonoe*, var.—St. Paulo.

Fig. 8. *Leptalis Theonoe*, var.—Ega.

Fig. 9. *Leptalis Theonoe*, var.—St. Paulo.

These six varieties occurred only in single or very few examples: they mutate (with the exception of fig. 6) in no other insect, and are supposed to be either simple variations (*spots*) or remnants of the steps of modification which have led to the various complete adaptations in the two districts where they are found. In any case (since it is impossible to suppose that each is an unmodified descendant of a parent originally created, in the usual sense of the term) they may be taken as affording proof of the variability of the species in several divergent directions, tending towards resemblance to *Ithomia*.

Fig. 6a. *Ithomia Illuissa* (Hewitson).—Ega.

Fig. 10. *Dioplis Aethia* (n. sp. or var. ?), deceptively like, when flying, *Ithomia Aethia*, a small species near akin to *I. Illuissa*, and found in company with it at Ega.

Fig. 11. *Dioplis Herdina* (n. sp. or var. ?). Closely resembles, when flying, *Ithomia Herdina* (Pl. LVI fig. 1 a), and found in company with it at St. Paulo.

Fig. 12. *Dioplis Onega* (n. sp. or var. ?). Closely resembles, when flying, *Ithomia Onega* (Pl. LV fig. 2 a), and flies in company with it at St. Paulo.

Fig. 13. *Dioplis Cyana* (Doubleday). Closely resembles *Ithomia Cyana*, a species similar to *I. Flora* (fig. 1 a of the present Plate), and flies in company with it at Para.

#### PLATE LVI.

Fig. 1. *Leptalis Theonoe*, var. *Erythroe*.—St. Paulo, 69 W. long.

Fig. 2. *Leptalis Theonoe*, var. *Erythroe*.—St. Paulo.

Fig. 3. *Leptalis Theonoe*, var. *Erythroe*.—St. Paulo.

Fig. 3a. *Ithomia Oruba*, var. *Chrysoloba*.—St. Paulo.

The linking variations between *L. Erythroe* and *Theonoe* can be traced through the varieties 5, 5, and 6 of the preceding Plate. The substitution of red for white in the fore wings is seen to be a simple variation. Some traces of the narrowing of the red margin of the hind wing are also seen. The mutation of *Ithomia* is not nearly so close as it is in the cases of figs. 4 and 2 of the preceding and fig. 4 of the present Plate, but there is a considerable approximation giving the appearance of a striving after a correct imitation. The selection of individual figures of most faithful likeness is here either not rigid or we see the formation of an exact natural analogue in process.

Fig. 4. *Leptalis Theonoe*, var. *Leurogæ*.—St. Paulo.

Fig. 4a. *Ithomia Herdina* (Hewitson).—St. Paulo.

This *Leptalis* appears at first sight an absolutely distinct species, but it is plainly a creature

tion whose adaptation is complete. As to the fore wings, the vacillating nature of the colours is seen in figs. 4, 6, and 8 of Plate LV. in the clearest manner. The hind wings appear very peculiar, on account of the milky colour; but this is shown to arise by variation in *Ithomiæ*, which exhibit all the grades of variation from dusky to white nervures and ground of the hind wing.

Fig. 5. *Leptalis Nehemia* (of authors).—New Granada and S. Brazil.

Figured to show the normal form of the family (*Pieridae*, called in England "Garden White" Butterflies) to which *Leptalis* belongs. The contrast in form and colours points to the conclusion that all the other forms of *Leptalis* are perverted from the usual facies of the family by long-continued process of adaptation to the Heliconidæ, in whose company (each species with its Heliconian model) they are solely found.

Fig. 6. *Leptalis Theonoe*, var. *Argochloe*.—St. Paulo.

Fig. 6 a. *Ithomia Virginia* (Hewits.).—St. Paulo.

The links of modification may be traced also with respect to this apparently distinct *Leptalis*. The shape of the spot of the fore wing is seen to be very variable in figs. 1, 2, 3 of this Plate, and in 9 and 4 of Plate LV.

Fig. 7. *Leptalis Amphione*, var. *Egaëna*.—Ega.

Fig. 7 a. *Mechanitis Polypania*, var. *Egacusis*.—Ega.

Fig. 8. *Leptalis Orise* (Boisduval).—Cupari, 55 W. long.; also Cayenne.

Fig. 8 a. *Methona Psidii* (Linnaeus).—Cupari; also Cayenne.

#### ERRATUM.

At p. 515, after the characters of Family 2. PAPILIONIDÆ, insert

Subfam. 1. PAPILIONINÆ.

Subfam. 2. PIERIDÆ.







