

OBSERVATIONS ON THE BIONOMICS OF THE LEPIDOPTERA
OF MATTO GROSSO, BRAZIL

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PLATES XIV-XIX AND ONE TEXT-FIGURE.

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1. ON SOME MIMETIC COMBINATIONS OF BUTTERFLIES OBSERVED.

By C. L. COLLENETTE.

THE insects dealt with in this paper were taken in Matto Grosso during the period April–November, 1927. They are listed in tabular form on page 401, and seven of the eight localities dealt with are indicated in the accompanying sketch-map. (See p. 392.)

It was first proposed to confine the account to butterflies captured in the locality alluded to as "Rio Serragem," but the remainder have been included for comparative purposes and to illustrate certain remarks on the insects dealt with.

Of the species mentioned, an endeavour was made to take every specimen seen.

RIO SERRAGEM LOCALITY.

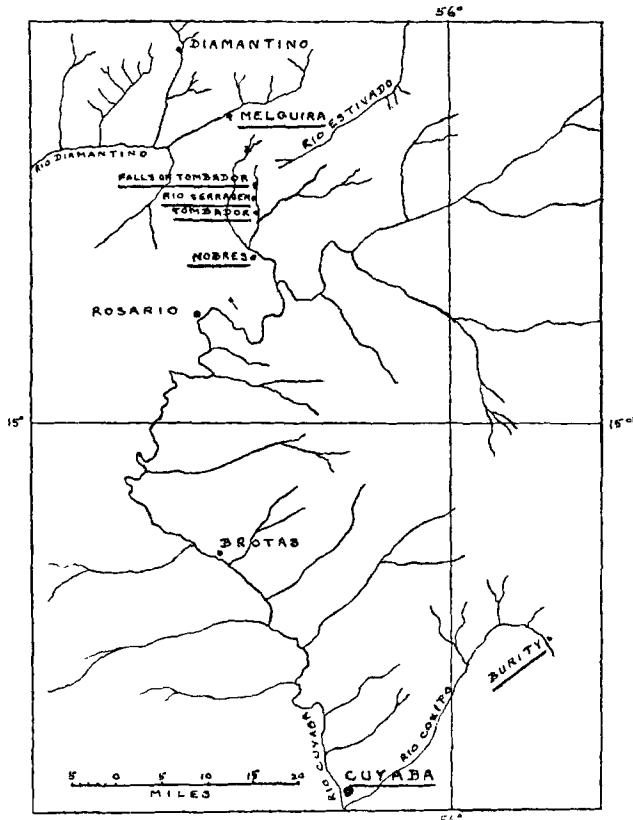
The small stream named the Rio Serragem rises on the plateau separating the basin of the Amazons from that of the Paraguay, and flows southward and over a line of cliffs, the fall being known as the "Tombador." It afterwards follows a winding course down a valley for some three miles, when it passes the *sítio* (or farm) of Tombador, which takes its name from the falls.

The writer explored both banks of the stream from the *sítio* to the falls, finding very dry and somewhat open forest interspersed with stretches of thickly growing bamboo and closely set Wakuri palms (*Attalea* sp.). The stream ran between high banks, sometimes developing into rocky cliffs, which supported little vegetation.

At a spot roughly midway between the *sítio* and the falls a tiny tributary entered the Serragem, and for the last 150 yards of its course and for a breadth of some 50 yards the vegetation was of an entirely different character, consisting of a number of large trees, the space beneath them covered with ferns and small straight saplings, largely free of obstructing leafy growth. I satisfied myself that this "oasis" was without parallel at any spot in the valley between the *sítio* and the falls, its nature being due to considerable moisture in the soil,

which received the drainage from small cliffs rising at a short distance back from each bank of the tributary.

In this small area, with its sharply defined boundaries of cliff, many butterflies were flying which exhibited mimetic coloration, and of which I met with no other specimens for a distance of $1\frac{1}{2}$ miles up and down the Rio Serragem. It therefore offered a rather unusual opportunity for establishing the relative numbers of the species and obtaining notes on their behaviour and habits. The first few storms heralding the wet season had taken place, and the month



Sketch-map of Cuyaba district, showing localities in which collections were made.

(August) was a favourable one as regards the number of species flying. I am of opinion that even during the rains of later months few of the insects would enter or leave the locality, owing to the brighter light in the surrounding forest and the unattractive vegetation.

The following is a list of species taken in the area during eight days between 12th and 27th August. No mention is made of sundry other species (Papilios, Morphos, Satyrids, etc.), some of which were also present in the surrounding forest and of which the total catch numbered 32 specimens. Single examples of two Pericopid moths, *Eucyane plagifera*, Feld., and *Pericopis catilina*, Crm., were also taken, which do not appear to be members of any mimetic combination seen there. It is noteworthy that no *Melinaea* or *Protagonius* was

met with in this or any other locality in Matto Grosso, and I have not been able to find mention of any species of these two genera taken in the State.

LIST OF SPECIES TAKEN IN THE RIO SERRAGEM LOCALITY.

	August, 1927.								♂	♀	Total
	12th	14th	16th	18th	20th	24th	25th	27th			
MECHANITIS COMBINATION.											
PIERIDAE. <i>Dismorphia asty- nome</i> , Dalm. .								1		1	1
DANAINAE. <i>Lycorea ceres ater- gatis</i> , D. & H. .	4	1	3	6					11	3	14
ITHOMINAE.											
<i>Hirsutis pseudonyma pseudonyma</i> , Stgr..	4	11	15	9	6	11	5	7	45	23	68
<i>Mechanitis polymnia angustifascia</i> , Talb.	50	57	60	38	29	26	4	9	177	96	273
<i>Mechanitis elisa con- nectens</i> , Talb. .	47	51	40	36	24	15	3	14	156	74	230
<i>Mechanitis lysimnia, Fab.</i> .				1						1	1
<i>Ceratinia cantabrica pamina</i> , Hnsch. .	42	44	32	27	18	30	19	17	85	144	229
<i>Sais rosalia brasiliensis</i> , Talb. .	1		2	1	2	4	1	2	6	7	13
<i>Pseudoscadada colle- nettei</i> , Talb. .		1	1			1			2	2	4
	149	164	153	119	79	87	33	49			833
TRANSPARENT ITHOMI- INE COMBINATION.											
ITHOMINAE.											
<i>Episcada hymenaea hymenaea</i> , Pritt. .				2						1	1
<i>Pseudoscadada arzalia</i> , Hew. . .	22	24	37	22	26	22	14	13	81	99	180
<i>Heterosais edessa nephela</i> , Bates. .	5	5	11	9	12	11	8	4	33	32	65
	27	29	48	33	38	33	22	17			247
ITHOMIINAE.											
<i>Dircenna dero dero</i> , Hbn. . .	2	2		1	1	1	1		5	3	8
<i>Dircenna zelie epi- dero</i> , Bates. .	1									1	1
	3	2		1	1	1	1				9
ITHOMIINAE.											
<i>Aeria olena</i> , Weym.	30	33	25	23	5	3	3	4	82	44	126
NYMPHALIDAE.											
<i>Eueides vibiliia uni- fasciatus</i> , Butl. .				1						1	1

Average temperature : 7 a.m., 71°. Noon, 90½°. 6 p.m., 84°.

Excluding a few hours on the 11th August, which I devoted to cutting out low-growing thorny creepers and in exploring the upper reaches of the tributary, I arrived on each occasion at the spot about 8.30 a.m. and left at about 3 p.m. The first half-hour was usually devoted to observation. On the first three days the catch was limited by the number which could be conveniently netted and papered in the time. On subsequent days the surviving insects had to be followed into the more difficult portions of the locality, which involved much wading in the rocky bed of the tributary and climbing the detritus at the base of the small cliffs. On the final day the catch certainly contained some insects which had emerged since the previous visit, but only occasional captures were made after the first three hours, very few remaining unnetted when I left for the last time.

In no case did I see an insect leave the shelter of the thicker growth or ascend the small cliffs, and none appeared to cross the 25 yards of open stream and sand at the lower end of the locality to the dry bamboos on the other side of the Rio Serragem.

In discussing the appearance presented by the above insects during life, it is necessary to emphasise the comparative twilight which existed under the trees. With Imperial Eclipse plates (H. & D. 650), the photograph of the forest (Plate XVII) was given a two seconds exposure with f. 10, and that of the tributary (Plate XVIII) a half-second exposure with the same stop. These exposures were made between 11.30 a.m. and noon on a sunny day, and in the open country 1/100th of a second would probably have been sufficient.

MECHANITIS COMBINATION. The nine species which I have placed in this section, so styled because *Mechanitis* predominates in point of numbers, appear to be an example of a Müllerian combination, with Batesian mimicry also entering in the case of one or more presumably edible species. It is characterised by an oblique yellow bar across the fore-wing, in some cases broken up into spots, and differing in the area covered.

In the poor illumination of the locality light colours such as yellows and whites were conspicuous, but details of fawns, blacks and browns were not clearly seen. Judging by my own failure to distinguish between several of the species when seen in flight at close quarters, I came to the conclusion that size, and similarity in the style of flight, were of greater importance in mimicry in this area than very exact resemblance in markings.

Discussing the species separately, *Lycorea ceres atergatis* (Plate XIV, fig. 3) and *Hirsutis pseudonyma* (Plate XIV, fig. 6) were quite indistinguishable from each other on the wing, but fairly easy to separate when settled by reason of the conspicuous dark loop on the hind-wing of the former.

Mechanitis polymnia angustifascia (Plate XIV, fig. 7) and *M. elisa connectens* (Plate XIV, fig. 8) were also indistinguishable on the wing and were liable to be confused when settled, the resemblance being accentuated by the fact that variation exists in the markings of each species.

Ceratinia cantabrica pamina (Plate XIV, fig. 10) and *Sais rosalia brasiliensis* (Plate XIV, fig. 12) were quite indistinguishable on the wing and at rest, the colour of the antennae being the difference most easily noted. The *Ceratinia* ♀♀ considerably outnumber the ♂♂ in the series taken.

The three couples enumerated above were readily distinguishable by size —large, medium and small. All had a very similar "fluttering, dancing flight," but in the first couple the flight was slightly stronger and more direct, with a superior power of acceleration when alarmed.

The six species had very similar habits, spending considerably more than

half of the period between 8.30 a.m. and 3 p.m. at rest on the tips of fern fronds and on the leaves of bushes, choosing by preference those which were isolated and jutting out from the mass, rarely above three or four feet from the ground. They flew freely in the deep shade, but not so frequently above the water of the tributary, which was broad enough to allow more light to penetrate. The largest couple was more often observed there than the others. On no occasion did I see any notice taken of flowers, either in this or any other locality in Matto Grosso, but flowers were of rare occurrence in the haunts of these butterflies.

All six species were of much the same wariness, and took to wing at some five yards from me when approached inadvertently, and at perhaps one yard if more carefully stalked. This seemed to argue a considerable distrust of the resting position if danger threatened. A striking note was made as to their behaviour when alarmed. Each species accelerated its flight and made straight for the water of the tributary, crossing it at right angles for the other side. This action was not without exception, especially in the case of the *Ceratinia* and *Sais*, but was a regular habit of which I took considerable advantage.

These six species in flight might readily be taken for large, normal and dwarfed specimens of the same race by an enemy not too skilled in observation.

The single specimen of *Mechanitis lysimnia* (Plate XIV, fig. 9) was not noticed among the long series of *M. elisa* until the insects were set. The yellow spot at the apex of the fore-wing in *M. elisa* fades almost to white in some old and worn specimens, and, seen in the poor light of the forest, the difference in appearance of the two species must be very slight. I met with no other specimens of *M. lysimnia* in Matto Grosso.

Dismorphia astynome (Plate XIV, figs. 1 and 2) was not distinguishable on the wing by colour or markings from *M. polymlnia* or *M. elisa*, but it could nevertheless be picked out as a different insect, for, while the same "fluttering and dancing flight" was present, the speed was noticeably swifter. Its acceleration on being alarmed was also greater, and it was not very easily caught. The two or three specimens which I saw at rest (in this and other localities), were betrayed at once by the different shape and perhaps by the considerable difference in ground-colour and pattern. The white patches on the wings of the male, so conspicuous in the cabinet, are covered and invisible during flight and when settled. I believe that this species is a member of the association, but the resemblance so far attained is only a rough one.

I have included *Pseudoscada collenettei* (Plate XIV, fig. 13) in this combination without hesitation, although in the cabinet it appears far closer to the transparent Ithomiine combination. The five specimens taken on the wing were in no case distinguished from *Ceratinia cantabrica pamina* until seen in the bottle. The *Ceratinia* in flight has a conspicuous yellow band and a rather indefinite suggestion of brown and black. The *Pseudoscada*, with a similar flight, also displays a prominent yellow band of the same shade and an indication of brown and black. The effect of the coloration of the latter species can be best judged by placing the insect above a dark background and viewing by reflected light, a proceeding which parallels conditions in the forest, throwing the yellow into prominence and destroying the appearance of transparency in the brown areas, which then appear of somewhat the same shade as those of the *Ceratinia*. The *Pseudoscada* is a better mimic within the combination than *Dismorphia astynome*. Only one specimen was seen at rest (which I missed by a mischance to the net), and was then readily distinguishable.

TRANSPARENT ITHOMIINE COMBINATION. The three species here included are connected by close relationship.

Pseudoscada arzalia (Plate XV, fig. 5) and *Heterosais edessa nephele* (Plate XV, fig. 12) can be distinguished when flying by the larger size of the white band in the former, and in a good light by the smaller dimensions of the whole insect. They have much the same flight. Both species appear to the eye as a couple of dancing white spots, the black veining and margins practically invisible, only an occasional glint being reflected by the polished surface of the hyaline portion. They were by no means easy to keep in view in the darker parts of the locality, but when in flight above the ferns bordering the tributary, which they largely frequented, were more conspicuous.

They did not usually fly across the tributary when alarmed, but made for the cover of a bush or a network of twigs. Owing to this habit they maintained their numbers in the face of my efforts better than other species.

The fragile *Episcada hymenaea* (Plate XV, fig. 2), which has no white band, was almost invisible in the half light of the forest. The first specimen flew closely past my face, and I netted it casually, thinking it a Micro or perhaps a Tipulid. Although I watched carefully for other specimens, only one was met with. It was seen for only a moment, but a series of quick strokes in the direction of its flight secured it.

These three butterflies are less conspicuous than the species in the *Mechanitis* combination, and the brown scaling on the wings of *Pseudoscada collenettei*, which separates the insect from the transparent Ithomiines, is very noteworthy.

DIRCENNA COMBINATION. The two *Dircenna* (Plate XV, figs. 9 and 10) appear to occupy a place by themselves in coloration. In other localities in Matto Grosso they were sometimes taken in less shaded areas than those chosen by the *Mechanitis* combination, and there seems little reason to connect the two sections. However, although little resemblance can be traced in cabinet specimens, the following note was made in the Rio Serragem locality:—"Darker than *Mechanitis polymnia* and *elisa*, and the flight more rapid and direct, but a fairly close view is required to distinguish them with certainty." This casual resemblance may be the means of eventually drawing the *Dircenna* into the *Mechanitis* combination.

Aeria olena, Weym. (Plate XV, fig. 7.) This species flew with a steady regular flight, was very conspicuous, and made practically no attempt to put on speed or make for cover when alarmed. It will be seen from the table that the numbers present in the locality quickly showed the effect of my collecting. I met with no mimic of the species, but it belongs to a genus known to be distasteful, and its habits and appearance fully bear this out.

Eueides vibilia unifasciatus, Butl. The single female of this species was evidently a casual visitor. It had probably wandered down stream from a locality above the Tombador Falls, $1\frac{1}{2}$ miles away, which will be mentioned under another heading.

URUCUM LOCALITY.

This locality, which is not shown in the sketch-map, is a range of wooded hills about 250 miles south of Cuyaba, and 15 miles south of the town of Corumba. During a period of two weeks in April and a further week in November I met with only *Lycorea ceres atergatis* (3 specimens) (Plate XIV, fig. 3) and one *L. halia* (Plate XIV, fig. 4). Several areas in this locality appeared perfectly suitable for others of the species dealt with in this paper,

and it is surprising that I did not come across them here or in other districts close to Corumba.

CUYABA LOCALITY.

A long series of *Eueides vabilia unifasciatus*, with form *vabilia* in smaller numbers, was taken on rocky ground covered with low scrub outside the town. Many were congregated in the partial shade of two or three big isolated trees, but they also flew freely in the open sunlight. Associated with them was one specimen of *Actinote pellenea calymma*, which I noted as "closely resembling in flight a somewhat faded *Eueides*." The flight and habits of the *Eueides* were indicative of a distasteful species. Although the coloration of both *Actinote* and *Eueides* bears some resemblance to the *Mechanitis* combination, the different habitats would prevent a frequent meeting. It has been pointed out to me that although species may fly in different types of country, they may yet have common enemies, and the resemblance may perhaps have some Müllerian significance.

NOBRES AND MELGUIRA LOCALITIES.

The latter contains some elements of the "siringal" or rubber forest which stretches from the northern side of the plateau through to the Amazons. The butterflies of both areas were rather disappointing, presenting only occasionally seen examples of some of the species already mentioned.

BURITY LOCALITY.

An area 30 miles N.E. of Cuyaba, on the plateau of Chapada, at about 2250 ft. Two visits were paid to this region, in June-July and Sept.-Oct., 1927. It will be seen from the tabular form, in which the two visits are separately listed, that far fewer insects were taken in Sept.-Oct.

The first storms of the wet season had taken place in August, but less rain had fallen at Burity than further to the north, and the forest in October was still drying quickly after a downpour. The insects dealt with in this paper were taken over a considerable extent of fairly thick forest, rather than in a single damp "oasis" as at Rio Serragem, and although the storms had brought out a large number of butterflies, including the shade-loving species, and the nightly catch of moths had passed its zenith, conditions in Sept.-Oct. were apparently not suitable for the Ithomiine groups.

Burity and the Rio Serragem-Tombador localities are 65 miles apart, and, for forest insects, are very definitely separated by large tracts of dry and open "campo." This "campo" is natural, due to conditions of soil and moisture rather than to any considerable clearing of forest. The greater elevation and exposure to wind at Burity results in a lower temperature, which in Sept.-Oct. averaged :—6 a.m. $67\frac{1}{2}^{\circ}$; noon, $83\frac{1}{2}^{\circ}$; and 6 p.m. $79\frac{1}{2}^{\circ}$. The average temperature in June-July at Burity is misleading, owing to short two- or three-day spells of really cold weather when the wind was in the south and south-west. Excluding these, the usual temperature was between 5 and 10 degrees less than in Sept.-Oct. A further distinction exists between the two localities in the occurrence of different species among the trees and plants.

Discussing the June-July period at Burity, it will be seen from the tabular form that nearly all the Rio Serragem insects were present, with the addition of several others, but in much smaller total numbers. The relative figures of each species at Burity are not very satisfactory, as the catch was made over an area of three or four miles and during the whole period of 33 days.

It will be noted that *Ceratinia nina chapadensis* (Plate XIV, fig. 11) is the dominant species in point of numbers in the *Mechanitis* combination, although it was not represented at Rio Serragem. A *Heliconius* has entered the combination which was also absent in the latter locality.

The same *Eueides* is present at Burity, together with form *vibilia* in small numbers, while a fresh *Actinote* appears. Here, as in other localities, they kept to open and slightly shaded areas, secondary growth and well-thinned forest, where they very rarely met with the other combinations.

TOMBADOR FALLS LOCALITY.

A small area just above the Falls and $1\frac{1}{2}$ miles from the Rio Serragem "oasis," visited on four afternoons in August. Of very little interest, but yielding an occasional Ithomiine in some shady growth close to the river, and with several *Eueides* flying backwards and forwards over the water in the sun, of which I was only able to capture two specimens.

TOMBADOR SITIO LOCALITY.

A narrow area, moistened by springs, bordering the river just below the *sitio* of Tombador, and also about $1\frac{1}{2}$ miles from the Rio Serragem "oasis." The relative abundance of each species is again of less value than in the "oasis" series, as the totals are far smaller and the specimens taken almost daily over a period of five weeks. However, the two series are very similar, the most interesting difference being the relative commonness of *Sais rosalia* at Tombador Sitio.

EVIDENCE OF ATTACK BY BIRDS.

On reaching England and looking through the series of insects, I at once noticed a series of marks on the wings which could only be interpreted as made by the beaks of birds (Plate XVI). Mr. H. W. Parker of the Dept. of Zoology (Reptiles), British Museum, agrees with me that they are too pointed to have been caused by lizards, and called my attention to the fact that no teeth marks were visible. Other marks consisting of one, two or even three simple creases right across the wing have been caused by its bending or doubling up in a corner of the net during capture or by some accident during life. It is difficult to determine where one class of marking stops and the other starts, but adopting a very conservative selection there are 23 beak marks in 1184 specimens of the *Mechanitis* combination, 2 in 447 specimens of the transparent Ithomiines, none in the *Dircenna* and *Eueides-Actinote* combinations, and but one (rather faint and open to a possible doubt), in 153 *Aeria*.

A strong grip with a pair of entomological forceps leaves no mark on the wings, and the marks (which are in all cases clearly outlined and visible on both upper and under surfaces) appear to have been made, not by the power of the bird's grip, but by creasing of the wings in the insect's struggles to escape, slight movements of the bird's beak, and the weight of the insect. As might be expected, the side of the beak mark nearest to the insect's body is usually more pronounced than the other. An apparently identical mark occurs in nine cases, of a short broad beak (Plate XVI, figs. 4 and 5). In five other cases the mark is of a narrow beak (Plate XVI, fig. 2), these two series being probably the work of two single species. In three cases both wings are marked similarly (Plate XVI, figs. 1 and 2), showing that the butterfly was taken at rest, or possibly with wings together in flight.

Two species of bird were often seen to take butterflies in the open, a Jacamar, *Galbula rufaviridis*, Cab., and a Tyrant Flycatcher. In neither case did the beaks of these birds, when measured in the British Museum against the marks on the wings, coincide as to angle, and considering the very many insectivorous birds of the region it is not possible to run down the species. The hooked tip which many birds exhibit on the upper mandible is slightly indicated on some of the specimens.

The markings on each species are as follow :—

	Per cent.
4 marks on 96 specimens of <i>Hirsutis pseudonyma pseudonyma</i> , or 4·2.	
8 " " 344 " " <i>Mechanitis polymnia angustifascia</i> , " 2·3.	
6 " " 312 " " <i>Mechanitis elisa connectens</i> , " 1·9.	
5 " " 307 " " <i>Ceratinia cantabrica pamina</i> , " 1·6.	
23 on 1184 specimens of the MECHANITIS COMBINATION,	1·9.
2 marks on 347 specimens of <i>Pseudoscada arzalia</i>,	.6.
1 " " 152 " " <i>Aeria olena</i> ,	" .6.

Comparing these with 1767 specimens of Matto Grosso butterflies outside the above series, excluding Skippers and Blues, and for the most part taken in open or sunny situations, we have :—

2 marks on <i>Heliconius erato phyllis</i> , Fbr.	
1 " " <i>Papilio ariarathes gayi</i> f. <i>cyamon</i> , Gray.	
1 " " <i>Amphidecta pigrerator</i> , Btlr.	
4 " " 1767 specimens, or .23 per cent.	

A striking and very puzzling predominance is shown in the markings on the insects of the *Mechanitis* combination, in view of the fact that during the eight days spent in the "oasis" in the Rio Serragem locality (from whence come 22 of the 23 marked specimens), I did not once see a bird. While watching the butterflies there and speculating on the Müllerian and Batesian theories, I looked around repeatedly for possible enemies of the insects, seeing none but a small herd of monkeys, which was usually present—this, although my diary is full of notes on the colours and habits of birds seen in the open and in other types of forest in the district.

Although the species in the *Mechanitis* combination seemed never to leave the shelter of thick shade after 8.30 a.m., I several times saw individuals crossing straight over the 20 or 30 yards of the river at the Tombador Sitio locality, and occasionally settling in the open, before 8 a.m. and when the sun had little power, this being at a time when sun-loving species congregating on the sand (very popular with the Tyrant Flycatcher and Jacamar) were not visible. It seems to me probable that the marked specimens of the *Mechanitis* combination were taken on the wing when making short flights over the river in the early morning.

This still leaves unexplained the large percentage of markings as compared with the insects of more open localities. On perhaps 13 occasions, of which 8 are noted in my diary, I saw a Jacamar catch a butterfly on the wing, generally a *Papilio* of the three very similar species *protesilaus*, L., *telesilaus*, Feld., and *orthosilaus*, Weym. If awkwardly caught, these were shaken and brushed against a bough until smashed. I did not see any specimens escape from the bird after being gripped. Reverting to the marked specimens of the *Mechanitis* combination I can find no examples which show a clearly severed

section of wing, such as might result if an insect had broken free from a beak. I have therefore thought that the marked specimens may have been purposely released by the birds, perhaps as a result of the close inspection, or taste or odour of the specimen, and possibly in an effort to find edible examples among a group which could not be separately recognised in flight. I am aware that this theory is founded on much that is speculative, but it appears to me as perhaps more feasible than any other explanation. Evidence of the rejection of distasteful species of butterflies by birds is to be found in *Proc. Ent. Soc. London*, 1912, p. iv, and 1913, p. xix, in some cases after the infliction of disabling injuries and in other cases with little damage.

I am indebted to Mr. J. J. Joycey for facilities afforded while working at the Hill Museum, and for kind permission to make use of the insects collected on his behalf; to Prof. Poulton for many helpful suggestions made both before and after the expedition; to Mr. G. Talbot, for much assistance rendered during the writing of the paper; and to Miss Cynthia Longfield, one of the two ladies who accompanied me during the earlier months of the expedition, for the loan of a number of specimens included with those dealt with in the paper. I have also to thank Prof. Poulton for authorising, from the Oxford University Fund for promoting the Study of Organic and Social Evolution, a grant in respect of the cost of illustrations accompanying this paper.

2. GATHERINGS OF BUTTERFLIES ON DAMP SAND, WITH NOTES ON THE ATTRACTION OF MOTHS TO HUMAN PERSPIRATION.

By C. L. COLLENETTE.

During 1927 the writer spent eight months (April to November) in the State of Matto Grosso, Brazil, mainly on the plateau between the Amazons and the Paraguay, near the sources of the Amolar, Nobres and Coxipo. Assemblages of butterflies on damp sand were common, and were usually under daily observation.

Although the banks of a stream might provide a number of apparently suitable sandy or muddy patches, only those frequented by animals or human beings were regularly patronised daily by the insects. Several miles of the bank could be traversed without seeing an assemblage, although butterflies were flying freely up and down stream, until a place was reached where a track came down to the water. Spots where the washing of clothes was performed were the most popular. Fords were also much frequented. Horse and cattle manure, well beaten into the sand by animals using the fords, was selected by some species but definitely disregarded by the great majority, and little notice was taken of urine.

The assemblages commenced about 10.30 or 11 a.m. and attained their greatest numbers about 1 p.m., a few stragglers being present at 5.30 or even until sunset at 6.

The forming of an assemblage was watched on a number of occasions. The commonest species was *Catopsilia statira statira*, Cram., which would appear flying up the centre of the stream in small "follow my leader" parties, the insects behind reproducing every turn and dive of the one in front. The earliest arrivals usually went straight past the sandspit under observation, flying either up or down stream. Succeeding parties deviated more and more to the sand as the sun grew stronger, individuals settling for a moment here and there, only to rise and join the others as they circled round and flew away. If one remained on the sand for a few seconds others would join it and "test"

TABLE SHOWING GROUPS AND COMBINATIONS OF BUTTERFLIES DEALT WITH IN THE PAPER, TOGETHER WITH NUMBERS TAKEN IN EACH LOCALITY.

the surface, using the proboscis and walking slowly about. Usually these parties quickly broke up, but in this manner most of the sandy area near the water would be tested, often several times over. The butterflies did not appear to be guided by scent, but rather by taste and trial. Eventually, and perhaps an hour from the appearance of the first parties, two or three butterflies would remain settled until others joined them, when the assemblage would become permanent until disturbed by bird or man. (Plate XIX.)

On a hot sunny day, especially after rain, the gatherings would sometimes muster as many as 2,000 individuals, in a crowded, jostling mass. Butterflies flying up and down stream, and passing at a distance of anything up to seven yards, would suddenly deviate and settle straight among the others without any preliminary hovering or flying around.

The washing of clothes offered three possible causes of attraction—moisture, soap or perspiration from the clothes. Experiments showed that a weak solution of the soap used locally for washing was quite disregarded, while water thrown up from the stream to moisten the sand was little better, except to some of the Lycaenids and Hesperids. Furthermore, places were often chosen which were scarcely damp, whereas a few inches away water could have been obtained quickly and easily. On the other hand, if a handkerchief well soaked in perspiration were dipped in the river and then squeezed out on the sand, this spot became the most popular on the sandbank, nearly always to the exclusion of any other place on which the butterflies had settled. This attraction lasted as a rule for only one day, after which it had to be renewed.

When these gatherings were first under observation, I used to wait for perhaps an hour for the day's assemblage to form, but found later that it could be induced in a few minutes in the following manner:—A couple of *Catopsilia statira* would be caught, killed, and placed in a life-like position on the sand. Others would shortly fly down and join them, but after testing the surface would usually disapprove of the place selected and leave again. If, however, I had previously doctored the spot with perspiration as outlined above, allowing five minutes for it to soak into the sand and for the sun to warm it, the first arrivals would settle down at once and the assembly gather forthwith. This experiment was tried in several localities and on a number of occasions. If the dead butterflies were omitted the prepared spots might or might not be found, but their presence nearly always induced the first arrivals of the day to settle down. I never succeeded in bringing butterflies to a prepared spot on an *unfrequented* sandbank unless the dead insects were included. If they were added, and sufficient butterflies were flying past, its success was practically certain.

I saw no evidence of the employment of scent by the insects, but notwithstanding this, it was only at fords, etc., that the first butterflies of the day descended to test the sand. This seemed to point to some memory of the previous day's assemblage, and I am inclined to think that this was actually the case.

The presence of perspiration in minute quantities on the bank of a stream is not dependent on the washing of clothes. Man, domestic and wild animals have always bathed, drunk and crossed at convenient places, and, when they leave the stream, a considerable amount of perspiration, freed and remoistened by the water, drains from their legs into the sand.

In addition to the situations which have been mentioned, assemblages were also met with on moist patches in footpaths and roads. The gatherings were usually smaller in number and variety of species than those near the streams, and I did not keep any under careful observation. However, of the

many moist areas which appeared to be suitable, only those were frequented which were in the track of men or animals, and where the surface showed traces of footprints or hoofmarks. The selected spots varied very little from day to day, but in some cases the latest disturbance of the surface by men or animals may have been two or three days old. It therefore seemed probable that, as I have suggested above, a selected spot might be retained for a time by habit or by memory of the previous day's assemblage.

The following instances are selected, from among a number, to illustrate the manner in which a gathering place is transferred. At Burity, 30 miles from the town of Cuyaba, three spots in one small area were especially frequented by butterflies in the month of July, two of these being fords and the third a pigs' mud wallow. On a subsequent visit to the locality in Sept.-Oct., rains had commenced and one of the fords was disused, owing to springs having softened the banks, making access difficult. After animals had ceased to cross, only an occasional butterfly was to be found there, although the other ford, still in use, invariably attracted some hundreds. Further up this stream, a woodcutter built a hut and took up residence with his family during the month of August. Although I had seen no butterflies there during July, the place chosen by the family for washing and drawing water had a large daily gathering of butterflies by the time I returned to the locality in September. This spot was kept clean, and was never visited by domestic animals.

Perspiration as an attraction, or some constituent of it, may be compared with the "salt licks" on which gather males of *Troides brookiana albescens*, Rothsch., in Malaya (*Singapore Naturalist*, No. 2, April, 1923, p. 85), the "salt-licks" being preferred to other adjacent moist spots, although one cannot exclude the possibility that here also the attraction may have originated from the wild animals which trample the ground in these places.

In Matto Grosso it is the practice to put out coarse salt for the cattle and horses once or twice a week, and the inside of the open wooden trough is invariably wet with saliva when the animals have finished. No butterflies were seen to visit these troughs at any time.

Among the many accounts in entomological literature of butterfly assemblages on damp sand in the tropics, there is frequent mention of such assemblages at fords, and at places where the washing of clothes is performed. Many of these would seem to fall into the same category as those I have described, and my own recollection of gatherings in West Africa and Malaya points to the same origin. Other accounts make it clear that in some countries the insects are attracted often by the desire for moisture alone, as well as to manure and urine.

In the gatherings on damp sand which I have described, the commonest and most easily observed species did not appear to be guided to a favourable spot by scent, but rather by a system of test and trial conducted by many individuals. A garment hung up close to a sandbank attracted none of the species concerned in the sand assemblages, although they might be eagerly grouped not far away on a spot prepared with perspiration from the same garment.

Other species are attracted to human perspiration by scent, and into this category seem to fall a number of observations published in recent years. These observations relate chiefly to the HESPERIIDAE, but also to members of other families, attracted to the human skin, and to places where perspiration had apparently been deposited (*Proc. Ent. Soc. London*, 1916, p. lxxx, and 1917, p. lxxvii, also *Trans. Ent. Soc. London*, 1921, p. 407). The same observation was made regarding a Hesperid attracted to dried ink (*Proc. Ent. Soc.*, 1913,

p. xl), and the suggestion put forward that a study should be made of the composition of perspiration in relation to climate and mosquito attraction (*Proc. Ent. Soc.*, 1918, p. clxxiv). Another observation relates to butterflies of the African genus *Crenis*, which settled on the skin in numbers, apparently intent on perspiration, having been attracted thereto from a large gathering of the same species on the surface of a road (*Proc. Ent. Soc.*, 1927, p. 89).

Garments soaked in perspiration and hung up in the forest in Matto Grosso attracted several species, notably *Morphos* and *Ageronias*, and at least two species of *Hesperiid*. In these cases scent was certainly employed, and two *Morphos* alighted on a handkerchief within ten minutes of its first display. Each garment usually attracted one or two butterflies in the course of a morning, but the species affected were not common ones, and experiments were consequently unsatisfactory. The *Hesperiids* were frequently seen to apply moisture to the perspiration in the manner described in the above references, but although the garments were usually quite dry, no such action was seen with either *Morphos* or *Ageronias*. Both the latter were seen at moist spots on forest paths, and both were also attracted by animal manure. No butterflies were seen at any time on the coats of horses which were perspiring after work.

The forest haunting Pierid, *Itaballia demophile demophile*, L., was seen in Matto Grosso on several occasions assembled in numbers on dead leaves which covered the ground under large trees. The insects were usually somewhat scattered, and only males were present. A close examination failed to reveal the source of attraction.

Notes were made as to the behaviour and grouping of different species of butterfly on damp sand near streams. The following is a general summary, referring to the great majority of individuals and not to exceptional cases which were sometimes noticed. Furthermore, they relate only to the plateau of Matto Grosso, and not to the flat "pantanal" country to the southward, where different species were present in the gatherings.

The first list comprises those species which made up the main bulk of the assemblages. They followed each other to some extent in the air and associated closely on the sand without distinction of species.

Appias drusilla, Cram.

Daptonoura lysimnia bianca, Fruhst.

Catopsilia eubule sennae, L.

" *philea philea*, L.

" *argante argante*, Fab., and form *hirselia*, Cram.

" *trite*, L.

" *statira statira*, Cram.

Gonepteryx menippe ab. calypso, Röb.

Dismorphia licinia, Cram.

The following often mixed indiscriminately in the assemblages, but were sometimes to be found apart in small gatherings of their own.

Papilio agesilaus autosilaus, Bates.

" *protesilaus protesilaus*, L.

" *orthosilaus orthosilaus*, Weym.

" *telesilaus telesilaus*, Feld.

" *thyastes thyastes*, Drury.

Terias thymetus, Fab.

The following were sometimes to be found in the main gathering, but always on its outskirts, associating with their own kind and sometimes forming separate patches of colour. They were attracted by perspiration, but apparently not by the presence of the main gathering, and I did not see any of them descend to dead Catopsilias on the sand.

Megalura chiron, F.

Caria castalia marsyas, Godm.

Lasaia agesilas narses, Stgr.

Leptotes cassius, Cram.

Two or three species of HESPERIIDAE (not identified).

The following were also to be found on the sandspits, some preferring wet sand and others a rather dry surface. None of them was seen to come to my artificially formed perspiration bait, and they were often scattered over the surface, returning to different spots after being disturbed. Notwithstanding this, they showed a distinct preference for sandbanks where washing was done or animals had passed. An examination of their settling spots led me to think that in many cases there was nothing but the plain moisture of the sand to attract them, but also that they could perhaps detect a foreign substance in the sand, caused by the traffic, in more minute quantities than could the species enumerated above. The first three Papilios in the list often settled closely together. *Papilio polydamas* was sometimes grouped with its own species and at other times scattered. The *Libythea* and the *Haematera* were frequently present in very large numbers, showing a tendency to associate with those of their own species, but at other times spread out over a considerable area. The other species in the list were usually solitary.

Papilio thoas brasiliensis, R. & J.

„ *lycophron phanias*, R. & J.

„ *androgeus androgeus*, Cram.

„ *polydamas polydamas*, L.

„ *pausanias pausanias*, Hew.

„ *ariarathes gayi* form *cyamon*, Gray.

„ *dolicaon delleon*, Feld.

Heliconius clytia clytia, Cram.

Colaenis julia, Fab.

Megalura peleus, Sulz.

Historis orion orion, Fab.

Eunica margarita ingens, Seitz.

Haematera pyramus pyramus, Fab.

Libythea carinenta carinenta, Cram.

Several HESPERIIDAE.

Six or seven species of *Callicore* and *Catagramma* were taken more commonly on damp sand than in any other situation, but notes on their habits in different localities differ so widely that they cannot be usefully summarised. The commonest species, *Callicore clymena janeira*, Feld., was not usually attracted by perspiration, but was often found in numbers on old deposits of horse and cattle manure, which it shared mainly with *Terias*, LYCAENIDAE and HESPERIIDAE. When the rains commenced in August, it gradually deserted the sandbanks in favour of the forest, where, in certain spots, it would commonly be found settled to the number of ten or twenty on the leaves of a single tree.

A number of other butterflies paid occasional visits to the sand. Some of these were scarce in the district and no continuous notes on them could be made. Others, such as the common *Heliconius erato phyllis*, Fab., and *Anosia erippus*, Cram., made rare appearances of short duration, apparently for the sole purpose of absorbing moisture during hot weather.

A series was taken of each of the species haunting damp sand. These were almost exclusively composed of males, but the following females were taken on the sand:—One each of *Daptionoura lysimnia bianca*, *Catopsilia statira statira*, *Haematera pyramus pyramus* and *Papilio thoas brasiliensis*, and two of *Leptotes cassius*.

Experiments were made on the sand gatherings with paper models. Pieces of white paper, torn to the shape and size of a butterfly and placed upright in the sand, induced an occasional insect to hover for a moment and investigate, but not to settle. My best attempts to imitate the colouring with painted paper succeeded better, but as I did not go the length of modelling the body, the results had a flimsy appearance and were only partly successful. The dead butterflies which I used seemed as attractive as if they had been alive. In these experiments I could find no evidence of the employment of scent, but only of vision.

A dead specimen of *Catopsilia statira* floating down the stream attracted the attention of others flying above. They would hover closely over it for several seconds and seemed occasionally actually to touch it. A floating *Catopsilia* was quickly taken by fish when it arrived at a deep pool.

Two species of bird were commonly to be seen perched on trees and bushes near the butterfly assemblages. One was a Tyrant Flycatcher, which fed sometimes on butterflies but more often on the other insects which swarmed on the sand. It would fly down and settle among them, look round for a moment, pounce on an insect and carry it into a tree. A *Catopsilia trite* was taken (identity certain), and swallowed wings and all in three or four gulps. Another capture appeared to be a *Catopsilia statira*. These were the only butterflies among twenty or thirty other insects which I saw taken, but I attributed to the work of this bird the wings of two or three *Papilio protesilaus* which I found scattered under its usual perch. The other bird was the beautiful Jacamar, *Galbulia rufaviridis*, Cab., with long curved beak and brightly-coloured plumage. This, so far as my observation went, lived exclusively on butterflies, and could frequently be seen at work. Its method was to plane swiftly down from a branch, and with a loud snap of its bill catch a butterfly on the wing. It never rested on the ground, but occasionally made an unsuccessful snatch at a settled insect. Its favourite prey was one or other of the three very similar Papilios *P. protesilaus*, *P. telesilaus* and *P. orthosilaus*, probably the first of these, as the other two were not common. I have notes of seven attempts to catch these Papilios on the wing, of which four were successful, and others were unfortunately not recorded, to the number of five or ten. In all cases the butterfly was held by the body and shaken and brushed against a bough before being swallowed, and in only one instance were any of the wings broken off, and these fell into the stream. The Papilios on the sand were usually few in number among a large crowd of Catopsilias, yet they were obviously selected by the bird in preference to the others. In one instance a *Papilio pausanias* was chased high into the air, but was not captured. On another occasion three *Catopsilia statira* were taken in rapid succession by the same bird, two wings being dropped in one case but the others swallowed, no Papilios being present in the small gathering from which

they were taken. It is perhaps worth recording that I also saw the bird at close quarters with what certainly appeared to be an *Anosia gilippus gilippus*, Cram., in its bill. I did not see the insect in flight, and it was swallowed entire, and I quote the incident with some hesitation.

Dismorphia licinia was common in the gatherings of Catopsilias and Papilos, and the characteristic shape of the genus was not noticeable when it was settled. Its mimicry did not appear to be directed to any special species, but it was quite inconspicuous in an assemblage and difficult to pick out from the crowded insects.

The small lizards which swarmed in the bushes and driftwood surrounding a sandspit were never seen to feed on the butterflies.

THE ATTRACTION OF MOTHS TO HUMAN PERSPIRATION.

The most successful method of attracting moths at night in Matto Grosso was by means of human perspiration.

The method used was to hang up in trees and bushes a number of garments which had been previously worn. The freshness of the perspiration was immaterial, and when the same garments were hung up for several successive evenings, their power of attraction was increased rather than diminished. A garment rinsed in a stream to remove the perspiration was afterwards quite disregarded.

The table at the end of this paper shows, as an example, the catch of moths on 34 evenings in one locality. Of the 2044 insects collected, 29 were bred or taken with a net, 27 were caught on damp sand, 288 were taken at light, and exactly 1700 by means of perspiration in garments.

Damp sand was much less attractive than the garments, and over 90 per cent. of the moths seen on the sand were Geometers. They showed the same preference for fords, etc., as did the butterflies, but were less grouped and more scattered over the surface. Much the same numbers were present after rain, which seemed to show that moisture alone was not the attraction. It is possible, however, that the heat of the sun is necessary to bring out fully the attraction of small quantities of perspiration present in the sand. A rough count on an average evening in October gave 210 moths on an area of damp sand 20 yards by 4 in extent. Only a few specimens were actually collected from the sand, as the same species were more easily examined and bottled on the garments.

Taken on the garments was a large number of species that never appeared at light, but the latter was useful for those having a vestigial proboscis, which of course were never attracted to perspiration. The light consisted of two 400 candle-power petrol vapour lamps, with a screen of 8 ft. by 6 ft.

The garments which were used averaged 15 in number, hung at intervals of from 20 to 50 yards through open ground and forest. There was strong evidence that the moths were attracted from a comparatively small radius round each garment.

On some occasions upwards of 100 moths would be present on a single garment, and a count made during one "round" of 15 garments on an average evening (6th October) gave 246 specimens, of which 17 were taken. If the same proportion is used for the period of 34 evenings, the catch of 1700 moths gives over 24,000 as the number actually attracted.

The moths which came consisted of many species, the catch of 102 on Sept. 17th containing about 49, and that on Sept. 27th, with a catch of 120,

about 62 species. The falling off in the numbers taken towards the end of the list of evenings was due to a sufficient series of each of the commoner species having been secured. The full number of species taken by this means is not yet available, but a rough estimate of the moths seen on the garments, made at the close of the period, gave perhaps 45 per cent. of the total number as Noctuids, with Geometers 25 or 30 per cent., and Pyralids 10 or 15 per cent. Micros were not numerous, and there were no Sphingids. Ants and cock-roaches were attracted in numbers, together with some crickets and grasshoppers, but no Cicadas or Coleoptera were seen.

Experiments were made with garments worn by different persons, including the coat of a negro, and those of several Brazilians of Portuguese and mixed descent. No difference from my own garments in the degree of attraction could be detected in any case. A cloth used in rubbing down a horse which had been working scarcely attracted a moth, and none was seen to settle on the hide of horses or cattle after dark. On one occasion three small Geometers were present at the same time in the eye corners of a horse.

TABLE OF MOTHS TAKEN AT BURITY, MATTO GROSSO, FROM
SEPTEMBER 15TH TO OCTOBER 22ND, 1927, EXCLUDING DAY-FLYING
SPECIES.

	Sundries.	Bred.	Flying over marsh (Sphingids).	At light.	On damp sand.	At perspiration.	Total.
Sept. 15th .				26		7	36
16th .			6	8		60	74
17th .						102	102
18th .			1			60	61
19th .			4	1	1	80	86
20th .			2		5	56	63
21st .			5	2	4	64	75
22nd .				7		92	99
23rd .				4		96	100
24th .			1	1	1	29	32
25th .				1		107	108
26th .				1	1	107	109
27th .			1			120	121
28th .	3			17	1	20	41
29th .				26		25	51
30th .		1		15		92	108
Oct. 1st .				8	1	66	75
2nd .				34		67	101
3rd .				21		58	79
4th .				2		11	13
5th .			1	11	2	29	43
6th .				10	1	47	58
7th .				2		22	24
8th .				3		23	26
9th .	1			7	2	16	26
10th .						13	13
15th .				10		48	58
16th .				5	1	36	42
17th .				5	4	12	21
18th .				19	2	30	51
19th .				5	1	16	22
20th .				10		42	52
21st .				12			12
22nd .				15		47.	62
	4	4	21	288	27	1700	2044

A moonlight night made no noticeable difference in the numbers attracted to the garments, but the light of a lantern scared many of the insects.

If a garment were dipped quickly in a stream and hung up alongside a dry one, a slightly larger number of moths visited the former. This experiment was difficult to carry out on account of dew.

An interesting visitor to the garments was *Oxytenis modestia*, Cram., a member of a group (the OXYTENIDAE) formerly placed among the Saturniids, but distinguished from them by, among other features, the presence of a fairly strong proboscis. The proboscis in this species was undoubtedly used in feeding. The moth was present in some numbers, together with a Geometer, *Microgonia apidamia*, Cram., to which it bore a strong resemblance, and I did not realise for some time that I was dealing with separate insects.

During a trip in 1926 in French Guinea, West Africa, I frequently hung up garments in the evening to dry, as also did the porters who accompanied me, but no insects were seen to visit them. Although human perspiration is so attractive to moths in Matto Grosso and Eastern Bolivia, I have been unable to find any accounts of similar attraction in other parts of the tropics.

3. ON THE ODOUR OF TWO SPECIES OF *HELICONIUS*.

By C. L. COLLENETTE.

During the expedition a series of notes was taken on the odour of *Heliconius erato phyllis*, Fab., and *H. melpomene burchelli*, Poulton. (Plate XV, fig. 11.)

Neither species was really common, and the numbers secured, as shown in the list at the end of the paper, represent all that could be netted.

Each specimen was tested for scent while still in the net, the following standard being adopted :—

SLIGHT SCENT. Where no odour was perceptible until the insect was held close to the nose and carefully tested.

FAIRLY STRONG SCENT. Where the odour was plainly perceptible at once, from several inches away.

STRONG SCENT. In which the odour was perceptible as soon as the insect was in the net.

VERY STRONG SCENT. A single instance in which the odour was detected by another observer at a distance of 6 yards.

The two species were not recognised as such until after their arrival in England, which adds to the interest of the observation made on the odour of *H. melpomene burchelli*. The note on the single specimen recorded as having scent reads : "Resembling that of a twig of elder freshly broken."

In all cases the odour of *H. erato phyllis* was that of witch-hazel, similar to that of *H. erato hydatus*, Hew., in the Panama Canal Zone.

The age of the insects when caught, indicated by the degree of fading in the red band, affords no criterion as to the strength of the scent. Fresh and faded insects are present in each category, scent being present in a slightly higher proportion of the faded specimens.

It was noted that the scent did not appreciably increase if the butterfly was held in the fingers and allowed to struggle. When the cyanide bottle was opened after an insect had been imprisoned for some minutes, the odour was often very strong, seeming to indicate that the scent-glands had been brought into play.

At Urucum, some 250 to 300 miles south of the other localities, no *H. melpomene* were met with. In the remaining areas both species flew together, *H. erato* being always the more common.

From the table below it will be seen that 10·5 per cent. of the ♂♂ of *H. erato phyllis* are recorded as smelling, which increases to 65·1 per cent. in the ♀♀. For *H. melpomene burchelli* the single record of odour represents 2·56 per cent. of the ♂♂.

Two ♂ specimens of *H. erato* show "beak marks" on the wings, and although the butterfly has a somewhat leisurely flight, its power of dodging and acceleration on being alarmed are considerable. The fact that the odour is present in both sexes of the insect seems to indicate that it may have a protective value. The relative commonness of *H. erato* over *H. melpomene*, together with the scarcity of scent in the latter, supports the view of model and mimic suggested in Dr. Eltringham's paper on "Mimetic Relationships in the genus *Heliconius*," *Trans. Ent. Soc. London*, 1916, p. 101.

LIST SHOWING NUMBERS OF *HELICONIUS ERATO* AND *H. MELPOMENE*
TAKEN IN LOCALITIES IN MATTO GROSSO, WITH PERCENTAGE OF
SPECIMENS HAVING SCENT.

	Specimens taken.	Percentage.	Urucum.	Cuyaba.	Buriti, 1st visit.	Buriti, 2nd visit.	Tombador Sítio.	Tombador Falls.	Melguira.	Rio de Casca.
<i>Heliconius erato phyllis.</i>										
MALE.										
No scent . . .	102	89·5	6		43	5	25	1	21	1
Slight scent . . .	6	5·2	2			2	1		1	
Fairly strong scent . . .	5	4·4	1		3				1	
Strong scent . . .	1	·9		1						
	114	100	9	1	46	7	26	1	23	1
FEMALE.										
No scent . . .	22	34·9	1	1	12					
Slight scent . . .	7	11·1	2		1	2	2			
Fairly strong scent . . .	22	34·9			6	7	7		2	
Strong scent . . .	11	17·5	1	1	6		2		1	
Very strong scent . . .	1	1·6			1					
	63	100	4	2	26	9	19		3	
<i>Heliconius melpomene burchelli.</i>										
MALE.										
No scent . . .	38				28	2	1	1	6	
Fairly strong scent . . .	1				1					
	39				29	2	1	1	6	
FEMALE.										
No scent . . .	12				9		1		2	

4. SYSTEMATIC ACCOUNT OF THE BUTTERFLIES CONCERNED,
TOGETHER WITH DESCRIPTIONS OF NEW FORMS.

By G. TALBOT.

The butterflies here listed and described comprise only those dealt with in Mr. Collenette's paper. All types are in the collection of Mr. J. J. Joicey at the Hill Museum.

Family PIERIDAE.

1. *Dismorphia astynome*, Dalm. (1823). Plate XIV, figs. 1 and 2. 6 ♂♂, 3 ♀♀. A variable species. The yellow band on the fore-wing is generally broken, the apical spots are usually small and the upper one is sometimes absent. In a ♂ from Burity the apical spots are very large, the lower one a little larger than the discal spot in 2, but in this specimen the discal spots of the band are smaller than usual. In a ♂ from Rio Serragem the discal spots are very large and are joined to form a broad band which encloses a black discal spot. The two ♀♀ from Tombador Sitio also show a broad yellow band which is slightly narrower than in the ♂ from the Rio Serragem (1½ miles distant). The single ♀ from Burity agrees with 4 of the 5 ♂♂ from this place in having a broken band, but the spots are smaller.

Family DANAIIDAE.

2. *Lycorea ceres atergatis*, D. & H. (1847). Plate XIV, fig. 3. 16 ♂♂, 8 ♀♀. The series is fairly constant and only in one specimen (Rio Serragem) is there a tendency for the spots in cellule 3 to become joined. The submarginal spot in 3 is variable with a tendency to reduction in size and in 2 from Serragem and 1 from Burity, this spot is entirely absent.

3. *Lycorea halia*, Hbn. (1816). Plate XIV, fig. 4. 1 ♂, 2 ♀♀. Also ab. *referrens*, Hnsch. (1909). Plate XIV, fig. 5. 1 ♂, 1 ♀. These are typical, with complete broad band on the fore-wing.

4. *Hirsutis pseudonyma pseudonyma*, Stgr. (1894). Plate XIV, fig. 6. 63 ♂♂, 33 ♀♀. The series is fairly typical except that in 5 ♂♂ and 1 ♀ the hind-wing shows a yellow discal band, and thus approaches the southern race *pseudeithra*, Butl. (1873). The band of the fore-wing is variable and is rather broad in 31 specimens. The discal spots of the hind-wing vary in number. There is always a spot in cellule 4 and in 3, but others may be absent. In most specimens there are three spots, in others four, and in a few there are five spots in 4, 3, 2, 1c, 1b.

5. *Mechanitis polynnia*, L. *angustifascia*, subsp. nov. Plate XIV, fig. 7. ♂ ♀.—Partakes of the characters of the typical form and of *veritabilis*, Butl. (1873). The apical patch on the fore-wing is absent in some specimens, vestigial in the great majority, and distinct in a few, but never so marked as in some other races, thus resembling the typical form. Band of the fore-wing broader than in *veritabilis*, but narrower than in *polynnia* from the Lower Amazon. Black band of the hind-wing narrower than the width between its lower edge and the outer edge of the brown ground-colour in the great majority of specimens. In a few specimens there is an approach to the form *casabranca*, Hnsch. (1905), in the presence of a yellow anterior border to the discal band.

Underside of hind-wing with the black subcostal band very narrow, much less heavily marked than in the allied forms.

The antennae are, in the great majority, two-thirds yellow, but in some cases the yellow is reduced until in extremes only the club is coloured.

Hab.—Matto Grosso : Rio Serragem, 1500 feet, 20.viii.27 (δ Type), 12.vii.27 (φ Allotype), also 176 $\delta\delta$, 95 $\varphi\varphi$, 12–27.viii.; Tombador Sitio, 1500 feet, 24.vii.–28.viii.27, 33 $\delta\delta$, 25 $\varphi\varphi$; Melguira, 2000 feet, 24.v.–3.vi.27, 3 $\delta\delta$, 1 φ ; Burity, 2250 feet, 11.vi.–14.vii.27, 1 δ , 2 $\varphi\varphi$; Nobrés, 1250 feet, 21.v.27, 5 $\delta\delta$, 1 φ .

6. *Mechanitis elisa*, Guér., *connectens*, subsp. nov. Plate XIV, fig. 8.

$\delta\varphi$.—The yellow discal spot in cellule 2 of the fore-wing is placed more proximal than in allied forms, and its anterior edge is produced proximally to touch the cell-spot or to become merged with it in some specimens. The form *elisa* occurs in only a few examples. In 13 specimens the yellow band is complete with, at the most, a minute black spot at the base of cellule 2; this extreme form is not taken as the type.

Hab.—Matto Grosso : Rio Serragem, 1500 feet, 12.viii.27 (δ Holotype), 24.viii.27 (φ Allotype), also 153 $\delta\delta$, 58 $\varphi\varphi$, 12.viii.–27.viii.27, also f. *elisa* 2 $\delta\delta$, 14 $\varphi\varphi$, and 1 φ approaching f. *ocona*, Druce (1876); Tombador Sitio, 1500 feet, 24.vii.–28.viii.27, 45 $\delta\delta$, 26 $\varphi\varphi$, also f. *elisa* 1 δ , 3 $\varphi\varphi$; Tombador Falls, 2000 feet, 8.viii.27, 1 φ ; Burity, 2250 feet, 3.vii.27, 1 φ ; Melguira, 2000 feet, 24.v.27, 1 φ ; Nobres, 1250 feet, 21.v.27, 2 $\delta\delta$, 1 φ , and f. *elisa* 1 φ .

7. *Mechanitis lysimnia*, Fabr. (1793). Plate XIV, fig. 9. A single φ from Rio Serragem, 1500 feet, 18.viii.27.

8. *Ceratinia cantabrica pamina*, Hnsch. (1905). Plate XIV, fig. 10. 110 $\delta\delta$, 197 $\varphi\varphi$. The series is fairly constant. A few specimens have the posterior part of the yellow band separated from the anterior part, and some specimens have the black mark on the hind-wing absent.

9. *Ceratinia nina*, Hnsch., *chapadensis*, subsp. nov. Plate XIV, fig. 11.

$\delta\varphi$.—Distinguished by the broader and more sharply defined yellow band on the fore-wing. The black border of the hind-wing is in most specimens broader than in the typical form.

Hab.—Matto Grosso : Burity, 2250 feet, 21.vi.27 (δ Holotype), 18.vi.27 (φ Allotype), also 31 $\delta\delta$, 12 $\varphi\varphi$, 11.vi.–14.vii.27, and 1 δ , 13.ix.27.

10. *Sais rosalia*, Cram., *brasiliensis*, subsp. nov. Plate XIV, fig. 12.

$\delta\varphi$.—Allied to *paraensis*, Hnsch. (1905). The yellow band of the fore-wing is narrower beyond the cell and is much narrower posteriorly. Hind-wing with reduced discal spots and no spot in cellule 2, or with this spot vestigial. Underside with reduced white dots and smaller black spots on the hind-wing.

Hab.—Matto Grosso : Rio Serragem, 1500 feet, 24.viii.27 (δ Holotype), 25.viii.27 (φ Allotype), also 5 $\delta\delta$, 6 $\varphi\varphi$, 12.viii.–27.viii.27; Tombador Sitio, 1500 feet, 24.vii.–28.viii.27, 8 $\delta\delta$, 7 $\varphi\varphi$; Tombador Falls, 2000 feet, 8.viii.27, 1 φ ; Burity, 2250 feet, 20.vi.27, 1 δ ; Melguira, 2000 feet, 2.vi.27, 1 δ , 31.v.27, 1 φ .

11. *Dircenna dero dero*, Hbn. (1823). Plate XV, fig. 9. 6 $\delta\delta$, 6 $\varphi\varphi$ from Burity, 2250 feet, 11.vi.–14.vii.27, and from Rio Serragem, 1500 feet, 12.viii.–27.viii.27.

12. *Dircenna zelia epidero*, Bates (1862). Plate XV, fig. 10. Burity, 2250 feet, 11.vi.–14.vii.27, 4 $\delta\delta$, 3 $\varphi\varphi$, 6.ix.27, 1 φ ; Rio Serragem, 1500 feet, 12.viii.27, 1 φ . A variable form. The $\delta\delta$ taken do not show a very marked transverse band on the hind-wing. The $\varphi\varphi$ vary in the amount of black, and in the presence or absence of reddish-brown marks on the margins of the hind-wing and at the base of the fore-wing.

13. *Episcada clausina striposis*, Hnsch. (1909). Plate XV, fig. 1. 1 ♂, 18.vi.27 & 1 ♀, 20.vi.27, from Burity, 2250 feet.

There is a ♀ in the B.M. from Chapada, Matto Grosso.

14. *Episcada hymenaea hymenaea*, Pritt. (1865). Plate XV, fig. 2. Rio Serragem, 1500 feet, 18.viii.27, 1 ♂, 1 ♀.

15. *Aeria elodina*, Stgr. (1885). Plate XV, fig. 8. A single ♀ from Burity 2250 feet, 9.ix.27.

16. *Aeria olena*, Weym. (1875). Plate XV, fig. 7. A series of 101 ♂♂ & 51 ♀♀ from the Rio Serragem and Tombador Sitio. All varying greatly in size, but otherwise very constant.

17. *Hypoleria consimilis*, sp. nov. Plate XV, fig. 3.

♂ ♀.—Allied to *oreas*, Weym. (1899), and of about the same size. Fore-wing with broader black apex and strongly-marked white band reaching vein 5, the space between this and the black margin being much narrower than in *oreas*. The black half-band as in *oreas*, but with a tendency to be broader. Two whitish submarginal spots in 4 and 5, much larger than in *oreas*, a submarginal spot in 2 as in *oreas*, and a submarginal dot in 3. Hind-wing margins as in *oreas*.

Length of fore-wing—♂ 26 mm., ♀ 25 mm.

Hab.—Matto Grosso : Burity, 2250 feet, 13.vi.27 (♂ Holotype), 21.vi.27 (♀ Allotype), also 2 ♂♂, 12.vi.27, 1 ♂, 17.vi.27, 5 ♂♂, 18.vi.27, 1 ♂, 30.vi.27, 1 ♀, 12.ix.27. In the B.M. from Casabranca, S. Paulo, Brazil (1), and Chapada, Matto Grosso (7).

18. *Pseudoscada quadrifasciata*, sp. nov. Plate XV, fig. 4.

♂ ♀.—Allied to *utilia*, Hew. (1856). The white band of the fore-wing does not reach vein 5 and forms a large square patch, diffuse on its posterior edge, instead of a narrow band. The black discocellular band is broader than in *utilia*, and is not pointed. There is a small whitish spot in cellule 4 and four submarginal spots as in *utilia*. Abdomen below grey-white as in *utilia*.

Length of fore-wing—♂ 22.5 mm., ♀ 21 mm.

Hab.—Matto Grosso : Burity, 2250 feet, 18.vi.27 (♂ Holotype), 19.vi.27 (♀ Allotype), also 2 ♂♂, 1 ♀, 18.vi., 1 ♂, 21.vi.27, 1 ♀, 28.vi.27, 1 ♀, 30.vi.

19. *Pseudoscada arzalia*, Hew. (1876). Plate XV, fig. 5. 165 ♂♂, 182 ♀♀. This series is rather constant. The black apex of the fore-wing is a little broader than in Hewitson's figure, but agrees with the figure in Seitz (v. pl. 41b) with which the series also agrees in the size of the black half-band.

A specimen in the B.M. from Chapada, Matto Grosso, is also to be referred to the above.

20. *Pseudoscada collenettei*, sp. nov. Plate XIV, fig. 13.

♂ ♀.—This species is remarkable for its close resemblance to *Pteronymia antisao*, Bates (1862), and is so distinguished from any other species of *Pseudoscada*.

Allied to *salonina*, Hew. (1855), but differs abundantly in the yellowish-brown coloration of both wings due to the minute hairs which take the place of scales on the semi-hyaline area. Fore-wing with yellow post-discal band in *salonina* and with a similarly shaped black-brown discal patch. Veins 4-4 striped with brown. A slight yellow stripe in cellule 2, accentuated at the margin, more prominent than in *salonina*. Hind-wing with the veins strongly yellow-brown.

Length of fore-wing—25.5 mm.

Hab.—Matto Grosso : Rio Serragem, 1500 feet, 16.viii.27 (♂ Holotype),

24.viii.27 (♀ Allotype), also 1 ♂, 18.viii.27, 1 ♀, 12.viii.; Tombador Sitio, 1500 feet, 29.vii.27, 1 ♀.

21. *Pseudoscada emyra*, Hnsch. (1905). Plate XV, fig. 6. 1 ♂ from Burity, 18.vi.27. A ♀ of this species is in the Hill Museum from Minas Geraes.

The ♂ above was taken in primeval forest flying with *P. arzalia*, which it very closely resembles. It differs from this species, however, not only by the pattern as described by Haensch, but also, to a very marked degree, in the genitalia.

22. *Heterosais edessa nephele*, Bates (1862). Plate XV, fig. 12. 39 ♂♂, 36 ♀♀ from Rio Serragem, 1500 feet, 12.viii.-27.viii.27, and Tombador Sitio, 1500 feet, 24.vii.-28.viii.27. The series is very constant.

Family NYMPHALIDAE.

23. *Actinote pellenea calymma*, Jord. (1913). A single ♀ from Cuyaba, 13.v.27.

24. *Actinote parapheles parapheles*, Jord. (1913). 2 ♂♂, 5 ♀♀ from Burity, 11.vi.-14.vii.27.

25. *Heliconius numata metalilis*, Butl. (1873). Burity, 2250 feet, 21.vi.27, 1 ♂, 22.vi.27, 1 ♀, 3.vii.27, 1 ♀.

26. *Heliconius melpomene burchelli*, Poulton (1910). Plate XV, fig. 11.

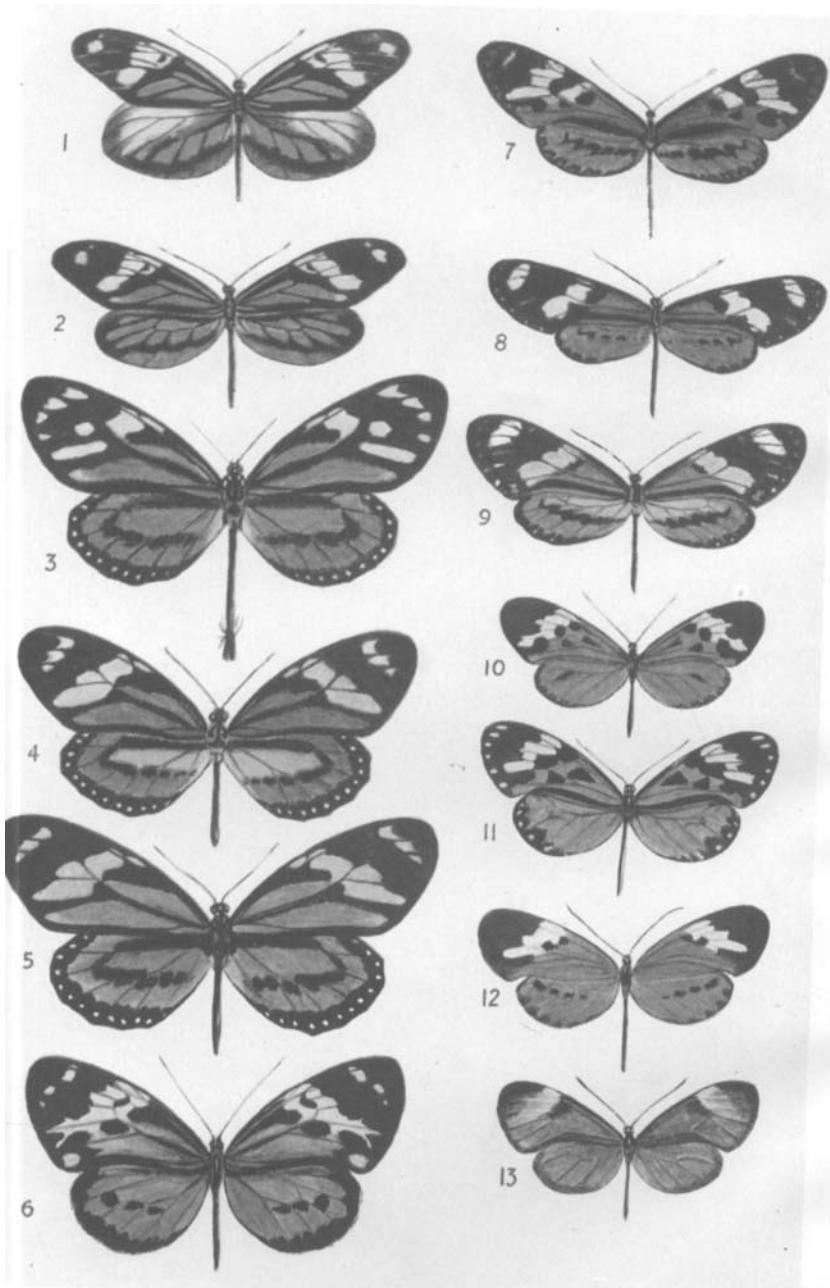
Burity, 2250 feet, 29 ♂♂, 9 ♀♀, 11.vi.-14.vii.27, 2 ♂♂, 6.ix.-22.x.27; Tombador Sitio, 1 ♂, 1.viii.27, and 1 ♀, 6.vi.27; Tombador Falls, 1 ♂, 9.viii.27; Melguira, 6 ♂♂, 2 ♀♀, 24.v.-3.vi.27.

27. *Heliconius erato phyllis*, Fbr. (1775). 114 ♂♂, 63 ♀♀.

The red band is rather variable and is less sharply defined on its proximal edge in cases where it enters the cell. In some cases also the band is prolonged proximally at its lower edge to touch the yellow median stripe.

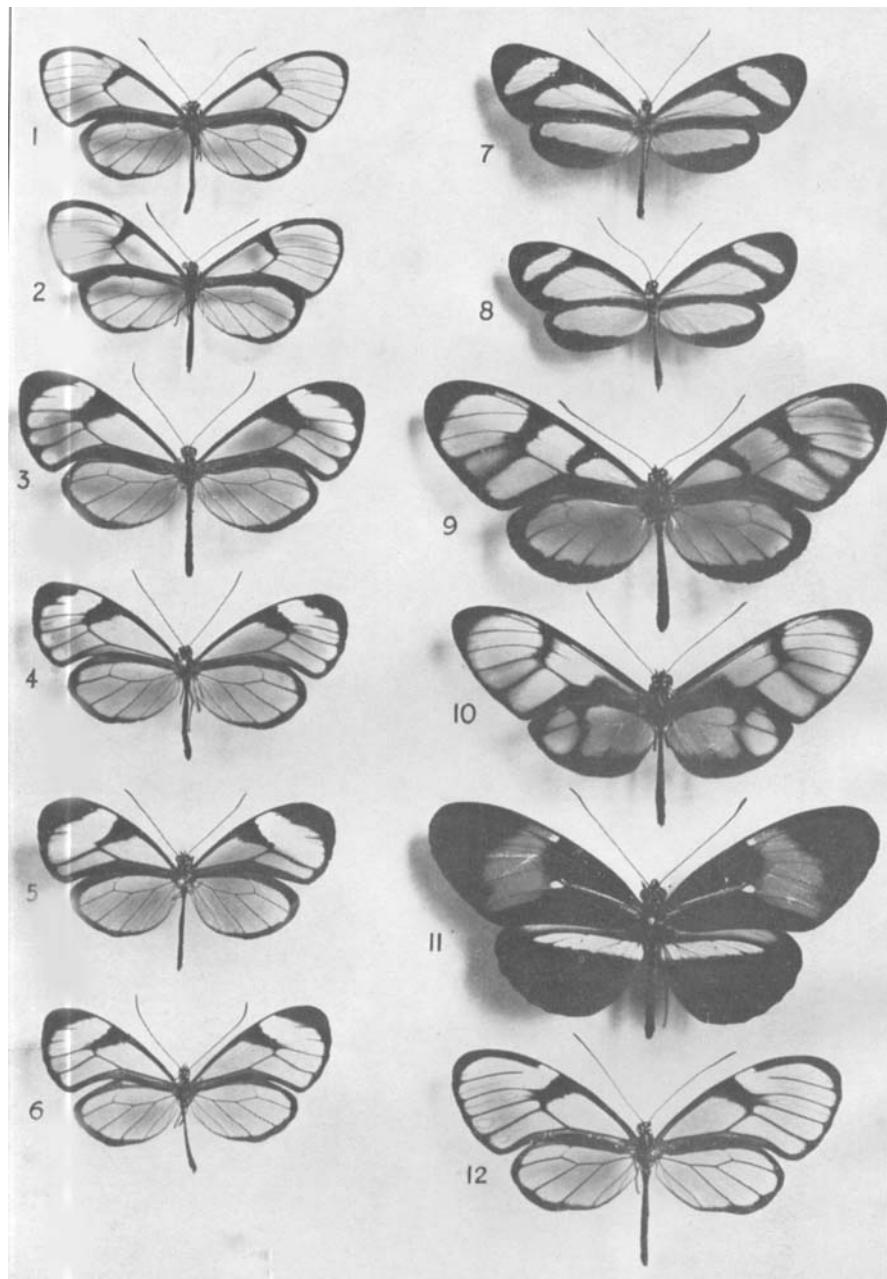
28. *Eueides vibilia unifasciatus*, Butl. (1873). 121 ♂♂, 35 ♀♀, from Cuyaba, 9.v.-19.v.27, together with f. *vibilia*, Godt. (1819), 9 ♂♂, 4 ♀♀; 9 ♂♂, 9 ♀♀ from Burity, 2250 feet, 11.vi.-14.vii.27, together with 2 ♂♂, 1 ♀ f. *vibilia*, Godt., 1 ♀ from the Rio Serragem, 1500 feet, 12.viii.-27.viii.27; 1 ♂, 1 ♀ from Tombador Falls, 2000 feet, 6 & 8.viii.27; 1 ♀ from Nobres, 21.v.27.

The form *unifasciatus* is not altogether stable as a few *vibilia* occur with it, besides some slight intermediates. The discal spots on the fore-wing of the ♂ are in some cases much paler than the other markings.



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BUTTERFLIES OF MATTO GROSSO, BRAZIL.
MECHANITIS COMBINATION.



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BUTTERFLIES OF MATTO GROSSO, BRAZIL.

EXPLANATION OF PLATES.

PLATE XIV.

MECHANITIS COMBINATION.

- FIG. 1. *Dismorphia astynome*, Dalm., ♂. Rio Serragem, August 25th, 1927.
2. *Dismorphia astynome*, Dalm., ♀. Tombador Sitio, August 15th, 1927.
3. *Lycorea ceres atergatis*, D. & H., ♂. Rio Serragem, August 14th, 1927.
4. *Lycorea halia*, Hbn., ♂. Burity, June 14th, 1927.
5. *Lycorea halia* ab. *referrens*, Hnsch., ♀. Burity, July 3rd, 1927.
6. *Hirsutis pseudonyma pseudonyma*, Stgr., ♀. Rio Serragem, August 16th, 1927.
7. *Mechanitis polymnia*, L., *angustifascia*, subsp. nov., ♂ Type. Rio Serragem, August 20th, 1927.
8. *Mechanitis elisa*, Guér., *connectens*, subsp. nov., ♂ Type. Rio Serragem, August 12th, 1927.
9. *Mechanitis lysimnia*, Fab., ♀. Rio Serragem, August 18th, 1927.
10. *Ceratinia cantabrica pamina*, Hnsch., ♀. Rio Serragem, August 12th, 1927.
11. *Ceratinia nina*, Hnsch., *chapadensis*, subsp. nov., ♂ Type. Burity, June 21st, 1927.
12. *Sais rosalia*, Cram., *brasiliensis*, subsp. nov., ♂ Type. Rio Serragem, August 24th, 1927.
13. *Pseudoscada collenettei*, sp. nov., ♂ Type. Rio Serragem, August 16th, 1927. Illustrated against a dark background.

PLATE XV.

- FIG. 1. *Episcada clausina striopsis*, Hnsch., ♂. Burity, June 18th, 1927.
2. *Episcada hymenaea hymenaea*, Pritt., ♀. Rio Serragem, August 18th, 1927.
3. *Hypoleria consimilis*, sp. nov., ♂ Type. Burity, June 13th, 1927.
4. *Pseudoscada quadrifasciata* sp. nov., ♂ Type. Burity, June 18th, 1927.
5. *Pseudoscada arzalia*, Hew., ♀. Rio Serragem, August 16th, 1927.
6. *Pseudoscada emyra*, Hnsch., ♂. Burity, June 18th, 1927.
7. *Aeria olena*, Weym., ♂. Rio Serragem, August 25th, 1927.
8. *Aeria elodina*, Stgr., ♀. Burity, September 9th, 1927.
9. *Dircenna dero dero*, Hbn., ♂. Rio Serragem, August 14th, 1927.
10. *Dircenna zelie epidero*, Bates, ♂. Burity, June 30th, 1927.
11. *Heliconius melpomene burchelli*, Poulton, ♂. Burity, June 23rd, 1927.
12. *Heterosais edessa nephele*, Bates, ♂. Rio Serragem, August 14th, 1927.

PLATE XVI.

Injuries probably inflicted by birds. Photograph taken by transmitted light.

- FIG. 1. *Ceratinia cantabrica pamina*, ♀. Rio Serragem, August 12th, 1927. Beak mark on both fore-wings. The insect was captured when settled, or possibly with wings together in flight.
2. *Mechanitis elisa connectens*, ♂. Rio Serragem, August 18th, 1927. Beak mark on both fore-wings, continued on hind-wings. The impression is of a long, rather narrow beak, and the insect was captured when settled, or possibly with wings together in flight.
3. *Ceratinia cantabrica pamina*, ♂. Rio Serragem, August 16th, 1927. Beak mark on left fore-wing, and another on left hind-wing, probably made during one attack, by the same bird.
4. *Mechanitis polynnia angustifascia*, ♂. Rio Serragem, August 14th, 1927. Beak mark on right hind-wing, similar to that in Fig. 5.
5. *Mechanitis elisa connectens*, ♀. Rio Serragem, August 14th, 1927. Beak mark on left hind-wing. The insect was evidently seized from in front, and the injury to the corresponding fore-wing may have been caused by friction against the base of the bird's beak.
6. *Hirsutis pseudonyma pseudonyma*, ♂. Rio Serragem, August 20th, 1927. Two parallel beak marks on the left hind-wing, the inner one extending to the fore-wing. The outer marks probably show movement of the wing in an insecure grip.
7. *Mechanitis polynnia angustifascia*, ♂. Rio Serragem, August 12th, 1927. Beak mark on right hind-wing.
8. *Mechanitis elisa connectens*, ♂. Rio Serragem, August 12th, 1927. Marks on right fore-wing, continued in one case to the hind-wing, and perhaps made by the same bird. The two longer marks, however, may possibly be due to creasing of the wings in the net during capture. This type of injury is not common.
9. *Sais rosalia brasiliensis*, ♂. Rio Serragem, August 24th, 1927. Beak mark on left fore-wing, faintly duplicated nearer the outer margin.

PLATE XVII.

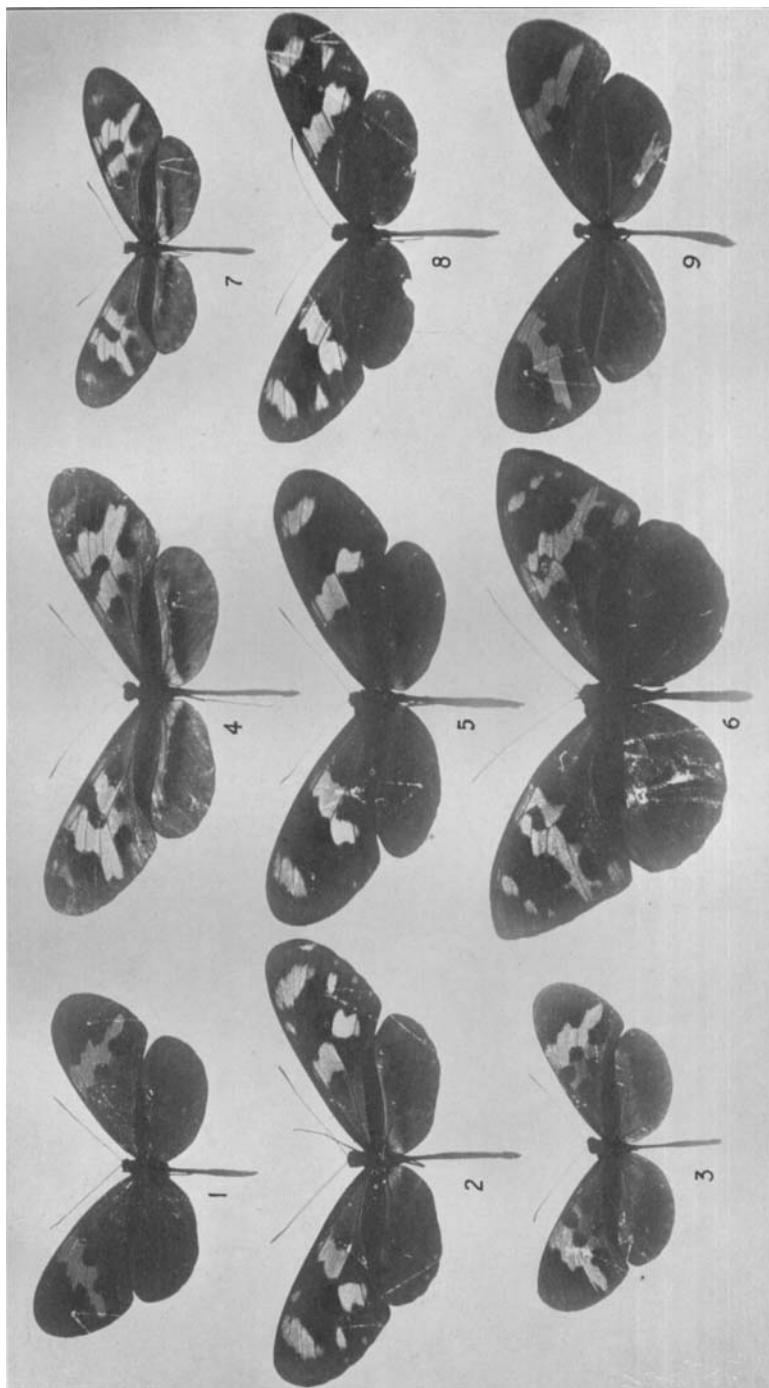
A view in the Rio Serragem "oasis," looking towards the tributary shown in Plate XVIII. Imperial Eclipse plate. Stop f. 10. Exposure 2 seconds.

PLATE XVIII.

Looking up the course of the tributary, Rio Serragem "oasis." Imperial Eclipse plate. Stop f. 10. Exposure $\frac{1}{2}$ second.

PLATE XIX.

Butterflies at damp sand. Including *Catopsilia statira* (the majority), *C. argante*, *C. philea*, *Papilio thyastes* (on right), *Megalura chiron* (on left), and *Libythea carinenta* (on extreme left). Burity, October 2nd, 1927.



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INJURIES PROBABLY INFlicted BY BIRDS. MECHANITIS COMBINATION.

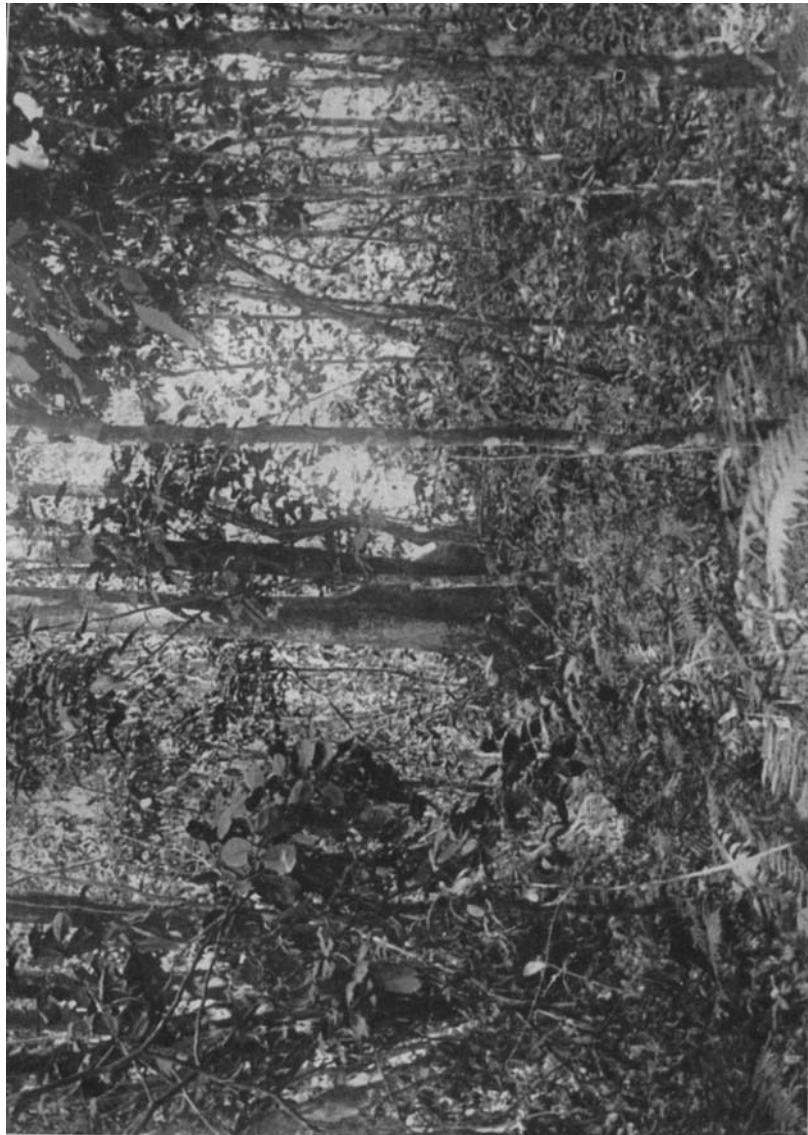


Photo. C. L. Collenette.

A VIEW IN THE RIO SERRAGEM "OASIS."

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Photo. C. L. Collenette.

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LOOKING UP THE COURSE OF THE TRIBUTARY, RIO SERRAGEM

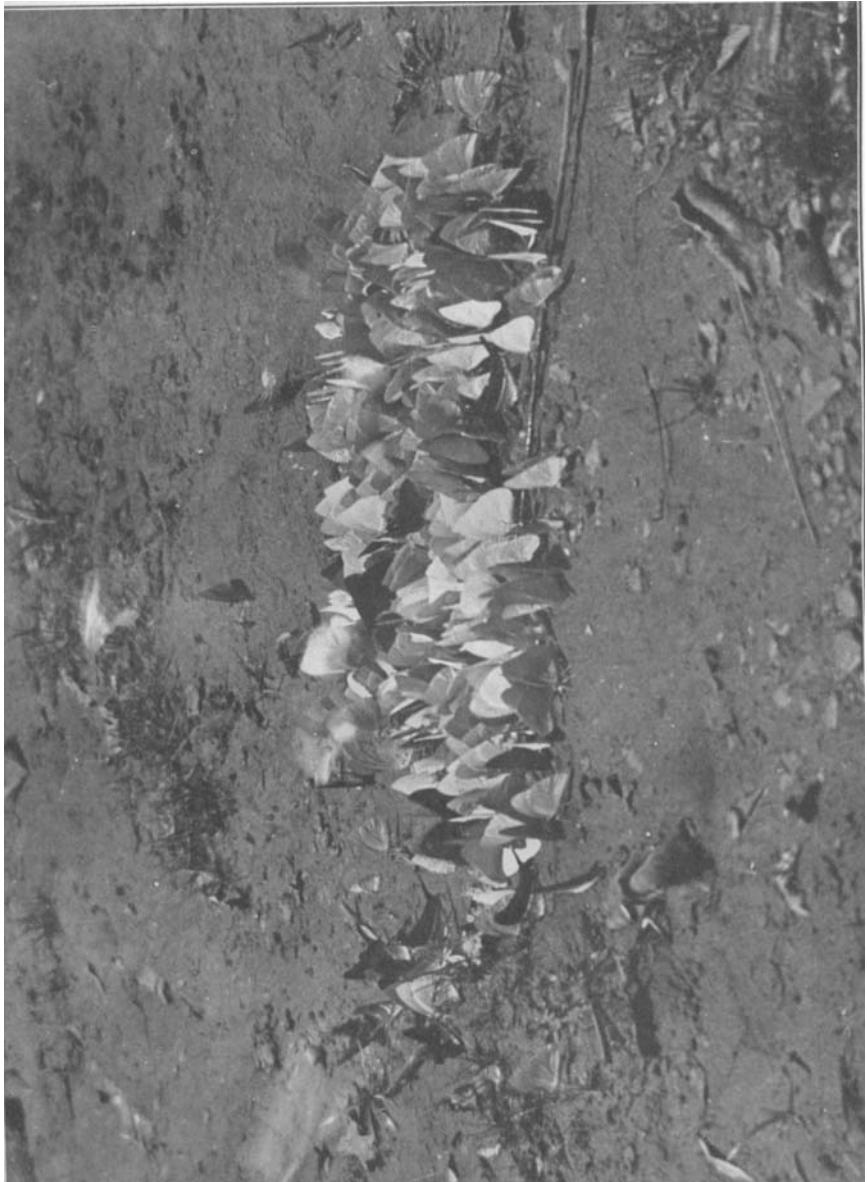


Photo. C. J. Callophryne.

BUTTERFLIES AT DAMP SAND

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