

XIX. *Contributions to an Insect Fauna of the Amazon Valley.* By H. W. Bates, Esq., Cor. Memb. Ent. Soc.

PART I. DIURNAL LEPIDOPTERA.

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In treating of the Insect Fauna of the Amazon Valley in the present and subsequent papers, I shall have to speak of the region, investigated by myself during seven years' travel and residence, as divided into three great districts; viz. Upper Amazon, Lower Amazon and Pará. It will be necessary, therefore, to commence with defining the limits of these sub-divisions, and adducing some of the reasons for establishing them. The Upper Amazon, then, is that portion of the Valley which, commencing at the eastern foot of the Andes, near the mouth of the Huallaga, in 70° W. long., extends on the north side to the right bank of the river Negro in about 52°; and on the south side to the left bank of the Madeira in 58° 20' W. long. The Lower Amazon commences at these points, and extends, on the north side, to the mouth of the river at Macapá, and on the south to the left bank of the Xingú, in about 48° W. long. The Pará district, comprising the southern half of the Delta of the Amazon, begins at the right bank of the Xingú and terminates at the mouth of the river near Pará in 48° W. long., including the southern and eastern shores of the island of Marajó.

The three districts thus defined, although forming one and the same river valley, presenting a range of latitude of at most not more than three or four degrees, offer a great diversity in their Zoological productions. If we take as an example the distribution of the species of the first and most conspicuous group of Diurnal Lepidoptera,—the genus *Papilio*,—we shall find the following data:—

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| Total number of species and distinct local sub-species | 41 |
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| Common to all three districts (seven being widely distributed non-tropical species) | 10 |
| Common to Upper and Lower Amazon only .. | 4 |
| .. Lower Amazon and Pará | 2 |
| Peculiar to Upper Amazon | 12 |
| .. Lower Amazon | 2 |
| .. Pará | 8 |

This result in an extent of country offering no great natural barriers to Zoological distribution, situated within the same parallels of latitude, and offering a great uniformity of mean temperature (about 81° Fahr.), will be contrary to the preconceived notions of most Zoologists on the subject. The whole country, too, presents no diversity of elevation, so contrary to other wide continental regions, and the rise from the Atlantic towards the Andes is so slight, that at Tabatinga, 1,500 miles from the mouth of the river, the height is only 420 feet above the sea level. But, in fact, there are other minor climatal conditions which operate, obscurely, but not less effectively, in influencing the animal and vegetable population of a country; and these it is the proper business of a faunist to point out. In the first place, the high lands of Guiana on the north, and of central Brazil on the south, towards the middle part of the Lower Amazon, approximate the banks of the river. They not only diminish the breadth of the river valley and the extent of the alluvial low lands, but they furnish from the detritus of their own igneous rocks a lighter and less prolific soil than that of the rich alluvial plains of the Upper Amazon and Pará. Through the soil the vegetation is affected; the forests are not only less dense and lower in height, but composed of a different class of trees. Through the soil and the scanty nature of the forests the meteorological forces are affected. The dry and the wet seasons are far more strongly contrasted here than in the other parts of the Amazon's course. Whilst at Pará or at Ega there is never a long uninterrupted dry season, rain falling more or less throughout; at Santarém and Vila Nova there is a season of always four, sometimes six months, without a shower; the dry woods become parched, and the periodical phenomena in animal and vegetable life present different features from those of the other two districts. The hills which compose the two ranges of highlands here alluded to are, however, of very small elevation; they are highest between Monte Alegre and Almeirim, below Santarém, where they form a line of flat-topped ridges or truncated pyramids, sometimes bare, sometimes wooded; and with the mag-

different river, here three or four miles broad, form, what the botanical traveller Poeppig, who describes with so much feeling the scenery of the Andes in crossing the continent, "eine unbeschreiblich herrliche Landschaft." Westward they terminate on the north at the mouth of the Trombetas, although the elevated land extends as far as the Rio Negro. On the south the hills are conspicuous only along the coast, extending about 100 miles below Santarém; westward the high undulating country continues at some distance from the river, past Vila Nova to the banks of the Madeira. The whole of this district, however, is not quite uniform in its physical features. In the low lands and the islands in mid-river, especially at the mouths of the rivers, the soil and the forests are very similar to those of the other two regions; but the general character of the country is such as I have described, and its zoological characters equally peculiar. The Upper Amazon and Pará, as we have seen, have more resemblance with each other, in their physical features, than either have with the Lower Amazon. Both have extremely humid climates and a uniform low land. The amount of rain which falls in either is probably nearly alike, but the seasons are rather differently apportioned; a circumstance which must affect in some degree animal life. The Pará region, too, is within the influence of the tides; daily the low lands are twice saturated with humidity. The Upper Amazon, on the contrary, has only the periodical rise and fall of the river; six months' ebb and six months' flow. During the one season the soil is left free from humidity, and during the other thoroughly saturated with it. Pará is affected by the daily sea breeze, while the Upper Amazon has a generally stagnant, sultry air, or winds of inconstant direction and short duration. The soil, too, is generally much lighter and more sandy in the Pará district than on the Upper Amazon, where it is wholly composed of clay and loam. The breadth of the alluvial plain of the Upper Amazon must be far greater than that of any other part of this great river valley; and throughout the whole region there is the same uniformity of soil and climate. Its insect fauna is very rich, containing many species peculiar to itself. The individuals of the species common to it and the Lower Amazon or Pará are generally larger and more brilliantly coloured, or are subject to remarkable variations, whilst very constant in the other districts. Another feature of its fauna is the resemblance to that of the Andean valleys of Bogotá and Bogotá, a resemblance which increases with every 100 miles in ascending the river. It is well known that the richness of colour, variety of form and number of species of Diurnal Lepidoptera, already so great along the Atlantic coast of South

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America, increase as we approach the eastern slopes of the Andes and culminate in the neighbourhood of Bogotá. There is a feature in the atmospheric conditions of this region which ought to be noticed in connection with this subject. Lieutenant Herrera (the American traveller) and M. de Castellanos found on the eastern side of the Peruvian Andes that the barometer and point of boiling water became uncertain guides in the measurement of altitudes. Lieutenant Herrera found that the boiling point at Sucre in Peru gave only 438 feet of elevation above the sea level, and that in descending the Amazona it increased, and, at Ega, the result was 2,052 feet, decreasing thence gradually to the Atlantic. As this result is evidently erroneous, he concludes that there is a great increase of atmospheric pressure towards the foot of the Andes. This phenomenon must have its weight in considering the local conditions as affecting the features of the fauna of the district.

With regard to the relations of the Amazonian fauna to that of other regions of tropical America, I can say very little at present. It has been classed,* together with Columbia, as one province. It has most affinity with that of Guiana and less with that of South Brazil. Recurring again for illustration to the genus *Papilio*, after deducting nine widely distributed Neo-tropical species, eleven of the remaining thirty-two are identical with Guianan species, and five others may be considered as local sub-species of Guianan forms. There only of the thirty-two are found in Brazil, from Pernambuco southwards, and four in Venezuela. The proposition of these thirty-two local species found in New Granada I cannot at present ascertain.

In compiling the catalogue of species, I shall make as few alterations as possible in the nomenclature of previous authors; the chief innovations will be in the determination of the sexes. I have been constrained to adopt the principle of treating every distinct and constant local variety as a separate form; giving it a separate name, but pointing out always what I have thought to be its true relation to the allied species. I have found it quite impossible to enter into considerations on the geographical distribution of the species without adopting this principle; for when all local varieties (sometimes incorrectly considered so) are forced together under one name and one definition, I think we cannot come to any just conclusions regarding the true relations of species, or make comparisons between different faunas. In following out this system many curious and interesting facts in geographical distribution come out in greater prominence. One is the very different degree of variability of different species, in the

* *Wiedemann's Bevoen and Ancient Fossil Shells*, map and p. 401.

same genus, when distributed over a wide extent of country, and subjected to different local conditions. For instance, of three allied species of *Morpis*, one (*M. hahnii*, Crum.) is found without any variation at three stations, in 48°, 56°, and 63° long. The second (*M. Morelani*, L. Crum.) is constant from 48° to 56°, but becomes changed (both sexes) into a well marked and constant variety at 63°; and thence farther westward, so completely changed that no individual occurs of the typical form of the species. The third (*M. Arbilis*, Crum.) becomes changed from 48° to 56°, and the variety thus produced continues farther westward to the exclusion of the type. In another class of species the varieties are not so clearly marked; sometimes a species is quite constant throughout all its individuals in one locality, whilst excessively variable in another, the typical individuals being in a minority, and in a third completely changed into a well marked and tolerably constant variety. In some species and genera the varieties thus produced would be classed by Entomologists, without dissent, as mere varieties and without a distinguishing name, and thus, in systematic works, the fact becomes lost to science. In other species, however, the change becomes so great, under the influence however of the same local conditions as the former case, that no difference of opinion would occur as to their being distinct species. In the following catalogue the nature of these different relations between the species will be mentioned under the head of each.

Gen. *PARUS* of authors.

Group 1. *P. Cereus*, and allies.

The species of this group I place first, on account of their evident affinity with the *Geothlypis* of Eastern Asia. They have the same stout antennae, with gradually forward, moderately strong, nearly straight club; similar broad and strong rhomboidal field to the hind wings, and pale coloured abdomen in the male. If this relationship be correct, we see how far more highly developed the type has become in the favoured lands of the Eastern Archipelago than in the same latitudes of America. The males of the American species have a bold powerful flight, an arched nose in the shade of the mouth, and are attracted by the mountain on the sandy and rocky shores of the stream, brooks and pools. The females are often seen at flowers on the borders of the forest.

P. Cereus, Crum. 112 C., and authors.

♂ and ♀. The female does not differ in colour of the wings from the male. The species occurs without any considerable variation from Rio Janeiro to Southern D. It is rare at Pará, but is the abundant species at St. Paulo on the Upper Amazon.

P. Bolai, Crum. 112 A. B.

The ♂ of this species is very well figured by Crum. Fehleisen and Godwin unpublished it with *P. Agrippis* (of which *P. Ergastus* is the ♀) and *P. Nominis*. Bolander (Sp. Gen. p. 315) professes to describe the ♀, but I doubt whether he had the true Bolai before him when he drew up the description. He gives, as a character of the ♀, the row of pale spots accompanying the red bandlet of the under surface of the hind wing; but I find that individuals of the

male sex have this character, he says also that the abdomen is "sometimes whitish and sometimes blackish," but, in fact, the white colour of the abdomen is proper to the ♀ alone. In Boisduval's collection, a specimen of ♀ *Lycides* stands as *P. Belsa*, Cramer, *Belsa* differs from *Lycides*, both ♂ and ♀, in every point. The dark, almost uniform browned fuscous colour of the fore wings, and the rufous-brown abdominal fold of the hind wings (the latter character very well shown in Cramer's figures) are two of the principal points of distinction. *Lycides* has, in both sexes, a long stripe of a pale yellow colour along the inner side of the abdominal fold. *Belsa* occurs in its typical form on the Amazon, only in the upper region. According to Cramer it is found also at Surinam. In other parts of tropical America, from South Brazil to Mexico, it appears to be transformed into a number of strongly-marked local sub-species. It is a rapid and bold flyer, and not an abundant species.

P. Favae, Kollar, Beitr. Ins. Fauna, N. Grön. t. 1, f. 3, 4?

I examined a specimen (and saw many others) of a ♀ *Pyralis*, which resembles very much the figure given by Kollar; it flowers on the borders of the forest at Ige, on the upper Amazon. I suspect it to be the ♀ of *Belsa*. The true *Belsa*, however, I have not yet seen from New Granada, the locality of Kollar's insect. A local representative, or sub-species of *Belsa*, the *P. Leontina* of Felder (Wien. Ent. Monatschr. ii. t. 8, f. 13), however, comes abundantly in collections from that country. It is possible that the *P. Favae* is the ♀ of *Leontina*, in which case the females of the two allied forms will resemble each other more than do their respective males.

P. Namiter, Cram. 113 B.

This is the local form, or sub-species of *Belsa*, which appears to take its place in the Park district; in the same way as *Leontina* does in the Andean valleys of New Granada. Cramer's figure is not sufficient to characterize the species. On this account, as well as to distinguish it from *P. Leontina*, I add a short description of it. ♀ rather smaller than *P. Belsa*. Fore wing pointed, outer margin very nearly straight; browned-fuscous, with a silky gloss; beneath brown, spotted. Hind wing above dark green, glossy; outer margin dusky green, with a sub-marginal row of four or five angular bands of the ground colour of the wing; a large, oblong, obliquely-truncated, yellowish-white spot in the middle of the vein, and a row of six smaller, rounded, postdorsal spots of the same colour across the middle of the wing between the nervures and a little exterior to the cell; beneath dark brown, with a sub-marginal row of seven large, rounded, sub-basal red spots, broadly margined with black. Inside of abdominal fold rufous-brown, as in *P. Belsa*. Body and fringe of the wings as in *P. Belsa*.

P. Erythraea, Cram. 113 A. ♀; 113 C. ♂ (*P. Erymantha*).

The male found at Park, on the borders of rivulets, in the forest and at Ige, abundantly at the commencement of the 4th season, viz. in June and July, in company with *P. Belsa*. It differs from *Belsa*, besides the white stripe within the abdominal fold, by the lighter, clearer green colour of the fore wings, which are darker only along the basal half of the costa. The fore wings are also more produced at the tip. The pale spot of the costa of hind wings is small, rounded and placed near the external angle of the wing. There is, in some specimens, a row of small pale spots across the middle of the hind wing; variation strongly marked in this respect would agree with Cramer's description of *Namiter* (vol. 4, p. 15), did not his figure show the continuous abdominal fold. The ♀ I have seen in Dr. Boisduval's collection; it agrees very well with Cramer's figure, 113 A.; the specimen was from Cayenne. The species is therefore now known from Surinam, Cayenne and the most humid parts of the forests of the Amazon. I have not seen it from any other part of America.

P. Polyplocosa, Lin. Cram. 211 D. E. and authors.

A species widely distributed in Tropical America, being found from Rio Janeiro to Surinam. On the Amazon it frequents gardens and semi-cultivated or neglected grounds, making it probable that it, as well as many other species of the same habits and same wide distribution, have been introduced with the clearing of the forest by man.