

XVIII.—*Entomological Notes bearing on Evolution.*

By RAPHAEL MELDOLA, Sec. Ent. Soc.

IN 1871, when working at the subjects of "mimicry" and "protective resemblance," Mr. Darwin was so good as to send me for perusal a letter which he had received from Fritz Müller, then in St. Catharina, Brazil. As this letter contains many entomological observations of interest, I have thought it advisable to take steps to secure their being placed upon record in a permanent form; and, with the permission of Mr. Darwin, I have selected extracts which I beg to make known in the present paper, together with other observations from various sources which tend to throw light on subjects connected with the descent theory.

Sounds made by Butterflies.

Mr. Darwin has already recorded* the sound produced by the South-American butterfly, *Ageronia feronia*, which is stated to make "a noise like that produced by a toothed wheel passing under a spring catch, and which could be heard at the distance of several yards." With reference to the object of this sound Mr. Darwin states †, "At Rio de Janeiro this sound was noticed by me only when two were chasing each other in an irregular course, so that it is probably made during the courtship of the sexes." With regard to this insect Fritz Müller writes, "I told you some time ago that I had not yet seen it here; but lately I have caught two specimens belonging to two species, and I have seen in the collection of a friend of mine a third specimen of a third species. One of these specimens had been observed for many days by my children flying around some orange-trees near my house; it frequently alighted on the putrefying fruit on the ground, on the juice of which it seemed to feed. My children never heard any noise produced by it, neither did I; and this seems to confirm your view that the noise is made only during the courtship of the sexes."

I may add that our common *Vanessa Io* is stated to make a faint hissing sound ‡; but the precise conditions under which this noise is produced require further observation.

* Journal of Researches, 1845, p. 33. On the sound-producing apparatus see E. Doubleday in Proc. Ent. Soc., March 3, 1845. See also a paper by Mr. A. H. Swinton, "On an Organ of Hearing in Lepidoptera," Ent. Mo. Mag., Nov. 1877.

† Descent of Man, 2nd ed. p. 307.

‡ Rev. J. Greene, Trans. Ent. Soc. new series, vol. ii. p. xcvi, and Mr. Hewitson, *ibid.* vol. iv. p. ii. The sound-producing structure has been figured by Mr. Swinton, Ent. Mo. Mag., Jan. 1877.

Display of Colour by Lepidoptera.

With reference to the display of colour by butterflies and moths, Mr. Darwin has already * recorded the case of a species of *Castnia* which possesses ornamented hind wings and displays them, while other species with plain hind wings do not display them †. Fritz Müller adds the following interesting case:—"I observed a curious little fact with our *Hesperidæ*. Most of them are of a dull brownish colour; but there are some in which the wings have a more or less vivid blue tint either on the upper or on the lower surface. Now the former when alighting on a flower always hold their wings expanded in a *horizontal plane*, while those of the latter are folded *vertically*, so that in either case the blue surface is exposed to view." Without further observation it cannot be assumed in this case that the colour is displayed as a sexual attraction, since it is well known that colour is displayed for other purposes, such as for *protection*, when the colour is a signal of distastefulness (as with brightly coloured larvæ, and those species which serve as models for mimicry), or for giving resemblance to some coloured objects, such as flowers.

Insects distinguishing Colours.

The distinguishing of colours by insects has been proved in the case of bees and wasps by Sir John Lubbock's experiments. This faculty is of paramount importance to the theory of sexual selection †. Fritz Müller states, "Butterflies not only discover flowers by colour, but certain species even give an unmistakable preference to certain colours. Thus *Callidryas Philea* and some other species of that genus almost exclusively visit brilliant red flowers (*Canna*, *Salvia*). A red *Hedychium* in my garden was constantly surrounded by a multitude of *Callidryas Philea* (and of *Papilio Thoas*); and so are at present some other plants with red flowers, while they never alight on plants of the same and other genera with yellow, white, or blue flowers."

Mimicry.

It has hitherto been considered a general rule that a mimicked species is commoner than the species which mimics

* Descent of Man, 2nd ed. p. 314.

† Ibid. 2nd ed. p. 315. Mr. Darwin has called my attention to Fritz Müller's "Beobachtungen an brasilianischen Schmetterlingen," a paper which contains some further remarks bearing on the subject of display, in the October number of 'Kosmos.'

‡ 'Descent of Man,' 2nd ed. p. 317. On the attraction of *Macroglossa stellatarum* by colour, see a letter in 'Nature,' vol. xvii. p. 11, Nov. 1, 1877.

it. Fritz Müller records the following exceptions:—"There are here some exceptions to the rule that the imitating species are comparatively rare, while the imitated swarm in large numbers. Thus *Mechanitis Lysimnia* is hardly more common than the imitating *Leptalis*; and the beautiful *Papilio nephalion*, Godt., is here so rare that I have seen only two or three specimens last summer, whilst the imitating *Euterpe tereas* is by far more common. But in other parts of Brazil the numerical relations of these species may be different."

I would add, with reference to this observation, that it is quite conceivable that in certain districts external conditions may so change that a species dominant in other regions may become rare or altogether extinct, while the species which mimics it may remain unaffected. Thus *Diadema misippus*, the female of which mimics *Danaïs chrysippus*, is found in South America, while the model *Danaïs* is not*. Mr. Trimen also remarks †:—"The magnificent *Papilio Antimachus*, Drury, of which but one specimen is known to science, is very *Acraëiform* in habit, and is possibly an instance of special modification in imitation of some gigantic *Acraëa* as yet unknown or perhaps extinct." *Papilio Zalmoxis* also, as I am informed by Mr. A. G. Butler, probably mimics some unknown or extinct gigantic *Acraëa*. Many cases are known in which a butterfly is obviously a mimic, but its exact model is unknown ‡. I am disposed to believe that such instances show us the process of mimetic resemblance in actual progress. For example, many species of *Elymnias* resemble species of *Euplœa*; but it is impossible to name the precise species of the last genus which in each case serves as a model. In these cases it is more reasonable to suppose that the mimicry of the *Elymnias* is in course of perfection, than to assume that the species which they imitate have become extinct. It is also

* This species (*D. misippus*) is stated to occur in Guiana on the authority of Boisduval. My friend Mr. A. G. Butler has just informed me that a large male from Formosa, in which the *Danaïform* characters are partially visible, has been lately added to the national collection. Here we have an interesting case in which mimetic characters originally acquired by a female butterfly are probably in course of transmission to the male.

† Trans. Linn. Soc. vol. xxvi. p. 503. I learn that probably two other specimens have been obtained since the above was written.

‡ For numerous instances of imperfect mimicry see papers by A. G. Butler:—"A Monograph of the Lepidoptera hitherto included in the Genus *Elymnias*," Proc. Zool. Soc. June 6, 1871; also on *Protogonius*, ibid. Dec. 2, 1873, and Jan. 19, 1875. Mr. Neville Goodman points out (Proc. Camb. Philos. Soc., Feb. 12, 1877) that *imperfect resemblances* are arguments in favour of the production of the phenomenon through the action of natural selection.

conceivable that a general resemblance to a protected group might in some districts be quite as efficacious as a resemblance to particular species of such a group.

As another instance bearing on the present subject I may cite *Argynnis niphe*, the female of which is a very fair mimic of *Danaïs chrysippus*. The former species (var. *inconstans*) ranges into Australia, while the *Danaïs* does not occur in that region; and what makes this case so particularly interesting is, that in Australia, where there is no model, *both sexes of the Argynnis are alike*, and resemble the male of the Indian form.

The degree of exactness with which mimics sometimes resemble their models has been noticed by all observers; but there are only a few recorded cases where the insects themselves have been known to be deceived. Mr. Trimen states* that the male *Danaïs chrysippus* has been deceived by the female *Diadema bolina*. Fritz Müller writes:—"One of the most interesting of our mimicking butterflies is *Leptalis melite*. The female alone of this species imitates one of our common white *Pieridæ*, which she copies so well that even her own male is often deceived; for I have repeatedly seen the male pursuing the mimicked species, till, after closely approaching and becoming aware of his error, he suddenly returned."

Correlation of Habit with Protective Resemblance.

Mr. Bates has already recorded the resemblance of a caterpillar (supposed to be a species of *Notodontidæ*) to a venomous snake †; and Dr. Weismann has likewise shown ‡ that the eye-like markings on *Chærocampa*-larvæ actually frightened away birds. Fritz Müller states that he "found the caterpillar of a *Papilio* which strikingly resembled the head of a venomous snake."

By referring to Mr. Bates's description it will be seen that the mimicry extended even to *attitude*. All observers have noticed how in some instances a mimicking insect copies the flight of its model; and such cases of correspondence between habit and resemblance are of great theoretical interest to the evolutionist. Thus Mr. Wallace has shown, in the case of the well-known "leaf-butterflies" (*Kallima*), how the insects settle on the bushes in an attitude which perfects their resemblance to dead leaves. The same observer also mentions, with respect to the stick-like *Phasmidæ*,

* Trans. Linn. Soc. vol. xxvi. p. 513.

† Ibid. vol. xxiii. p. 509.

‡ 'Studien zur Descendenz-Theorie,' part ii. pp. 100 *et seq.* This observation has been confirmed in the case of *C. elpenor* by Lady Verney (see a paper in 'Good Words,' Dec. 1877, p. 838).

that "they hang loosely about shrubs in the forest, and have the extraordinary habit of stretching out their legs unsymmetrically so as to render the deception more complete." Fritz Müller supplies the following analogous instances:—"The caterpillars of some *Papiliones* resemble fresh excrements of a bird; these caterpillars always rest on the *upper* surfaces of the leaves on which they feed, while those of some other *Papiliones* (*Nephalion*, *Polydamas*), which are not protected by some such resemblance, always hide themselves on the *lower* surfaces of the leaves."

Even among our own insects hundreds of such cases might be noted. Thus the weevils, which resemble pellets of earth, tuck in their legs and feign death when alarmed, and the stick-like geometer larvæ erect themselves stiffly from the twigs on which they rest. *Cucullia chamomillæ* and *Galeria cerella* both resemble broken splinters of wood when at rest; and I have seen these moths at the extreme ends of pointed palings, where they had erected themselves at an angle to the wood, making the resemblance to a broken-off splinter remarkably deceptive. *Calocampa vetusta* is very like a piece of broken stick when its wings are closed; and this moth has been seen hanging to a twig by one leg. *Gasteropacha quercifolia*, which, when at rest, resembles a withered leaf, has been seen in a similar attitude. *Cilix spinula* is well known to resemble a piece of bird-excrement; and I have often seen this moth at rest by day, fully exposed to view, on the upper surfaces of leaves.

It is interesting to observe how, in many cases, natural selection has probably taken advantage of characters originally acquired for some other purpose. Thus the common *Anthocharis cardamines* of this country has been shown by Mr. T. W. Wood to rest at night on the heads of umbelliferous plants, where the green marblings on the underside of the hind wings of the butterfly cause the latter to bear a very exact resemblance to the flower-head. Now, as this style of marbling is common to many butterflies of the genus in various parts of the world, it cannot be assumed that this character has been specially acquired to adapt the insects to umbelliferous flower-heads. It is quite as probable, in the case of *A. cardamines*, that the *habit* of the butterfly has been adapted to its particular mode of coloration, natural selection afterwards perfecting the resemblance. A similar instance is offered by *Lithosia caniola*, the larva of which feeds on *Trifolium repens*, and is stated to occur on stony ground which abounds with a species of small shell, probably a *Helix*? When alarmed the larva rolls itself into a ring and falls off

its food-plant, in which attitude it "has almost exactly the appearance, in form, colour, and size," of one of these shells, "which greatly increases the difficulty of finding them when thus feigning death"*. The habit of rolling up into a ring when alarmed is common with many caterpillars which are found in situations where mimicry of shells cannot possibly be adduced as a reason for the habit. Hence in the case of *L. caniola* I am inclined to believe that natural selection has taken advantage of and improved upon a habit originally acquired for a distinct purpose.

The most remarkable case referable to the present class that has recently been published is that of *Gongylus gongyloides*, Linn., an Indian *Mantis* which simulates a flower†. When exhibiting some of these insects at a meeting of the Asiatic Society of Bengal, Dr. Anderson remarked that when seen from above "they did not exhibit any very striking features beyond the leaf-like expansion of the prothorax and the foliaceous appendages to the limbs, both of which, like the upper surface of the insect, are coloured green; but on turning to the under surface the aspect is entirely different. The leaf-like expansion of the prothorax, instead of being green, is a clear pale lavender-violet, with a faint pink bloom along the edges of the leaf; so that this portion of the insect has the exact appearance of the corolla of a plant—a floral simulation which is perfected by the presence of a dark blackish-brown spot in its centre, over the prothorax, and which mimics the opening to the tube of a corolla. A favourite position of this insect is to hang head downwards among a mass of green foliage; and when it does so it generally remains almost motionless, but, at intervals, evinces a swaying movement as of a flower touched by a gentle breeze; and while in this attitude, with its fore limbs banded violet and black and drawn up in front of the centre of the corolla, the simulation of a papilionaceous flower is complete. The object of the bright colouring of the under surface of the prothoracic expansion is evident, its purpose being to act as a decoy to insects, which, mistaking

* Newman's 'British Moths,' p. 473.

† Proc. As. Soc. Beng., Aug. 1877. For an analogous case see a paper by Mr. Wallace in Macmillan's Mag. for Sept. 1877. The *Mantis* referred to resembles a pink orchid, and is stated to be attractive to butterflies. Prof. J. Wood-Mason informs me that the floral resemblance of the above and other species of *Gongylus* has been known to him for years; but its object had remained unexplained till 1875, when he received from Assam some larvæ of *Hymenopus bicornis*, Serville, in which species the resemblance to a flower is, according to Prof. Wood-Mason, even more perfect than is the case with the *Gongylus*. See also Proc. Ent. Soc., Nov. 7th, 1877, p. xxix.

it for a corolla, fly directly into the expectant, serrated, sabre-like raptorial arms of the simulator."

A case like that of *Gongylus* is of the highest interest—can, in fact, be only *completely* appreciated by the believer in natural selection. The green foliaceous expansion of the limbs and prothorax is common with many species of this group of insects, and serves unquestionably as a protection by causing the insects to resemble leaves. Such, in all probability, was the object of the leaf-like expansions acquired by the ancestor of the present *Gongylus*. Later in the history of the species the acquisition of food became of equal or greater importance than the mere evasion of foes; then we must believe that natural selection took advantage of the underside of the foliaceous expansions and coloured them by minute gradations till they acquired their present floral tints and markings; hand in hand with this modification of colour, habits tending to complete the deception were gradually acquired, till the marvellous coördination which we now behold was perfected.

XIX.—*Descriptions of new Species of Heterocera from Japan.*

—Part II. *Noctuities*. By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

[Continued from p. 85.]

Caradrinidæ.

RADINACRA, n. gen.

Closely allied to *Caradrina*, from which it may at once be distinguished by the great length of the apical joint of the palpi, and the great development of the anal tuft and appendices of the male. Type *R. palpalis*.

81. *Radinacra palpalis*, n. sp.

♂. Colour and general pattern of *Caradrina respersa*, but the transverse lines rather more parallel; the reniform spot irrorated along its outer edge with whitish; the ground-colour of the primaries tinted with reddish; the secondaries paler, whitish, with diffused brownish outer border; the tarsi above blackish, banded with white: wings below browner, discal line on both wings better defined, nearer to the margin; a series of distinct black marginal dots. Expanse 1 inch 5 lines.

Yokohama (*Jonas*).