

PSYCHE.

CONVERGENCE AND POECILOGONY AMONG INSECTS.

BY ALFRED GIARD, PARIS, FRANCE.

[Professor Alfred Giard in the *Annals of the Entomological Society of France** presents a careful discussion of convergence and poecilogony among insects and a resumé in the form of a rather free translation may be of interest to some who do not have access to this publication. HERBERT OSBORN.]

It is a well known fact to entomologists that certain insects which are very similar to each other in the adult state have larvae which are quite different. Many examples of this peculiarity have been indicated, principally among the Lepidoptera, the larvae of which are better known than those of other groups. But all insects with complete metamorphoses may present the same phenomena, and, if it is more rare among the ametabola, it is because, among these, the passage from the larval to the adult stage is gradual, by insensible steps, and the larvae and imago are subject to much the same conditions. One of the questions of much importance and at the same time a problem of much difficulty to solve is to determine if, in the recognition of the agreement between similar animals which present differences in

the earlier stages, we should attach more importance to the early dissimilarity than to the similarities of the adults. The question would be answered immediately in the affirmative if the principal of Fritz Mueller, the fundamental biogenetic law of Serres and Haeckel, were applicable in its exactitude. That is to say, if the various ontogenetic states of an animal repeated exactly the phylogeny or the successive ancestral forms. Were this so, embryology would indicate the true relation of the parents.

The more or less perfect resemblance of the adults in certain cases would be interpreted as the result of convergence due to similar ethology of these adult forms. But, among animals with metamorphosis, embryonic forms are subject during a long period to the modifying action of the surroundings and often, also, their evolution depends in a large measure upon the ethology of the adult. Accordingly, the principle of Fritz Mueller is applied with difficulty and singularly though actually the determination of the relation of the parents becomes more arduous the better we know the different phases of development. If it be true that partial knowledge happens thus to complicate

* Vol. 63, pp. 128-135.

the problem, we may hope that a more complete knowledge, that is a knowledge of the dynamic embryology of a large number of species, will give us the solution.

At present we may distinguish two principal categories of insects which are similar in adult stages and differ in earlier stages of development.

First: certain insects pertaining to the same genus or to distinct genera, sometimes even widely separated, which present in all cases larval stages which are quite different and in each case adult forms similar by convergence, a convergence due to the surrounding conditions (protective resemblance, mimicry direct and indirect, isotypy, etc.).

Second: among other insects the different generations of the same species considered at different points of their geographical distribution, at different seasons of the year, or in different conditions of nutrition, have larvae which are dissimilar while the adults are very similar to each other and present very slight modifications. It is to this form that we apply the term Poecilogony.* In this case the larvae have become divergent in adapting themselves to different ethological surroundings. The final result is the

same in all cases but from the point of view of consanguinity and therefore of natural classification the two categories are far from having the same signification.

The related species of poecilogonic origin have between them direct parentage and approach each other notwithstanding their embryonic divergencies. The species which resemble each other by convergence can on the contrary have only phylogenetic separation and must be considered as naturally distinct. From a practical point of view it is not always easy to decide if two similar forms are poecilogenic or convergent species. In certain cases, however, the distinction is easy and no doubt is permissible. When, for example, the species which by selection have become convergent, belong to genera sufficiently separated, the profound anatomic characters and the embryonic characters are not altered by convergence to the point of being unrecognizable. The resemblance is only superficial and if the older naturalists have been deceived by a similar aspect of the adults the error is not possible to-day. Mimicry, so perfect in *Leptalis* and *Ithomia*, of *Papilio paradoxa* and *Euplaea midamus*; imitation of *Danaides* or of the *Acraeides* by different species of *Papilio* or of *Diadema* do not impose upon any entomologist.

The resemblance although less exact in other respects of *Dichonia aprilina* and *Moma orion* is, nevertheless, an example of the same kind. Even when convergence of the adults takes place

*A. Giard, Sur le bourgeonnement des larves d'*Astellium* spongiforme Gd. et sur la poecilogonie chez les ascidies composées (C. R. de l'Académie des Sciences, 2 Février 1891).

A. Giard, Nouvelles remarques sur la poecilogonie (C. R. de l'Académie des Sciences, 27 Juin 1891).

among congeneric species, that which deprives us in great part of the advantage of indications of comparative anatomy, we can in most cases still recognize the origin as entirely distinct for the two species and establish the resemblance as due to the effect of the surroundings upon the imago.

It is this which occurs, for example, in the case of isotypy. Some related forms such as *Pieris brassicae* and *Pieris rapae*, the numerous Euplaeae, etc. The fact that these species frequent the same localities without mixing and without crossing indicates that the larval differences which they present in the midst of identical conditions are differences of ancestry. This is still more evident when it is applied to Hymenopterous parasites (Isotypes) of which the larvae have the same hosts or of parasites of plants of which the larvae feed side by side upon the same plant. *Hormomyia capraeae* Bremsi is distinguished with difficulty in the adult state from another Cecidomyian living also very often upon the willow (*Salix capraea*).

The gall has been described by Schlechtendahl under No. 332.* But the larvae of these two Diptera remain distinct and produce very different galls upon the leaves of the same tree. There is here no doubt that the resemblance of the adults is simple convergence and does not indicate a closely related ancestry.

When, in the place of living in the same surroundings the larvae have a different habitat the question becomes more difficult to solve.

Guénée in a remarkable memoir upon some European bombyces† has considered as distinct species two types, *Bombyx spartii* Hb. and *Bombyx callunae* Palen, which represent one the southern and the other the northern form of *B. quercus* L.

If one examines an extensive collection of *B. quercus* such as that of our colleague M. J. Fallou he will easily see that it is almost impossible to separate the adults of these three species. Certain forms of *B. quercus* passing manifestly, as Guénée and Bellier de la Chavignerie already have recognized, in part to *B. spartii*, in part to *B. callunae*.

Guénée had discovered that the young caterpillar of *B. callunae* differs from that of *B. quercus*, but that the divergence diminishes after the first moult and finally disappears. One may attempt to see in this dissimilarity of the larvae in the early state a proof of the primitive separation of the two species. But the habitat differs sufficiently to explain this divergence. One of the two forms, without doubt *B. callunae*, represents the first ancestral larva which is modified in *B. quercus* and *B. spartii* and this species may truly be considered as a poecilogonic form slightly modified in the adult stage.

* Schlechtendahl, Die Gallbildungen (Zooecidien) 1891, p. 40.

† Annales Soc. ent. Fr. 1858, 435-442.

We have elsewhere direct proof of the existence of poecilogony among insects. In two very important memoirs published in Russian and of which we have a translation by our learned colleague C. R. von Osten Sacken, the Russian entomologist Portchinsky has demonstrated that the common *Musca corvina* presents two distinct forms in different parts of its wide habitat. In the north of Russia this coprophagous fly generally deposits 24 eggs of medium size from which arise larvae that present two very distinct phases of evolution. In the Crimea where coprophagous insects are more abundant and consequently the struggle for life more intense, the same Dipteron deposits only one large egg in which the metamorphosis is very rapid and condensed and recalls that of the Pupipara, the larva arriving almost immediately at its last phase of development. Analogous cases are known among different Lepidoptera and notably in the mulberry silk-worms (*Sericaria mori*). In the south of Europe this species furnishes an interesting race called *Trevoltini* which not only produces several generations annually but is distinguished from the type in that the caterpillars have only three moults in place of four. Cultivated in the north this race regains the ordinary characters of the species (the second or third year) as shown by Robinet.*

As the caterpillar of *Sericaria mori*

varies more or less the physiological peculiarity of the suppression of one moult attracts the eye, but in other cases structural modifications are more apparent.

Th. Goossens has indicated several very interesting examples of geographic poecilogony. *Deilephila euphorbiae* does not present in Ardache and in Var the ordinary yellow points and the rosy spots are replaced by spots of a pale yellow. The caterpillar of *Heliothis marginata*, light or green in the North is more often of an almost black brown in Provence. In the south of France the dorsal part of the caterpillar of *Zygaena fausta* is almost always tawny. At Paris this part is water green.†

When in cases of this kind the adults of two poecilogonic varieties come to differ but little at the two extremities of its habitat, we do not err if we establish two species, saying: Without doubt the perfect insects differ but little, but the larvae present differences so great as not to permit us to unite the two forms. This is certainly what occurs for a large number of species called representative for the old and the new world, *Triaena psi* and *T. occidentalis*, for example. Comparison of the monographs of Guénée and Abbot is very instructive in this respect.

Sometimes even the variation of the adults rests exclusively upon the anatomical characters of the genital apparatus of such a kind that the

* Robinet, Art d'élever les vers a soie; traduction du comte Dandolo, 1825, p. 317.

† Th. Goossens, Des variations sur les chenilles (Ann. Soc. ent. Fr., 1871, p. 118).

poecilogonic forms, while preserving a great resemblance in the adult state, cannot be crossed and this inability to cross facilitates the divergence of the two species even if they come in contact in some point of their habitat. It is thus, that, according to Grote and Smith, *Agrotis haruspica* and *A. rubifera* are the American representatives of the European *A. auger* and *A. rubi*, from which they differ only in the genital armature of the male; but that these modifications may be effective they should perhaps recede and determine the poecilogony instead of being caused by it or produced by it. This question is hard to solve at present and stands with the numerous problems that Romanes has stated in his work on physiological selection. In other circumstances poecilogony seems to be due to the varying nourishment of the larvae. If certain caterpillars are modified directly by the supporting plant as is known to be the case among a great number of species, we know also that some are adapted definitely to a determined plant and are protected by a permanent form, a different livery. Poulton has stated, as well as other authors, that many caterpillars die of hunger rather than touch nourishment

for which their race has lost the habit. Perhaps it is to poecilogony of nourishment that we should attribute the differences found in the caterpillars of *Cuculia verbasci* and *C. scrofulariae*, moths, the similarity of which in the adult state is not easily explained by convergence. Further, certain cases of resemblance among insects, in which the larvae differ but live in the same localities, sometimes upon the same plants, are difficult to interpret under one or the other of these alternatives which we have indicated (convergence or poecilogony). We cite for example *Lithosia complanata* and *L. lurideola*, *Deilephila euphorbiae* and *D. nicaea*.

Finally the only purpose in this short note is to state a very important problem of general biology, touching at once embryology, ethology and taxonomy. Perhaps on certain sides the problem is capable of experimental solution. In any case the question ought to receive light from our specialist friends, if they will study into the numerous cases of the kind enumerated above, which pass daily under their eyes, and of which they; better than any others, can state precisely the actual value.

In "The butterfly hunters in the Carribees" (N. Y., Scribner) Mr. E. M. Aaron, in the guise of a learned "Dr. Bartlett," takes two boys of a friend collecting in the Bahamas, Hayti and Jamaica, and brings them back laden with spoil and honors, culminating in their election into the Philadelphia Academy. What with history

and other matters butterflies themselves play a minor part, but there are some observations due to personal experience which lend a certain value to the book. It ought to interest boys, for it has the odor of the camp about it, but we could wish there had been less of the mercantile spirit in it. It is well printed.

