

gence is the lighter. Take, for instance, the genus *Pieris*. The vernal broods of *P. napi* and *P. protodice* are distinctly more dusky than those which have undergone their whole metamorphosis in a single season; but, on the other hand, the spring emergences of *P. rapæ* and *P. brassicæ* are wont to be pale, and the spring-emerging *P. virginensis* is pale, and as Mr. W. H. Edwards remarks ("Papilio," 1881, p. 97), more like the summer than the winter form of its progenitor *P. napi*. In Japan, it would appear ("Entomologist," 1888, p. 24,) that the vernal form of *P. napi* is less dusky than the summer emergence.

Hitherto it has been held by the majority of Entomologists that the darkening of vernal forms was due to the cold to which the pupæ were subjected during the winter, and this view seemed to receive ample confirmation when Mr. W. H. Edwards proved experimentally that cold applied to pupæ did produce darkening of the forms.

Supposing, then, that cold is the sole cause of the darkness of vernal broods, why are not *all* vernal broods dark, since they have all been subjected to a greater amount of cold in the pupa-stage than the summer ones?

It seems to me that this question is unanswerable on the supposition that duskiness is the simple effect of cold, and I have therefore been led to seek another explanation of the phenomenon.

On one occasion, I bred a specimen of the European *Geometra papilionaria* Linn., and paid particular attention to the appearance of the pupa before emergence. I noted that although there could be no doubt that the vital organs of the body were gradually formed during a considerable period before emergence, the wing-pigments did not begin to be developed until the last few days. First of all the pigment appeared brown, and only just before emergence did it assume the vivid green characteristic of the insect.

Now suppose that *G. papilionaria* were a species hibernating in the pupa-state, how would cold effect the formation of the wing-pigment? Obviously, not at all, since the pigment is not called into existence until a short time before emergence, that is to say, not until the warm spring sun has wakened the sleeping pupa into new life.

I have not had the opportunity of making careful observations of a similar kind with the pupæ of *Rhopalocera* since I began to pay special attention to the subject, but I think it will generally be accepted as a fact