XXV. *Observations on some remarkable Varieties of* Sterrha sacraria, *Linn., with general Notes on Variation in* Lepidoptera. *By* R. M'Lachlan, F.L.S.

[Read 4th December, 1865.]

At the last Meeting of this Society (see Journal of Proceedings, 6 Nov. 1865, p. 124), I exhibited some bred specimens of *Sterrha sacraria*, showing an extraordinary amount of variation. It has been strongly urged upon me that I should not allow these examples to be distributed without leaving a suitable record of their peculiarities, and I have therefore drawn up the following notes, and have taken advantage of the occasion to make a few remarks on variation in *Lepidoptera* generally, especially in the British species.

With respect to *S. sacraria*, I will first repeat what has been already recorded, viz., that on the 19th of last August, my nephew, Mr. W. J. Wilson, when walking with me in a lane near Worthing in Sussex, captured a damaged female of this insect which immediately commenced depositing eggs; but she laid only seven, and I imagine that she had previously almost exhausted her stock, as her abdomen was thin and collapsed. This female example (Pl. XXIII. fig. 1) differed in nowise from the ordinary typical form and size of the species (expanse of wings 11 lines). The eggs I at once sent off to my friend the Rev. John Hellins, chaplain of the county prison at Exeter, so well known for his success and skill in breeding *Lepidoptera*. One egg unfortunately was destroyed in transit, but the remaining six all hatched on the 29th of the same month. As the larva and its usual food-plants were quite unknown (excepting from an unpublished figure by Herr Carl Plötz of Greifswald, who attaches it to a species of Chamomile), Mr. Hellins, as is his usual custom with all larvæ of *Geometridæ* with whose food he is unacquainted, offered the young larvæ *Polygonum aviculare*, and they at once commenced feeding on that plant, and thrived well. On the 19th of September one larva commenced spinning, and by the 30th of that month all had changed to pupæ. On the 15th of October the first imago, a female, emerged; two other females came out on the 17th, and a fourth on the 19th; this was kept alive with the idea of pairing her, but she died on the 25th, just before the fifth example, a male,

made its appearance; the last pupa likewise produced a male on the 28th; thus about a fortnight elapsed between the appearance of the first and last moths. The larvæ were beautifully figured by Mr. W. Buckler of Emsworth, Hants (a copy of this figure is here given on Pl. XXIII.), and have been most minutely described by Mr. Hellins in the "Entomologists' Monthly Magazine," vol. ii. pp. 134, 166. With respect to the moths produced from these eggs, I can only say that they show an extraordinary amount of variation *inter se*, and bear little resemblance to the parent moth, or to what has been always considered as the typical form of the species, and I have little hesitation in saying that had any one of them been taken at large, it would hardly have been referred to this species. I will describe them *seriatim*.

No. 1. ♂. (Pl. XXIII. fig. 2.) Anterior wings uniformly rosy-grey; the apical cilia rosy-pink; no discal spot; the oblique transverse line blackish, becoming grey on the inner side, and merging into rosy at its junction with the hind margin. Posterior wings pale silky grey, broadly blackish-grey on the costal and apical margins, and with a well-defined central blackish-grey line; cilia whitish-yellow. Head and thorax greyish-ochreous. Legs and antennæ dark fuscous.

Expanse of wings 13½ lines.

No. 2. ♂. (Pl. XXIII. fig. 3.) Anterior wings uniformly greyish-yellow, suffused with rosy; the apical cilia bright rosy, bordered by a narrow yellow line at the base; a small purplish discal spot; costal margin purplish for about a third of its length from the base; oblique transverse line purplish, becoming rosy internally and bordered on each side by an indistinct yellowish space. Posterior wings silky whitish-grey, bordered with darker grey, and with an indistinct dark-grey central cloud; cilia very pale whitish-yellow. Head and thorax pale dirty greyish-yellow. Legs and antennæ dark blackish-fuscous.

Expanse of wings 12 lines.

No. 3. ♀. (Pl. XXIII. fig. 4). Anterior wings smoky-buff; apical cilia bright rosy, with a very narrow yellowish line at the base; a very distinct, but small, blackish discal spot, with an indistinct smoky cloud below it; costal margin purplish-grey at the extreme base; oblique transverse line black, becoming grey internally. Posterior wings silky whitish; the veins grey, especially at their terminations on the costal margin. Head and thorax dirty greyish-yellow. Legs and antennæ dark blackish-fuscous.

Expanse of wings 13 lines.

No. 4. ♀. (Pl. XXIII. fig. 5.) Anterior wings greyish-ochreous; apical cilia pale rosy, with a distinct pale yellow line at the base; discal spot distinct, elongate and blackish, with a purplish-grey cloud below it, more towards the base; costal margin purplish-grey for about a third of its length from the base; oblique transverse line blackish externally, purplish internally, slightly and indistinctly margined with yellowish. Posterior wings pale silky whitish, with an indication of a broad greyish central band. Head and thorax concolorous with the anterior wings. Legs and antennæ fuscous.

Expanse of wings 12 lines.

No. 5. ♀. (Pl. XXIII. fig. 6.) Anterior wings uniformly pale buff; apical cilia paler; a very distinct small black discal spot, with a slight indication of a greyish blotch below it; costal margin greyish at the extreme base; oblique transverse line deep black, paler internally. Posterior wings silky whitish, slightly greyish at the costal portion of the apical margin, and in the centre. Head and thorax concolorous with the anterior wings. Legs and antennæ fuscous.

Expanse of wings 13½ lines.

No. 6. ♀. (Pl. XXIII. fig. 7.) Anterior wings pale yellow, the spaces between the veins filled in with rosy-pink, hence the veins appear conspicuously yellow, with the rose colour predominating on the ground; cilia bright rosy, with a narrow yellow line at the base; discal spot small and blackish; costal margin rosy for about one-half of its length from the base; oblique transverse line very broad, narrowly blackish externally, and broadly rosy internally. Posterior wings silky whitish, with a broad and well-defined central grey band. Head, collar and petagia greyish-yellow, the thorax rosy-grey in the middle. Legs and antennæ pale fuscous.

Expanse of wings 12 lines.

This specimen, though it is apparently the most curious of all, in reality more nearly approaches a recognized form, figured by Esper (Die Schmetterlinge, pl. xxx. fig. 10, 11), under the name of *sanguinaria*, and which has been justly considered as a variety of *sacraria* by modern authors.

With respect to the geographical distribution of the species, I may say that it is found over almost all the warmer portions of the old world. Linnæus described it from an example from Barbary (Systema Naturæ, ed. 12, p. 863, 220), and it has been received from all parts of the African continent, from Algiers to the Cape; in India and Asia Minor it is not uncommon, but I am not sure

that it has been observed in Australia. In Europe it is common in the South, chiefly in the autumn months, and Mr. G. F. Mathew has recorded ("Weekly Entomologist," vol. ii. p. 83), that in October at Lisbon and Gibraltar it was the most common Lepidopterous insect. Duponchel, however, mentions June as the time of its appearance, and says "Elle se tient suspendue à l'extrémité des tiges de gramen dans l'état de repose" ("Lépidoptères de France," tom. viii. pl. 178, fig. 7). In Sweden it was recorded as long since as 1784 by Thunberg (Dissert. Ent. Insect. Suecica, pt. 1, p. 14), but I am uncertain if it has since been observed there; indeed Herrich-Schäffer (Schmett. von Europ.) doubts the correctness of Thunberg's observation, but the latter's description and remark, "*Pyralis sacralis*—magnitudine et facie omnino *P. forficalis*," can surely leave no uncertainty on this point. In England it has only been observed in the south and was unknown until 1857. Since then about twenty specimens have been taken, all in the autumn, and often at gas-lamps; the year 1865 has produced at least half of the native examples. It has not been observed further north than London, but several have been found in the suburbs of the metropolis. Thus Africa may be considered its head-quarters, and it is almost invariably found in boxes of insects from thence.

The position of the insect in repose has been remarked by several writers, and is in itself sufficient to separate *Sterrha* from *Aspilates*, in which latter genus *sacraria* was at one time placed. It would seem to rest head downwards, after the manner of a *Crambus*, with its wings crossed at a very acute angle, and in this respect it has been compared by Zeller (Isis, 1847, p. 492) to the well-known *Cilix spinula*, and Hellins (Ent. Mo. Mag. vol. ii. p. 135) also makes the same comparison, without being aware of Zeller's observation.

We have yet almost everything to learn of the habits of the creature. Are there two broods or only one brood in the year? Does it hibernate in the imago state? For my part I shall not be surprised if it prove to be only single-brooded, the imago hibernating and not appearing after hibernation until the summer is well advanced.

I now come to the subject of the recorded variability of the species. The figures given by Esper, Duponchel, Freyer, &c., vary little, and Guenée (Phalénites, vol. ii. p. 175) says, "Elle se retrouve, sans autre différence que le bord terminal un peu plus droit, en Algérie, dans l'Afrique centrale, en Abyssinie, et dans le nord de l'Inde." I have examined thirty-two examples in the collection of the British Museum, chiefly from Africa and India,

and they are remarkably constant, save that two females from South Africa pertain to the form known as *sanguinaria*. Zeller ("Isis," 1847, p. 491) gives the fullest information on this point; he indicates seven forms (including the type), chiefly differing in the presence or absence of a discal point, in the colour of the transverse fascia, and (slightly) in the ground-colour.

The great amount of variation exhibited in these English bred examples opens up the question of the right that the so-called species of *Sterrha*, allied to *S. sacraria*, have to be considered as distinct. *S. sanguinaria*, Esper, has already been disposed of as a variety of *sacraria*. There then remain—

(1.) *S. Labdaria*, Cramer (Papil. Exot. pl. 181, D.), from Surinam; now known only from the figure, which extremely resembles *S. sacraria;* the only instance, supposing the locality to be correct, of a *Sterrha* occurring on the American continent.

(2.) *S. anthophilaria*, Hübner, from South Russia; with the anterior wings of the typical *sacraria*, and with the posterior wings blackish, with a central pale band.

(3.) *S. rosearia*, Treitschke (Schmett. von Europa, vol. vi. pt. 2, p. 298), from the Ionian Islands and South Russia, figured by Duponchel (pl. 178, fig. 8), and by Herrich-Schäffer (*anthophilaria*, fig. 29); differing from the typical *sacraria* slightly in the form of the wings, with the colour of the anterior entirely rosy-grey, and with the posterior wings of *anthophilaria* (much resembling the hereinbefore described No. 1); given by Eversmann as a variety of *sacraria*, and by Staudinger ("Catalog Lepidopteren Europas," p. 76) as perhaps a variety of the female of *anthophilaria*.

(4.) *S. plectraria*, Guenée (Phalénites, t. ii. p. 176, pl. viii. fig. 7), from Abyssinia; differing from *sacraria* by its larger size, more triangular wings, and different coloration.

(5.) *S. participata*, Walker (Brit. Mus. Cat. Lep. pt. xxiii. p. 1060, 7), from Namaqua Land; with reddish anterior wings, and a dark purplish-red broad oblique band, white discal spot, and pinkish-purple apical cilia.

(6.) *S. peculiata*, Walker (*loc. cit.* 8), from Natal; with reddish-ochreous anterior wings, and a pale discal spot.

S. florilegaria, Zeller, Guenée, from Caffraria, I put out of the question, because Guenée states that, despite its resemblance to *S. sacraria*, he is uncertain if it really pertains to the genus.

After examining the six English specimens, bred from the same brood of eggs, I can come to no other conclusion than that all

these supposed species should probably be referred to *Sterrha sacraria*, for most of them really approach more nearly to the typical form of that species than do most of the bred examples.*

I deeply regret that Mr. Hellins was unable to obtain eggs from these examples, so as to prove if they would continue to vary in like manner, or would all or in part revert to the typical form, for I cannot but consider it a very extraordinary circumstance that not one of them should have in any degree approached to this form. To what are we to attribute this variation? I ask the question, but confess that I see no satisfactory method of answering it. "Unusual food-plant" will no doubt be suggested by some. I cannot admit this explanation, because I have no belief in the power of the food of the larva to produce any immediate and striking effect upon the imago; such an effect must be the work of ages, combined with previous isolation; besides as *S. sacraria* is almost cosmopolitan, even the typical form, it is reasonable to suppose, is by no means confined to any one plant. I rather look to climate, but here again I do not understand the immediate effect. It may be worth remarking that these examples show precisely the peculiarities that one would expect in a delicate tropical or semi-tropical species adapting itself to a colder climate, for their texture is denser, and their general form more robust.

I will now make a few general remarks on variation in *Lepidoptera*, chiefly based upon observations of British species. Britain has been emphatically styled by Guenée "le pays des variétés," and it is well known that British specimens are always desired by continental collectors. Indeed I could not help remarking, when looking over some of the Parisian collections, on the absence from or rarity in them of what we are wont to consider as the typical forms of many species. This great richness in varieties may be due, first, to our insular position; secondly, to our anomalous and variable climate; and thirdly, and perhaps chiefly, to the diversity in the geological structure of these islands. I, of course, place out of the question sexual variation, and also the so-called cases of "hermaphroditism" or "gynandromorphism,"

* This suggestion is of course based on incomplete evidence; for should the larvæ of these forms prove to be constantly distinct from each other and from that of *S. sacraria*, that would establish the right of all or any of them to be considered as species. I may add that, through the kindness of Mr. Doubleday, I have examined specimens of *anthophilaria* received from Dr. Staudinger; these differ from any variety of *sacraria* that I have seen in the direction of the oblique fascia, which leaves the costa before the apex, whereas in *sacraria* it leaves the costa at its junction with the apical margin.

considering these latter more in the light of monstrosities ; also those cases which must come under the head of accidental variation ; likewise variation in the broods of species that have two generations in the year. In this country the species of the genus *Selenia* are familiar examples of the latter, and a more remarkable one is found on the continent in the case of *Vanessa Prorsa*. Local variability is therefore the chief head under which to class variation in the imago.

Many species become more or less "melanised" when occurring in the North of England and Scotland, the darkening becoming more marked the further we proceed northwards. Among these may be cited, *Spilosoma fuliginosa*, *S. mendica* (♂), *Liparis monacha*, *Crocallis elinguaria*, *Hypsipetes elutata*, *Melanthia rubiginata*, *Cidaria testata*, *C. populata*, *C. suffumata*, *Notodonta dromedarius*, *Ceropacha flavicornis*, *C. or*, *C. duplaris*, *Acronycta rumicis*, *Xylophasia rurea*, *X. polyodon*, *Luperina testacea*, *Celæna Haworthii*, *Rusina tenebrosa*, many species of *Agrotis*, *Noctua festiva*, *N. neglecta*, *Trachæa piniperda*, *Tæniocampa gothica*, *T. leucographa*, *T. miniosa*, *Orthosia lota*, all the genus *Dianthœcia*, *Polia chi*, *Aplecta nebulosa*, *A. tincta*, *A. occulta*, *Hadena adusta*, *H. dentina*, *Calocampa vetusta*, together with many species of *Tortrices* and *Tineina*. On the contrary there are a few species which become paler the further we proceed north. As instances of this I may cite *Fidonia piniaria*, in the male of which those portions of the wing which are rich yellow in southern examples, become white in northern ones ; and *Cidaria corylata*, in which, in northern examples, the ochreous bands entirely disappear, and the black markings are much less extensive, being frequently broken up into grey spots. Another instance may be cited in which locality actually changes and confuses the normal sexual variation in the colour ; I allude to *Hepialus humuli*, in which the sexual characters in the coloration are generally so well marked, but in the Shetland Islands a form of this species is found with the male frequently coloured as in the female. Variation tending towards melanism, but of a peculiarly smoky character, is found in many species from the northern districts of England, especially the country about Warrington (but disappears again still further north), and this district would appear to be peculiarly adapted to the production of varieties. I may mention *Epunda viminalis*, *Amphidasys betularia*, *Hypsipetes impluviata*, *Tephrosia biundularia*, and *Cidaria russata*, as instances in which this smoky form predominates in that locality ; and Mr. Doubleday remarks that aberrations of *Arctia caja*, *Spilosoma menthastri*, and *Abraxas grossulariata*, are much more

frequent there than in other parts. It appears to me then not difficult to imagine that should this district suddenly become isolated, these forms would of necessity develope into what we should very fairly call species. Many North American insects are very similar to ours; some of these are considered identical, others possessing rather wider differences are called distinct species; surely here is a very clear case of "developmental" handywork. Again, to slightly diverge from the subject of British *Lepidoptera*, I would add that a very slight acquaintance with exotic *Rhopalocera* has convinced me of the probability of the developmental theory, for we find there the greatest difficulty in distinguishing between what are to be considered as species and what as varieties, because differences of locality produce forms which, though closely allied, present certain minor differential characters; no doubt these are rightly termed "species," but still we cannot doubt their common origin. In Europe the genus *Erebia* is an instance of this, and precisely the one in which we should expect to find such a result, because as these insects appear to require a certain low average temperature, they naturally are chiefly found in mountain districts, which from upheaval, or from sinking of the surrounding country, have become isolated, and present the most favourable conditions for gradual development. To return to my subject, I may say that there are some few British species which present dimorphic forms of the female only, as in the familiar instances of *Colias Edusa* and *Argynnis paphia*. Others again present almost endless variation, without regard to locality, such as most of the species of the genus *Miana*, several *Geometridæ*, the genus *Peronea*, &c. In another British insect there exist two forms, which though I think without doubt of common origin, are yet entitled to rank as distinct,—I allude to *Lasiocampa quercus*, which on the northern moors, and in some similar isolated positions in the south, presents the form known as *L. callunæ*, which differs remarkably in habit from *L. quercus*, and in which the larva differs slightly, correlated with still smaller differences in the imago. *Metrocampa margaritaria*, which is double-brooded in the south of England, has only one brood in Scotland, and I believe there are other analogous instances; it is also well known to all Scotch Lepidopterists that many species habitually remain there in the pupa state for two, three or four years, although in the south this would form quite the exception in the same species; this retardation of development may probably have some effect in causing variation, according to the observations of M. Bellier de la Chavignerie.

I now come to consider variation in the larval condition. I have been kindly favoured by Messrs. Hellins and Buckler (than

whom none are more competent to speak on the subject) with the following table, which I reproduce *in extenso*:—

Species.	Food-plant.	Variation of Larva.	Notes on Imago. C.—constant.
Vanessa Atalanta.	*Urtica dioica.*	Various shades of ground-tint.	C.
V. cardui.	*Carduus.*	Various shades of ground tint; lines more or less distinct and bright.	Rather variable in tints.
Arge Galathea.	*Graminaceæ.*	Ochreous or green.	C.
Thecla quercus.	*Quercus.*	Various shades of warm brown; greenish.	C.
Smerinthus populi.	*Populus; Salix.*	One or two tints of green ground colour; sometimes more or less blotched with red.	Variable in tint of ground-colour.
Acherontia Atropos	*Solanum tuberosum.*	Brown or yellowish.	C.
Sphinx convolvuli.	*Convolvulus; Impatiens*, &c.	Green or brown, &c.	C.
Chærocampa elpenor.	*Epilobium; Vitis; Fuchsia*, &c.	Green; brown.	C.
Macroglossa stellatarum.	*Galium*, various species.	Green; lead-colour; olive-brown.	C.
Zygæna filipendulæ.	*Lotus corniculatus*, &c.	Green; yellowish-green.	C.
Orgyia pudibunda.	Polyphagous.	Green; yellow; brown; white? &c.	C.
Trichiura cratægi.	*Prunus spinosus; Salix; Cratægus*, &c.	Brown; white; black; red spots, &c.	C.
Pœcilocampa populi.	*Populus; Quercus; Salix; Prunus; Betula*, &c.	Brown; blue; grey, &c.	C.
Saturnia carpini.	*Calluna; Salix; Rubus*, &c.	Spots yellow or pink.	C.
Rumia cratægata.	*Prunus spinosus; Cratægus*, &c.	Green, red spots; brown-grey, green spots, &c.	C.
Odontopera bidentata.	*Fraxinus; Hedera Helix*, &c.	Grey; brown; white; green.	Tolerably constant.
Crocallis elinguaria.	*Salix; Prunus; Cratægus*, &c.	Brown; grey; greenish; ochreous, &c.	Tolerably constant.
Ennomos fuscantaria.	*Quercus; Ligustrum vulgare.*	Green; brownish-grey, &c.	C.
E. angularia.	*Quercus; Fagus?*	Brownish; green; (sometimes smooth).	Rather variable.
Biston hirtarius.	*Salix; Quercus*, &c., &c.	Dark brown; greyish-brown; slaty.	C.
Amphidasys betularia.	.. ..	Greenish; grey; brown, &c.	Permanent varieties.
Boarmia repandata.	*Salix; Rubus; Cratægus;* low plants.	Grey; whitish-ochreous, &c.	Variable.
B. rhomboidata.	*Ligustrum; Hedera; Cratægus; Ulmus; Spartium; Vitis; Trifolium; Clematis*, &c.	Warm brown; reddish; dirty white, with black markings, &c.	Variable.
Tephrosia biundularia.	*Larix* and ?	Reddish; blackish; ochreous-grey.	Variable.

Species.	Food-plant.	Variation of Larva.	Notes on Imago. C.—constant.
Gnophos obscurata.	*Cistus; Sanguisorba; Potentilla*, &c.	Greyish; ochreous; blackish.	Variable.
Hemithea thymiaria.	*Quercus*; also low plants.	Green; reddish.	C.
Halia wavaria.	*Ribes.*	Green; purplish-brown.	C.
Macaria notata.	*Salix; Betula.*	Yellowish-green; brownish-green; brown; purplish, &c.	C.
M. liturata.	*Pinus.*	Green; smoky, &c.	C.
Fidonia atomaria.	*Calluna* and *Erica.*	Pale green; grey; ochreous; brown; pinkish-red.	Variable.
Ligdia adustata.	*Evonymus europæus.*	Bright green; pale brown.	C.
Hybernia rupicapraria.	*Prunus; Cratægus; Calluna; Ribes*, &c.	Pale green; blue-green; smoky.	C.
H. leucophæaria.	*Quercus.*	Whitish; pale green; olive-green; brownish.	Variable.
H. progemmaria.	*Quercus; Betula; Ulmus; Prunus*, &c.	Pale buff; blue-green; smoky.	Tolerably constant.
Cheimatobia brumata.	*Quercus; Pomus; Cratægus*, &c. &c.	Pale greenish-grey; various shades of green.	C.
Oporabia dilutata.	*Prunus; Acer; Castaneus; Betula; Quercus; Laurus*, &c.	Green; green, covered with red markings.	Variable.
Larentia cæsiata.	*Vaccinium vitis-idæa.*	Full green; rich red.	Mostly constant.
L. pectinitaria.	*Galium.*	Deep brown; grey, &c.	C.
Emmelesia decoloraria.	Seed vessels of *Lychnis.*	More or less green.	C.
E. alchemillata.	*Galeopsis tetrahit.*	Red or brown.	C.
Eupithecia linariata.	Flowers and seeds of *Linaria.*	Yellow; green; brown.	C.
E. pulchellata.	Flowers and seeds of *Digitalis.*	Pale green; green; smoky.	C.
E. centaureata.	Flowers of *Senecio; Solidago; Clematis; Saxifraga; Reseda*, &c. &c.	Whitish-green; full-green; yellow; buff; with red, purple, blackish or green markings.	C.
E. satyrata.	Flowers of low plants.	Green; puce; brown or red markings.	Rather variable.
E. castigata.	On any plant.	Different shades of brown and grey.	Scarcely variable.
E. virgaureata.	Flowers of *Solidago* and *Senecio.*	Red-brown; darker-brown.	C.
E. tripunctata.	Flowers of *Angelica.*	Pale-green; full-green; olive-brown; deep brown.	C.
E. fraxinata.	*Fraxinus.*	Full-green; yellow-green; puce; uniform or with rich pattern.	C.

Species.	Food-plant.	Variation of Larva.	Notes on Imago. C.—constant.
Eupithecia vulgata.	*Cratægus*; also various flowers.	Red-brown; olive; blackish, &c.	C.
E. expallidata.	Flowers of *Solidago.*	Yellow; yellow-green; full green; uniform or richly marked.	C.
E. absinthiata.	Flowers of *Senecio; Achillæa; Artemisia; Agrimonia; Centaurea,* &c. &c.	Yellow-green; olive; puce; brown; with pink, blackish, brown, or green markings.	C.
E. minutata.	*Calluna vulgaris.*	Greenish; rosy-pink.	C.
E. assimilata.	*Ribes nigrum; Humulus.*	Green; pink; purplish.	C.
E. nanata.	*Calluna vulgaris.*	Rose-pink; olive; white; green; yellow, &c.	Mostly constant.
E. dodoneata.	*Quercus.*	Olive-green; red-brown.	C.
E. lariciata.	*Pinus larix.*	Full green; puce; brown.	C.
E. exiguata.	*Cornus; Cratægus.*	Full green; puce.	C.
E. sobrinata.	*Juniperus communis.*	Green; olive; light-red; uniform, or with red or brown pattern or lines.	Variable.
E. pumilata.	*Clematis; Scabiosa; Agrimonia; Senecio; Potentilla; Spartium,* &c.	Whitish; pinkish; yellow; brown; purple; uniform or with markings.	Mostly constant.
E. coronata.	Flowers of *Clematis.*	Various shades of green, olive and brown.	C.
Hypsipetes elutata.	*Salix caprea.*	Various shades of brown.	Very variable.
Melanippe rivata.	*Galium.*	Green, with brown or reddish markings.	C.
M. subtristata.	*Galium.*	Brown, &c.	C.
M. galiata.	*Galium.*	Pale ochreous; dark brown; variable markings.	C.
M. fluctuata.	Low plants.	Brown; green; uniform or with markings.	Variable.
Anticlea badiata.	*Rosa canina.*	Pale green; purplish-red.	Rather variable.
A. berberata.	*Berberis.*	Ochreous; purplish-red.	C.
Chesias spartiata.	*Spartium scoparium.*	Dark green; yellow, &c.	C.
Camptogramma fluviata.	Low plants.	Yellowish-green; greenish brown; reddish-brown.	Variable.
Scotosia rhamnata.	*Rhamnus catharticus.*	Green; black and yellow.	C.
Cidaria russata.	Polyphagous.	Green; yellowish-green; with or without purple red line.	Variable.

Species.	Food-plant.	Variation of Larva.	Notes on Imago. C.—constant.
Cidaria silaceata.	*Epilobium.*	Green ; pinkish-green.	Variable.
C. prunata.	*Ribes rubrum* and *grossularium.*	Brown ; grey ; pale green.	C.
C. populata.	*Vaccinium vitis-idæa.*	Brown ; reddish-green, &c.	Mostly constant.
Notodonta camelina.	*Quercus ; Fagus ; Corylus.*	Green ; lilac ; reddish.	C.
N. dictæa.	*Salix caprea*, &c.	Green ; brown.	C.
N. dictæoides.	*Betula.*	Green ; purple.	C.
Xylophasia rurea.	*Graminaceæ.*	Various tints of ochreous, reddish, and dark brown.	Variable.
Mamestra brassicæ.	Polyphagous.	Green ; grey ; brown.	C.
Gortyna flavago.	In stems of *Cnicus ; Arctia ; Verbascum ; Digitalis*, &c.	Purplish-grey ; yellowish flesh-colour.	C.
Rusina tenebrosa.	Low plants.	Rich red ; reddish-brown ; brown.	C.
Grammesia trilinea.	*Plantago.*	Dark grey ; ochreous.	Rather variable.
Agrotis porphyrea.	*Calluna* and *Erica.*	Dark green ; buff ; red.	C.
Triphæna orbona.	Polyphagous.	Many tints of grey and brown.	Variable.
T. pronuba.	Roots of *Graminaceæ*, &c.	Green ; olive-green ; various shades of brown.	Variable.
Noctua plecta.	Low plants.	Various shades of brown ; ochreous ; green.	C.
N. C-nigrum.	Low plants.	Grey ; brown.	C.
N. ditrapezium.	Various.	Various tints of ochreous, red and brown.	C.
N. triangulum.	Various.	Various tints of ochreous, red and brown.	C.
N. neglecta.	*Erica* and *Salix caprea.*	Orange ; brown ; green.	Variable.
N. xanthographa.	*Graminaceæ*, &c.	Many tints of buff and brown.	Variable.
Tæniocampa gracilis.	*Salix ; Rubus.*	Green ; red-brown.	Rather variable.
T. cruda.	Chiefly *Quercus.*	Green ; black ; brown ; puce.	Mostly constant.
Dianthœcia carpophaga.	Seeds of *Silene inflata.*	Many tints of buff and ochreous.	Variable.
D. capsincola.	Seeds of *Silene* and *Lychnis.*	Buff ; brownish ; greenish.	C.
Epunda lichenea.	*Senecio vulgaris*, &c.	Brown ; green ; grey.	C.
Phlogophora meticulosa.	Polyphagous.	Green ; brown ; ochreous.	C.
Hadena chenopodii.	*Chenopodium* and *Atriplex.*	Green ; brown ; with or without red lines.	C.
H. contigua.	*Salix.*	Green ; bright red.	C.
H. oleracea.	Low plants.	Green ; brown.	C.

Species.	Food-plant.	Variation of Larva.	Notes on Imago. C.—constant.
Hadena pisi.	*Erica; Spartium; Salix; Pteris*, &c.; perhaps polyphagous.	Dark-green; crimson.	Rather variable.
Cucullia chamomillæ.	*Anthemis.*	Pink; green; yellow.	C.
C. lychnitis.	*Verbascum nigrum* and *lychnitis.*	Green; yellow.	C.
Heliothis marginata.	*Ononis; Betula.*	Green; red; smoky.	C.
H. peltigera.	*Hyoscyamus; Ononis.*	Green; red; uniform or with pattern.	C.
Stilbia anomala.	*Graminaceæ.*	Green; brown.	C.

Mr. Hellins then adds a list of species which, though very variable in the imago state, are constant or nearly constant in the larval. Among these may be cited *Arctia caja*, *Hadena protea*, *Tæniocampa instabilis*, *Anchoscelis lunosa*, *Apamea oculea*, &c.

A glance at the foregoing table will show that often when the imago is most constant, the larva shows the greatest tendency to variation; this is especially marked in the species of the genus *Eupithecia*. To what then are we to attribute this variability in the larva? I have before expressed my doubt as to the effect of food in causing variation in the imago; not so, however, in the larva, for I believe that variability in the latter is caused in a great measure, but indirectly, by food, and that the object of such variation is, as Mr. Hellins has justly surmised in his letters to me, mimicry. Not that the larva of one species mimics that of another, but rather the plant on which it subsists. In fact the prevailing colours of the majority of Lepidopterous larvæ are green and brown, and admirably assimilate to those of the foliage and stems of plants and shrubs. This is especially noticeable in the majority of the larvæ of *Geometridæ*, which are not strictly nocturnal feeders as are most of the *Noctuæ*, which retire to some place of concealment during the day, when they would be the most liable to the attacks of birds. The larvæ of many species of the genus *Eupithecia* show this power of mimicry to very great advantage. These are, for the most part, flower feeders, and have evidently the power of assuming the same colour as that of the flowers on which they feed. Some five years since I, one autumn, collected about a hundred larvæ of *Eupithecia absinthiata*, and I remarked that when found on *Senecio Jacobæa*, they

were yellowish, when on *Centaurea nigra* reddish, when on *Matricaria* whitish, &c.; afterwards I placed them all on *Senecio Jacobæa*, they being then nearly full grown. I did not find that they showed a tendency to become yellowish ; and this proved to my mind, first, that it was necessary for the larva to have fed on the one kind of flower from the egg in order to acquire this power of mimicry, and secondly, that the colour of the larva could not be caused by the food showing through the somewhat transparent integuments. Hence, it appears that the colours of Lepidopterous larvæ are in a great measure adapted to save them from being carried off by birds and other enemies, and it is reasonable to suppose that in those cases, where the colours do not assimilate with, or are directly opposed to, those of the food-plant, some other circumstances may exist, rendering such mimicry unnecessary. The larvæ of most internal feeders, which are not greatly exposed to external enemies, show little variation, either in particular species or as a whole.

I conclude, therefore, that food has an immediate though indirect effect in producing variation in the larva, but that in the imago it possesses this attribute in a very small degree. In the latter we must look to other and more subtle causes. That mimicry does not exist in the imago to the same extent as in the larva appears evident, but I cannot believe that Nature is ever aimlessly prodigal, and, no doubt, the causes of variability in the imago-state are as potent as in the larva-state, but at present they are, for the most part, beyond our comprehension.

With respect to range of variation I will say but little. It appears to me that ordinarily varieties have a tendency to revert to what we consider as the type, but that under certain circumstances, not only will they not so revert, but that the divergence will gradually become wider, until eventually they develope into what is considered as a species. I do not say that I am prepared to accept the "development theory" to the full extent to which some would apply it; but that it is a reasonable way of accounting for phenomena, which otherwise cannot be satisfactorily settled, must, I think, be evident to all who endeavour to rid themselves of hereditary prejudices. The acceptation, partial or entire, of this theory is not so disastrous as some would appear to consider it. The most inveterate describer of new species need not fear that the darling object of his existence is useless and aimless if well done, for the process of development is of necessity so immeasurably slow, that to all intents and purposes, a faithful description of a new "form" or "species" is as useful

to a naturalist holding the one view as to another who prefers to adhere to old ideas; it is only that the one looks upon the origin of that species in a different light from the other.

I must ask my readers to bear with me for one moment whilst I diverge from the *Lepidoptera* to refer to another Order to which I have paid more particular attention—the *Neuroptera*. It is a fact that cannot be too strongly insisted upon, that in this Order, the secondary or auxiliary sexual appendages present almost infallible characters for the separation of species. Were these characters perfectly infallible, were there not some forms in a transitional or variable condition, this would, I consider, be fatal to the "development" theory, but such forms or species do exist, and, for instances, I refer to De Selys Longchamps and Hagen's "Monographie des Gomphines," in which it is shown that in two species at least, *Gomphus* (*Onycogomphus*) *forcipatus* (pp. 28-40, pl. ii.) and *Cordulegaster annulatus* (pp. 333-337, pl. xvii.), the anal appendices present rather remarkable variations in form according to locality, and, perhaps, correlated with certain differences in coloration. I have no doubt that other instances could be cited, and I believe that even in the *Trichoptera* parallel cases may be found.

In bringing these notes to a close I must glance at a very elaborate paper "On phytophagic Varieties and phytophagic Species," by Mr. Benj. D. Walsh, of Rock Island, Illinois (a writer thoroughly imbued with Darwinian views), published in the Proceedings of the Entomological Society of Philadelphia, vol. iii. pp. 403-430. In this paper he classes variation by food under twelve different heads (pp. 427-428), which are too lengthy to reproduce here. So far as I understand him, Mr. Walsh is also opposed to the notion of food being an immediate cause of variation in the imago, but he argues that in some insects there are certain more or less constant forms attached to particular plants, and as a rule breeding only *inter se*, which are very closely allied, and which he considers as only phytophagic species, but, nevertheless, quite worthy to be considered and named as distinct. Under this rule would come many of the British species of Micro-Lepidoptera,* and I fancy that had Mr. Walsh been extensively ac-

* In the genera *Gelechia*, *Elachista*, *Lithocolletis*, *Nepticula*, &c., there are certain groups of closely-allied species, each of which apparently feeds exclusively on different species of the same family of plants. In *Lithocolletis* this is especially noticeable in the group of species (*L. pomifoliella* and its allies) attached to the fruit-bearing *Rosaceæ*. On the contrary, we often see totally distinct species of one genus living side by side in the same leaf. I wish to

quainted with the American species of this group, he would have laid more stress on it to illustrate his views.

In taking leave of this subject, I tender my sincere thanks to Mr. Hellins and Mr. Buckler for their kindness in assisting me with notes.

be distinctly understood that I am directly opposed to the view held by some Entomologists, that these cognate forms are immediately occasioned by the difference of the food-plant, though they may have *originated* from that cause, and are thus what Mr. Walsh terms "phytophagic species."

EXPLANATION OF PLATE XXIII.

Fig. 1. *Sterrha sacraria*, ♀; the parent of the following:—

1*a*. Larvæ of *S. sacraria*; on *Polygonum aviculare*.

2—7. Varieties of *S. sacraria*, bred from eggs laid by fig. 1. [Unfortunately, Art has failed to re-produce the beauty of Nature.]
