A NATURAL HISTORY OF THE

BRITISH LEPIDOPTERA

THEIR WORLD-WIDE VARIATION AND GEOGRAPHICAL DISTRIBUTION.

A TEXT-BOOK FOR STUDENTS AND COLLECTORS

BY

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PREFACE.

The volume now completed perhaps requires two words of apology, (1) the apparently elementary character of the preliminary chapters, (2) the small number of species treated in the systematic part.

Whilst accumulating the material for our life-histories, we were struck with the remarkable paucity of useful observations on the habits of the larvæ. One was quite aware that the life-histories of each species would have to be worked out *de novo*, and that detailed descriptions, laying stress on structural characters, would have to be made, yet one somehow expected that the actual details of the habits of larvæ which had supposedly been reared by a great many lepidopterists, would be well-known, and have been often recorded, yet this was not so, and, at the very outset of our attempt to write some general notes on the larval habits of the Ruralids, we were struck with the facts that, (1) the information was either not available, or so scattered as to be of very little use; (2) the variation of the larval habits in different groups was apparently so unequal (sometimes in allied species very dissimilar, at others through large groups very similar), that, if carefully considered, the facts might bring out some useful generalisations, and the comparisons give a meaning to scattered observations, otherwise almost meaningless.

Simple, therefore, as these chapters appear, they are the outcome of the expenditure of considerable time and labour, and the writer can only hope that, as the chapters on "The family-habits of butterfly larvæ," here published, have crystallised, as it were, a mass of loose ideas and filmy material floating in his own mind, so the reading of them will crystallise similar ideas in the minds of his readers, and lead them to make, and publish, systematic observations on one of the most interesting features of the life-histories of our lepidoptera, and thus give us the material by which we may more fully understand the main directions in which their habits lead to, and help in, their protection, either by their general appearance, their position of rest, peculiarity of movement, particular form of eating, or by any special character the larvæ may exhibit. Elementary, then, as these preliminary chapters are known to be, there can be no doubt that they are a great advance on, and comprise a very much greater number of facts than, anything ever previously published on this subject. And, here, we would publicly thank our mentor in work of this kind, Mr. S. H. Scudder, who, in his great work, *The Butterflies of New England*, not only set a standard of excellence in dealing with the life-histories of individual species that must leave its effect on the best biological lepidopterists for all time, but also struck a strong note against the so-called "museum" or "catalogue" entomology, which, growing out of the Linnean shibboleths, tended to replace the natural history of Réaumur and the old masters, and substituted the orderly cataloguing of captures for the study of living things. How important both sides of this work are to a true understanding of any branch of zoology was never more clearly shown than by Scudder in his monumental work, which must go down to the ages, the admiration of all those who recognise how difficult pioneer work of any kind really is, and as focussing the strugglings of Curtis, Stainton, Buckler, Hellins, and others, in attempting to show that a knowledge of living things is, after all, the true aim of the naturalist, that observations with the naked eye and the microscope lead to exact knowledge, and that the observer must fight against his life being wasted by the bonds that everywhere stretch out to hold him in leash, if once he is attracted to the excrescences that have grown up around his favourite study. This, then, is the writer's excuse for these preliminary chapters, simple as they may appear, yet comprising most of the facts accumulated by lepidopterists up to the present year of grace. As bearing on the excellence of the work of the old authors we would suggest that almost the only real piece of observation on the early stages of the "hairstreaks" that we found to be worth quoting, came from Réaumur (*Mém.*, i., pp. 450-454), and was written nearly 180 years ago. We would refer our readers to pages 190-192 of this volume, in order to see Réaumur's masterly account of the silk-spinning, in preparation for pupation, done by the larva of *Edwardsia w-album*; few lepidopterists of the present day have done any observational work that excels this.

It will be observed that, in this volume, the subject of the symbiotic relation between ants and Lycænid larvæ has been, in many places, dealt with at length. Although known to continental lepidopterists for nearly 130 years, it has only recently been introduced to the notice of British lepidopterists as a detail in the habits of our own "blue" butterfly larvæ, by the observations of Mr. A. L. Rayward. This and many other items we may look upon as likely to be worked out at considerable length in the immediate future, now that the attention of our native workers has been called thereto.

The second item is a serious one, but the explanation is simple, *viz.*, that one cannot get a quart into a pint pot. It was intended to deal first with the more generalised Lycænids or "blues" before the "hairstreaks," but the material for an account of the life-histories of the latter came to hand before the former, and hence a little topsy-turvydom in the arrangement has been the result. Up to the time of our working out the life-histories of our British "hairstreaks," the ignorance concerning them was appalling. Newman was obliged to concoct his descriptions of the early stages of *Callophrys rubi* and *Strymon pruni* from Hübner's somewhat crude figures of larvæ and pupæ, over a century old; of *Edwardsia w-album* an egg evidently of some other species was described, and was coupled with a short note of some twenty-seven half-column lines of the adult larvæ and pupæ; whilst his life-histories of *Ruralis betulae* and *Bithys quercûs* were equally vague and unsatisfactory. Nor did Buckler and Hellins really move matters; a page on the larva and pupa of *Callophrys rubi* is all that Buckler attempted; a page also on the larva of *Ruralis betulae* (no pupa), and two on *Bithys quercûs* are to Hellins' account, and this was all; whilst of *Lampides boeticus*, a mistranslation of Millière's meagre remarks of the larva by Newman, and an account of the larval variation of *Celastrina argiolus*, with notes on the egg and pupa by Buckler were all, whilst, in addition, a Tortricid larva seems to have been mistaken for a larva of *C. argiolus* by this observer, so that practically everything was left to be done *de novo*, for even Newman regretted his "inability to give, with confidence, any particulars of the life-history of the latter species." Whether our subscribers will be satisfied that we have succeeded in giving them a real history of the species attempted we do not know, but we venture to hope that, with the aid of the excellent photographs, for which we are so much indebted to Messrs.

F. Noad Clark, Hugh Main, and A. E. Tonge, made from the living objects or from the natural objects *in sitû*, as well as from the microscopic preparations of Dr. T. A. Chapman, and the descriptions thereof, as well as the more comprehensive and detailed descriptive matter in the body of the work by Dr. Chapman, and our own researches from various sources, they will feel that they have now the means of getting at most of the facts connected with the life-histories of the species described.

Possibly the greatest satisfaction that we feel in connection with this volume is that engendered by our having drawn Mr. G. T. Bethune-Baker into the toils of our entomological socialistic community. His unequalled wealth of knowledge of the extra-European Ruralid species, and his excellent grip of the essential characters that have to be considered in critical questions of specific and non-specific value have enabled us to present with confidence our conclusions as to the specific or varietal value of all those forms of our own species that have so wide a geographical range. The detailed examination by Dr. Chapman and Mr. Bethune-Baker of the genitalia of *Celastrina argiolus*, and a large number of allied species, leaves no manner of doubt that all the various American races of *C. pseudargiolus*, as well as many of the Indian forms treated as distinct species by de Nicéville, are mere geographical races of our common and widely-spread species, and are in no wise to be considered as distinct species.

One other point we would urge, *viz.*, the necessity of every British entomologist obtaining a grip of the general characters of, and the particular literature relating to, the group he is studying. To the isolated worker, as well as the busy one, much of the reference work needed to get this grip is impossible, and hence we have no hesitation in summarising that which we have used for our own results. By this means, facts are at the disposal of all, and every student can at least draw his own conclusions, when such are based on these facts.

Now, as to the generous help received. First and foremost the author's thanks are due to Dr. T. A. Chapman, for there is hardly a page that does not bear witness to his great kindness. To Mr. Stanley Edwards, who has laboured most ungrudgingly at the authorities and unearthed a great mass of detail from their works; to Messrs. Gillmer, Kappel, Kirby, and Sich, for translations of important articles from the foreign magazines; to Mr. H. J. Turner for the "Synopsis of Contents" and "Special Index," to the Rev. G. H. Raynor for looking through the proofs, to Mr. F. N. Pierce for working out the characters of the "androconia," to Professor Blachier, Messrs. Aigner-Abafi, Rowland-Brown, Federley, Gillmer, Commander J. J. Walker, and Paymaster-in-Chief G. F. Mathew, for their comprehensive distribution lists, and to Mr. Heron, who has kindly helped with the material in the British Museum collection, the author's most grateful thanks are due; in short, it may best, perhaps, be put that the author's share of the work has been the least, and yet he has not felt himself free with a moment's leisure since the first pages began to assume the form that was required in order to make the volume now presented. If the student only feels that he has the best that we can offer, and the collector that he has at least all he wants, if not something besides, we shall be amply repaid for the work bestowed on the production of the volume.

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RURALIDES (THECLIDES).

BRITISH BUTTERFLIES.

CHAPTER I.

THE ÆSTIVATION AND HYBERNATION OF BUTTERFLY LARVÆ.

We have already, in the previous volume (pp. 72 *et seq.*), dealt with certain of the resting-periods of butterfly larvæ, but the resting-period, by means of which many larvæ, in a lethargic state, pass the autumn and winter months, and a small number, most of the summer, as well as the autumn and winter, months, is exceedingly interesting, and must have come under the observation of every field naturalist. This phenomenon, which may extend from only a few weeks in the depth of winter, to many months, *e.g.*, July to March, is usually known as "hybernation," although Scudder attempts to differentiate (*Butts. New England*, p. 551) between a summer and winter rest, calling the former æstival portion "lethargy," and the latter, "hybernation." To this we shall refer later.

It is a well-known fact that all species of butterflies, at least in north temperate climates, pass the winter in the same stage (at any rate there are few well-authenticated instances in which this is not so, *Pararge egeria* being the only one known to us), and, although this may be the egg, larva, pupa, or imago, it is always (with the rare exceptions above noted) the same for the same species. The proportion of butterflies that hybernate as larvæ in a torpid state, in temperate regions, is a comparatively large one, and among our British butterflies we find the following :—*Nisoniades tages*, *Cyclopides palaemon*, *Augiades sylvanus*, *Adopaea flava*, *Cupido minima*, *Aricia astrarche*, *Polyommatus icarus*, *Agriades bellargus*, *Lycaena arion*, *Rumicia phlaeas*, *Chrysophanus dispar*, *Aporia crataegi*, *Colias edusa*, *C. hyale*, *Dryas paphia*, *Argynnis aglaia*, *Issoria lathonia*, *Brenthis euphrosyne*, *B. selene*, *Melitaea cinxia*, *M. athalia*, *M. aurinia*, *Limenitis sibylla*, *Apatura iris*, *Pararge egeria* (also as pupa), *P. megaera*, *Epinephele ianira*, *E. tithonus*, *Erebia aethiops*, *Melampias epiphron*, *Coenonympha typhon*, *C. pamphilus*, *Enodia hyperanthus*, *Hipparchia semele*, and *Melanargia galatea*, *i.e.*, considerably more than one-half of our butterfly fauna, whilst some doubt is attached to the particular stage in which two other species, usually reputed to pass the winter as larvæ, really do hybernate. These are *Thymelicus acteon* and *Everes argiades*.

But, besides these, it is a remarkable fact that some, possibly all, of the butterflies known to us to hybernate in the egg stage, really do so as fully-formed larvæ, but within, and not without, the eggshell. This is the case with *Parnassius apollo*, *P. smintheus*, and *P. elodius*, *Argynnis adippe*, *Bithys quercûs*, *Ruralis betulae*, *Strymon* (*Thecla*) *w-album*, *S. pruni*, *Agriades corydon*, *Plebeius aegon*, *Adopaea lineola*, and possibly also *Urbicola comma*. The young larva of *Argynnis elisa*, like that of *A. adippe*, hybernates within the egg, but most remarkable of all are the resting-periods of *Argynnis aglaia* and *Dryas paphia*, for, although the larvæ of these two species hatch in July or August, when there is an abundance of food and a high temperature, they positively refuse to feed, and, in exactly the same stage as they leave the egg, pass through the winter, awaiting the first warm days of spring before partaking of their first food, *i.e.*, they rest for fully six months after hatching before making a single move towards food and ultimate growth. Although, as already noted, *Argynnis adippe* must be said to hybernate as an egg, yet the larva is fully formed in autumn, and it, too, lives on until February, but inside the eggshell, whilst those of *A. aglaia* and *Dryas paphia* live outside it. Scudder, evidently without any definite knowledge on the point, notes (*op. cit.*, p. 689) that larvæ may rest fully-formed throughout the winter in the unhatched egg, and he thinks that "it is possible that, to the list of butterflies hybernating in the larval stage, should be added those "Theclids and Chrysophanids that ostensibly pass the winter in the egg state." "If," he says, "as is probable, these eggs mature during the hot season in which they are laid, and not in the succeeding, cooler, early spring, when the caterpillar escapes, then the only difference between these caterpillars and those of the Argynnids is that one passes the winter within, the other without, the eggshell; and their refusal to escape in the warm weather points to premature hybernation, beginning in a kind of lethargy." Certainly this is the case with regard to our British egg-hybernating species, and one wonders whether both phenomena are not shown in the American, as well as in the European, Argynnids. Of the North American species, stated by Scudder to hybernate as soon as hatched, he notes (*op. cit.*, p. 561) of *Argynnis cybele*, "the eggs hatch in about fifteen days, but the caterpillars from them go immediately into hybernation without eating anything more than their eggshell;" of *A. aphrodite*, he says (p. 568), "it hybernates direct from the egg," and of *A. atlantis*, "it hybernates as soon as hatched, and before eating" (p. 577). Of *Brenthis myrina* and *B. bellona* (*op. cit.* pp. 599, 616) he says, respectively, "winters sometimes just from the egg, sometimes when half-grown," and "some larvæ feed until they have passed two or three moults and then winter, ... while others hybernate at once after leaving the egg." Both these latter statements require careful confirmation. Scudder notes (p. 689) of this peculiarity of larvæ hybernating as soon as they leave the egg: "The hybernation of caterpillars just born is a most surprising fact. As they eat nothing, one would think they might at least have had the protection of the eggshell and wintered within the egg, but, in the cases in point, Satyrines and Argynnids, the eggs are naturally laid upon the leaves of plants which die down in winter . . . . . Hybernation at this tender age is all the more surprising from the fact, known only too well to everyone who has attempted to raise butterflies from the egg, that the greatest mortality exists among caterpillars in the first stage of existence, whether from natural causes or from the attacks of enemies, and also because, in no case, do these apparently helpless little creatures, generally but 2mm. or 3mm. long, construct any sort of nest or retreat for their common or individual protection. They merely seek hiding-places separately in curled leaves, on the ground, in crevices of bark and similar spots, where they are certainly not out of the way of mites and ants. Neither have they any appendages which are not shared with other juvenile caterpillars that do not hybernate. There is no evidence, from any poverty of butterflies in these groups, that they do not retain as good a hold upon the fauna as those species which do not pass what would seem to be so perilous a winter; on the contrary, our Satyrids and Argynnids are plenty enough on the wing."

At the opposite end of the scale, compared with the hybernating stage of *Dryas paphia*, *Argynnis aglaia*, etc., are *Nisoniades tages*, *Cyclopides palaemon*, and *Cupido minima*, for these species hybernate as fullgrown larvæ, the last-named being usually fullfed in early or mid-July, when it becomes dormant, and not pupating till the following May; Buckler notes larvæ full-fed July, 1872, pupated June 3rd, 1873, with a larval existence of more than ten months. Similarly, *Nisoniades tages* is fullgrown at the end of July, when it spins a silken hybernaculum, remaining unchanged therein all the winter (even in a warm room), and pupating during the following April, whilst the larva of *Cyclopides palaemon*, fullfed about the middle of August, remains in its hybernaculum till early April, when it becomes restless, and soon afterwards pupates.

We have already noted that more than one-half of our British butterflies hybernate in the larval stage, and one suspects that this percentage is well-maintained throughout the north temperate zone. Speaking of New England, Scudder says (*op. cit.*, p. 688): "Certainly a quarter, not unlikely one-half, of our butterflies survive the winter as caterpillars; in the larger part of these the existence of the species depends upon their power of survival in this condition. Most of them pass the winter partly grown; some, as the species of *Thanaos* and *Pholisora*, fully grown, partaking of no further nourishment when the winter is passed, but changing to chrysalids almost or actually before their foodplant puts forth its leaves in the spring. Others still, and among these are most *Satyrinae* and *Argynnidi*, winter as young larvæ just hatched from the egg, generally, perhaps always in New England, before they have touched a morsel of vegetable food, though their natural foodplant, upon which they were born, still offers sufficiently tender leaves . . . . Of those that pass the winter half-grown, we may specify *Cissia*, *Basilarchia*, *Brenthis*, all the New England species of *Melitaeidi*, probably the species of *Eurymus*, and not improbably most of the *Pamphilidi*, of whose complete transformations we know far too little." As far as our Palæarctic species are concerned, no such sweeping generalisations can be made with most of these groups, for, although *Nisoniades* (*tages*) and *Cyclopides* (*palaemon*) hybernate as fullfed larvæ, and *Augiades* (*sylvanus*) as a half-grown one, yet *Urbicola comma*, another Pamphilid, hybernates as egg; and, whilst the large Argynnids hybernate as newly-hatched larvæ, or larvæ in the egg-shell, and *Brenthis* as half-grown larvæ, there are few European Satyrids, whose life-history we know, that adopts the Argynnid habit, although *Coenonympha mathewi*, Chapman informs us, does so.

So far as we know, the Melitæids (as exemplified by *Melitaea aurinia* and *M. cinxia*) and the Eurymids (as exemplified by *Colias hyale* and *C. edusa*) follow their American allies in being about half-grown at the time of hybernation. There is, therefore, great difference in the amount of development of larvæ of the same, as well as of different, groups at the hybernating period. As already noted, *Nisoniades tages*, *Cyclopides palaemon*, and *Cupido minima* are absolutely fullgrown, and have spun their winter home long before the autumn is really here; in this they remain at rest the whole winter, and early spring, and do not pupate until a few weeks before the imagines are to be found at large, and without leaving their winter hybernacula. *Pararge egeria* seems to be the most elastic in its winter resting-habit of all our British butterflies, for, whilst many larvæ, almost full-grown, pass the winter as such, and do some early feeding in the spring, others pass the winter in the nibbling stage, resting in unsuitable, and feeding during suitable, meteorological conditions, whilst some, already fullfed in late autumn, pupate in November and early December, and remain as pupæ, the imagines emerging in the spring, often with those from pupæ whose larvæ have passed the winter as such. It may be here noted that some species, *e.g.*, *Pararge megaera*, *Coenonympha pamphilus*, *Issoria lathonia*, *Colias hyale*, *Rumicia phlaeas*, etc., which have a very definite hybernating period, feed up very rapidly in the spring, and emerge quite early in the year.

There is also a marked difference in the amount of completeness or intensity which the resting-habit assumes during this period. In all the butterflies that hybernate as larvæ, whose foodplants are deciduous trees, the lethargy is absolute and complete, *e.g.*, *Apatura iris*, which hybernates from early September to March, spinning a quantity of silk on a stem, and enveloping the hinder part of its body in a mass of silk, remaining, thus protected, immovable. *Limenitis sibylla* hybernates from September in a hybernaculum composed of a leaf bent partly over, with the edges spun together, and strongly bound to the twig with silk, etc. One is much reminded of the hybernating habit of *Limenitis sibylla*, when one reads Edwards' account of that of *Lemonias nais*. He says (*Can. Ent.*, xvi., p. 113) that "each larva makes a close-fitting jacket out of a leaf, snipping away here and there all superfluous parts till the pattern is cut out; then the sides are drawn together by spun threads and held fast, and the whole interior is covered with a coating of silk. Moreover, the larva provides itself against the fall of its hybernaculum by carefully weaving threads from leaf to stem and around the stem, so that the winds and storms of winter cannot possibly tear the case away." He also notes (*op. cit.*, p. 87): "The larvæ of *Limenitis disippus* and other species spend the winter in cases cut out of the leaves of their foodplants, one larva to one case, and fitted as nicely as a tailor would fit a coat to his customer." Very complete, too, is the hybernating habit in the larvæ of the gregarious species—*Aporia crataegi*, *Melitaea cinxia*, *M. aurinia*, etc. The larvæ of the last-named species rarely leave their hybernacula until March, but, in the early season of 1893, they were already out and nibbling their food by February 9th (*Ent. Rec.*, viii., p. 4). The larvæ of *Aporia crataegi* rarely move at all until the buds of their foodplants are well opened. The hybernation of the larvæ of *Dryas paphia*, *Argynnis aglaia*, *Brenthis euphrosyne*, and

Brenthis selene is just as complete, the first-named crawling under leaves, etc., as soon as hatched, and remaining immovable till the end of March (Buckler, and see also *Ent. Rec.*, x., p. 28), as also does *A. aglaia* (*Ent. Rec.*, ix., p. 118), whilst larvæ of *B. euphrosyne* and *B. selene* commence their hybernation in early July, the latter when about ·375in. in length, and do not commence feeding again till March. The larvæ of *Colias hyale* hybernate from September-October until mid-March, whilst those of certain Chrysophanids also have a very thorough hybernation, *e.g.*, *Loweia* var. *gordius* larvæ, after the third moult, and early in November, cease feeding with considerable unanimity, and attach themselves to sorrel leaves until March, when they again begin to feed (*Ent. Rec.*, xviii., p. 246). The larvæ of *Chrysophanus dispar*, on the other hand, cease feeding in their third stage, about mid-August, their hybernation, however, being as complete as the last-named. On the other hand, the larvæ of *Rumicia phlaeas* hybernate at different ages, and feed in mild weather, etc. (see preceding vol., p. 385).

Although the Satyrid larvæ do not, as suggested by Scudder, mostly hybernate as larvæ directly from the egg and without feeding, and, on the contrary, in many cases, feed on slowly in the "nibbling" stage in mild weather, all the winter, without very definite hybernation, *e.g.*, *Enodia hyperanthus*, *Epinephele ianira*, *Pararge egeria*, etc., yet the larvæ of some species do so hybernate (*e.g.*, *Coenonympha mathewi*), whilst others hybernate small, and pretty completely, *e.g.*, that of *Erebia aethiops* hybernates when rather over 2 lines in length, creeping down the blades and hiding in the thickest parts of the tufts, and commencing to feed again in March (Buckler); those of *Hipparchia semele* remain very small all the winter (although they feed a little occasionally), but commence to be more active about April (Wolfe); whilst those of *Melanargia galatea*, *Coenonympha pamphilus*, etc., also remain small till well into March. On the other hand, the larvæ of *Melampias epiphron* are almost 8mm. in length when they commence to hybernate in August (Alderson). Similarly, among the Lycænids, the two habits of (1) hybernating small, and (2) going on slowly in the nibbling stage, are well-illustrated—the first by *Aricia astrarche*, which hybernates when about 2mm. in length, from November until February; and by *Polyommatus icarus*, which ceases to feed from November to January, when it feeds slowly on until the commencement of April, after which it grows much more rapidly, whilst the latter phase is illustrated by the larvæ of *Agriades bellargus*, which feed throughout November and December, and often well into January; they then commence, occasionally, to feed in suitable weather, growing very slowly until the end of March, when they feed up rapidly; during the resting-period, however, they come up from their resting-places on the underside of leaves in sunny weather, and lie stretched out along the midrib on the upper side of a leaflet (Buckler).

Scudder says (*op. cit.*, p. 690) that, "with few exceptions, such as *Cissia*, *Eurymus*, and some *Melitaeidi*, all other hybernating caterpillars (in New England) pass the winter in some sort of a nest; most of them, separately or collectively, in one which has already given them protection during their partially completed larval life, but, generally, specially strengthened or enlarged for the purpose, and almost always with all approaches closely sealed." He curiously, however, continues:

"The species of *Basilarchia* are the only ones among New England butterflies which construct hybernacula, properly speaking, *i.e.*, nests for the special purpose of wintering in them, and which they use at no other time; here, each individual makes for itself its separate nest. *Euphydryas*, however, alters and strengthens its social nest for the winter to such an extent that its appearance is then quite different, and, in the centre, as the nest contracts with the withering of the leaves, the caterpillars are crowded together into an almost solid mass. The other larger caterpillars, which make no nest, probably seek merely some cranny upon or near the ground wherein to lie concealed during the winter." We cannot support the whole of Scudder's statement here given from the Palæarctic species known to us. With the exception of the "skippers," which spend their larval life in folded tubular leaves, the gregarious Melitæids, and *Aporia crataegi*, we cannot call to mind any species that forms a winter nest, except *Limenitis sibylla*, which has very similar habits in this respect to the American *Basilarchia* species, *e.g.*, *B. archippus* (see *Butts. New England*, i., p. 274), *B. arthemis* (*op. cit.*, p. 301), etc. None of our hybernating Ruralid (Lycænid) or Satyrid larvæ do so, and these, at least in our western Palæarctic area, form a large percentage of our larva-hybernating butterfly species. Of this fact, at least so far as it relates to the Argynnids and Satyrids, Scudder seems, in spite of his statement, to have been fully aware (see *anteà*, p. 3). The winter-nest of *Melitaea cinxia* appears to be a somewhat strengthened and better-hidden form of the feeding autumnal nest, in the former respect, perhaps, resembling that of *Euphydryas phaeton*. The latter, by the time the larvæ have passed their third moult, is sometimes 11ins. × 4ins. in extreme length and width, sometimes considerably smaller. Edwards describes a large one as "long and narrow, tapering at either end, about 3ins. broad in the middle, and so thick and closely woven as to conceal the interior. For egress while at work, two somewhat tubular openings were left on the middle of one side, and the threads about these were doubled. To support this large web the upper part of a stem of swamp grass . . . . was bent down, and its broad and spreading leaves were bound over the surface, and this, with the stem of *Chelone*, was stiff enough to resist the wind. After the larvæ had ceased work and finally retired within the web, a slight covering was spun across the outlets, sufficient, evidently, to throw off water and to keep out spiders . . . . Six weeks later the webs were found to be bleached white, and were weather-worn and considerably shrunken, often distorted, too, by the growth of the plants. The effect of the shrinkage was to compress the larvæ into a hard, compact mass." Strangely enough, *Cinclidia harrisii*, another North American Melitæid, is said by Scudder (*op. cit.*, i., p. 681) to form larval nests like *E. phaeton* when young, but he adds that the larvæ desert these nests before hybernation, probably passing the winter in curled-up dead leaves, or beneath sticks and logs.

The phenomenon of hybernation, as here detailed, most probably had its origin in a reaction to low temperature and want of food, and even now, in many cases, shows distinctly its relation thereto, but it is really remarkable that some larvæ, hatching in early or middle summer, should at once, *e.g.*, *Dryas paphia*, *Argynnis aglaia*, commence to hybernate, or feed up only a very short time before doing *e.g.*, *Erebia aethiops*, *Aricia astrarche*, *Chrysophanus dispar*, etc., and then fall into a state of greater or less torpidity, from which they will not stir till the following spring, although, at the time, surrounded by an abundance of food, and apparently suitable temperature, etc. This summer or æstival rest, Scudder, under some misapprehension as to the details relating to certain partially double-brooded species, terms "lethargy." He writes (p. 551): "The period of inactivity termed lethargy is directly connected with hybernation, although neither of the provocative causes (low temperature and absence of food) are present. It is a period of greater or less duration, lasting from a few days to a few months, generally as much as two or three weeks, often in the very heat of midsummer, when the foodplant of the caterpillar is superabundant and low temperatures are at furthest remove. In some instances, it extends from midsummer to winter, and so may be called premature hybernation. In nearly, if not quite, all cases, it affects only a portion of any given brood of caterpillars, the remainder of the brood continuing on its regular course. Even the portion which is concerned in it may be unequally affected, some arousing from the torpor at the end of a few weeks, and proceeding regularly thereafter with their transformations, others continuing torpid to and through the winter. This shows its direct relation to hybernation . . . . This lethargy was first observed by a French naturalist named Vandouer, some sixty years ago." Vandouer's remarks, here referred to, are based on certain observations recorded in the *Mem. Soc. Linn. Paris*, vi., pp. 374-8. He observed that, in May, 1819, a ♀ *Brenthis euphrosyne* laid eggs which produced, in 10-12 days, larvæ 2mm. long, that fed on violet leaves until after the third moult, when they ceased eating and attached themselves to the sides of the breeding-cage. Food, sun, air, disturbance, failed to make them more than move their position and fall again into a lethargic state, when after a month, disgusted with what he considered his want of success, Vandouer threw them away, believing that they required natural conditions for success; but, in early September, 1825, larvæ of *B. dia* hatched, and these, at the end of October, hid themselves in dry leaves, etc., as the larvæ of *B. euphrosyne* had done, and then Vandouer understood that he had made a mistake, due to the fact that he had not conceived it possible that any larvæ could become lethargic or "marmotic" at the beginning of summer, especially as *B. euphrosyne* was, in his district, on the wing twice in the year, *viz.*, May and July-August. So, in May, 1826, he again obtained larvæ of *B. euphrosyne*, which stopped eating at the end of June, except a few, which fed sparingly through July, and became pupæ and butterflies in August. The rest of the larvæ, however, continued their primitive æstival torpor until February 26th, 1827, when they began to move, but partook of no food till the temperature was somewhat higher; then they grew slowly, moulted twice, and finally completed their metamorphosis between April 7th and May 10th. At the same time, Vandouer, on July 27th, 1826, had obtained eggs from a second-brood ♀ of *B. euphrosyne*. These produced larvæ, which moulted three times, and then became torpid, as in the case of the May-June larvæ, going over the winter 1826-7 with them, and in the same larval stage. These also awakened on February 26th, 1827, at the same time as the larvæ which had remained concealed in dry leaves since the close of June, 1826; in fact, these two batches underwent their final metamorphosis together, without showing any sign leading one to suspect that some were born later than others. Here was a very clear and distinct account of what has been long called partial double-broodedness, and which is now known to occur more or less in all so-called double-brooded species in north temperate climes.

In the course of his account, Vandouer notes the apparent slowness of the feeding of the few larvæ that went on to a second brood in July and August, 1826; in fact, he evidently thought that they had a partial rest in early July; this supposition Scudder makes much of, and it is this that he really refers to in his papers as "lethargy," as apart from the continued rest which he includes under the term "premature hybernation." So far as our experience goes, however, the larvæ, forming a partial second-brood, as a rule, feed right on, *e.g.*, Buckler notes of a brood of *Brenthis selene*, that the larvæ hatched June 22nd, 1870, that, for a time, all fed level; then he divided them, putting one part into a hothouse, and leaving the other part outside; one of the outside lot was noted on July 18th still feeding, and, by the 30th, was fullfed, all the others (both inside the hothouse and outside) remaining quite dormant, being about ·375in. in length when they commenced to hybernate. This remarkable phenomenon is much more common in *B. selene*, etc., in the neighbourhood of Torre Pellicè, in Piedmont, where a large second-brood occurs in early August. But the peculiarities observed occur also in almost all our British species that are partially double- or triple-brooded, *e.g.*, *Rumicia phlaeas*, *Cupido minima*, *Aricia astrarche*, *Agriades bellargus*, *Polyommatus icarus*, *Pararge megaera*, *Coenonympha pamphilus*, etc., and it was also recorded in the hot summer of 1893, in *Dryas paphia*. In these species, the eggs laid in May or June by the ♀s of the first brood of the first series all hatch in due course, *e.g.*, in June or July, the larvæ, kept under identical conditions of temperature, moisture, food, etc., from the very first feed at different rates, and, whilst a "forward" lot go ahead, pupate, and produce imagines in August, a "laggard" lot reach a certain point, the natural hybernating instar, and there remain throughout the rest of the summer, autumn, and winter, until the spring, before arousing themselves from the lethargy into which they have fallen. Scudder's attempt to distinguish between those larvæ that commence early to æstivate, and continue without break their æstivation into hybernation, calling the summer resting "lethargy," is, therefore, purely artificial, although, occasionally, individuals of the second and third broods do commence a formal hybernation in the summer, and then yield and go on. He says: "This same feature (lethargy) occurs in some of our North American species of *Brenthis*, as I have several times observed. It is also found in some of the *Melitaeini*, and, I suspect, also in the genus *Argynnis*." As we have already said, there are many well-known illustrations of larvæ presenting this phenomenon in Europe, especially in southern Europe; *e.g.*, *Brenthis selene*, *Melitaea cinxia*, *M. didyma*, etc., in which the larvæ from eggs laid in May develop unequally, some of the larvæ not resting at all, but which, feeding up rapidly, produce pupæ and imagines in August, whilst their brothers and sisters, having reached the normal hybernating stage, commence their resting in July or August; and the August imagines, laying eggs in due course, produce larvæ that go on to the same resting-period, and then hybernate with their uncles and aunts, all commencing to feed at the same time in the spring, and producing imagines together, just as Vandouer described 80 years ago in *B. euphrosyne.* Edwards notes (*Can. Ent.*, xxi., p. 42) that, of a batch of young larvæ of *Colias meadii*, hatched July 23rd, 1888, one larva alone fed on, pupating August 19th, and producing an imago August 25th, whilst all the other larvæ of the brood fed up slowly till after the third moult, commenced to hybernate on August 28th, and did not produce imagines till the following year.

Prideaux notes (*Ent. Rec.*, xviii., p. 246) a peculiar case, in which a larva of *Loweia alciphron* var. *gordius*, with twelve others, commenced hybernation in November, 1905. The larvæ all recommenced feeding in the following March, and by May 25th, 1906, all, except one, began pupating, and the imagines appeared at the end of June. This one larva, oddly enough, ceased feeding after its last moult, shrank somewhat in size, attached itself to the side of the cage, and remained, æstivating, in this situation, for about three months, when, early in September, it again showed signs of activity, and fed on through the month evidently with the intention of pupating, but it ceased again in October, hybernated through a second winter, till the end of February, when an attempt to force it in a warm room killed it.

As already noted, the only European species of which we have actual evidence of its ability to hybernate in two distinct stages is *Pararge egeria*. There can be no doubt of this most unusual phenomenon. Merrifield notes (*Ent. Rec.*, viii., p. 168) that, in August, 1892, New Forest eggs of this species hatched, producing pupæ between October 28th and November 27th, which were kept out-of-doors, and emerged in April, 1893. Carpenter observes (*op. cit.*, p. 169) that eggs, laid at the end of August, 1895, produced larvæ, some of which fed up rapidly and pupated in November, emerging in March and April, 1896, the others fed up slowly, hybernated from October till mid-February, after which they fed up rapidly, pupated as usual, and emerged a little later than that part of the brood that had been pupæ all the winter. Williams notes (*op. cit.*, pp. 181-2) that eggs obtained July, 1892, hatched August 7th, that one larva outstripped its relatives, pupated September 1st, and imago emerged September 19th; the remaining larvæ (about 30) pupated September 20th-27th, emerged in a warm room between November 19th to December 31st; but 8 pupæ placed out-of-doors November 20th, remained exposed all the winter, and produced 8 imagines April 1st-9th, 1893. Our experience has been for the larvæ to hybernate rather small from November to February, and then feed up rapidly. Even as far south as Grasse, in April, 1898, Chapman found fullfed larvæ of this species, evidently having hybernated in this stage.

One cannot, however, pass over this phase of the subject without noting, in some detail, Scudder's account of *Brenthis bellona*, of which he observes (*Butts. New England*, p. 615) that imagines appear in May-June, again in July-August, the larvæ resulting from this second-brood producing a partial third-brood of imagines in September, a considerable proportion, however, commencing to hybernate after the second or third moult, whilst the eggs from the third brood produce larvæ in about 8 days, ... and these hybernate at once after leaving the egg. There appears to be no evidence that this is a fact, the supposition that it is so resting on the observation that the spring butterflies emerge over a long period, supposed to be due to this difference in the size of the hybernating larvæ. More definite evidence is certainly wanted. Of the larvæ of the North American *Phyciodes tharos*, a many-brooded Melitæid, varying in its number of broods according to latitude, Scudder writes (*op. cit.*, p. 640): "Edwards finds that lethargy does not appear in the earlier broods, but only in the last two broods of larvæ, in West Virginia, and, while invariable in those of the last brood, which winters, and sometimes becomes lethargic as early as the end of August, ... it also appears in the larvæ of the preceding brood, some of which become lethargic in very warm weather, while the greater number proceed rapidly, like the larvæ of the preceding broods, to pupation. In the north . . . . caterpillars from eggs laid at the end of July (and therefore of the second-brood of butterflies) all became lethargic after the second moult (about September 4th); but, two weeks later, part of them resumed activity, fed a few days, passed another moult, and then became lethargic again; these were placed in a cellar, and remained without change through the winter. On another occasion, eggs laid in the middle of August in Coalburgh, were taken to the Catskills, where they hatched on the 20th; after the second moult, a portion, about 40 per cent., became lethargic, while the remainder continued their changes until the butterflies appeared (September 15th-26th), and some of the chrysalids, kept in a cool place in Albany, produced imagines between October 21st and November 2nd . . . . It is interesting to note that about one-half of the 40 per cent. that became lethargic began to feed again about September 26th, passed another moult, and then resumed their lethargy. A third experiment showed that eggs, laid in the Catskills at the end of June, by butterflies of the first brood, and carried to West Virginia, hatched there on July 3rd, most producing butterflies by the end of the month, but that a portion (about 5 per cent.), even in this southern locality, became lethargic after the second moult, a thing which Edwards had not found to occur with native West Virginian larvæ at that season. This leads him to conclude that, probably, a portion of the caterpillars from the first brood of butterflies in the north become lethargic, and continue so until the following spring, *i.e.*, that, in the north, the species is partly monogoneutic and partly digoneutic, and that, in the northernmost part of the range, to judge from the short season and dates of flight of the butterflies, it is monogoneutic only. . . . . This conclusion is in the highest degree probable, and the proportion of the caterpillars from the first brood of butterflies which develop directly into the second as we pass southward from the north, would be a very interesting subject for investigation." We may assume that, in the Nearctic, as in the Palæarctic, region, the variation in number, or proportion, of individuals that go on to form a partial double- or triple-brood, even at the same latitude, would, in different years, depend greatly on the difference in individual seasons; at least, this is so in western Europe. Edwards is quoted (*Butts. New England*, i., p. 700) as stating that, "in the wintering webs of *Euphydryas phaeton*, he invariably found a small percentage of larvæ which had not passed the third moult," the bulk of the hybernating larvæ having done so and reached the 4th stadium, but Scudder could not confirm this; he had only observed hybernating larvæ to moult once (not some once and others twice) in the spring.

Scudder thinks that the phenomenon is to be attributed to the struggle for the perpetuity of the species. Should disaster befall the advance guard which has not halted by the way, the sluggards can take up the work, and the chances of survival are greatly increased. This may be so in the warmer areas in which these partially double-brooded species occur, but, in exceptionally warm summers in the colder areas of their distribution, it may often lead to their undoing, for, although in such seasons imagines of the partial second-brood may emerge safely, they do this so late in the season that the larvæ have hardly time to reach the normal resting-stage before the winter is upon them, and, if they fail to do this, they are killed off to a larva, for the hybernating stage of partially double- or triple-brooded species, *e.g.*, *Brenthis selene*, *Melitaea cinxia*, *Colias hyale*, etc., is fixed and constant in a definite stadium, and, although that of certain Satyrids, whose winter-rest is much less complete, may be less fixed, and spread over two instars, and even in the case of *Pararge egeria* two different stages, yet the larva of *Colias hyale* must rest in its fourth stadium, *Dryas paphia* and *Argynnis aglaia* in their first stadia, *Brenthis selene* and *B. euphrosyne* in their fourth stadia, or die, and the progeny of the partial second-broods of these species must reach the proper hybernating stage, or annihilation must result. The inability of *Colias hyale*, *C. edusa*, *Pyrameis cardui*, and possibly other species, to regulate their hybernating period to our winter, is possibly the cause of their repeated extermination and absence for long periods (sometimes extending to many years) in our Islands.

It will be seen from this short chapter that there is much variation in the hybernating habits of butterfly larvæ, and many difficult incidental unsolved puzzles raised, even by the consideration of so simple a subject.

CHAPTER II.

THE GREGARIOUS HABIT IN BUTTERFLY LARVÆ.

The gregarious habit is exhibited by the larvæ of certain species of such widely different superfamilies of lepidoptera, whose immediate relations show little or no sign of the peculiarity, that there can be no possible doubt that the habit has arisen quite independently in almost every instance. In the Pierids it is exhibited in *Pieris* (*brassicae*), *Aporia* (*crataegi*), and *Eucheira* (*socialis*), in quite varying degrees, although most of the Pierid larvæ live solitarily; in the Vanessids, and in the Melitæids, similar cases occur, in each case with solitary relatives; whilst the species of the far-distant Lymantriids, Lachneids, Hyponomeutids, etc., whose larvæ exhibit similar social traits, must have developed the habit quite independently of one another. In the same manner there is no doubt that the various butterfly groups have developed the habit separately, although, in the same group, there is probably some show of reason for a different opinion, *e.g.*, the Melitæid species—*aurinia*, *cinxia*, etc.; the Vanessid species—*io*, *antiopa*, *polychloros*, *urticae*, etc.

The various degrees of gregariousness, in different species, is very marked and noticeable. Among our Palæarctic butterflies, a very great proportion of their larvæ lead solitary lives, *e.g.*, the Urbicolids, the Ruralids, the Satyrids, and, with few exceptions, the Nymphalids, Pierids, and Papilionids, and, between the absolute solitary life of many species and the social life of *Euvanessa antiopa*, there is almost every possible intermediate condition. Usually the ♀ butterfly lays her eggs singly, often only one on a plant, and these at considerable distances apart, and, to this plant, the larva, in its early life at least, is often absolutely restricted. On the other hand, the ♀s of other butterflies lay several eggs on a plant, usually on different leaves, but sufficiently numerous that several young larvæ may have to exist on the same plant. In other cases, the eggs are laid in small batches, the young larvæ living in comparatively close companionship during their early stages, but spreading widely as they get older, and often evidently under the pressing necessity of seeking fresh feeding-places, whilst, in cases where the larvæ are strictly gregarious in their younger stages, the ♀ parent laying her eggs in a large mass in one place, and the young larvæ spinning silken webs to form a common home, the stress of food-conditions leads them to spread as they tend towards maturity, and a more or less solitary life is passed in the later larval stages; indeed, the number of butterflies that retain the gregarious habit entirely throughout larval life is exceedingly small. The return of activity in early spring, after a long-continued hybernation, is often the signal for a break-up of the society, in many gregarious species that hybernate *en masse* within a common web, but it also happens that exactly the same habit is observed in gregarious non-hybernating butterfly larvæ, *e.g.*, *Aglais urticae*.

Of this particular view of the question, Scudder writes (*Butts. New England*, i., p. 671): "As a general rule butterflies live solitary lives throughout their entire existence. The mother lays an egg here and there upon a shoot suitable for the food of its young, and here the caterpillar takes up its abode with more or less wanderings. In two of the four families of butterflies there is scarcely an exception known to this rule, but, in the Nymphalids, and in a few instances in the Papilionids, caterpillars, during at least a portion of their lives, are more or less gregarious. Whenever the caterpillars are strictly gregarious, the eggs are invariably laid in clusters; there are, however, some butterflies which lay their eggs in small clusters, whose caterpillars are not properly gregarious; yet all such are closely related to others whose caterpillars are gregarious, so that we find every gradation from solitary to social. There are also some caterpillars which are gregarious in their early life, but afterwards part company; in such cases, the caterpillar usually hybernates, and its social life lasts in some degree throughout the autumn and winter, the company dispersing at the renewal of activity in the spring; indeed, in almost all cases, the association is most conspicuous in early life, when the caterpillars feed in rows upon the same leaf in such close proximity, that it would seem to interfere with convenience. Sometimes this is the only mark of their social nature, but, as all caterpillars spin more or less silk in moving about, a web of greater or less extent generally accompanies a colony, and, in some cases, the community constructs a close structure, within which they retire to rest or moult. A Mexican butterfly, closely allied to our sulphurs, constructs a web, first noticed by Hardy, which is nearly as close as parchment. With rare exceptions, all butterfly caterpillars feed upon the outside of plants; but there are a few which live in the interior, and one of these, an Indian species of Lycænid, is known to be social, living in numbers within the fruit of the pomegranate." The latter suggestion is traversed by Nicéville (*Butts. of India*, iii., pp. 477-481).

If we restrict ourselves to our better-known British butterfly species, we may note the difference in the social habits in the three groups presenting this phenomenon, *viz.*, the Pierids, Vanessids, and Melitæids. In the former, the eggs of *Pieris napi* are laid solitarily, and the larvæ are quite solitary in habit; those of *Pieris rapae* are laid in small batches, and one rarely finds this larva quite solitary in its younger stages, and a loose social condition is sometimes noticeable even in the adult larvæ; the eggs of *Pieris brassicae* are laid in large clusters, and the gregarious habit is strongly maintained throughout, but no web is spun, except a slight one for footing, either in the earlier or later larval stages. In all these species, however, hybernation is passed in the pupal stage. In the somewhat allied *Aporia crataegi*, however, the eggs are laid in a cluster, the newly-hatched larvæ immediately spin a web, into which they retire for the purpose of resting, and in this they hybernate during the winter. Soon after they recommence feeding in the spring, they distribute themselves, and finally give up entirely their gregarious habits.

The various stages exhibited here are recapitulated, as it were, by the Vanessids inhabiting this country, *e.g.*, *Pyrameis cardui* and *P. atalanta* live a purely solitary life. *Polygonia c-album* usually lays several eggs (one on the other) on a plant, and several larvæ, at least when young, live in close proximity. *Aglais urticae* lays her eggs in masses of from 100-250 eggs, the larvæ from their birth spinning a web, in which they live in the most strictly gregarious manner, enlarging their web with growth, until, in their penultimate skin, they leave the protection of the web and spread abroad for food, although, even in this state, two or three may often be seen on the same or adjacent leaves. *Vanessa io* acts very similarly. But the allied *Eugonia polychloros* and *Euvanessa antiopa* spin larval webs, less, however, for hiding purposes, it would appear, than as ropes leading from one part of a branch of their foodplant to another, retaining their gregarious habit to the end, the common and conspicuous web forming a safe footing on their lofty habitations in windy and stormy weather.

The larvæ of the final group of gregarious butterflies in this country, the Melitæids, have, in at least our two best-known British species, *Melitaea aurinia* and *M. cinxia*, strictly gregarious habits, at least till after hybernation, restricting themselves to the area covered by the common web in their wanderings, and accumulating *en masse* for purposes of rest and shelter. After hybernation, the gregarious habit largely passes away with the first moult, although the larvæ are often found in numbers in close proximity, even up to the time of pupation. Goodwin also notes (*in litt.*) that the larvæ of *M. athalia* are gregarious until after hybernation, and pass the winter in a web.

It is a remarkable fact, and one tending largely to show the antiquity and fixity of habit in species, that the larvæ of those species noted above, that are common to both the Palæarctic and Nearctic areas, have retained their habits absolutely unchanged, although the species inhabiting the two hemispheres must have been entirely separated for a vast period of time. Thus Scudder, writing of this same subject, illustrates his remarks by reference to certain *Polygonia* species, *Pieris rapae* and *Euvanessa antiopa*. He says (*Butts. New England*, i., pp. 672-3): "Among our American butterflies there is nearly every gradation, from brief and partial companionship up to a social life, which lasts throughout the entire period of larval existence. The weakest form of social life is found in the larvæ of some of the species of *Polygonia* (others being purely solitary), where the eggs, being often laid in columns of two to nine, or several eggs being scattered by the mother upon one leaf, the caterpillars in earliest life are, naturally, found feeding upon one leaf. Rarely are more than four or five found in company, and each takes up its independent position upon the leaf and acts as if the others were not present. As, however, it is their habit to remain upon the leaf until it is almost eaten, they naturally leave it at the same, or nearly the same, time, and, following a similar instinct, are apt to pass together to the nearest leaf, but scatter more or less, so that, by degrees, as they approach maturity, they are found widely separated from each other. Yet, even in this weakest form, their numbers are often so great upon a single plant, that, when they leave it for pupation, the chrysalids hang almost in company, thirty or forty spinning their silken shrouds in such proximity, that they may be pulled down together. A somewhat similar, or perhaps weaker, case may be found in *Pieris rapae*, which often lays a considerable number of eggs, singly, upon one plant, and the caterpillars, naturally, seeking the interior of the cabbage-head,* may often be found in close proximity. But this, even more than the preceding, is a case of mere accident, from the nature of the foodplant upon which they subsist.† In all other cases of social life among our caterpillars, the eggs are laid by the parent in decided clusters. The slightest of these is probably *Laertias philenor*, the masses being, ordinarily, confined to a dozen or so. The caterpillars in this case not only feed in company, but, in earliest life at least, range in rows along the edge of the leaf they are eating, with their heads towards the eaten portion, and, in this way, they live during at least the earlier half of their lives, scattering more or less after the third moult, upon separate leaves, so that, at maturity, rarely more than one is found upon a single leaf, though the leaf of their foodplant is exceptionally large." He further notes that, so far as the New England fauna is concerned, the great mass of social caterpillars are found in the Nymphalids, and that, "as in *Laertias philenor*, the larvæ of some species, in early life, live exposed upon the surface, generally the under surface, of the leaf, ranged side by side, feeding and sleeping in unison, but, in most cases, some sort of web is constructed by the caterpillars, upon, or beneath, which they live, and to which, should they wander beyond their haunts for food, they retire for rest and moulting. Some use this web, with certain alterations in

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* Is this really an explanation? We have seen three or four large fullfed larvæ lying side by side on each of several exposed nasturtium (*Tropaeolum*) leaves, on a plant climbing up a lattice.

† Nor do we think this is a sound explanation, as, in this country, at least, the habit is maintained on several foodplants widely different from cabbage in their manner of growth.

its structure, as a winter residence, but then invariably leave it on the approach of spring, and part company, though often being still found in close proximity. Others leave it at the hybernating season, to seek, each for itself, its own hiding-place." Scudder then adds that "this alteration of habit from companionship to solitariness is a natural incident due to growth," a statement that may be true of *Laertias philenor*, and some other cases, but cannot, one supposes, apply to all instances. He says: "Up to the end of the third moult the size of the caterpillar has not increased enough to make it a conspicuous object, but, by the time the third moult is passed, the caterpillar is half-grown, and, during this stage and the next, its size becomes an important element in its security, and this alone is sufficient to account for the fact that mature caterpillars of butterflies are rarely found in company. It is at this stage, too, that, in many instances, the winter season overtakes the caterpillar, and it hybernates, and since, in the spring, it revives when the plants have put forth but tender leaves, impossible to nourish more than one, or at most two, such ravenous beasts as now come out of their winter-quarters, such a change of habit would seem to be compulsory. Possibly the change in habit which generally takes place at this middle period of caterpillar life, even when winter does not intervene, is an inheritance from a common ancestor, whose habits were fixed by the necessity of hybernation at this age."

We have already referred to the gregarious habits of the larvæ of *Melitaea aurinia*, *M. cinxia*, and *M. athalia*, and we may here note that the American Melitæids have practically identical habits; thus the oviposition of *Euphydryas phaeton*, as described by Emery, Edwards, and Scudder (*Butts. of New England*, i., p. 696), might do almost equally well for that of *M. aurinia*, and the marshy habitat is similar to many the latter loves; for Edwards says (*Can. Ent.*, xvi., p. 131) that the foodplant grows always in swampy places, often half under water, and the webs in winter are beaten down by snow and rain, but the inhabitants get through safely. Emery states that a batch of eggs he discovered upon a leaf of *Chelone glabra*, consisted of three layers of irregular outline, the first 8·5mm. long and 5·5mm. broad, this was the floor of the second, which was rather smaller, and this in turn the floor of the topmost layer, 6mm. long and 3·5mm. broad. The total number of eggs was supposed to be about 200, and Edwards has estimated similar clusters as containing from 100 to 400 eggs, and, in one, instance there were five layers. The newly-hatched larvæ prepare a small web upon the under surface of a leaf, the web thin, and covering a space only sufficiently large for feeding. They feed in rows, those of each row simultaneously moving the head and anterior part of the body from side to side, frequently wandering uneasily and rapidly from the web, but always returning again. After a day or two, however, the young larvæ no longer feed on an open web, but bend the leaf upon itself into a knot, or construct a covering web, usually on the topmost leaves of the stem, and feed on the green leaves enclosed, whilst, as they are consumed, the web is extended down the stem, covering fresh leaves. As the larvæ grow they enlarge the web, all working for the common good, and, especially as each moult approaches, all wanderers come home, the web is made tight, and into it they retire and pass the moult, which over, the web is extended again. If at any time the web is injured by storms, the caterpillars forthwith set to work repairing it, and do not rest until the work is done. Edwards thinks they have a prevision of storms, and observes that, just before such, all hands may be seen working at their dwelling industriously, strengthening it here and there, even when the sky is clear and there appears no reason for work. . . . . In case of damage to the nest during a storm, it is at once repaired when sunshine returns. A few holes are left for ingress and egress. To this nest they retire for the night and for moulting, feeding only by day, when they extend their webs over new feeding-ground, although many are found wandering beyond its protection. The first nests built are slight and quite transparent. . . . . Each succeeding nest is more securely built, till finally, when the third moult approaches, the web is often as large as a man's open hand, made of closely woven silk, of more than one coat, and capable of resisting storms, and even the wear and tear of winter. Edwards found one 11ins. by 4ins. at its extremes. Within this more compact web the larvæ pass their third moult, and in it remain hybernating with their cast off skins. . . . . In the spring, all is changed; the larvæ forsake the web, and, though still gregarious to a limited extent, wander ceaselessly about, swarming over *Lonicera* and other plants, seeking only the concealment of dead leaves and the under surface of sticks on the ground in their moultings or during storms, but, at other times, always exposed to full view, when their brilliant colour and active movements make them very conspicuous; nor do they seek protection by feeding at night, their only sensitiveness to danger being shown by the readiness with which they coil up and drop to the ground. . . . . Somehow, for pupation, they do not disperse widely, and several may sometimes be found hanging on the same bush or fence-rail, and Edwards once had half-a-dozen brought to him suspended from one button, like a string of fish." Edwards further notes (*Can. Ent.*, xvi., p. 114) that *Euphydryas chalcedon* makes a web, in which it lives and hybernates, much like that of *E. phaeton;* but, according to the observations of Wright, it varies the nature of its hybernation, according as the species lives in the valleys or at high elevations in the mountains. In the valleys the caterpillars go to ground to hybernate, whilst, in the mountains, they live in the webs. Of another gregarious Melitæid, *Cinclidia harrisii*, whose larvæ live on *Aster umbellatus*, Scudder notes (*Butts. New Engl.*, p. 681) that " eggs are apparently laid only in a single crowded layer, that the young larvæ first attack the apical half of the leaf on which they are born, and then march in company to the summit of the plant, beginning upon the tenderer leaves, and next move down the plant, devouring the parenchyma of both surfaces as they go, and covering everything with a thin web, beneath, and upon, which they live. They continue to live in society while young, forming nests not very unlike those of *Euphydryas phaeton;* but these nests they desert before winter, and probably hybernate in curled-up dead leaves, or beneath sticks and logs. . . . . In the spring, they awaken early, and, although they do not properly seem to live in company at this season, and spin no kind of web, they are rarely found alone, and generally may be discovered in large numbers on *Aster* (*Dollingeria*) *umbellatus*, sometimes twenty may be seen upon a single stalk, and often four or five upon the same leaf, etc." Yet another Melitæid, *Charidryas nycteis*, is described by Edwards as laying its eggs in clusters of a few to about a hundred, and Scudder says (*op. cit.*, p. 664) that "the larvæ are gregarious when young, and, when alarmed, they immediately loosen their hold on the leaf and fall to the ground with their bodies bent in a circle . . . . They spin a slight web on a leaf when they wish to moult, but do not construct one for concealment or protection at any other time, hybernating without that aid." Yet another Melitæid, *Phyciodes tharos*, lays its eggs in clusters, Edwards says (*Can. Ent.*, xvi., p. 114), "but the larvæ do not cover themselves with a web, but lie naked on the leaves, coming together and forming clusters when the moults take place." Scudder says that "the gregarious larvæ of *P. tharos* feed in close company, always on the under surface of the leaves, moving up or down, but generally down, the plant, as they need fresh pasture, but without spinning any web, and continue thus until hybernation, when they leave the plant, and wander more or less, but still, in some degree, in company. After hybernation they feed up apparently solitarily" (*Butts. New Engl.*, i., p. 637).

We have given in detail Scudder's notes on the gregarious larvæ of these New England Melitæid species, as illustrating their similarity to those of Europe, and to enable our European lepidopterists, conversant only with the larval habits of the Palæarctic species, to compare the latter therewith. Scudder says (*op cit.*, p. 619) "the Melitæids are mainly characteristic of the New World, where they abound in the tropics and north temperate zone, but are also well represented in all the northern parts of the Old World . . . . The eggs are generally (perhaps always) laid in clusters, and the caterpillars, at least in the early half of their lives, are social, often constructing common webs, in which some kinds hybernate . . . . In one Pacific coast species, Henry Edwards says that each individual makes a separate web of its own. The web-constructing habit appears to be confined to, and almost universal in, that tribe which is best developed in the Old World, and on the Pacific slope of our own country, in distinction from eastern America, and the tropics. To it belong *Cinclidia* and *Euphydryas* of our New England genera," the gregarious habits of the larvæ of the species of which have just been fully dealt with (*suprà*).

We have already noted the gregarious habits of the young larvæ of *Melitaea cinxia*, and have further observed that they retain some measure of the social habit after hybernation and until fullfed. The web in which they spend their early lives is thin and open, and largely serves as a carpet to lead from one part of their foodplant to another, but that in which they hybernate is close and compact, spun low down near the ground, entirely different from that in which they feed, and is woven of silk, with grass and plantain stems interwoven, so that the inside of the structure is quite dry. Luff says that, in the spring, they spin another web, on their foodplant, much less compact than the winter-nest, although larger. Most of the larvæ, when nearly full-grown, leave this nest, and live singly, but others keep to it and live more or less gregariously even up to the time of pupation. The larvæ of *Melitaea aurinia* live similarly, leaving their hybernacula regularly in March, and living singly. One unusual occurrence has been recorded (*Ent. Rec.*, xix., p. 74) by Head, who notes that the larvæ of this species sometimes hybernates over two winters. He says that, on

April 2nd, 1900, he received a quantity of *M. aurinia* larvæ, from Cumberland, just out after hybernation. They all came out and basked in the sunshine as usual, but, after a few days, about 5 per cent. spun fresh webs, and went inside, and although he tried to force these to feed up under glass, it was of no use. They refused to leave the web until March, 1901, when they fed up in the usual way. On another occasion he had the same experience, but as there were only some five or six larvæ involved, he did not trouble to keep them. Wilde says (*Stett. Ent. Zeitg.*, xx., p. 381) that, he found, near Zeitz, on several young trees of *Fraxinus excelsior*, webs, which contained multitudes of small larvæ of *M. maturna;* the larvæ went down to the ground, at the end of September, when about ½in. long, and in spring were found up again, feeding on the ash. No remark, however, is made as to whether they hybernate gregariously or have any social habits in the spring. Gillmer says (*in litt.*) that *M. cynthia* larvæ hybernate in common webs.

Scudder says (*Butts. New England*, i., p. 673) that, as far as the New England fauna is concerned, the great mass of social caterpillars are found in the Nymphalids, which includes, of course, the Vanessids and Melitæids. Outside these two groups, however, the Nearctic fauna presents us with another characteristic gregarious species, *viz.*, *Chlorippe clyton*, an Apaturid, that lays its eggs in large dense clusters of from 200-500, in two, or often three, and sometimes even four or five, tiers. Edwards says (*Can. Ent.*, xvi., p. 87) that the larvæ of the autumn broods of *Chlorippe clyton* and *C. celtis* hybernate after the third moult and gather in dense clusters on the underside of the leaves of their foodplant, as close as they can pack. On September 21st, he found 165 larvæ of *C. clyton* so collected on one leaf. These Apaturids are unprotected by any webs. Of the larvæ of *C. clyton*, Scudder writes (*Butts. New England*, p. 245): "They are gregarious during the first three stages, 'feeding side by side, eating the leaf from the tip downward, but leaving the stouter ribs. Spinning a thread wherever they go, they often, in travelling from leaf to leaf, make quite a pathway of silk; and, if the pathway be suddenly jarred, they will drop and hang suspended in mid-air, and after reassurance climb up again with the thoracic legs' (Riley). In thus feeding together, they completely conceal the leaf, according to Edwards, but do not, as in many gregarious larvæ, 'rest with heads all turned the same way and bodies in line and parallel . . . . but form an irregular mass, the heads mostly outside and fronting in every direction.' . . . . After the third moult and when about halfgrown, hybernation commences; the larvæ cluster upon the leaves and fall with them to the ground, and, in spring, make their way again from the ground to the tree." The gregarious habit here noticed is very like that of the Vanessids, in which the larval web is undoubtedly, especially after the second stage, merely a means of keeping up a satisfactory connection between the various parts of the gregarious company, and seems to be little used for the purpose of hiding, and, in this respect, the gregarious habit is much more complete in the larvæ of the tree-feeding *Eugonia polychloros* and *Euvanessa antiopa* than in those of the allied species *Vanessa io* and *Aglais urticae* (see *Nat. Hist. Brit. Butts.*, vol. i., pp. 57-58). There is no need to repeat an account of the gregarious habits of the larvæ of *A. urticae*, already fully dealt with in the preceding volume, but exactly similar habits to those of *A. urticae* larvæ in Europe are noticed in the larvæ of *Aglais milberti* in America. Of the latter, Scudder notes (*Butts. New England*, i., p. 426): "The young larvæ, on escaping from a cluster of eggs, do not stop to devour the eggshells in the least, but, after eating a portion, or the whole, of the leaf on which they are born, climb to the summit of the plant by weaving a silken path; within a day they smear the whole of the summit with a web, and may be seen swarming (for they are highly gregarious in early life) upon the dried, curving projections of the leaves, upon which they soon fasten themselves for a moult. They feed crowded side by side, and, on the least disturbance, raise their heads and front part of the body at right angles to the rest, and wag them slowly in concert, producing a ludicrous effect . . . . They are generally found on the upper surface of the leaf, and, until half-grown, make no attempt whatever to conceal themselves. After the third moult, when they have attained half their size, they quit these webs and scatter over the neighbouring plants, living singly, or in small companies of three or four, 'leaving their deserted habitations mere leafless stalks, covered with the dense and cloth-like web, and with the excrement and sloughed skins of the caterpillars' (Gosse). At this time, they occasionally collect together in larger or smaller numbers in incompletely closed leaves of nettle, but they leave these nests to feed in the most exposed manner. These nests are thoroughly closed next the base of the leaf, the edges having been drawn closely together with silk along the basal half of the leaf, to effect which, an irregular, triangular notch is eaten close to the base, cutting through one or both of the principal lateral ribs which spring from the very base of the leaf, leaving two considerable flaps, which are flattened beneath the stem by their tips, thus bending the leaf at a strong angle between the deepest parts of the notches; the edges of the notch are then united, closing completely the pocketed base of the leaf; the opposite extremity, however, flares completely open, but, by the bend in the leaf, is hidden from view above," etc. Comparison of this account of the larval habits of *Aglais milberti* with those of *A. urticae* makes one feel doubtful whether the insect can be really specifically different from *A. urticae* (see *Nat. Hist. Brit. Lep.*, viii., p. 58).

It will be observed that, more or less, the gregarious habit of the larvæ of *Aglais milberti* and *A. urticae* (and, similarly, that of those of *Vanessa io*) fails after the third instar, but those of *Eugonia polychloros* and *Euvanessa antiopa* continue through the whole of larval life. Chapman observes that the young larvæ of both these species cover their eggs, and the neighbourhood where they were deposited, with a silken web, not spun, as it were, of set purpose, but the result of journeying to the nearest leaves to feed and returning again to the central position for resting. They appear often to feed in turns, one lot going out to feed whilst others have just returned to rest. As they get larger they move their headquarters, again apparently, according to such exigencies as may occur from the form of the branch they are on, to make another position more central to the available food, than to any instinct that makes them move at any particular stage or instar. Different broods seem to vary a good deal as to how far they remain gregarious in the last instar or become quite solitary. If food remains at hand, few larvæ wander far off until they do so for pupation, but they cease to go to and fro so much, and so, though still spinning silk to walk upon, do not increase the considerable webs spun during the early stages. As in the Palæarctic, so in the Nearctic, region, the habits of the larvæ of *Euvanessa antiopa* make it the outstanding gregarious species of the butterfly fauna, and Scudder says (*Butts. New England*, i., pp. 404, 673) of this: "Perhaps, of all our caterpillars, although it constructs but a slender web, *Euvanessa antiopa* is the most pre-eminently social. The eggs are laid in a cluster of greater or smaller size around a terminal twig, which the larvæ leave together, and, as if by common impulse, range themselves side by side in compact rows along a chosen leaf, their heads always thereafter remaining together at the edge of the eaten leaf. Even if they are separated forcibly from each other they come together again and rearrange themselves. When disturbed, they will simultaneously strike an attitude of alarm and turn their heads in unison, as if worked by a machine. They spin a thin web, which Meyer-Dür has compared with that spun by the larvæ of the European *Lachneis lanestris*, enclosing the whole twig, but not the leaves upon which they are feeding, nor ever leave this carpet nest until the branch is stripped of its leaves, when they move to a neighbouring twig. The web they form is thus simply that which they make as they crawl about, each following hurriedly in the track of its predecessor, and as it moves adding its thread to the carpet upon which it treads. They are generally found high up in the tree and remain social throughout the larval life . . . . Their progress on a tree may sometimes be traced by the clusters of cast-off skins they have left in their track, the first on a leaf-rib, the others on a stem of one of the twigs, for they crowd together at the time of ecdysis as at others, and, as they undergo their changes, at least the earlier ones, at nearly the same time, the clusters of cast-off skins (which they never eat) remain to mark the steps of their progress. When the caterpillars have finished a repast they retire to the stripped twigs and leaf-stalks for a siesta, where they place themselves, almost invariably, head downwards, and remain almost immovable for a long while, the head and first thoracic segment a little raised, so that the front pair of legs is lifted from the twig and directed forwards, while the body hangs from the other legs and prolegs which thus have a backward direction." Harrison notes (*Ins. inj. Veg.*, 3rd ed., p. 297) that "he has seen the larvæ sometimes in such profusion on willows and elms that the limbs bend under their weight, and the long leafless branches which they had stripped and deserted gave sufficient proof of the voracity of these caterpillars." [We doubt very much the limbs of any elm bending under the weight of these larvæ.]

Ratzeburg notes (*Die Forstinsecten*, pp. 71-72) that the young larvæ of *Eugonia polychloros* cover the whole of the area traversed from the eggs from which they have hatched to their feeding-place, with white web, that the distance is slowly increased, and that, by the time they have moulted the first time, they have spun several leaves together, leaving the cast skins on the web. Directly after this moult (June 4th, 1839) a batch under observation divided into two lots, which went their separate ways on different branches. The members of each division remained associated until the end of June or the beginning of July, when the mass of larvæ hung like bunches of dark grapes from the already bare and leafless twigs, only separating finally for the purpose of pupation.

Somewhat similar to these are the habits of larvæ of *Araschnia levana*, which Roesel describes at length (*Ins. Belustigung*, i., pt. 1, p. 50), noting that they feed on the great stinging-nettle, and are not to be found on those clumps growing in open fields, but in woods and gardens, growing in the shade. He observes that, not only are the eggs laid in groups (or strings, one egg placed on the other), on the underside of a nettle-leaf, but the larvæ of each batch keep constantly together from the time of hatching up to very nearly the time of pupation. As soon as the larvæ have left the eggshells, the whole batch covers itself with a whitish-grey web, under which the caterpillars remain together until their store of food runs out, when, of necessity, they have to seek pastures new; at this time they also undergo their first moult, leaving their cast skins in the old web, and change from the shining dark brown unspined, to a much more markedly spined, form. As soon as they have selected a fresh pasture-ground, they surround themselves with a new, though rather looser, web, and so continue until nearly fullgrown, when the largest amongst them scarcely attain 1in. in length.

Of the most strikingly gregarious butterfly larvæ discovered, it is unfortunate that so little is really known. One of the most remarkable of these is *Eucheira socialis*, a Mexican Pierine, whose wonderful larval nest appears first to have been described by Hardy (*Travels in the interior of Mexico*), Westwood (*Trans. Ent. Soc. Lond.*, 1836, p. 38), etc. Dixey strangely hazards the opinion (*Trans. Ent. Soc. Lond.*, 1894, p. 303) that the common larval habitations are a sign of affinity between *Aporia* (*crataegi*) and *Eucheira* (*socialis*), stating that that of the former, " though merely rudimentary, and belonging only to the early larval stages, is no doubt a degenerate or undeveloped form of the elaborate silken nest constructed by *E. socialis*." We should state this in exactly opposite terms, and suppose that that of *Eucheira socialis* was a highly-developed form of the social nest, towards which that of *Aporia crataegi* already showed some tendency to approach, for there can be no doubt that the ancestral Pierid larva was solitary. It is, indeed, rare for the larval social habits to be carried so far as is the case in *E. socialis*, for, according to Holland (*Proc. Ent. Soc. Lond.*, 1905, pp. xxi-xxii), the larvæ remain within the nest when quite fullfed, pupating therein, and the imagines even (at least sometimes) lay their eggs within the social habitation. Strangely enough, the larvæ suspend themselves, Nymphalid-like, by the tails, for pupation, and not as do normal Pierids, by means of an anal pad and silken girth. Holland further notes (*op. cit.*) that Lumholz figures a group of Mexican Indians engaged in extracting the caterpillars from the silken tents, the former being a staple article of diet among some of the mountain tribes, whilst he adds that the forests, in places, are literally white with the big silken webs, many of which are five or six times greater than the original specimen described and figured by Westwood. It would appear that somewhat similar webs are made by the larvæ of *Neophasia terlootii* (Behr, *Trans. Amer. Ent. Soc.*, 1869, p. 303; *Proc. Calif. Acad. Sci.*, 2nd series, ii., p. 91), for Behr says that the larvæ of this species are very common in Mexico and Arizona, on *Arbutus*, and form common habitations, in which they pupate gregariously. As

Sallé also describes (*Ann. Soc. Ent. France*, 1857, p. 20) gregarious Mexican larvæ that he observed, living on the branches of a small *Arbutus*, one suspects that his reference is also to this species. Our own *Aporia crataegi*, a species approaching to this *Eucheira* group, alone of our European Pierids, shows real gregarious tendencies, accompanied by abundant silk-spinning. Its nest is well-formed, and used most regularly both for shelter and rest until after hybernation, *i.e.*, from July to April, and, to some considerable extent, after the larvæ have recommenced to feed in the spring, but there is no attempt to approach the habits of *Eucheira* and its allies, in the later larval stages, by making a still more effective silken nest for the purpose of pupation, but, on the contrary, the larvæ of *A. crataegi* become quite solitary in their last stages, although they still spin plenty of silk to enable them to keep their footing, and pupate, in true Pierid fashion, by means of an anal pad and body girth. The Australian Pierid, *Delias harpalyce*, is also gregarious, spinning an extensive web on *Loranthus pendulus*, essentially, however, to give a safe footing, but being used, also, when the larvæ are fullfed, as a base for attachment before pupation.

As to the meaning of gregarious larval habits, those species known to us appear to have at least four or five objects in view: (1) To make a safe carpet for their travels. (2) To afford a safe hiding-place when not feeding. (3) To make a safe retreat during the moulting period. (4) To make an adequate hybernaculum. (5) To make themselves conspicuous, so that their tints become, in the mass, effective as warning colours, and their movements equally so. The origin of gregariousness had, no doubt, also, as one of its essential factors, the economical use of silk, etc., either as a carpet, or as cover, although there were, presumably, other powerful inducements.

There can be no doubt that almost all gregarious larvæ find the silken web a great advantage in getting from one part of their food to another, without possibility of being lost, particularly when small. This is well illustrated if one observes the young larvæ of *Pieris brassicae*, which have to travel over leaves with smooth glabrous surfaces, and whose not abundant silk-spinning becomes much more effective in association than would be the case if they travelled singly. The gregarious habits of young larvæ of *Melitaea aurinia*, *M. cinxia*, etc., similarly enable them to spin a useful path, uniting the somewhat distant leaves of their foodplant together, and thus save them from the many possible dangers that might occur if they lived solitarily, and had to descend to the ground and climb up the farther parts of their foodplant for a meal. There can be no doubt whatever as to the effectiveness of the widely-spread, thin, spider-web-looking carpet spun by these larvæ in the autumn, and a similar purpose is no doubt served by the extensive webs spun by the young larvæ of *Aglais urticae*, *Vanessa io*, and continued to maturity by the larvæ of *Eugonia polychloros* and *Euvanessa antiopa*. The journeys necessary for these species, and also for *Aporia crataegi*, should the larvæ be dislodged, especially when young, by winds or storms, would be very great, and a possibility of much loss is undoubtedly thus prevented by enabling them to travel safely from one part of their foodplant to another, without descending and reclimbing to a new position, as well as enabling them to maintain a firm footing in time of storm and stress. The trouble that fullgrown larvæ of *A. crataegi* have to maintain a footing on a smooth surface, on which a silk holding has not been previously spun, is very marked, in fact, they appear scarcely to be able to maintain their footing at all apart from the silk.

That the gregarious habit is useful, in that the nests of some species form a safe retreat when not feeding, *e.g.*, in the case of *Aporia crataegi*, the Melitæid species, young larvæ of *Aglais urticae*, etc., appears to be certain, from the manner in which they retire and form little close companies within their web at such times, and, thus hidden, remain motionless in the presence of danger. It would appear that *Eucheira* carries this side of the value of gregariousness to its extreme possibilities.

That the web also forms an excellent protection at moulting-time is certain, for at such times, the larvæ retire within the web, and remain together till the critical operation is over. This is the case, not only in *Aglais urticae*, *Vanessa io*, *Melitaea aurinia*, and many other species, but has also been noted in *Aglais milberti*, *Euphydryas phaeton*, and many of the allied American species.

The fact that the nests make an adequate hybernaculum in many species, *e.g.*, *Aporia* (*crataegi*), *Melitaea* (*aurinia*, *cinxia*, etc.), is possibly due to the fact that the larvæ have discovered that their natural hiding-places by night form, most effectively, in winter, not only a protection from wet and cold, but also a place of safety against wind and flood, removing them well away from the foodplant, from the surface of the ground, etc., and also as affording protection from enemies, such as birds, etc., that hunt so assiduously throughout the winter. Our previous description (*anteà*, pp. 15-16) of the hybernaculum of *Euphydryas phaeton* illustrates this particular phase of the value of gregariousness.

There can be little doubt that gregariousness is also available as a means of accumulated protection in making warning movements, at least in the tree-feeding species, especially in those that maintain the gregarious habits until the end of larval life, and, in this respect, considerable weight must be given to the combined movements observable in most Vanessid larvæ, etc., when disturbed, and already noticed (*anteà*, p. 19) in those of *Aglais milberti* (*anteà*, p. 20), in *Euvanessa antiopa*, as well as in our British Melitæids and the American *Cinclidia harrisii*, etc. In the Vanessid larvæ, it has been repeatedly observed that, when annoyed or alarmed, every larva raises its head in just the same way, and all make a simultaneous movement, at the same time exuding a drop of fluid from the mouth, if the irritation be severe enough. A solitary larva would not produce any definite effect in time to preserve it from fatal injury, even though by that time its enemy discovered it was distasteful; whilst, in the mass, not only is the movement more remarkable, and thus likely to be more effective, but the accumulative secretion makes the distastefulness much more apparent.

One may ask why, among the fritillaries, Melitæas require a web, whilst the Argynnids want nothing. One may ask in return, why the individual larvæ of the former move slowly or fall to the ground if disturbed or handled, whilst the latter run at a tremendous pace to find a hiding-place. We only know that nearly all objects are attained in very different ways by different, but often allied, species, and why one took one direction, and another another direction, can only have resulted from the particular method adopted being a line of evolution easy or convenient to some ancestor.

In comparing the Melitæid gregarious larval habit with that of the Vanessids, one appears to get a clue that, whilst the larvæ of both use the silken web for a carpet, in order to obtain a safe footing, the accumulative result in the one case is for hiding and hybernation purposes, and the other for protection by means of the warning and distasteful properties, the larvæ freely exposing themselves. This lies in the fact that, whilst the Vanessid larvæ are largely inedible, those of the Melitæids are much less so, and may even be palatable, for, whilst the Vanessid larvæ develop marked warning colours, those of the Melitæas, especially as they reach adult age, are often particularly cryptic. Still, this view cannot be carried too far, as the larvæ of *Aglais urticae* do a considerable amount of spinning for hiding purposes, after the social nest has been deserted, and, on the other hand, the larvæ of *Euphydryas phaeton* are noted by Scudder as being usually, after hybernation, exposed to view, when their brilliant colours and active movements make them very conspicuous.

The gregarious habit, as we have already pointed out, must be considered as a purely modern development, a habit that has been adopted and dropped over and over again, and not one retained by the present gregarious species from remote ancestors. It would be absurd, for example, to suppose that gregarious Nymphalids (*Melitaea*, *Vanessa*, *Chlorippe*, etc.) are descended from gregarious Pierids (*Aporia*, *Pieris*, *Eucheira*, etc.), or *vice versâ*, and the non-gregarious Nymphalids (*Argynnis*, *Apatura*, etc.) from non-gregarious Pierids, or *vice versâ*, although one may safely assume a common origin for the gregarious Melitæas at a comparatively recent date, and similarly for the gregarious Vanessids, or Pierids, etc. Nymphalids arose together, and in the mass are solitary, and so, most probably, was the original ancestor. Similarly, the Pierids are, in the mass, solitary, and had a solitary ancestor, and so on, each of the gregarious groups having arisen long after by itself, within its own superfamily group.

CHAPTER III.

FAMILY HABITS IN BUTTERFLY LARVÆ—THE VANESSIDS.

It will be within the knowledge of most lepidopterists that there is considerable resemblance in what one may term the family habits of butterfly larvæ, and yet, when one considers the available facts, in detail, it will be at once observed that there are sometimes very great differences in the habits of the larvæ of what are evidently closely allied species. Thus, in a general way, the idea is prevalent that the Vanessids have gregarious summer-feeding larvæ; that the Melitæids have gregarious larvæ living from autumn to spring, with a long hybernating period, in which they are closely packed *en masse* in their hybernacula; similarly, that the Satyrids have long-lived, solitary, grass-feeding, winter larvæ, that the Pierids have short-lived, summer-feeding larvæ, inclined to develop, in most broods, some rapidly-feeding larvæ, or "forwards," thus tending to the production of more than one brood in a year, and the Ruralids short-lived, solitary, tree-feeding, summer larvæ, and so on.

These are, as we have hinted, general impressions, quite true in the main, and yet not at all so in detail, for we have to admit, so soon as we give careful consideration to the question, that the general impression bristles with exceptions, and the fact that these similarities and dissimilarities in the habits of the larvæ of allied species have never been properly reviewed, even so far as relates to our British species, is our only excuse for writing this and the following chapters.

If we consider the larval habits of the Vanessids first, as being among the best known of all butterfly larvæ, we shall at once be struck with the fact that the genera *Araschnia* (*levana*), *Aglais* (*urticae*), *Eugonia* (*polychloros*), *Vanessa* (*io*), and *Euvanessa* (*antiopa*), all have summer-feeding gregarious larvæ, whilst *Pyrameis* (*atalanta*, *cardui*) and *Polygonia* (*c-album*) have summer-feeding solitary larvæ. It may be at once urged that these are, of necessity, summer-feeding larvæ, because the species hybernate in the imaginal stage, but here one is met with the fact that *Araschnia levana*, with larval habits closely akin to those of *Aglais urticae*, hybernates as a pupa, and not as an imago, and yet has two broods per year, coinciding almost exactly with those of *A. urticae* and *Polygonia c-album*. It is also clear that a purely summer-feeding habit of the larvæ involves the recognition that the species of butterflies that have this habit must live through the winter as eggs, pupæ, or imagines, *i.e.*, that species that pass the winter as eggs, pupæ, or imagines, must have a summer-feeding, and cannot possibly have a winter-feeding, habit. Here, then, the comparative uniformity of the imaginal habit of wintering as such, is largely responsible for the summer-feeding habit of Vanessid larvæ. Similarly, too, the fact that most of the Vanessid imagines lay their eggs in comparatively large heaps, may be looked upon as the basis of the gregarious habit in so many Vanessid larvæ, yet it cannot be overlooked that hundreds of species of lepidoptera, in other superfamilies, lay their eggs in large batches, imbricated, overlapping, etc., and yet have larvæ of most marked solitary habits. Still, unconnected as the two things are in other superfamilies, yet, in butterflies, it is quite clear that it is an important factor, and, even in the Vanessids with solitary larvæ, the solitariness is often very partial, the ♀ butterflies rarely laying only one egg on a plant, although laying them singly, but usually several pretty close together, and hence we usually find many larvæ at no great distance from each other in the solitary species. Thus we often find several larvæ of *Pyrameis cardui*, each in a separate leaf, or bunch of leaves, on one thistle plant, several dozen larvæ, maybe of *P. atalanta*, on a large bed of nettles. We frequently find, also, many larvæ of *Polygonia c-album* on a currant bush, but this species is reputed to often lay five to seven of its eggs in close proximity, and so on. It is, however, very surprising to find that, where the species are distributed over the whole of the Palæarctic and Nearctic areas, as is the case with *Pyrameis atalanta*, *P. cardui*, *Euvanessa antiopa*, etc., the habits of the larvæ are identical, although the races of the species must have been separated for thousands of years, and, in cases where differentiation has gone to the length of developing new species, *e.g.*, *Aglais milberti* (in Canada), *Polygonia faunus* (throughout America), and so on, the habits of the representative species are practically identical, *e.g.*, those of *Aglais milberti* with those of *A. urticae*, *Polygonia faunus* with *P. c-album*, etc.

Comparing the larval habits of the Vanessids of the Nearctic, with those of the Palæarctic, region, we observe that Scudder remarks (*Butts. New England*, i., p. 307): "The Vanessid larvæ are solitary or gregarious according as the eggs are laid singly or in masses. Of those that are gregarious, some retain the habit throughout the larval existence, others change the habit when halfgrown. Whilst associated, they spin for themselves a common web, and even the solitary species weave nests, though more of leaves than web." Dealing with the larval habits in detail, Scudder notes (*op. cit.*, p. 435) that "the eggs of the Pyrameids are laid singly, that the larvæ live singly, usually in vertical nests, but, whilst the species of the '*atalanta*' group, to which he restricts the term '*Pyrameis*,' construct their nest of a single leaf, the lower portion of which they gradually devour, the larvæ of the '*cardui*' group, for which he coins the term '*Neopyrameis*,' at least after they are halfgrown, form their nests of several leaves, feeding only upon the parenchyma of the upper surface of the leaves until nearly mature." As showing that the larvæ of *P. atalanta* have exactly the same habit in Europe and North America, Edwards notes (*Can. Ent.*, xv., p. 15) how the young larva encloses itself in a leaf of *Boehmeria*, and states that, during the first stage, the larva eats the substance of the leaf within the cave, at some distance from the tip, leaving the framework untouched; he then describes how, in the second stage, it moves to a new leaf, gnaws the midrib, making the leaf to droop, and how this is followed by the construction of its new home, the leaf being completely closed, etc. In fact, the slight variation in the details of the larval habitations are just such as one may find any year, in Britain, when the larvæ are fairly abundant on nettle. As Edwards says, "the one occupation of the larval life appears to be to secure privacy." Scudder notes (*Butts. New England*, p. 466) that "the larvæ of *P. huntera* construct nests of a leaf of *Gnaphalium*, taking advantage of the silken hairs which profusely cover the surface of the leaves to form a dense white mat of silk and leaf-hairs, beneath which they take up their abode; beneath this, the caterpillar devours the soft tissue of the leaf, forming a larger nest as it gets older, drawing two or three leaves together with silken thread, consuming the undersurface of the leaves, and hence making them crisp and blanched, the whitened portions of the leaves, together with the size of the nest occupied by the larva when fully grown, making them conspicuous." The same author's account of the habits of the larva of *P. cardui* (*op. cit.*, pp. 482-3) shows that they are precisely the same as those so well-known to us in Europe.

It is remarkable how nearly the larvæ of the Nearctic Polygonias, of which there are several species, agree in their habits with those of our own area. Of the former, Scudder observes (*op. cit.*, p. 314): "The caterpillars of the *Polygonia* species feed almost exclusively on *Urticaceae* and *Grossulaceae*, usually resting on the underside of the leaves, sometimes partially concealing themselves by drawing together the outer edges with silken threads. When young, they eat little roundish holes in the middle of the leaves, and, when their meal is over, rest with their tails close to the holes, their heads towards the midrib; although a number are usually born on the same leaf, or several in one cluster, and, therefore, for at least a part of its life, a caterpillar does not lack companions, yet they are in no way social, but strictly solitary from birth, *e.g.*, *Polygonia comma* in early life lives without concealment, on the under surface of a leaf; later, it still conceals itself on the underside of a leaf, the outer edges of which are drawn together by silken threads sufficiently to afford protection from light and weather, and, from this cover, the larva emerges at night to feed, beginning at the extremity of a leaf and consuming it evenly across until not enough is left for shelter, when it betakes itself to another and repeats the processs." Edwards found that the larva of this species first sheltered itself very shortly after reaching its third larval stage, and that it effected its object by biting off the principal ribs of the base of a leaf on either side of a midrib, after the manner of *Pyrameis atalanta*, and was thus the better able to pull the sides of the leaf together, but, in the later stages, the ribs were not bitten, the caterpillar being able to draw the edges together without that precaution. The leaves of elm, being more refractory than those of the other foodplants, the larva bites out a couple of channels on either side of the leaf, starting about 1cm. from the base, and cutting obliquely towards, but not to, the midrib, through two or more ribs; the corners of the flaps thus formed of the larger parts of the leaf are then fastened together by a few strands of weak silk, rarely extending more than 1·5cm. beyond the corner. The rest, therefore, flares open apically, and, when half-eaten, bears some resemblance to a saddle. In these nests one never finds more than a single inhabitant. It may be further noted how similar the larval habits of *P. comma* are to those of *P. c-album*, for they feed on hop, elm, and nettle, and the species are both double-brooded. Similarly, the larva of the allied species, *P. satyrus*, draws the leaves of nettle together for a hiding-place, just as that of *P. comma* does, and the larvæ of *P. faunus* and *P. progne*, like those of their allies, live on the underside of the leaves of their foodplant, particularly when young. Edwards notes, too, the peculiar habit that the more mature larva of *P. progne* has of coiling round on a leaf, and then throwing the last three abdominal segments high in the air when at rest, much as one notices *P. c-album* to do sometimes when nearly full-grown.

Of the gregarious Vanessids, Scudder notes (*op. cit.*, p. 405) that the larval habits are just the same in North America as in Europe; the young larvæ spinning a thin web, enclosing a twig, but not the leaves, keeping to the carpet, and extending it as they grow and as twig after twig is stripped, whilst the social instinct is retained throughout the larval life. Of *Aglais milberti*, generally considered specifically distinct from *A. urticae*, and the larvæ of both of which feed on nettle, the same author observes (*op. cit.*, p. 417) that, during early life, the caterpillars are sociable, living together under a common web, subsequently dispersing themselves indiscriminately over the plant, almost identically in the same manner as the larvæ of *A. urticae*. Reference to Scudder's detailed description of the larva of this species (*op. cit.*, pp. 426-7), and already quoted (*anteà*, p. 19), will show how closely similar are the habits of these two allied species.

It is interesting to observe that the imagines of the genera *Eugonia* (*polychloros*), *Aglais* (*urticae*, *milberti*), and *Polygonia* (*c-album*, *comma*, etc.), have retained broadly the same wing-markings, yet the larvæ of the first two have developed social, and those of the last has retained solitary, habits; whilst the genera *Euvanessa* (*antiopa*) and *Vanessa* (*io*), the imagines of which have entirely dissimilar wing-markings from those of the genera just mentioned, have developed, in common with *Eugonia* and *Aglais*, social larval habits.

CHAPTER IV.

Family habits in butterfly larvæ—the fritillaries.

Probably nothing is more striking than the close general resemblance in the larval habits of the various groups of the fritillaries. To consider these habits, we may divide these butterflies into three groups—the Argynnids, or large, solitary, violet-feeding species; the Brenthids, or small, solitary, chiefly violet-feeding species; and the Melitæids, or gregarious fritillaries, the last-named group only rather distantly related to the two first-named groups, which are very closely allied. The larval habits of the Argynnids proper, *i.e.*, the large fritillaries, present three striking peculiarities, apart from the remarkable limitation to violet as a foodplant: (1) The fact that all hybernate as larvæ in the first instar, either inside or outside the eggshell, and without feeding until the spring. (2) That they are all spring-feeding larvæ, an evident result of their hybernating habit. (3) The fact that they hide most persistently by day, running with great rapidity if disturbed, and disappearing very rapidly, especially as they approach maturity. Of our three British Argynnids, *Dryas paphia* and *Argynnis aglaia* hybernate as little newly-hatched larvæ outside the eggshell, whilst *Argynnis adippe* hybernates in the same larval stage, but inside the eggshell, as also do *A. elisa* and *A. niobe*; the other European species, so far as is known, hybernating similarly. But this habit must be an exceedingly old one, for, although specifically very distinct from their European allies, the North American species have exactly the same habit, *e.g.*, *Speyeria idalia* eggs, like those of *Dryas paphia*, hatch in about a month, the young larvæ eat the entire eggshells, and then, without touching any vegetable food, retire at once into hybernation (*Butts. New England*, p. 542). Speaking of the other large Nearctic Argynnids—*Argynnis cybele*, *A. aphrodite*, *A. atlantis*, etc.—Scudder notes (p. 550) that the eggs hatch in about a fortnight, that the caterpillars, similarly to those of *S. idalia*, only eat their eggshells, and then immediately go into hybernation. This is exactly the habit of the larva of *A. aglaia*,* and of *A. adippe* also, except, as

* Barrett's remarkable statement (*Ent. Mo. Mag.*, xix., p. 6) that the Argynnid larvæ he notes—*paphia*, *adippe*, *aglaia*, *euphrosyne*, and *selene*—"pass the winter as small social larvæ under a silk tent on the ground," is quite inexplicable.

noted above, that the latter hybernates within, and not outside, the eggshell.

Of the rapidity of movement among these larger Argynnid larvæ, and their general habit of hiding, Buckler says that a larva of *Argynnis adippe*, above an inch long, when turned out for figuring, was very shy at first, and curled up for several minutes, then, stretching itself out gradually, it set off to run at a pace quite equal to the fastest larva of *Arctia caia*. He also notes that, when feeding, it takes its meals in a most rapid or hurried manner. He further observes that the larva of *Argynnis aglaia* also eats most rapidly, that, when feeding, it keeps advancing with every mouthful until it gets to the end of a leaf, then walks quickly back to the point of commencement, and proceeds as before, always making a quick retrograde movement before again eating its way forward, and that these operations were performed with such rapidity, that half of a large leaf quickly disappeared. When its hunger is appeased it retreats below the leaves, or rests on the stalk of the plant. Of the American species, Edwards says that the larva of *Euptoieta claudia* travels with wonderful rapidity, so that a journey of several feet would be a small affair, whilst he also remarks on the fact that the larva of this species hides by day. Scudder notes (*Butts. New England*, p. 550) that the larvæ of the larger North American Argynnids usually feed only by night, hiding beneath leaves or in crevices in the ground by day. Of the late summer-feeding larvæ of *Issoria lathonia*, the winter-habits of whose larvæ are practically unknown, Frohawk notes (*Ent.*, xxxvi., pp. 302, 303): "They are very active in their movements, running rapidly and feeding voraciously," also that "they appear to avoid the strong sunlight, by sheltering on the underside of the leaves, and often select the most shady part of the plant to rest upon; but yet they enjoy warmth, becoming very active and feeding rapidly on the brightest and warmest days."

It appears to us somewhat remarkable that the habits of the Brenthid larvæ should be so similar to one another, especially so far as the hybernating habit is concerned. In this they differ entirely from their allies, the Argynnids, which we have just considered, as they hybernate in the fourth instar, commencing their winter rest often at the end of July, and, recommencing to feed at quite the end of February and early March, and are fullfed by the end of May or thereabouts. The Brenthid larvæ are essentially, therefore, late summer and early spring feeders, and not spring- and early summer-feeding larvæ as are the Argynnids. Another great point of difference is the inherent tendency in many of the Brenthid species to produce a few larvæ in each brood, with a "forward" habit that results in a partial second-brood, the proportion of "forwards" depending (1) on latitude, (2) altitude, and (3) on the individual season. It is to be noticed, however, that, so far as the Palæarctic Brenthid species, of which we have intimate knowledge of the larval habits, are concerned—*Brenthis selene*, *B. euphrosyne*, *B. dia*, etc.—the larvæ resulting from these second-brood examples must reach the normal fourth instar before winter (usually they do so at the end of September or in early October), and hybernate in the same stage as the more "laggard" larvæ resulting from the early brood, or perish.

The restricted larval food-habit, too, is less marked in the

Brenthids than in the Argynnids. The former have, like the latter, essentially violet-feeding larvæ, *e.g.*, *Brenthis selene*, *B. euphrosyne*, *B. thore*, *B. pales*, etc., but there are other species which, although using violet as a pabulum, are reputed to avail themselves of other foodplants, *e.g.*, *B. aphirape*, which is said to eat *Polygonum bistorta* as well as violet; *B. amathusia*, also on *P. bistorta*, in addition to violet; *B. ino*—*Rubus idaeus*, *Spiraea ulmaria*, etc.; *B. dia*—*Rubus*, etc. *B. frigga* is only recorded from *Rubus chamaemorus*; *B. daphne* is recorded as feeding on *Viola* by Wilde, and *Rubus idaeus* and *R. fruticosus* by Ochsenheimer. Unfortunately, modern continental lepidopterists are mostly satisfied to rely on the records of their century-old ancestors, and modern details on these points are not forthcoming.

The rapidity of movement and the love of hiding are almost as highly developed in the Brenthid, as in the Argynnid, larvæ, and, consequently, we find that the natural habits of the larvæ are little understood, because they have been so little observed. Buckler observes that, when walking, the pace of the larva of *B. euphrosyne* is very rapid; it loves to bask in the sun's rays, and, in the case of a larva that he reared, he observes that, as soon as the sun went off, it retired to the underside of a leaf, and remained, apparently without motion, till the next day, when the sun again shone on its resting-place, when it walked about, fed, and basked as before. Strangely enough, Buckler says that the larva of *B. selene* shows an aversion to the sun's rays, and does not, at any period of its larval existence, care to expose itself to their influence, but reposes either on the underside of the leaves, or, otherwise, on the stems which are more or less shaded by leaves. All the Brenthid larvæ appear to agree in hiding when not actually feeding, unless, as in the case of *B. euphrosyne*, they take a special sunbath.

Scudder says (*Butts. New England*, i., p. 582) that the Brenthid larvæ "appear to present among themselves greater differences in habit than occur in any other similar group of butterflies, the central European species differing considerably from those of the United States, though all the known species, whether European or American, winter as only partly-grown caterpillars." A careful study of the Brenthid larval habits leads one to entirely opposite conclusions on both points noted, and to surmise (1) that the habits of all Brenthid larvæ are particularly alike, and (2) that there is marked similarity between the habits of the North American and European species. The only facts on which Scudder appears to base his statement are those relating to the partial-broodedness of many of the species, by means of which two modes of larval life are set up in one brood, resulting in partial double-broodedness (as already noted *anteà*, pp. 7-9), and secondly, the assumption that, because imagines from the spring larvæ emerge over a long period of time, they are of different ages when hybernation takes place (*anteà*, pp. 9-10). One suspects, on the contrary, from the evidence, that the family or general larval habits of the Brenthids are very similar, *e.g.*, everything goes to show that the larval habits of *Brenthis myrina*,* *B. montinus*, and *B. bellona*,* are almost identical with those of our European species, the question of one, two, or even three broods, or rather partial broods, being, in the Nearctic, as

* Scudder's theories (*Butts. New England*, p. 587) on the larval habits of *B. myrina* and *B. bellona* appear too far-fetched to be taken seriously.

in the Palæarctic, region, merely a matter of the nature of the season, weather, altitude, or latitude. Prittwitz's remarkable guess, quoted by Scudder (*op. cit.*, p. 607), that *Brenthis thore* only flies in alternate years, appears to be absurd, the larva of this species, like those of *B. selene*, *B. euphrosyne*, etc., having almost identical family habits (see *Ent. Rec.*, xviii., p. 69), only that, even less than *B. euphrosyne*, there appear to be no "forward" larvæ to form a partial double-brood.

Possibly no family of butterflies shows more marked family larval characters than the Melitæids. It is unfortunate that some of the absolute knowledge one would like does not appear to be available concerning the non-British, but European, species. Still, of those that are known, the uniformity of the family larval traits is sufficiently remarkable. These are exhibited in (1) their abundant silk-spinning habits in their earliest stadia; (2) the gregarious habits of the young larvæ up to, and including, hybernation; (3) the social hybernation in a fixed stadium, usually the third (or fourth); (4) the tendency to solitary life after hybernation; (5) the lethargic habits accompanying the assumption of cryptic habits after hybernation; (6) the thoroughness of the hybernating rest. We are unfortunate in not having very reliable data concerning many of the habits of the larvæ of the Palæarctic species, but, so far as our three British species—*Melitaea aurinia*, *M. athalia*, and *M. cinxia*—are concerned, they are remarkably similar in most of their habits in the larval stage, *e.g.*, they spin silk freely, are quite social in early life, hybernate crowded in a common web, all hybernate, we believe, in the third stadium, distribute themselves considerably directly after the first moult after hybernation, are then lethargic in their movements, and trust rather to cryptic effects in relation to their surroundings for protection, than hiding away. This latter trait does not imply the inability of the larvæ to travel rapidly, which they can do if necessity arises. All this seems to be equally true of the larvæ of *Melitaea didyma*, *M. parthenie*, *M. dictynna*, and possibly others. In America, the habits of the Melitæids are very similar, and Scudder writes (*Butts. New England*, i., p. 619) that "the eggs are generally (perhaps always) laid in clusters, and the caterpillars, at least in the early half of their lives, are social, often constructing common webs, in which some kinds hybernate, for, as far as is known, all the species of this tribe, whether in the New World or the Old, pass the winter as halfgrown caterpillars." The larvæ of *Phyciodes tharos*, however, are described as "social," without spinning any web, and at the time of hybernation leaving the foodplant to hide in crevices of the ground (*op. cit.*, p. 638). Similarly, the larvæ of *Charidryas nycteis* are said (*op. cit.*, p. 664), to be gregarious when young, feeding only on the parenchyma of the leaves, leaving only a transparent membrane, but not constructing any web for concealment or protection, hybernating, also without spinning any protective covering, possibly in crevices, etc. It may be well here to notice that, according to Wilde, the larvæ of *M. maturna* are social until the time of hybernation, living in webs, after the fashion of *M. aurinia*, *M. cinxia*, etc., on *Fraxinus excelsior*, but that, in the third stadium, they leave the tree for hybernation, going down to the ground, hiding among leaves, etc., apparently without spinning web of any description, and remaining solitary after they recommence feeding in the spring.

This habit of *Melitaea maturna* appears to be exactly parallel to that of the American *Cinclidia harrisii*, the larvæ of which are said to desert their nests at the approach of winter, and hybernate in dried leaves, etc., but the information available on this point is small. In the spring, these larvæ awaken early, and, though they spin no kind of web, are rarely found alone, but may generally be seen in large numbers on *Doellingeria*, sometimes as many as twenty on a single stalk, often four or five on the same leaf (*op. cit.*, p. 681). On the other hand the habits of the larvæ of *Euphydryas chalcedon* and *E. phaeton* appear to be identical with those of *M. aurinia*, etc., and the observation (*op. cit.*, pp. 699-700) that, "in the spring, the larvæ of the latter forsake their web, and, though still gregarious to a limited extent, wander ceaselessly about, swarming over *Lonicera* and other plants, seeking only the concealment of leaves and the underside of sticks in their moultings or during storms, whilst, at other times, they live fully exposed to view," reminds one much of the larvæ of *M. cinxia*, *M. aurinia*, etc., as also does the further observation that they "do not seek protection by feeding at night, whilst their only sensitiveness to danger is shown by the readiness with which they coil up and drop to the ground when the plant on which they are is jarred." The statement that "their movements are active" only applies in part, however, to our British species. These latter agree, especially when nearly fullfed, much more with the larvæ of *Phyciodes tharos*, which Scudder says (*op. cit.*, p. 638) are very inactive and cannot be roused to movement, and which, at the most, will coil themselves in a circle and drop to the ground. This also is the case with the larvæ of *Charidryas nycteis*, which, if disturbed, loosen their hold and fall to the ground, their bodies bent in a circle, and which, after lying motionless for a few minutes, will, if not further disturbed, arouse themselves and travel rapidly away to some place of concealment.

The capacity of producing "forwards," in what is generally a group with larvæ of single-brooded habits, is markedly noticeable in some species in more southern localities. In *Melitaea parthenie*, the number of "forwards" is a very large one; in *M phoebe*, *M. didyma*, and *M. cinxia*, moderately large; whilst in *M. dictynna*, *M. athalia*, etc., a "forward" larva is a great rarity. As a result, there is considerable variation in the length of the æstivating period leading up to hybernation, the larvæ of both broods going through the winter in the same stadium. Edwards is described (Scudder's *Butts. New England*, p. 665) as stating that *Charidryas nycteis* is partially triple-brooded in its southern habitats, about one-third of the larvæ of the first brood becoming dormant, *i.e.*, two-thirds develop "forward" habits, of the second brood about one-third develop "forward" habits, whilst the whole of the third brood pass through the winter in the same stage as the "laggards" of the first and second broods.

It may be here interesting to note that the peculiar jerking motion which one notices when the young larvæ of our British species of Melitæids are alarmed, the head being jerked from side to side, the larva clinging by its last segments to a leaf or stalk, is noted by Scudder as occurring also in *Cinclidia harrisii*. One must add, however, that this is not confined in any way to this family, but is much more general, being common in certain Vanessid larvæ, and also in those of many moths.

CHAPTER V.

FAMILY HABITS IN BUTTERFLY LARVÆ—THE LIMENITIDS.

It is remarkable how strongly developed are the family larval habits of the Limenitids or "white admiral" butterflies. Although we have only one British species, *Limenitis sibylla*, it offers, in its larval habits, almost all the main features common to the larvæ of the group, both throughout the Palæarctic and Nearctic regions. All, for example, are autumn- and spring-feeding larvæ; all hybernate in the third (or fourth) instar, *i.e.*, fairly well grown; each spins a peculiar encasement, made of a leaf of its foodplant, in which to hybernate; in the spring they spin an abundance of silk to give a safe footing in travelling from one part of the foodplant to another; they eat greedily, and then retire to a safe place (usually a stem of the foodplant) to rest, and are then readily overlooked; they often select a similar part of the foodplant for pupation. The Palæarctic group of the Limenitids is represented by *Limenitis* (*sibylla*, *camilla*), *Najas* (*populi*), and *Neptis* (*lucilla*, *aceris*), the Nearctic by the interesting genus *Basilarchia* (*arthemis*, *archippus*, *eros*, etc.).

Among the most remarkable of the family habits mentioned are those (1) relating to the position of rest when not feeding, and (2) the formation of a hybernaculum. We have already quoted Buckler's description (*Larvae*, etc., i., p. 41) of the hybernaculum of *Limenitis sibylla*, which is usually placed three or four buds down from the tip of a twig shooting out from the main stalk of a honeysuckle-bine. The one described is made of a honeysuckle leaf, which had been first partly bitten through near its axil, and then securely fixed by its two edges for about half its length to the twig from which it grew, and across which its edges are firmly bound with a spinning of strong silk; the remainder of the leaf curved off from the twig at an angle of about 40°, being divided along the midrib for about ·1in. from the tip—thus forming two little hare's-ears as it were—and from them up to the twig, having its two edges firmly spun together. Just at the point where this half of the leaf meets the underside of the twig, there is a circular aperture, apparently designed for the egress of the larva in spring. As the leaf withers, the hybernaculum becomes puckered, and little more than half-an-inch in length, and has the appearance of a small shrivelled leaf, clinging to the dry stem, and would thus easily escape ordinary observation. The whole structure is firmly fixed to the twig, and could not swing with an independent motion of its own. Of the same species, Breyer observes (*Ann. Soc. Ent. Belg.*, v., pp. 62-63) that the larva of *L. sibylla*, when preparing to hybernate, rests on the pedicel of a leaf, of which it has eaten all but two basal portions; these two lobes it pulls over itself to form a small tube; and the pedicels are so attached to the twig by silk that the leaf does not fall during the winter. Gillmer states (*in litt.*) that the larva of the allied *L. camilla* has a very similar habit, forming its hybernaculum by standing on the bine of the honeysuckle and spinning a piece of leaf over itself. Of *Najas populi*, Dorfmeister notes (*Verh. zool.-bot. Gesell. Wien.*, iv., pp. 483-6) that the larva constructs its hybernaculum after its second or third moult, rolling a piece of leaf into a cylinder, which is fastened by its large axis flat upon a twig. Dorfmeister adds to this crude description the fact that some larvæ observed continued to feed for a week or two, after they had taken up their winter residences, each returning to its own after every meal. Of a third European species, *Neptis aceris*, Gartner observes (*Stett. Ent. Ztg.*, xxi., pp. 296-7) that, after the third moult, the larva of this species constructs its hybernaculum of a partly-eaten leaf of its foodplant, which is attached by silken threads to the twig to which it belongs. His general remarks on the larval habits just previous to hybernation suggest, however, considerable difference from those of the preceding species.

The Nearctic species of *Basilarchia* are very closely allied in their larval habits to our European *Limenitis sibylla* and *Najas populi*. Sufficiently exact observations have not been made for absolute certainty, but Edwards states that all the American Limenitids appear to hybernate after the second or third moult. Edwards further notes (*Can. Ent.*, xvi., p. 87) that the larva of *Basilarchia archippus* (*Limenitis disippus*) and those of the allied species spend the winter in cases cut out of the leaves of their foodplants, one larva to one case, and fitted as neatly as a tailor would fit a coat to his customer. Scudder, summarising the observations of Walsh, Riley, and Edwards, notes of *Basilarchia archippus*, that the hybernaculum is made of a willow-leaf. The larva eats the side of the leaf nearly to the midrib, for about one-third the distance from the tip, ordinarily selecting for the purpose a leaf near the end of a twig; it brings together the opposite edges of the leaf, and not only fastens them firmly with silk, but covers this nest outside and inside with a carpet of light brown glossy silk, so that the leaf is nearly hidden; it also travels back and forth on the leaf-stalk and around the twig, spinning silk as it goes, until the leaf is firmly attached to the stalk, and, in spite of the frost and wind, it hangs until the spring. Following the projecting midrib, the caterpillar creeps into the cell headforemost, closing the opening with its hinder segments all abristle with spines and warts. For its hybernaculum, the allied *B. arthemis* selects a growing leaf of birch, eats away the apical third or fourth, excepting the midrib and a narrow flange on each side of it, or it uses the leaf it has been eating, already trimmed in this fashion; it then draws together, above, the outer edges of the uneaten portion to construct a tube, which it lines very heavily with brown silk, within and without, and further binds the leaf-stalk to the stem with repeated bindings of silk, to prevent its falling to the ground in winter; by means of the ledge formed by the projecting midrib, it then enters the tube head foremost, and completely fills it, so that the opening is just closed by the roughened end of the body. The resemblance that the hybernacula of this species bear to the opening buds and curving terminal shoots of the twigs on which they occur, is very striking; the colour of the soft down of the buds and the enveloping silk of the hybernacula are as similar as their forms, and this mimetic resemblance is, doubtless, as effective as it is interesting. Of the hybernacula of the larvæ of the southern *Basilarchia eros*, Edwards notes that they are constructed apparently after the second moult, possibly from the leaf upon which the larva commenced its existence, whether willow or aspen, as in the case with *B. archippus* (*disippus*). The ends of the leaves used have been eaten away, and only the sides need shaping, but, if the residue be insufficient, or for any reason does not answer the purpose, the caterpillar moves to another leaf, and begins the necessary cutting to construct a suitable hybernaculum.

Probably still more peculiar are the feeding- and resting-habits of the larvæ when young. Gartner observes (*Stett. Ent. Ztg.*, xxi., pp. 296-7) that the larva of *Neptis aceris*, as soon as it leaves the egg, begins to eat through a leaf of *Orobus vernus*, laterally, as far as the midrib, which, together with the tip of the leaf, it leaves untouched; at the next meal it attacks the opposite side of the leaf, and so on alternately, gradually approaching the base; after each meal it crawls over the untouched midrib, to the very tip of the leaf, where it takes a siesta, its head directed outwards, and thus it continues through three stages, when, after some modification in its habits, hybernation takes place. This may now be compared with Scudder's description of the larval habits of *Basilarchia arthemis* in its earlier stages. He writes (*Butts. New Engl.*, i., p. 257), "The egg of *B. arthemis* is placed near the tip of a leaf, and, as soon as hatched, the larva eats away the leaf on both sides of the midrib, and it then rests on the stripped portion of the rib." He then quotes Edwards as saying (*Pap.*, ii.) that the larva of *Basilarchia archippus* (*disippus*) has, in all respects, habits similar to those of that of *B. arthemis*. The larva of the former no sooner lays bare the rib than it is coated and wound with silk, and to the extremity are fixed grains of larval excrement, only two or three at first, placed one after the other in line; these are bound together and to the rib, and, being small as grains of rifle-powder, they form a continuation of about the same dimensions as the rest of the perch, and seem effectual to prevent curling as the rib dries. As the larva grows the process is continued, until the artificial portion measures ·5in. or ·6in., and makes a stout irregular cylinder, the entire perch measuring about 1·5ins. It is constantly strengthened by additions of silk, the larva almost invariably, as it goes back and forth, to and from its feeding-ground, adding threads and patching the weak places. On this perch the young larva, *i.e.*, before hybernation, always rests, going therefrom to the leaf for food at short intervals. It occupies the middle of the perch, when resting, and its usual attitude is a twist, the ventral legs clasping, but the anterior half of the body bent down by the side and somewhat under, the perch. If two larvæ of *B. arthemis* be born on one leaf, one always takes possession of the midrib, whilst the other constructs an artificial perch by the side of the leaf. This perch is irregularly cylindrical, and composed of frass and small bits of leaf woven together and covered with greyish silk, and is, at first, nearly ·25ins. long and about ·02ins. in diameter. As the larva increases in size so this special resting-place is made larger. Edwards also notes (*Pap.*, ii.) that, if two larvæ of *B. archippus* (*disippus*) are placed on the same leaf, one always takes possession of the extremity of the midrib, often with something of a contest and knocking of heads together, but the other will presently be found on one edge, excavating the leaf on either side of a narrow slip, which is to constitute the base of its perch. This is bound with silk, lengthened with frass in exactly the same way as when the midrib is used, and serves every purpose that the latter does to the larva in possession thereof. Scudder says (*Butts. New Engl.*, p. 274) that the larva of *B. archippus* never remains upon its feeding-ground when its appetite is satiated, but retires to the untouched midrib of the leaf, where the sides have been eaten away, or, when larger, to a twig; in either case, it stops when it has reached its favourite spot, and rests immovable, heading away from its food. Appetite returning, it wheels about, hurries to the old feeding-spot, and, its meal finished, returns again to its accustomed station for a new siesta. Of *Basilarchia astyanax*, Scudder notes (*op. cit.*, p. 295) that, whilst feeding, it rests upon the upper surface of a leaf, eating the edges from the apex to the base, invariably returning to the same spot at each meal, until all is devoured excepting the basal half of the midrib, when it passes to the adjoining leaf. The lovely *B. eros* is a southern species, and of it Edwards observes (*Pap.*, ii.) that the larval habits are precisely like those of *B. arthemis* and *B. archippus*. The larvæ make at once, after leaving the egg, perches of the midribs of the leaves they feed on, lengthen and stiffen the perches by binding on, with silk, morsels of chewed leaf, so that their slender resting-places do not curl up or bend; on these they live, except when they go to the next edges of the leaves to feed. Equally interesting is it to find the following note on the habits of the young larva of the Indian species, *Maduza procris*, of which Davids and Aitken write (*Journ. Bomb. Nat. Hist. Soc.*, v., p. 274): "When young, it is slender, cylindrical, evenly clothed with short spinous tubercles, and of an uniform dark brown colour. It remains on one leaf, eating it regularly back from the point, but leaving the midrib, and, as it eats, it fringes the eaten margin with its excrement, held together by silk, among which it is absolutely indistinguishable." Of the European species, *Najas populi* is distinctly nearer the American Basilarchias than are the Limenitids and Neptids. It is, perhaps, therefore, a little less remarkable to find the larva of this species having almost identical habits with the American species, but, according to Dorfmeister (*Verh. zool.-bot. Wien.*, iv., pp. 483-6) the young larva of *N. populi* eats a piece out of a leaf of *Populus tremula*, on either side of the midrib, on the extreme tip of which it takes up a position whilst resting. The midrib is covered carefully with silk, a habit already noticed as occurring in *Basilarchia*, and the minute a meal is finished, or the larva is disturbed, it travels back over its silken bridge and takes up its position at the tip, invariably remaining upon the leaf where it was born until after the first or second moult. How similarly the larva of *Limenitis sibylla* acts, is to be gleaned from Breyer's observation (*Ann. Soc. Ent. Belg.*, v., pp. 62-63) that the newly-hatched caterpillar makes its first attack on the leaf, on one side of the tip, and eats very moderately, so that the leaf on which it is born answers all its needs till autumn, by which time the leaf is reduced to two small flaps near the pedicel, which it fashions into its hybernaculum.

One of the most remarkable features of the Limenitid larvæ is narrated at length by Edwards and Scudder. The former says: "The larvæ of both *Basilarchia arthemis* and *B. archippus* (*disippus*) have a habit of accumulating little scraps of leaf at the base and underside of the perch or resting-place, till quite a packet is formed, and this is rolled back as the substance of the leaf is eaten, so as always to be close to the cut edge of the leaf. This edge, in narrow leaves, and at first in broader ones, is kept nearly square by eating first on one and then on the opposite side of the leaf. Occasionally a canal is eaten from the edge of the leaf, parallel to the outer edge all the way to the midrib; as the bit of leaf thus left unsupported begins to droop, guys are spun from it to the solid leaf on the opposite side of the canal, and to the midrib; it is then eaten away from the leaf, and the triangular bit remaining falls, hanging by its threads, and swings to the base of the perch, or is pulled there by attaching successively shorter threads. Here it is bound loosely. As other bits are added there comes to be an open packet, held together by simple threads, and of about $\frac{1}{10}$in. in diameter. The packet is moved along as the larva feeds, in the two younger stages, and is always kept close to the leaf, partly by pushing, what is gained at each effort being secured by threads, or it is rolled by attaching successive threads from the farther side to the leaf and rib, till the mass is turned over. The packet is not increased after the second stage is passed, and is left behind, the caterpillar no longer frequenting the perch constructed in its earlier days, and which has now become too weak for its weight; it now prefers the footstalk of a leaf or a twig. The same observer further notes that the young larvæ of *Basilarchia eros* also make little packets of bits of food, which are held together and fixed to the perch, near its base, by silk, and that they push and drag these packets back as the substance of the leaf is eaten. The interest of this to European lepidopterists lies in the statement made by Scudder that "the larva of *Najas populi* is also described by Dorfmeister (*Verh. zool.-bot. Ges. Wien.*, iv., pp. 483-6) as making a similar packet of riff-raff to that made by *Basilarchia*."

As to its supposed value, Edwards states that he was at first puzzled to account for this construction; but, happening to see one of the caterpillars back down the perch and drop its excrement directly into the packet, it occurred to him that really this was the magazine whence the larva drew its materials for lengthening the perch. On pulling some of the packets apart a few grains were always found in them. This Edwards believes to be the use of the packets, and he observes that, without some contrivance to catch the frass, it is difficult to see how the larva could obtain the materials it uses. Apparently it drops just about enough into the packet for the object in view, for it is certain that the grains are usually expelled wherever the larva happens to be, and fall to the ground. After the end of the perch is sufficiently strengthened and there is no further need of the grains, the packet is dropped behind and neglected. Scudder, on the other hand, thinks that this loose ball, about the size of a small pea, made out of bitten scraps of leaf held together by strands of silk, and attached by a thread to the midrib on which the larva is resting, so that it is moved by every breath of wind, is perhaps a device to distract from itself the attention of an enemy, for, by constant removals, it is always kept close to the eaten edge of the leaf, whilst the position of the larva is as far out on the stripped midrib as it can find a good footing.

It appears to be a very definite habit in the Limenitids to feed up comparatively rapidly in the spring after hybernation. Dorfmeister notes (*Verh. zool.-bot. Ges. Wien.*, iv., pp. 483-6) a larva of *Najas populi* that was in winter-quarters on May 17th, but ate so voraciously and fed up so rapidly that it had pupated by June 5th, and Breyer similarly observes (*Ann. Soc. Ent. Belg.*, v., pp. 62-3) that the larva of *Limenitis sibylla* is voracious and grows rapidly in the spring, whilst Buckler also states that it loves the sun, and, when it is exposed to it, appears to be most active and hungry, Gillmer adding (*in litt.*) that the larva of the allied species, *L. camilla*, after hybernation, grows very quickly, and is already fullgrown in Germany by the middle of May. Buckler further says (*Larvae, &c.*, i., p. 37) of *L. sibylla*, that, after hybernation, the larva feeds on the leaves of young and tender shoots of honeysuckle, clearing the leaves from the apex to the foot of the shoot. It rests on the stem when not eating, and, spinning a considerable amount of silk, ascends the stem to feed, and descends after each meal to its resting-place; Gillmer similarly notes (*in litt.*) that the larva of *N. populi*, whilst resting, sits closely against a branch, but, when almost fullgrown, chooses the upperside of a leaf, on which it rests safely with its prolegs well inserted in the silken web with which it covers the leaf. From here it goes forth to feed, and returns when its appetite is satisfied. This remark is similar to that made by Scudder (*Butts. New Engl.*, i. p. 274) concerning *Basilarchia archippus*, of which he notes that it never remains upon its feeding-ground when its appetite is satiated, but, when young, retires to the untouched midrib, and, when larger, to a twig; in either case, it stops when it has reached its favourite resting-place, and rests immovable, heading away from its food. Appetite returning, it wheels about, hurries to the old feeding-spot, and, its meal finished, returns again to its accustomed station for a new siesta.

Two of our best known European species, *Najas populi* and *Limenitis sibylla*, are single-brooded, and the larvæ show no sign of dividing into "forwards" and "laggards"; on the other hand, almost all the summer larvæ of the graceful *L. camilla* develop into "forwards," in the warmer latitudes it haunts, and at low altitudes, so that, in favourable seasons and places, the second brood is frequently almost as large as the first, although the number of "forwards" markedly decreases in the higher latitudes and altitudes where it ranges. According to Gartner (*Stett. Ent. Ztg.*, xxi., pp. 296-7), a very fair percentage of the early summer larvæ of *Neptis aceris* become "forwards" and develop a second brood. Of the American species, *Basilarchia arthemis*, *B. archippus*, and *B. astyanax*, Scudder observes (*Butts. New Engl.*, i. p. 256) that a fair number of the summer larvæ develop a "forward" habit, but that the second brood is always less numerous than the first (see also *op. cit.*, pp. 285-6, pp. 302-3). Edwards further observes that the southern *Basilarchia eros* has developed an almost entirely "forward" larval habit, the species tending to be continuously-brooded, the longest hybernating period not lasting more than 60 days.

CHAPTER VI.

FAMILY HABITS IN BUTTERFLY LARVÆ—THE APATURIDS.

In our consideration of the Limenitid larvæ, we have pointed out the remarkable similarity in the habits of the European and American species. In the case of the larvæ of the Apaturids, there is considerable difference in the habits of the species belonging to the two areas. The European species have larvæ that are characteristically solitary in their habits, whilst those of the American species show, at least in their early stages, strongly marked gregarious habits.

The habits of the larvæ of our only British species, *Apatura iris*, previous to hybernation, are described by Buckler and Newman. The former states (*Larvae*, etc., i., pp. 45-46) that the newly-hatched larva rests on the tip of a leaf, eats on either side of its resting-place till its first moult; after moulting it still takes up its position on a leaf-point to rest, eating on either side and returning to the same resting-place; soon after its second moult it hybernates. Newman adds (*Brit. Butts.*, p. 73) that a portion of the leaf is consumed every day, the midrib being left intact; the little larva, when resting from its alimentary labours, climbs to the denuded bristle-like tip of this midrib, and there remains perfectly motionless with the anterior extremity raised. Scudder says (*Butts. New England*, i., p. 231) that Müller describes a South American species with similar eating-habits, which also resemble those of the North American *Anaca*, but the larvæ of the species of *Chlorippe* act very differently.

Of the two best-known North American Apaturids, *Chlorippe celtis* and *C. clyton*, the most remarkable feature previous to hybernation, is their gregarious habit. Of this, Edwards says that the eggs of *C. clyton* are laid in clusters of hundreds, those of *C. celtis*, either singly or in lots of from five to twenty. The larvæ of *C. celtis* are gregarious, but are satisfied with nearness without contact, those of *C. clyton* require actual contact and assemble in groups, to which all scattered ones are attracted, and, if a group be separated, the members will, in a few hours, be found to be together again. When the larvæ of *C. clyton* hatch, they gather in a dense group, are intensely gregarious in habit, and, until after the third moult, lie close together, completely concealing the leaf beneath, and it is one of their peculiarities, even to maturity, that they do not often lie straight, but take a sinuous position, and, when in cluster, as one curves, so do the others adjoining; moreover, they do not rest with their heads all turned in the same direction, and bodies in line or parallel, as is the habit of many species of gregarious larvæ, but they form an irregular mass, the heads mostly outside and pointing in every direction. Edwards found, further, that they fed principally at night, the leaf in the morning having been eaten at one spot, as if all had fed at the same time. When, finally, there remained nothing but the patch on which they rested, they were forced to move to a fresh leaf. From the earliest stage, the surface of the leaf about and beneath the larvæ was kept thoroughly clean, but just outside the group was a mass of excrement in a pretty regular ridge, that looked as if it had been voided at that place, but Edwards discovered that certain individuals from time to time acted as scavengers, and that the larvæ themselves threw the frass there with their jaws, the members of the colony after the cleansing settling down to their normal attitude of rest. This sanitary work could only have been necessary because the larvæ were in confinement, he says, since, in nature, they would have rested on the underside of the leaf. After the second moult, as in our European Apaturids, the larvæ change colour, and prepare for hybernation. Riley says (*Ann. Rept. State Missouri*, vi., p. 141) that the larvæ of *C. clyton* are gregarious during the first three stages, feeding side by side, eating the leaf from the tip downwards, but leaving the stouter ribs. Spinning a thread wherever they go, they often, in travelling from leaf to leaf, make quite a pathway of silk, and, if the branch be suddenly jarred, they will drop and hang suspended in mid-air, and, after reassurance, climb up again with the thoracic legs." Edwards says that the young larvæ of *Chlorippe celtis* are not so intensely gregarious as those of *C. clyton*, but they remain upon the same leaf, scattered in small bodies over the surface near together without being in close contact as is the habit of *C. clyton*. It is not usual to find more than one on a leaf in the natural state after they have become halfgrown, and they probably disperse at the third moult.

Buckler observes that, after the second moult, the larva of *Apatura iris* takes up a position on a twig for hybernation; it envelops the hinder half of its body in a mass of silk and remains immovable. Newman observed one, on November 13th, descend from a leaf, cover with silk the rind of a twig immediately below the attachment of the leaf, grasp this web firmly with its claspers, stretch itself out at full length, with its horns porrected before it, and thus settle itself down for the winter. Muschamp always finds the larvæ of *A. iris* and *A. ilia* in nature, in the Bavois Woods, on the smooth part of a branch, never near a twig, and they are invariably in spring-time of the same colour as the bark, on green wood the hybernating larvæ are green, on red wood, red, and on grey wood, grey (*Ent. Rec.*, xix., p. 145). Gillmer observes (*in litt.*) that the larva of *Apatura ilia*, towards the end of October, spins up near a leaf-bud of *Populus tremula*, to which it bears considerable resemblance, and where its detection is very difficult, or it chooses a place where a twig has been broken off, or a quite smooth place on a branch, where it may hybernate. Occasionally one finds hybernating larvæ on twigs, or even in cracks of the bark of the main stem. It has been suggested that the latter larvæ have fallen with leaves before the necessity of hybernation has overtaken them, and have crawled up the stem again in order to find a suitable position.

The actual details of hybernation of the North American Apaturids in nature appear to be unknown. Edwards observes that "the larvæ of *Chlorippe clyton* probably, to some extent, seek shelter in the rough corky bark of the hackberry, though many, no doubt, fall with the leaves and perish." Scudder converts (*Butts. New England*, i., p. 247) this suggestion of falling with the leaves into a certainty, for he remarks that the larvæ "feed in company till the time for hybernation arrives, when, huddled together in companies of five or more, on a leaf whose surface they have covered with silk, and thereby curled somewhat, they change with the leaf to a brownish or vinous tint, and drop with it to the earth . . . . In spring they make their way again from the ground to the tree." This is partly extracted from Riley's statement (*Ann. Rept. State Missouri*, vi., p. 141), but much is so contrary to the usual habits of Apaturid larvæ that one would like to have very definite confirmation. In confinement, Edwards observed that "the hybernating larvæ rested on a common bed of silk web, which covered the surface of the leaf, each with its head bent under, so that the face was in the same plane with the lower side of the body, the back arched, and the last segment appressed. The larvæ of *C. celtis*, also, hybernates after its second moult. Edwards says that some commenced as early as June, in 1873, in confinement, some composing themselves on the leaves in the glass in which they were kept, others directly on the sand at the bottom of the glass, in either case, upon a coating of silk, which the larva had spun. The colour of these larvæ also changed to brown with a slight mottling of vinous and green. (The rest of the larvæ of this brood went on to form a partial second-brood.) The larvæ of the autumnal brood all assume the hybernating colour after the second moult. The young larvæ of this brood are disinclined to move, and will remain many hours in the same position or place, and were observed, in 1874, to seek the sides of the heavy midribs, or depressions in the surfaces, of the leaves, remaining motionless, although then, and at any time during hybernation, it was not difficult to rouse one from its lethargy, when it would slowly raise its head, or, perhaps, move along a little, or it would throw back its head drowsily as if to intimidate an enemy. Of the actual mode of hybernation of this species in a natural state Edwards appears to be ignorant. He suggests the bark, and the ground, as possible positions, based, perhaps, on Riley's statement (*Ann. Rept. State Missouri*, vi., p. 139) that the larva, after passing the second moult, ceases to eat, shrinks in size, stations itself on the underside of a leaf, changes its fresh green colour for a dingy greyish-brown, the better to keep in conformity with that of its dying support, with which, eventually, it falls to the earth and there hybernates. Riley's observations on this point were evidently made on larvæ in confinement (*op. cit.*, p. 142, lines 1 and 2), and one suspects that the larvæ of this American Apaturid, having taken the trouble to spin over, and fasten with silk, a leaf, Limenitid-like, or, as Edwards suggests, on the bark, Apaturid-like, hybernate on a twig, or leaf which remains attached to the plant and does not fall in the autumn, so that the actual natural hybernating habit of the Apaturid larvæ of both the Nearctic and Palæarctic species is probably after all not so very different.

After hybernation the larva of *Apatura iris* covers a leaf with silk, and on this rests when not feeding; for the purpose of a meal it leaves its resting-place, eats rapidly and voraciously, cutting out a large portion of a leaf in a few seconds, feeding chiefly at night, although sometimes also by day, returning again to its silken carpet to rest. When moving, the larva is not at all slow in its movements, which are very graceful, as it turns and accommodates itself to the various positions necessary to its progress. When eating or moving it is easily alarmed, a touch of the leaf, or a slight shake of the spray, transforming it into a very different-looking creature. When resting, its head faces the footstalk, and is bent down so as almost to touch the leaf; sometimes all the ventral legs, at other times only the 3rd and 4th pairs, in addition to the anal pair, have a footing on the silk. After a moult the pale colour of the larva assimilates with the underside of a leaf, and here at moulting-time it is to be found, but when its green colour has become brighter it returns to the uppersurface of a leaf to rest. Gillmer states (*in litt.*) that the general habits of the larvæ of *Apatura ilia*, after hybernation, agree with those of *A. iris*, but that, as the buds of *Salix caprea* unfold much earlier than those of *Populus tremula*, the larva of *A. iris* commences feeding long before that of *A. ilia*, and has made considerable progress before the latter starts; however, so rapidly does the larva of *A. ilia* mature that it overtakes that of *A. iris*, pupation taking place almost exactly at the same time. Muschamp observes that, in the Bavois Woods, he also finds the larvæ of *A. ilia* on *S. caprea* (as well as on *P. tremula*), but that, even then, they always began to feed later, although his experience points to this species assuming the perfect stage about a week later than *A. iris*. The larva of *A. ilia*, like that of *A. iris*, covers the upperside of a leaf with silk, and of this makes a resting-place, going hence to feed, when it eats first one half of a leaf and then the other half. Its movements also are similar to those of *A. iris*.

After hybernation, which, as in the European species, takes place after the second moult, the larvæ of *Chlorippe celtis* soon undergo their third moult, and become solitary in their habit. Thus Riley says (*Ann. Rept. State. Missouri*, vi., p. 138) that the larva of this species is to be found at rest on the underside of a leaf, usually on a carpet of silk, and often with a portion of the leaf bent around it. The lower part of the head is then drawn under the neck, and the antlers thrown forwards; sometimes, but not often, it partially covers itself with a curled leaf or with two leaves drawn together, whilst, of the larvæ of *C. clyton* (*op. cit.*, p. 141), he says that "the habit, after they scatter, of hiding with leaves drawn around them, is more determined than in *C. celtis*." Scudder says (*Butts. New Engl.*, i. p. 246) that, after the larvæ of *C. clyton* have passed their third moult and scattered, they live independently; some, which he had, crawled to the separate terminal leaves of twigs, where they took up their permanent abode, returning to the leaf after excursions for food, and resting always on the upper surface. After a time, apparently by repeated zigzaggings at every return, the sides of the leaf or leaf-cluster were brought towards each other to form a kind of trough, so that the caterpillar was only in view from above. One larva, when removing to new quarters, made at once, of several leaves, a sort of open bower, which concealed it well, though not completely. Edwards says that, after the 4th moult, each larva of *C. clyton*, in captivity, makes for itself a web on the surface of a leaf, and draws the sides together until a sort of case is formed, within which it lives. From this it emerges to feed at night, as was evident by leaves at a distance being constantly fed upon during the night. He thinks that this habit in captivity was only a modification of the larval habit when free. Edwards makes one or two further observations on the habits of *C. clyton*, *viz.*, (1) that the moulting of the individuals of a brood was not simultaneous for all the individuals, but was going on for two or three days, before all were changed, and that this was noticed at each moult, including the first; (2) that some hybernating larvæ, brought from a cool cellar on May 9th, fed on at much different rates, some passing the third moult on May 16th, whilst the greater proportion did not do so till May 23rd and 24th; that, by this time, the "forwards" were passing the fourth moult, and by May 30th pupated, the butterflies emerging June 10th and following days. Meantime the "laggards" continued to grow, reached a size that seemed enormous for the species, and, pupating later, produced females only, so that no females appeared till nearly all the males had emerged. Of a brood obtained later and which fed up in the spring of 1874, under apparently identical conditions, Edwards observes that every stage was prolonged, the first pupa not formed till July 7th, the butterflies appearing about ten days later. He adds that he can give no explanation of the difference.

The European Apaturids are entirely single-brooded, but Buckler records (*Larvae*, etc., i., p. 47) that, of three larvæ of *Apatura iris* that he reared from eggs in the summer of 1875, two went on past the hybernating stage and practically reached the adult stage at the end of September, when they unfortunately died just as they were about to pupate, a week of sudden, severe, cold weather being suggested as the cause. Presumably this development of "forward" characters was due to the artificial conditions under which the larvæ were reared. (See also Watson, *Entom.*, xxvii., pp. 61-62.) We know of no observations that go to show that *A. ilia* ever develops "forward" larvæ, even in the south of Europe, so that it is possible that our European species are absolutely single-brooded in nature. The Nearctic species are, however, inclined to produce "forwards" much more frequently, although Edwards states that *C. clyton* does not develop "forwards," and that there is, therefore, no partial second-brood; Scudder, on the other hand (*Butts. New England*, i., p. 247), asserting that "forwards" are developed in this species, and that the species is partially double-brooded; but he gives no data beyond dates of capture of imagines. One would suppose from Riley's statement (*Ann. Rept. State Missouri*, vi., p. 139) that the whole of the larvæ of *Chlorippe celtis* coming from June eggs developed a "forward" habit, since he notes that "the larvæ of this, the first, brood feed for rather less than a month, when they transform and give out the second brood of butterflies"; but this is by no means the case, and Edwards notes a brood reared in June, 1873, of which fully half of the larvæ stopped feeding in July after the second moult, and became lethargic, the aestivation being continued into hybernation without break, whilst the remainder developed a "forward" habit, and progressed so rapidly that they were only 20 days in passing from the egg to the pupal stage, the larvæ remaining green throughout. Such marked differences between the habits of larvæ of representative species of the same group of butterflies in the Palæarctic and Nearctic regions, as have been here outlined as occurring in the Apaturids, are very unusual.

CHAPTER VII.

FAMILY HABITS IN BUTTERFLY LARVÆ—THE SATYRIDS.

Although the Satyrids are, on general characters, placed with the Nymphalids in all classifications, largely on account of their agreement therewith in two main features, *viz.*, the modification of the front legs of the imago, and the suspension of the pupa by its tail, yet the larval structure and larval habits show practically no feature in common with those of the Vanessids, Argynnids, Limenitids, Apaturids, or other main divisions of the large Nymphalid group. Restricted almost entirely to grass as food, the larvæ, in response to their environment, are coloured like the growing or dying grass-blades, are marked with longitudinal lines in agreement with the venation of the grass leaves; are provided with a covering of short hairs to add to the general appearance of the slightly hirsute surface of their foodplants, and present a gradual tapering at the anal end, which, by being pressed closely on the resting-surface, adds to the general resemblance the larvæ bear to their foodplant when at rest. There can, it seems to us, be no possible doubt that the longitudinal markings of the Satyrid larvæ are such as best render them inconspicuous, and consequently offer the greatest amount of protection on foodplants in which an arrangement of parallel lines and parts are the predominating feature. To complete the cryptic resemblance when at rest, some Satyrid larvæ have, in addition, horns on the head, which are held out directly in line with the body. Thus Scudder notes (*Butts. New Engl.*, p. 197) that the head-horns of *Satyrodes eurydice* are, when the larva is active, inclined forward, their hinder edge forming an angle of about 35° with the perpendicular; when at rest the head is bent beneath the body, so that the hinder edge of the horns lies in a line with the dorsal surface of the body. He adds that he has found that the abdominal horns are always held horizontally, whether the caterpillar is at rest or in motion; but Edwards says that, when feeding, they are elevated at about 45° and separated.

In accordance with their specialised colour and markings, fixity of position and immobility are the two main necessities for the absolute perfection of their special mode of cryptic protection. These characters we find developed in a high degree in all Satyrid larvæ. The caterpillars remain immovable for a long time in the position of rest they take up; when disturbed they fall to the ground, and, by almost imperceptible wrigglings, work their way down among the roots of their foodplant, or, if moving from one place to another, do it so slowly and unobtrusively, with a slow gliding movement, that the eye hardly perceives the motion. This, then, is one of the first family features of the Satyrid larvæ, *viz.*, the uniformly sluggish character of their movements. This lethargic condition is common to the Nearctic and Palæarctic species, *e.g.*, Scudder notes that the caterpillar of *Cercyonis alope* is exceedingly lethargic in its action, and, even when full grown, moves with exceeding slowness, by almost imperceptible nervous forward twitches. He further observes that, during the earlier stages, the larvæ of *Satyrodes eurydice* are exceedingly quiet, remaining on a single blade of grass, near the tip, from the sides of which they eat long irregular patches, nearly or quite to the midrib, with very slow movements. He quotes Sandberg as observing that the larvæ of *Œneis bore* are very indolent, and when handled shrink and remain long motionless, and adds that this is also true of the larvæ of *Œ. semidea*, which are very sluggish, and coil themselves into a half-ring when handled. The larvæ of *Cissia eurytus*, he says, excel in their lethargic habits and slow movements, for, when about to moult, the larvæ remain for three or four days, before this event, motionless, and as many after, whilst there are also periods of several days, between the moults, when they rest absolutely, and take no food. They are sluggish at all times, move very little, and with great deliberation . . . . The actual larval movements are exceedingly slow, and almost as difficult to see as the motion of the minute hands of a clock.

The general feeding-habit of the Satyrid larvæ is very uniform, and presents another marked family feature. In the early stadia the larvæ usually remain on the foodplant, feeding occasionally both by day and night, but as they get older they feed only at night, retiring to the roots of the foodplant by day, hiding in comparative darkness among the lower part of the culms, *e.g.*, the young larva of *Hipparchia semele* remains rigid on its food, with its head uppermost, but later remains all day at rest near the roots of the grass, with its head downwards, and well hidden from sight. The habits of the larva of *Melanargia galatea* are similar, and so are those of *M. lachesis* and *M. syllius*, which rest on the grass-culms both by day and night when young, but, after the second stadium, hide low down in the grass tufts, and come up to feed at night. Powell observes also (*in litt.*) that the larvæ of *Erebia scipio*, *E. epistygne*, *E. zapateri*, *Satyrus circe*, *S. hermione*, *S. alcyone*, *Hipparchia prieuri*, *H. arethusa*, *H. neomyris*, *H. dryas*, *H. cordula*, and *H. actaea* are all day-feeders up to the third stage, after which they appear to be entirely night-feeders, hiding by day among the grass culms and roots. The larvæ of *Hipparchia fidia* and *H. statilinus* remain exposed on their foodplants, till well towards the end of their third stadia, feeding by day, but, after the third moult, their colour changes, and they become night-feeders, hiding low down like their near relatives. The larvæ of *Epinephele ianira*, *E. ida*, and *E. pasiphae* are also day-feeders when young, but become nocturnal feeders later, the larvæ resting low down on the plant, or, in the case of the two last-named species, sometimes quite on the ground, leaving the foodplant, and concealing themselves under dead leaves or twigs.

Among the Nearctic species similar habits prevail. Edwards says (*Can. Ent.*, x., p. 107) that the young larva of *Cissia eurytus*, in its first and second stadia, eats only the edges of blades of grass, and moves about but little (a character that seems universal among the Satyrines). At this time the larva feeds both by day and night, resting after feeding wherever it may happen to be, extending its body along the blade of the leaf, sometimes with the head uppermost, sometimes downwards. In the later stadia it feeds only by night, rests on the stems and not on the leaves, returning generally to the very foot of the stalk, pushing its way headforemost as far as it can go down to the base of one of the blades, turning back to feed again towards sundown. When thus at rest, the caudal horns are kept nearly horizontal with the resting surface. Scudder adds that the larvæ of this species are shy and fall to the ground at the least disturbance. The latter author quotes Fyles as stating (*Butts. New England*, p. 154) that the young larva of *Œneis jutta* is very sluggish, feeds, at first, head downwards on the edge of a blade, afterwards bites off the end of a blade, and, thereafter, feeds head upward, from the bitten end, gradually retreating down the shortened blade. Scudder adds that a larva he had, ate from the commencement head upward, and fed both day and night. Of *Œ. semidea*, he observes (*op. cit.*, p. 142) that the larva feeds upon *Carex* by night, concealing itself under surface stones by day, and falling readily to the ground if disturbed.

The Satyrid larvæ exhibit an uniform autumn- and spring-feeding habit, the larval life extending, in many cases, from August until the following June or July. Throughout the whole of the Palæarctic and Nearctic areas, the Satyrids hybernate uniformly in the larval stage, and we know of only one species, *Pararge egeria*, concerning which this statement is not absolutely true, for, although the normal habit of this species is to follow the remainder of the group and pass the winter as a larva, yet it can, and sometimes does, hybernate in the pupal stage (see *anteà*, p. 9).

Within this general statement concerning the winter-life as larva, there is much variation. Some species winter directly from the egg without feeding, others are nearly fullfed before wintering, and, in this respect, there may be very considerable difference between closely allied species, a difference, one suspects, that is sometimes more or less distantly connected with a final result of single- or double-broodedness, *e.g.*, the larvæ of *Coenonympha mathewi* hybernates directly from the egg (*teste* Chapman), but the allied *Coenonympha pamphilus* in the third stadium at considerable size, so far as it does so at all, although it really never becomes absolutely torpid (*teste* Russell, *Ent. Rec.*, viii., p. 107); the former is single-, the latter, in the south of Europe probably entirely double-, or even partially triple-, brooded. *C. iphioides*, however, eats before winter, and is single-brooded (Chapman), so also does *C. tiphon* (Hudson).

Scudder observes (*Butts. New England*, i., p. 169) that "the young larvæ of *Cercyonis alope*, like the larvæ of the nearly allied European species, *Minois phaedra* (*Satyrus dryas*) and *Œneis aello*, and many other Satyrids, hybernate without having eaten a morsel of vegetable food. He also states (*op. cit.*, p. 173) that the eggs of *Cercyonis nephele* are dropped loosely on the ground, the eggs hatch in a month's time, and, as with *C. alope*, the larvæ go at once into hybernation. Of this latter species Edwards says that the eggs hatch in August, that the young larvæ become lethargic almost directly after leaving the egg, descending to the base of the grass on which the egg is laid, and so hybernate, commencing to feed towards the end of February.

That this difference in habit is not always connected with the number of broods in allied species is certain, for, whilst the larva of *Erebia aethiops* hybernates when only 2mm. long, and possibly without undergoing any moult, that of the somewhat distantly allied *Melampias epiphron* appears to hybernate in its third stadium when 8mm. in length. One suspects that these two species are not so closely allied as *Coenonympha mathewi* and *C. pamphilus*, and *Melampias epiphron* exists at such high altitudes compared with *Erebia aethiops*, that one may safely assume that a considerable growth is necessary before hybernation, otherwise the short spring in the localities at the altitudes at which this species lives, would be insufficient for it to feed up and emerge at its normal time.

It would appear that, among others, the species that live at high elevations and high altitudes may do considerable feeding before hybernation, or otherwise, hybernate twice as larvæ. Thus, Edwards observes that *Œneis ivallda* feeds on for some considerable time before hybernation; *Œ. bore* is said to hybernate twice as larva, first quite small in the second stadium, secondly when quite fullfed, *Œ. jutta*, according to Holmgren, also hybernates twice in Europe, first in its third stadium, and secondly, when fullfed; but Fyles (*Can. Ent.*, xx., pp. 131-3) states that, in Canada, it only hybernates once, *viz.*, when practically fullfed, scarcely feeding at all in the spring. One suspects that, in all these species, restricted to extremely high altitudes and latitudes, there is some considerable range of variation, and it is just possible that there may be two hybernating points in the larval constitution, at one, or both, of which, rest may come.

Taking our more common Palæarctic species which divide up roughly into two pupal groups, those that suspend themselves by the tail, and those that go on, or under, the ground to pupate, it would seem that the former tend to feed on considerably before the winter, and to keep in a more or less nibbling condition during the mild weather in the winter, whilst the others hybernate small and pretty completely, but that, in both groups, there are numbers of exceptions. Still, as bearing on this point, it may be noted that Marloy observes that the larvæ of *Satyrus* (*Hipparchia*) *circe*, *S. briseis*, *S. semele*, and *S. fidia* hybernate small, and commence to feed actively by night in March; whilst similarly Gillmer states (*in litt.*) that *Satyrus* (*Hipparchia*) *hermione*, *S. alcyone*, *S. arethusa*, *S. statilinus*, and *S. dryas*, also do so. Buckler notes a larva of *S. semele* hybernating in the autumn of 1864, when only four lines long; it had only reached eight lines by May 13th, 1865. The Melanargiid larvæ also hybernate similarly. These all pupate on or beneath the ground. On the other hand the Parargid larvæ are a good size when they commence to hybernate, but, against this, is the case of *Epinephele tithonus*, which, hatching September 15th, 1873, had only reached a length of 3½mm. by January 21st, 1874 (*teste* Hellins). Among the Erebias, as we have already noted, the larva of *Erebia aethiops* hybernates small, so also does that of *E. ligea*, whilst those of *E. neoridas*, *E. zapateri*, and *E. melas*, are reputed to do so; on the other hand the larva of *E. lappona* is said to hybernate of fair size, as also, as we have already noted, does that of *E. epiphron*, the former section emerging late in low latitudes and altitudes, and the latter emerging earlier at high altitudes. *E. aethiops* is recorded as hybernating when about 2mm. long (Buckler); *E. zapateri* does not pass its first moult until the first week of February (Powell). The Melanargiid larvæ hybernate particularly small, *e.g.*, *Melanargia galathea* is not more than 3mm. long in late autumn; some observed March 31st, 1864, were only 6mm. long, and had then been on the move a considerable time. Of the larva of *M. lachesis*, Powell observes (*Ent. Rec.*, xviii., pp. 302-3) that eggs, from Albarracin, hatched on August 28th, 1905; the larvæ did not seem at all anxious to feed, and he thinks that, in their native haunts, they may wait some weeks before doing so, until, in fact, the grasses have been freshened by rain. If they do eat during this period, it is very little, and he found that they touched no grasses that he gave them for the first ten days of their lives, though he thinks they nibbled some *Festuca* later, but it was not till October 29th that, on examining the plant, he found eight larvæ on the leaves, still in the first stadium and quite small, a tinge of green on the fore part of the body, and the freshly-eaten leaf-ends, showing that they were feeding. After that date they were several times observed up in the grass in the daytime, and, when startled, they assumed a most unusual attitude for Satyrid larvæ, coiling the head under in the form of a note of interrogation (?), loosening their hold except by the fourth and anal pairs of prolegs, curving the body and bringing the head well down beneath the 2nd abdominal segment as represented (*Ent. Rec.*, xviii., pl. xiv., fig. 3). At the end of November they were quite healthy but no larger.

The larvæ of the four closely-allied *Pararge* species, *P. maera*, *P. hiera*, *P. megaera* and *P. egeria*, are somewhat similar in their larval habits. Apart from the unusual habit shown by *P. egeria* of occasionally hybernating as pupa, the larva of this species, as well as those of its congeners, feeds on gradually until

November; then, through December, January, and February, the larva of *P. egeria* continues to do so occasionally in suitable weather (Wolfe), attaining a considerable size by January (Tutt); the larva of *P. megaera* feeds on, in the autumn, till nearly three-quarters of an inch in length (Christy), and then slackens off till February, when it becomes active again, similar habits being reported of those of *P. maera* and *P. hiera*. In central Europe it is to be noted, these species are all double- or partially double-brooded, and that the spring-feeding larvæ are fullfed in May. It may be observed that *achine*, sometimes placed in *Pararge*, hybernates after the manner of Satyrids, very small, and feeds up rather rapidly in April and May, the species being single-brooded. On the other hand, Wolfe observes (*Ent. Rec.*, viii., p. 5) that the larvæ of *Enodia hyperanthus* feed occasionally all through the winter. Edwards notes (*Can. Ent.*, x., p. 107) that, after the third moult, some larvæ of the Nearctic *Cissia eurytus* that he was rearing, "all ceased feeding and some appeared to be in profound lethargy, but others, after resting several days, would rouse and eat a little, and then sleep again, but every one, notwithstanding its lethargic condition, was found to have changed its position several times." Evidently this is a Nearctic species that passes the winter in what we have become accustomed to call the nibbling stage. Russell observes (*Ent. Rec.*, viii., p. 107), that the larvæ of *Coenonympha pamphilus* that pass the winter do not become torpid, but feed intermittently during the winter.

We have already noted that certain of the Œneids pass the winter almost as full-grown larvæ, also that the larvæ of *Pararge egeria*, *P. megaera*, etc., have attained considerable size. Scudder notes (*Butts. New England*, p. 198) that the larvæ of *Satyrodes eurydice*, after the second moult, begin to eat more rapidly and abundantly, but wander restlessly from blade to blade, eating mostly, or only, by day, passing the winter as a larva nearly, or quite, fullgrown.

The habit of hiding by day, exhibited by so many Satyrid larvæ, has already been referred to (*anteà*, pp. 44-45). This is particularly the case with the species of *Melanargia* whose larvæ are known, the Hipparchiid group of the Satyrids, *alcyone*, *hermione*, *semele*, etc., the Epinephilids and most, if not all, the Erebiids. Wolfe observes (*Ent. Rec.*, viii., p. 5) that the larvæ of *Enodia hyperanthus* only show themselves at night, hiding all day, but, in confinement, do not appear to avoid lamplight. Buckler gives a most interesting account of the hiding-habits of two larvæ of *Hipparchia semele*, one of which, reared in confinement from egg, hid low down by day among the tuft of grass on which it was feeding, whilst a second, which he dug on May 20th, 1865, under the surface of some sand, continued its burrowing habit in confinement, hiding completely by day and feeding by night, its presence only known by the diminished grass, until pupation. The other did not burrow, but simply continued to hide among the lower part of the stems in comparative darkness, with its head downwards, coming up to feed at night, but finally burrowing for pupation below the surface of the ground like the other. In some notes forwarded recently, Gillmer observes that the larva of *Hipparchia hermione* hides during the day under stones, etc., and that of *H. alcyone* in the compact tufts of grass on which it feeds. Powell observes also, as we have already stated, that the larvæ of *Epinephele ianira*, *E. ida*, and *E. pasiphae* become nocturnal feeders after hybernation, resting low down on the plant, those of the two last-named species often leaving the foodplants and concealing themselves under dead leaves or twigs close to the grass, sometimes quite on the ground.

Among so large a family of the butterflies as the Satyrids (the largest in the world), whose range extends from far within the polar regions, over all the temperate regions, and throughout the tropics, it would be remarkable if there were not considerable variation in the rate of larval development. Even when one confines oneself to the species of the Palæarctic and Nearctic regions, one would expect to find considerable difference, and we have already pointed out that certain species of the more or less subarctic genus, *Œneis*, extend their larval life over two years. On the other hand it is remarkable, considering the wide extent of latitude and altitude covered by many of the Palæarctic species, that the development of "forwards" is, throughout the group, a matter of extreme rarity, even in the most southern species. Only one purely southern European species occurs to us as absolutely double-brooded, *viz.*, the Corsican *Coenonympha corinna*, whilst, of the central European species, *Pararge maera*, *P. megaera*, *P. hiera*, and *P. egeria* are regularly double-brooded at low altitudes, adopting a single-brooded habit, however, at high altitudes and latitudes. The common *Coenonympha pamphilus* has similar larval habits in this direction to the Pararges just mentioned. In the extreme south of their range, *Pararge egeria* and *P. megaera* tend to be triple- or even continually-brooded, and so also does *Coenonympha pamphilus*. In Britain, the number of "forward" larvæ in each brood of *Coenonympha pamphilus* appears to be very small, *e.g.*, Hellins notes that he obtained eggs, May 28th, 1874, that one developed a "forward" habit, fed away from the rest, pupated August 11th, when the remaining larvæ were 7mm. long, and the imago emerged in due course; the other larvæ fed on slowly, hybernated (in the nibbling stage), becoming active, and being observed sunning themselves on February 13th, 1875. Russell, however, records (*Ent. Rec.*, viii., p. 107) that, from eggs laid in May, 1895, about half the larvæ developed "forward" habits, fed up, pupated, and the imagines appeared in the autumn, the other half being "laggards," went over the winter, and fed up in the spring, although all were treated exactly alike. As already noted a very large percentage, often the whole of the individuals of a brood, develop "forwards" in *Pararge megaera* in this country. It is, however, remarkable that so extensive a group should present so fixed a character in this direction, and that species, with a range from the Arctic Circle to the Mediterranean, *e.g.*, *Hipparchia semele*, *Epinephele ianira*, *Melanargia galathea*, *Erebia aethiops*, etc., should be so absolutely single-brooded. The slow lethargic habits of the larvæ of the greater part of the species, especially between July and March, are possibly the real reason. As an example of this fixity of habit being broken through, even in a species with most determined single-brooded habit, we would note that Alderson records (*Ent. Rec.*, xviii., p. 205) eggs (from Cumberland) of *Melampias* (*Erebia*) *epiphron* laid in July, 1906, the larvæ of which went on feeding till $\frac{5}{16}$ in. in length, that four continued to feed up, became fullgrown and pupated in due course in September, the rest hybernating from August.

We have already noted the extremely lethargic habits of Satyrid larvæ. It is, therefore, possibly worth notice that the larvæ of *Coenonympha tiphon* (*davus*) are said to differ from those of the allied genera, in being particularly active and lively, travelling much over their foodplant, a provision it is suggested that enables them possibly to escape the inundations to which their marshy habitat is liable (Buckler, *Larvae*, etc., vol. i., p. 35).

CHAPTER VIII.

FAMILY HABITS IN BUTTERFLY LARVÆ—THE PIERIDS.

Just as the family habits of larvæ have been shown to be exceedingly diverse in the typical sections of the Nymphalids, as represented by the Vanessids, Argynnids, Brenthids, Melitæids, Limenitids, Apaturids, and Satyrids, so an almost equal dissimilarity is to be found in the larval habits of the Pierids, when one compares those of the Aporiids, the Pierids, the Pontiids, the Anthocarids, the Coliads, and the Gonepterygids.

The larvæ of the Aporiids, as represented by *Aporia crataegi*, *Eucheira socialis*, and *Delias harpalyce*, are remarkable in having strongly-developed social or gregarious habits from the time they hatch. Of these, the first-named has them developed in the weakest form. Spinning a web as soon as hatched, the larvæ increase it as they get older, using it not only as an aid to obtain a safer footing, but retiring therein to shelter, and to rest after a meal has been taken; they enclose themselves therein for the winter, and, for some time after hybernation, they still live together, but, later, they spread out, leading henceforth a more or less solitary life, although still spinning a large quantity of silk in order to obtain a safe footing on the glabrous leaves and stems of their foodplants. *Aporia hippia* is also said to hybernate gregariously in a somewhat solid common web. *Delias harpalyce*, an Australian species, is similarly gregarious, but the larvæ continue to spin more and more web until maturity, when they attach themselves thereto for pupation. *Eucheira socialis*, a Mexican species, carries the gregarious habit to its farthest limit, forming a retreat in times of danger and for rest, and, finally, when fullfed, pupating therein, the pupæ hanging, Nymphalid-like, from the inside of the nest by their tails, and without the aid of the girth found in the other Pierid groups. Bingham, on the authority of Davidson and Aitken, says that the larvæ of the Indian *Delias eucharis* are also gregarious, and remain so to the end of larval life, the pupæ also being found in close proximity. Moore also notes the larvæ of *Belenois mesentina* as being gregarious throughout life, whilst those of *Appias hippoides*, *Teracolus amatus*, and others, are also noted, but without detail, as having social habits.

The larvæ of the Pierids (*sens. rest.*) themselves are very different from the Aporiids in their habits. Mostly solitary in their mode of life, they yet show, in some species, a tendency to gregariousness, although in no species to the degree exhibited by the larvæ of the Aporiids. This is shown most markedly in *Pieris brassicae*, much less so in *P. rapae*, but, in almost all the other species, the larvæ live solitary lives, none of them, even in the more social species, spinning a web, except for a safer footing. The larvæ of *P. chieranthi* are said to live socially, when young, like those of *P. brassicae*, collecting together on leaves of *Tropaeolum*, but scattering before the last moult, after which they live singly. The main habits of the larvæ of the Pierid species are: (1) The purely summer-feeding habit exhibited, all the species hybernating as pupæ. (2) The tendency to develop "forwards" and "laggards" in direct response to the meteorological conditions of the particular season producing one, two, or three broods, or partial broods. These points are noticeable in all our British species—*P. brassicae*, *P. rapae*, and *P. napi*. (3) The silk-spinning habit, most probably to obtain a safer footing on the usually very glabrous leaves of their various foodplants.

The manner in which the larvæ of our common Pierids devastate their foodplants is known to everyone. They devour everything, often leaving only the main stems of the leaves of whole fields of vegetables, *e.g.*, cabbage and its allies, and frequently do great damage. In North America, where *Pieris rapae* has been introduced, it is almost equally destructive, and Edwards observes (*Butts. North America*, vol. i) that *Pieris virginiensis* has exactly similar habits. He notes that, "when young, the larvæ of this species are green in colour, and that keen sight is required to discover them; at this time they attack the leaves of certain garden vegetables, making small holes, returning to the margin of the hole from time to time, till all the surrounding parts are eaten away. The large leaves of horse-radish may be seen entirely consumed in this way, leaving but the skeleton untouched. When at rest, the larvæ lie extended upon the surface of a leaf, generally along one of the ribs or in a depression, and, as they retain their green colour to maturity, they are effectually screened from notice."

The habits of the larva of the Nearctic *Pieris oleracea* are very similar to those of *P. napi*. Scudder says (*Butts. New Engl.*, p. 1199): "It eats small round holes through the leaves of its Cruciferous foodplants when young, making larger and less regular ones as it matures. It feeds mostly at night, and remains at rest during the day, frequently standing in the groove made by the midrib on the upperside of a cabbage- or turnip-leaf with its head towards the base of the leaf . . . . spinning silk for a foothold. It returns to the same place upon a leaf day after day; moving about but little, crawling very slowly, with its mouth to the surface on which it is crawling, placing there a silken thread to aid it in clinging. . . . The larva, at all times, feeds to repletion, so that the skin of the body is tense and glistening when it has finished a meal. It never eats the leaf at the edges, and generally, or always, leaves the veins untouched, feeding upon the undersurface only." This description will be seen to apply very fairly to our own Palæarctic species, and Scudder's further note on *P. rapae* (*op. cit.*, p. 1210) that "the young caterpillar eats small patches in the parenchyma of the underside of a leaf, and later feeds exposed, usually on the underside of a leaf, and devours the whole leaf, except the harder veins," and that, "when the plants are 'headed,' it works its way up from below in disconnected passages, so that the leaves are riddled in every direction, etc.," will be recognised as being as true of *P. rapae* in Europe as in North America.

As in the allied Palæarctic species, the Nearctic *Pieris oleracea* also is single-, double-, or triple-brooded, according to latitude; thus, it is recorded as having only one brood in Labrador, two in Newfoundland, etc. *P. rapae*, too, as in Europe, varies in the same manner; in New England, Scudder says that it is triple-brooded. Our three British species are, in this country, usually partially double-brooded, in very cold summers they may be purely single-, and, in exceptionally hot summers, almost entirely double-, brooded. In the south of Europe they are even partially triple-brooded, but at high elevations and latitudes only single-brooded. The larva of *Pieris callidice*, however, which has, to some extent, a Pontiid facies in its imaginal stage, is single-brooded, as might be expected, from the high altitudes at which it is always found, the length of summer in its habitats being altogether against the formation of even occasional "forward" habits. Edwards notes that *P. sisymbrii*, a close Nearctic ally of this species, is also single-brooded, the larvæ not developing any "forwards."

The Pontiids are, larvally, a very intermediate group, with habits perhaps rather more strongly approximating to those of the Anthocarids than to the Pierids. Like the latter, they mature very rapidly, and are almost always solitary in their habit in nature. Our only well-known European species is *Pontia daplidice.* Although, when young, the larvæ eat holes in leaves or flowers, yet, later, they certainly seem to prefer flowers, and, like the larva of *Anthocaris belia*, love to lie stretched along the stem of the foodplant during the day, rarely moving their position during this period, and, whenever we have found the larva in nature it has been singly, only one larva on a stem or even plant. In its resting-position the larva of *Anthocaris belia* is very characteristic, seeming to be nothing more than a slight thickening of the stem of *Biscutella laevigata*, on a cursory glance. Buckler notes (*Butts.*, i., p. 22) that, in confinement, he found the almost fullfed larvæ of *Pontia daplidice* "fond of lying at full length along the flower-spikes, and several crowded together at the summit in amiable companionship; often they would have the head downwards, sometimes with the anterior segments hanging free. Their movements when feeding were slow and very graceful, as their flexible bodies accommodated themselves readily to any inequality of surface over which they glided; they covered the stems and other parts with fine silk threads, which proceeding rendered their footing more secure. They seemed quite as partial to the flowers as to the leaves, and thus varied their food." *P. daplidice* is quite Pierid in its habit of producing "forwards," the species being fully double-, and possibly often partially triple-, brooded in the more southern part of its range. The larva, however, is a delicate one, and, although the butterfly is continuously attempting to push its way into more northern latitudes, the larval habits evidently prevent it from making a permanent home in the colder parts of the Palæarctic area. The somewhat-allied Nearctic *P. protodice* also produces "forwards" freely, and is more or less triple-brooded in the more southern parts of its range. Its further larval habits, however, as recorded by Riley, remind one of rather of those of the common Pierids than of those of *Pontia daplidice.* This observer states that "it appears to confine its ravages more closely to the cabbage than do the other 'white' butterflies, but is occasionally found feeding upon turnip, and does great injury to sweet alyssum, *A. maritimum*, etc., commencing at the head, and eating down to the base of the plant, whilst it has also been found on mignonette" (Scudder's *Butts. New Engl.*, ii., p. 1168).

The larvæ of the Anthocarids appear, in their general habits, to fall with the Pontiid group of Pierids. Edwards points out, so striking is the resemblance between the larvæ of the two Nearctic species. *Pontia protodice* and *Anthocaris ausonides*, in colour, form, and markings, that they more closely resemble each other than often happens between the larvæ of the same species; the pupa of each, however, is characteristic of its own group. The Anthocarid larvæ agree with those of the Pontiids in the solitariness of their larval life, in the purely summer-feeding habits, and to some extent in the development of "forwards," though it is to be noted that the species of *Euchloë*, although possessing purely summer-feeding larvæ, appear, even in the most southern latitudes, to resist any attempt to produce "forwards." The differences between the habits of the larvæ of the Pierids and Anthocarids, in other ways, is somewhat marked. The Pierids proper eat ravenously to repletion, and rest almost exactly where they have fed, trusting to their general similarity to their surroundings, or, possibly, in the case of *Pieris brassicae*, to their warning colours and objectionable taste, for protection. The Anthocarid larvæ, on the other hand, are more delicate in their feeding-habit, choosing foodplants of long and slender habit, and, after a meal, are particularly expert in choosing a resting-place, so that they are most difficult to find, and appear to rely on their habitual quietude during the day for safety. Green in colour, stretched along a stem of foodplant, with the head and anus considerably attenuated, the longitudinal pale lines with which the ground colour is marked, make the larvæ most difficult to be seen, except by special search, their delicately-striped green bodies closely resembling various parts—stems, leaves, seedpods, etc.—of their foodplants, and the larva of *Anthocaris belia* is thus easily overlooked. The larvæ of the Nearctic *A. ausonides* feed on the flowers and seed-vessels of a Cruciferous plant, and, just as is the case with *A. belia*, they are solitary, and lie stretched at length on the stem or seed-pods of the plant.

Exceedingly similar to these are the larvæ of *Euchloë*, or "orange-tips," which, also, flower- and fruit- rather than leaf-feeders, love to lie stretched along the long seed-pods of the Cruciferous plants they haunt. As Scudder notes (*op. cit.*, ii., p. 1144): "The long and slender form of this (the *Euchloë*) larva, with its striking longitudinal stripes, would seem to render it a conspicuous object, but, if seen upon the lank vegetation upon which it feeds, lying beside the long-drawn seed-pods, it would hardly be noticed." All lepidopterists who have collected the larvæ of *Euchloë euphenoides* from *Biscutella laevigata*, or those of *Euchloë cardamines* from *Sinapis arvensis*, *Cardamine pratensis*, *Sisymbrium officinale*, horse-radish, garden-rocket, etc., will know how true this statement, evidently based on Scudder's knowledge of the larva of *Euchloë genutia*, is. Of the larva of the latter, Edwards says: "The young larva feeds on the flowers and buds of *Arabis perfoliata*, *Barbarea vulgaris*, etc., and, as these pass away, on the seed-pods, usually beginning at the end of the long slender pod, and eating towards the stem." This is equally true of the larvæ of *E. euphenoides* and *E. cardamines*. The larva of *E. cardamines*, on any of its foodplants, is not at all easy to discover at a casual glance, appearing something like a thickening of the stem, an irregular growth of the seedpod, or similar frequently-met natural peculiarity, whilst that of *E. euphenoides* bears a similar resemblance to one or other of the peculiar structures of *Biscutella laevigata*. It appears to be a fixed habit in *Euchloë*, however, as already noticed, to produce no "forwards," *i.e.*, the species preserve a purely single-brooded habit, *e.g.*, although both *E. euphenoides* and *E. cardamines* are in the imaginal state in April in southern Europe, and fullfed larvæ may often be obtained before the end of the month; there is no record of any attempt at forming a partial second-brood in either of the species; similarly, Scudder says that *E. genutia* is quite single-brooded, and, like the two European species already noted, the larval life lasts only from two to three weeks. This is the more remarkable, because all the allied genera, *Anthocaris*, *Pontia*, *Pieris*, etc., have, as we have already shown, larvæ noted for their frequent development of a "forward" habit. Like the rest of the Pierids, however, the species of *Euchloë* have purely summer-feeding larvæ.

It is to be observed that the essential food-habit of the larvæ of Pierids and Anthocarids is the selection of cruciferous plants. Not that they are confined to such, *e.g.*, *Pieris rapae* may go out of its way to choose *Tropaeolum*, and *Pontia daplidice* to choose *Reseda*, of various species. *Leptidia sinapis*, with real Anthocarid larval habits, *i.e.*, purely-summer-feeding, developing "forwards" in warm summers (and a consequent partial second-brood), fails to adopt the cruciferous food-habit, and selects *Lathyrus* and *Vicia*, in this respect following the food-habit of the allied Coliad larvæ, and, not only is this so, but it follows the resting-habit adopted by the Anthocarids, for, being long and slender, it rests stretched out along a stem or petiole of a leaf, with which its colours assimilate exactly, the white stripe on the larva representing light and shade effects on the plant, whilst, in the youngest larvæ, the hairs also aid in its resemblance to the general aspect of the plant. The genus, therefore, as illustrated by our species, *L. sinapis*, has, in its usual larval habits, although not in its food-habit, quite Pierid leanings. It is a slender larva, obtaining protection by its lethargy during the day, combined with its colour and striping, produces "forwards" with facility under suitable meteorological conditions, has wholly summer-feeding larvæ, but, in its food-habit, leaves the Pierids, which are so closely confined to cruciferous plants, and follows the Coliads, by choosing leguminous plants for food. Chapman observes that the colour and arrangement of lines on the larva protect it excellently on *Lathyrus pratensis*. The larva, for a Pierid, is rather long and slender, and, stretched out along a stem, or a petiole of a leaf, is extremely difficult to see, the coloration being identical, the white stripe of the larva representing light and shade effects on the plants. In the youngest larvæ the hairs agree very closely in general aspect with those of the plant, greatly increasing the difficulty of observing it.

CHAPTER IX.

FAMILY HABITS IN BUTTERFLY LARVÆ—THE COLIADS AND GONEPTERYGIDS.

The "clouded yellows" and "brimstones" have many structural features in common, in all their stages — egg, larva, pupa, and imago—yet the general habits of their larvæ are widely different in most of the broad features presented. The larval habits of the Coliads are, in one character at least, also widely different from those of the Pierids, Pontiids, Anthocarids and Gonepterygids, *viz.*, the Coliads have winter-feeding larvæ. Like the true Pierids, they produce "forwards" very freely under suitable climatic conditions in the lower latitudes and altitudes that they inhabit, and the peculiar characteristics exhibited in this direction, often resulting in continuous-broodedness both in the Nearctic and Palæarctic regions, are somewhat remarkable, yet, in the most marked polygoneutic forms, the larval is the stage in which the insects pass the winter. In stating that the larvæ have winter-feeding larvæ, it must be understood that this is the family habit, exhibited by all species, whether single-, double-, or many-brooded. In those with more than one brood, the species have of course summer-feeding larvæ in addition, so that these may be said to differ from the true Pierid larvæ in having not only spring-, and summer-, but also winter- (autumn-to-spring-) feeding larvæ.

The "forward" habit is, in this group, specially worthy of attention. The species of quite high latitudes and high altitudes, *e.g.*, *Colias phicomone*, *C. palaeno*, *Colias meadii*, *C. interior*, etc., are distinctly single-brooded; in other species (*Colias hyale*, *C. myrmidone*) limited to moderately temperate climes, a double-brooded habit is engendered, the larvæ hybernating from September or October until mid-March, whilst, in others (*Colias edusa*, *C. eurytheme*, etc.), with their real home in warm temperate and even subtropical areas, a many-brooded habit is the rule, a partial hybernation occurring from November to February. The fixity of this many-brooded habit is apparently the real cause of the repeated annihilation of these species in the cooler temperate regions to which their wandering habits lead them, the larval habits not including a sufficiently prolonged hybernating period to enable them to live through a long winter. On the other hand, it is generally supposed that the larvæ of the subarctic species have a habit enabling them to hybernate over at least two winters if necessity arises. We have no information as to whether *Colias palaeno* or *C. phicomone* ever develop "forwards," but Edwards notes (*Can. Ent.*, xxi., p. 42) that, of a batch of larvæ of *C. meadii*, hatched July 23rd, 1888, one larva alone fed on pupating August 19th, and producing an imago on August 25th, whilst all the other larvæ of the brood fed up slowly till after the third moult, commenced to hybernate on August 28th, and did not produce imagines till the following year. The two common American species appear to have almost exactly parallel habits in this respect with our two common European species, *viz.*, *Colias philodice* with *C. hyale*, and *C. eurytheme* with *C. edusa*. The former are double-brooded in the northern parts of their range, triple-brooded in the southern; the latter are continously-brooded in the warm southern localities in which they live, and, spreading from these centres, are triple- or double-brooded in the more northern parts they reach, being annihilated in the last, *i.e.*, winter, brood, and relying on fresh incursions to keep any position in these areas. The hybernating larvæ of *Colias philodice* in their more southern habitats in North America feed up rapidly and give imagines by May, just as is the case along the Mediterranean littoral with *C. hyale;* the larval stage of the next brood does not last more than about eighteen days in the favourable lowlands of West Virginia to almost double the time at a moderate elevation in the Catskill Mountains; the larvæ of the next brood leave the eggs in August and September and hybernate when about half-grown, although some of these attempt, under very favourable conditions, to complete the cycle as imagines in November; in the more northern parts of its range it is only double-brooded, exactly as is *C. hyale* in its more northern permanent haunts in central Europe. The larval habits of *Colias eurytheme* are almost parallel with those of *Colias edusa*. In its more southern haunts, in the lowlands of California and Texas, under the most favourable climatic and geographical conditions, the species produces "forward" larvæ very rapidly. The winter-larvæ during the early part of their hybernation appear merely to be in a sort of restless sleep, and, though they may remain motionless for days, will, if breathed upon, start as if alarmed (Fletcher); they commence feeding in the earliest spring, and feed, as do the larvæ of *C. edusa*, in its southern European habitats, at different rates, so that the earliest imagines are out in Texas in March and April, whilst slow-feeders of the same brood are somewhat later. The species then goes on by a continuous series of broods, until the late autumn, when the last lot of larvæ divide into two sections: those that get beyond the third moult passing on to the final imaginal stage in November, the slower ones of the same brood going, as already described, into partial hybernation, and producing the earliest spring imagines, so that, in North America, at different latitudes, we find the species two-brooded in North Carolina, three-brooded in Illinois and Nebraska, four-brooded in California and Texas, whilst Edwards' remark that *C. eurytheme* is, in North Carolina, killed off in the autumn, suggests that its conditions there are exactly those of *C. edusa* when it penetrates into central Europe in the spring and gets a summer footing in a suitable spot in a favourable season.

The food-habit appears to be a very fixed one, almost all the species choosing leguminous plants; and the growth of these crops for fodder, both in the Palæarctic and Nearctic regions, probably explains the occasional autumnal abundance of certain species when immigration takes place. Among our European species, *Colias palaeno* offers an exception, being said to feed on *Vaccinium uliginosum*, whilst *Colias scudderii* also feeds on *Vaccinium* (Bruce), and willow, the larvæ refusing clover (Edwards) (*Can. Ent.*, 1892, p. 54); *C. nastes* is also said to live on willow, but in confinement feeds well on *Hedysarum* (Bean, *Can. Ent.*, 1892, p. 54); the larva of another species, *Colias behrii*, feeds on a species of ground huckleberry (*Vaccinium*) in the mountain meadows of the high Sierras of California (Dyar, *Can. Ent.*, 1893, p. 158), and yet, again, the larva of *Colias interior* feeds upon *Vaccinium* (Lyman, *Can. Ent.*, 1897, pp. 249-258). It must be confessed, however, that the specific value of some of these insects is very uncertain, and that they all inhabit either extremely high latitudes or altitudes, and partake largely of the general appearance of *C. palaeno*. As for other species, it is well known that the larvæ of *Colias edusa*, *C. hyale*, etc., feed on various low-growing leguminous plants—*Medicago*, etc., *C. phicomone* on others—*Vicia*, etc., *C. myrmidone* on *Cytisus*, etc. Of the American species, the larvæ of *Colias meadii*, *C. elis*, *C. alexandra*, as well as the common species *C. philodice*, *C. eurytheme*, etc., are well-known feeders on leguminous plants, and, with the exception of the little group already mentioned, the family-habit of selecting this order of plants must be looked upon as a pretty constant one. It may be here noted that Harrison asserts (*Ent. Rec.*, xvi., pp. 173-176) that the larva of *C. edusa* will eat grass.

For the purpose of hybernation, the larvæ of *Colias hyale* spin a pad of silk on the upper surface of a clover leaf; this they did in November, commencing to feed again from February 20th-23rd (Sheldon, *Ent. Rec.*, xiii., p. 222). The larvæ of the widely different Nearctic species, *Colias interior*, commence to hybernate at the end of August in the second instar, lying along the midrib of a leaf near the petiole, upon a slight carpet of silk, and commence to move in early May (Lyman, *Can. Ent.*, 1897, pp. 249-258). *Colias meadii* hybernates after the second or third moult, commencing its period of rest in August or September, the larvæ hiding themselves, in confinement, in and among the dead leaves at the base of a clover-plant; in their natural haunts at Loch Laggan, they are covered with snow until the end of May; the form *elis* also hybernates from August to May (Edwards and Bean, *Can. Ent.*, 1892, pp. 55-56). Of *Colias christina* (=*astraea*), the larva comes out of hybernation quite at the end of May (Bean *teste* Edwards, *Can. Ent.*, 1892, p. 111).

The feeding-habits and resting-habits of the larvæ of the various Coliad species appear also to be pretty similar. Dollman observes (*Ent. Rec.*, xiii., pp. 213-215) that the young larva of *Colias edusa*, from the first, feeds almost invariably upon the upperside of a leaf, and has a habit of lying along the midrib, to which position it particularly resorts before evening, so that when the clover-leaf closes, as it does at night, it lies shut within it; during the day it rests with the claspers firmly holding the surface of the leaf, elevating the forepart of the body in a bent posture, like a "Sphinx" larva, to a slight extent, with the head depressed, and just resting the tips of the legs upon the leaf. It is very sluggish from the time it hatches, lying extended at full length on the upperside of the leaf, on which it moves only to feed; it appears to be rather more active as it gets older, but the difference is a very slight one. He further observes that the larva of *Colias edusa* appears seldom to feed at the edge of a leaf, but to eat small holes in the broad surface on the upperside, which are gradually enlarged by consumption to the margin, in a ragged and broken manner. Harrison adds (*Ent. Rec.*, xvi., pp. 173-176), that the larva refuses to feed upon the underside of a leaf, that the little larvæ fret out irregular holes in the upperside of a leaf, but do not eat the epidermis on the underside; that they feed during the day, and, retiring to the midrib when a meal is finished, stretch themselves at full length along it, so that, when the clover-leaf closes for the night, the small larvæ are folded up and thus protected. He adds that they continue the habit during the second instar, but change their habits with the third moult; for they no longer feed by day on the upperside of a leaf, but rest on the petiole of a leaf head downwards, and feed only about sunrise and sunset, and, when they feed, eat at the edge of a leaf, consuming stalks and stipules of very young leaves. These habits are now continued throughout life. When full-grown, the larva rests lengthwise, with the thoracic segments slightly raised, and the head bent under, the first pair of legs not resting on the stem. The larva is very sluggish, only moving when compelled. If irritated, it does not fall, but, if made to fall, it forms a complete ring, but soon unfolds and climbs up a fresh stem. Frohawk adds (*Ent.*, xxvi., p. 185) that the larva of *C. edusa*, after the third moult, resembles very closely the colour of the upper surface of a clover-leaf, and rests with its anterior segments slightly raised in a gentle curve, feeding during the day in sunshine or shade, but preferring the former. These detailed notes as to the feeding- and resting-habits of the larvæ of *Colias edusa* are largely applicable to those of most other species of which the larvæ are known. Thus Scudder observes (*Butts. New Engl.*, ii., p. 1120) that the young larva of *Colias philodice* rests on the midrib of a leaf, usually upon the upper surface with the head indifferently towards the base or apex of the leaf, and maintains this position after the first moult and can scarcely be seen, so closely does its colour resemble that of the leaf. He also notes that, when first hatched, the larva makes a hole in a leaf, feeds at its edges for several days, and then makes another, and so on until only the principal veins are left. In its later stages, however, it devours a leaf from end to end; and, in this stage, rests upon the stalk of a leaf, with the first two pairs of true legs raised from the surface and extended forward. Edwards says that the young larvæ of this species tend to roll off the leaves, and retain this feature till they are mature, so that it appears to be a means of protection against enemies. Scudder says (*op. cit.*, p. 1132) that the full-grown larva of *C. eurytheme* moves forward in a series of scarcely perceptible starts. Frohawk states (*Ent.*, xxv., p. 273) that, when the larva of *Colias hyale* is quite young it feeds on the upper cuticle of a leaf, close to the midrib, and, after each meal, returns to the midrib, along which it rests in a straight position, with its head furthermost from the spot where it feeds, and is very sluggish in its movements; when a few days old the larva eats through a leaf, completely perforating it, and generally attacks a leaflet near the tip. Just before hybernation it rests in a straight position, but, upon any disturbance, elevates the anterior half of its body, remaining in a curved attitude for a few minutes and then attains its former posture; it feeds principally by day, and prefers the sunshine. Williams observes (*Ent.*, xxvi., p. 8) that, in the third skin, the larva of *C. hyale* corresponds exactly in colour with a clover-leaf. The feeding- and resting-habits of the larvæ of those species that feed on *Vaccinium* are very similar. Lyman observes (*Can. Ent.*, 1897, pp. 249-258) that the larvæ of *Colias interior* eat the parenchyma of the *Vaccinium* leaves in small round patches, feeding on the upperside of the leaves, and resting, when not feeding, along the midrib, the head sometimes up, and somet mes down. After hybernation, and when the second moult is passed, they eat entire leaves (when young and tender). The larvæ are decidedly sluggish for the greater part of the time, but, when feeding, they are very nervously active, biting with great rapidity, and moving with short jerky steps. The larva of *Colias behrii*, another species occurring at very high altitudes, is noted by Lembert (*teste* Dyar, *Can. Ent.*, 1893, p. 159) as resting quietly, when young, and being almost invisible on the huckleberry leaves, being very like the withered huckleberry fruit. When the larvæ get larger, however, they hide.

The rapidity with which the larvæ of many species feed up after hybernation has ended, has been frequently noted; this is particularly the case with those of *Colias edusa*, *C. eurytheme*, *C. hyale*, *C. myrmidone*, and *C. philodice*, possibly also of most, if not all, those species that are particularly restricted to high latitudes and altitudes. It is also specially noted of *C. interior* (Lyman, *Can. Ent.*, 1896, p. 145).

The Coliad larvæ make good use of the anal forks, Lyman observing (*Can. Ent.*, 1897, pp. 249-258) that the larva of *Colias interior* throws its excrement a considerable distance, whilst Frohawk states (*Ent.*, xxvi., p. 185) that the larva of *Colias edusa* ejects its excrement to some distance as if by means of a spring.

Closely allied to the "clouded yellows" proper, are what we may term the "*Cassia*-feeding" Rhodocerids. The larvæ of this group neglect the low leguminous plants and find their sustenance in one of the shrubby sections. One regrets that, of the larval habits of these interesting species, so little is really known, but from the recorded observations some useful details may be collected, and some comparison may be made between their larval habits and those of the more typical members of the Pierid stirps, *e.g.*, the larval habits of the Nearctic *Eurema lisa*, whose natural food is *Cassia chamaecrista*, remind one much, in some respects, of those of *Leptidia sinapis*, in others of *Colias edusa*. The species resembles *L. sinapis* in that it has purely summer-feeding larvæ, and, in this respect, it differs from the Coliads, yet the resemblances of its larval habits to those of *Colias edusa* are, in other respects, very great. With a range extending from 30° N. lat. (about equal to the north African range of *Colias edusa*) to 44° N. lat., there is a considerable difference in the larval habits at the two limits, *e.g.*, in South Georgia, the larvæ produce "forwards" at a rapid pace, and eggs laid by the newly-emerged imagines of February and March develop larvæ that produce a fresh brood of imagines in April and May, these another in July, and these yet another in September and October, the latter producing pupæ which are said to go over the winter. In the north of Pennsylvania, a small brood is noticed in June and a large one in August and September, the larvæ from which have not been apparently closely followed up, and one seems only to know that here, in confinement, the larvæ go steadily ahead, feed up, and produce imagines during the winter and early spring, giving one the idea that the most northern areas of its distribution may be supplied by immigration. (A strong point in favour of this view will be found in the facts recorded concerning this species in our *Migration and Dispersal of Insects*, p. 80.) The feeding-habits of the larvæ of *Eurema lisa* (*euterpe*) are compared by Scudder with those of the Coliads. He states (*Butts. New England*, p. 1093) that, from the very first, the larva crawls to, and feeds on, the underside of a leaf, eating long, parallel and narrow holes entirely through between the veinlets, after the manner of *Colias*

(*Eurymus*), and adds that, "as the leaflets of the foodplant close at night, this would seem to be a necessary one, and also probably induces a habit of feeding only by day." This habit is strange, for the larvæ of *Colias hyale* and *C. edusa*, in their first two stadia, select the upperside and feed only by day, apparently for the specific purpose of being shut in by the closing leaves at night. Scudder adds that, "when not feeding, the caterpillar invariably stretches itself out at full length, either along the stalk of the plant or the midrib of one of the leaflets, which, being of the same colour as they, and the stigmatal stripe resembling in its straightness and stiffness the midrib of the leaflets themselves, its detection is very difficult," so that, in this habit, the larva of *E. lisa* much resembles those of *C. edusa* and other typical Coliads. When disturbed, the larva raises the front portion of the body barely above the surface, and, swings it from side to side in a slow but deprecatory manner, but, if roughly handled, it will drop from the leaf, spinning a thread and hanging thereby. Another of the southern Nearctic *Cassia*-feeding species with larval habits that appear to be almost identical with those of *Eurema lisa* is *Eurema* (*Xanthippe*) *nicippe*. With its home in the southern States, it is there continuously-brooded, the larvæ feeding on rapidly and producing "forwards" in every brood. Of the irregularity in the rate at which the larvæ mature, one may quote Edwards' observation, that, one day in September, 1875, he cut a branch of *Cassia* on which, at the moment, were newly-laid eggs of *Eurema nicippe*, larvæ in every stage of growth, and a butterfly of the same species just emerged and still resting on the empty shell of its chrysalis. The October larvæ produce imagines in November, and these are said to reappear in April—a statement that has led some entomologists to the view that it hybernates in the imaginal state. Although not definitely worked out, it is supposed by the American entomologists that the species has not a winter-feeding larva, nor do any of the authorities suggest that the November and April imagines are from the same brood of larvæ maturing at different rates. The larva in general appearance, however, is said to resemble those of *Colias*, as also does that of *Eurema lisa*, but the latter is more slender.

Of the larval habits of the *Cassia*-feeding Callidryads (Catopsilias), both of the Old and New Worlds, practically nothing is known. One suspects that real study would discover many interesting facts. But our ignorance is profound. It would appear that in its southern haunts, the Nearctic *Callidryas eubule* is quite continuously-brooded, that just as *Colias edusa* spreads in Europe, so this species spreads in North America, and, just as our text-books, based on imperfect knowledge, often state categorically that the latter is double-brooded in northern Germany, Britain, etc., so the American text-books incline to this opinion concerning *C. eubule* in the more northern parts it reaches. There appears to be no doubt that it immigrates into, and is annihilated continuously in these areas, the species taking its many-brooded, forward-producing, southern, larval habits with it into northern climes and being killed out, just as is *C. edusa* with us.

The food-habit of this group appears to be a very constant one, for *Cassia* is the chosen pabulum in districts as far apart as the United States of America and Sumatra. In America, *Callidryas eubule* selects *Cassia chamaecrista*, whilst in Sumatra, *Catopsilia crocale* chooses *Cassia* *florinda*, *C. pyranthe* feeds on *C. elata*, and *C. scylla* on *C. sophera*. Mathew says that the larva of the Australian *C. gorgophone*, feeds fully exposed on the upper surface of leaves of a *Cassia* at Sydney, in early March, eggs and pupæ occurring at the same time, that, when the larva is feeding, it keeps its head and anterior segments Sphinx-like.

In spite of the habit of hybernating in the imaginal stage, the Gonepterygids (so far, at least, as our European species are concerned) incline to the Pierids in at least one of their general larval habits, *e.g.*, they have purely summer-feeding larvæ, whilst, like the *Euchloë* larvæ, they appear to have little or no tendency to develop "forward habits," the single-brood being spread over a considerable period, suggesting different rates of feeding up in the larval stage, but not producing any marked second-brood.*

In their food-habit, however, the Gonepterygid larvæ of the Palæarctic area have wandered far from the cruciferous foods of the Pierids, and appear to be restricted to *Rhamnus* of various species. It would be interesting to know how this food-habit, on the part of these species arose, and whether there is any real alliance between the *Rhamnaceae* and *Leguminosae*, for the larvæ of *Callophrys rubi* and *Celastrina argiolus* utilise both.

The special habits of the larvæ of particular species are exceedingly interesting. In form, colour, and striping, they bear considerable resemblance to certain aspects of their food-plant, and that of our commonest Palæarctic species, *Gonepteryx rhamni*, appears to be most careful in choosing a suitable resting-place on the leaf of its food-plant, and the difficulty of discovering the larva, unless one places oneself so that the sun falls across the *Rhamnus* leaf, showing the shadowed side of the larva, is, of course, well known to all field-lepidopterists; otherwise it so exactly resembles the midrib along the centre of the leaf, where it rests, that it readily escapes observation.

CHAPTER X.

FAMILY HABITS IN BUTTERFLY LARVÆ—THE RURALIDS.

The Ruralids, in their widest sense, comprise the "hairstreaks," "coppers," and "blues," and these vary considerably in their larval habits. The tribes, however, show rather characteristic habits in the larval stage, and, if we consider merely those species that make up the tribes in the *Ruralinae*, *i.e.*, the "hairstreaks," we find these tribal larval habits very marked, *e.g.*, the larval habits of the Thestorids, Callophryids, Strymonids and Ruralids (*sens. strict.*) are peculiarly similar within each tribe, and, whilst those of the Thestorids and Callophryids incline to each other, and, in some respects, are not very unlike those of the larvæ of some of the "blues," the Strymonids and Ruralids are, in their turn, somewhat similar and differ considerably from their allies.

In considering the larval habits of the Thestorids and Callophryids, one notes that the former are not very dissimilar from those of the typical "blues," whilst the larval habits of the Callophryids resemble

* We are, whilst writing this, fully aware of Mr. Purefoy's remarks (*Ent.*, xxxv., p. 301), but some statements made by him both here, and *Ent.*, xxix., p. 363, are so remarkable, that full confirmation of all details appears necessary.

more those of the shrub-feeding larvæ among the blues—Celastrinids, Lampidids, etc. In spite of the difference exhibited between these and the larvæ of the Strymonids and Ruralids, the latter resemble them in retaining a semi-boring habit when young, although, as they get older, they fail to maintain it as do the larvæ of the Callophryid species. The "hairstreak" larvæ are, however, all slow and lethargic in their movements, with marked cryptic coloration. They have also purely spring and early summer feeding-habits, and, whilst the Thestorid and Callophryid larvæ hatch in spring from eggs laid only a few days previously, and then feed up rapidly for the purpose of going over the winter as pupæ, those of the Strymonids and Ruralids, curled-up in the egg-shell all the winter, hatch in spring, and feed up moderately quickly, producing imagines which, in due course, lay eggs that again pass over the winter.

Judged by our only Palæarctic Callophryid, *Callophrys rubi*, the larva, probably like those of the Thestorids, was originally confined to leguminous plants. Be that as it may, it now ranges over a considerable variety of food-plants; it evidently prefers flowers, but will, on occasion, attack leaves and fruits; when feeding, it buries its head into the tissues of its food, the smallness of the head and neck greatly facilitating the habit. But its habits may be greatly varied, *e.g.*, it may bore into the flowers of *Calycotome spinosus*, *Ulex nanus*, *Genista tinctoria*, *G. anglica*, *Lotus major*, *L. corniculatus*, *Helianthemum vulgare*, etc., or feed on the flowers and leaves of *Erica tetralix*, or bore into the young shoots of *Ledum palustre,* hollow out the flower-buds of bramble,range over the corolla, stamens and ovary of the blossom of *Vaccinium myrtillus*, as well as feed on the very young leaves, bore into, and clear out the contents of, the immature berries of *Rhamnus catharticus*, just as do the larvæ of *Celastrina argiolus*, or the berries of *Cornus sanguinea*, which are hollowed out in the same way, and so on.

This variation is very interesting when one compares the larval feeding-habits of the various Nearctic Callophryid species therewith. Thus, the young larva of *Incisalia irus* bores into the flowers of *Lupinus perennis*, devouring the stamens, pistil and corolla, and, according to Cook (*Can. Ent.*, xxxviii., p. 143), hides quite within the flower, afterwards feeding on the seeds by boring into the pod from outside. This is very similar to the habit of the larva of *C. rubi* when feeding on leguminous plants. Again, the young larva of *Incisalia augustus*, eats an irregular hole into the flower of *Vaccinium corymbosum*, into which it crawls, feeding upon the stamens and maturing ovary, its resemblance to the lower part of a stamen being very striking; by the time the corolla has fallen the larva has turned green, and it then feeds openly by boring into the fruit, eating voraciously, making a hole in the side of each berry, attacking and eating only the interior. This appears to be almost precisely what the larva of *C. rubi* does on *Vaccinium myrtillus*. Edwards reared (*Papilio*, i., pp. 150-2) the larvæ of *Incisalia henrici* to maturity on wild plums, the young larva at once making its way up the stalk and fastening on the young plum, boring into it, just as the larva of *Celastrina pseudargiolus* bores into a bud, a hole being eaten out large enough for the head to enter, and thereafter the caterpillar spends most of its time with its head in the cavity; when half-grown, it seems to have its head and shoulders buried, and was never observed to withdraw them, though looked at frequently. Cutting open the plum, the excavation was found to reach quite across, and around the pulpy stone, which, in the early larval stages, was not eaten, although, after the third moult, it was devoured and the entire plum excavated; in no case was the skin eaten except in the autumn. Cook avers (*Can. Ent.*, xxxix., p. 232) that the larval habits, when feeding on plum, do not differ essentially when *Vaccinium vacillus* is selected for food; in this case, when young, the larvæ eat the floral organs, but, by the time the second moult is reached, these have disappeared and the green fruit is eaten. A tunnel just large enough to accommodate the head is made in the side of a berry, and, as the mandibles work this deeper and deeper, the "collar" is brought up flush with the surface of the fruit, and this gives the larva the appearance of being halfway in a berry not large enough to hold the half. Cook further notes that the larvæ apparently remain motionless for hours at a time, and do not evince any desire to wander from a fruit-cluster till all the edible pulp has disappeared; he observed one larva take up a fixed position and then clear out five berries in eight hours without moving. These habits appear to be identical with those of *Callophrys rubi* on the green berries of *Rhammus catharticus* and *Cornus sanguinea.* Bethune states (*Can. Ent.*, xxxvi., p. 156) that the larva of *Incisalia irioides* was found in June, 1897, feeding in the same manner in young apples. Of *Incisalia niphon*, Cook observes (*Can. Ent.*, xxxix., p. 259) that the young larvæ feed on the tender tissues of the young needles of *Pinus rigida*, the larva boring a minute hole into which its head is thrust, in this position excavating as much of the interior as it can reach without getting its body inside. When first born, the larva is yellow- or grey-green but soon becomes brown, marked with a creamy-white line on the latero-dorsal ridge, the coloration being an excellent protection, whilst the larva is feeding, on the brown needle-bundles; when the needles begin to thrust their tips beyond the sheath, the larva ascends to the lowest visible green tissue, and bores into it in a manner which causes the tip to droop away; after the second moult the larva becomes green with pronounced white stripes, and, coincident with this change, alters its method of feeding, ascending to the tip of a young needle, which it commences to devour, and then works gradually downwards, until it encounters the brown sheath, when it attacks a fresh needle. This appears to be very similar to the manner in which the larva of *Callophrys rubi* is said to attack the young stems of *Ledum palustre.* It is here, perhaps, advisable to note that Edwards mentions the similarity in the larval feeding-habits of *Incisalia henrici* and *Celastrina pseudargiolus*, since we ourselves have already drawn attention to the similarity in these same habits in the parallel pair of Palæarctic species, *Callophrys rubi* and *Celastrina argiolus*. Like the larva of *Callophrys rubi*, the larvæ of *Incisalia niphon*, etc., feed only in spring and early summer, maturing rapidly from eggs laid in the first warm days of March, April and May, pupating in the early summer, the pupal stage lasting from June until the following spring. Thanks to Cook's energy we now know tnat the larva of *Incisalia polios* feeds on *Arctostaphylos uva-ursi*, although an account of the larval habits has not yet been published.

In their larval habits, the Thestorids appear to be not unlike the Callophryids. The larvæ are more specialised with regard to the food-habit, being apparently confined to leguminous plants. They have, as in the Callophryids, a distinct spring-feeding habit, they also mature rapidly and pupate early, remaining in the latter stage for some 10 months out of 12. They are also as lethargic as the larvæ of the Callophryids, and Chapman notes (*Ent. Rec.*, xvi., p. 278) that a larva of *Thestor ballus* under observation, apparently at rest, was really busily eating, the front segments raised from the stem of *Lotus* on which it rested, whilst, in its true legs it held a flower-bud of the plant, which it was munching vigorously, and which disappeared in about a minute; the head was quite bent under so that the mouth-parts were directed backwards. The marginal flange in this attitude hangs down like a curtain, so as completely to hide not only the head and legs, but also the small flower-bud that was being eaten; the motionless reposeful appearance of the larva whilst eating rapidly was very striking.

The Thestorids and Callophryids appear to have a very marked objection to producing "forward" larvæ, at whatever latitude or altitude they may be found, for the Thestorids are essentially inhabitants of the warmest temperate regions, and *Callophrys rubi* is apparently as completely single-brooded in Algeria and southern Europe, as in Finland and Lapland. On the other hand, at least two Nearctic "hairstreaks," with the same habit as these so far as hybernating in the pupal stage is concerned, that inhabit, however, fairly low latitudes in the United States, produce "forward" larvæ, *viz.*, *Uranotes melinus* that appears to be continuously-brooded in the south, and double-brooded farther north, and *Mitura damon*, certainly triple-brooded in the south, double-brooded and partially double-brooded farther north, according to latitude. Of this latter species, which feeds at the tips of sprigs of *Juniperus virginiana*, Scudder notes (*Butts. New Engl.*, p. 866) that the colour of the larva is so exactly of the same rich green as the plant on which it feeds, that it is admirably protected. When feeding, the head is covered by the prothorax as with a cowl, so that one would not know it was at work but for the regular muscular movements of the body.

The Strymonid larvæ are very uniform in their habit of hybernating within the eggshell, of feeding in the spring and early summer, of an entire absence of producing "forwards," whilst they show some variety in the food-habits, although usually restricted to tall shrubs and trees. The larvæ of our two British Strymonids—*Strymon pruni* and *Edwardsia w-album*—are somewhat similar in their habits; they are both external-feeders, yet, bore into their food when young, burying the head and neck; later they cling somewhat tenaciously to the upper- or underside of a leaf, eating holes through the leaves on which they rest, and, whilst eating, appear to be quite still and immovable, there being practically no movement of the body buried beneath which, and quite out of sight, the larval head and neck may be actively reaching for and devouring its food. The larvæ of both species, too, have a very slug-like habit of walking, but their safety lies in their habit of resting for a long time immovably in the same position on a leaf. Of the larva of *E. w-album*, Bird observes that it prefers to rest on the underside of a young leaf of wych-elm, growing at the end of a twig, clinging by its anal claspers to the midrib at the bottom of the leaf, the body resting on the leaf alongside the midrib which is exactly the same position as that taken by a young folded leaf of the wych-elm, so that, at first glance, one can hardly tell one from the other. The larva of *Strymon pruni*, on the other hand, appears to rest on the upperside of a leaf, but hides so successfully that, when larvæ can be beaten freely, it is almost impossible to find them by searching. The larvæ of some of the Nearctic Strymonid species, *e.g.*, those described as *Thecla liparops*, *T. calanus*, *T. edwardsii*, and *T. acadica*, by Scudder, have very similar habits. This author says that *T. liparops*, when quite young, eats holes through the leaf, and afterwards eats holes or bites the edges indifferently; when nearly full-grown and eating, the prothorax covers the head and edge of leaf so that one cannot see the operation, whilst the larva itself is very inactive. Of the larva of *T. calanus* also he observes that it eats holes in the leaves of its foodplant, not touching the edge, that it is slow in its movements, differing considerably in this respect from that of *T. edwardsii*, which, Scudder says, walks with considerable rapidity, in marked distinction from the sluggishness of allied species, although it eats small holes in the leaves of oak in quite approved Strymonid fashion; *T. acadica* larva, however, feeds on leaves, eating from the edge onward; this larva is noted as very supple in its movements, the body curving like that of a snail, whilst its movements are slow. Just as the larva of *S. pruni*, in its food-habit, is restricted to blackthorn and plum, and *E. w-album* to elm, so *T. acadica* is confined to willow of various species, *T. edwardsii* to oak, *T. calanus* also to oak, but *T. liparops* is said to be almost polyphagous, although the evidence (*Butts. New Eng.*, p. 882), is not at all convincing. Lintner states (*Rept. Ins. New York*, iv., p. 137), that he found the larvæ of this species burrowing into cultivated plums, and eating out their interior much as *Incisalia irus* (*henrici*, see *anteà*, p. 63) does. This certainly is a most unusual habit for a Strymonid larva.

Like the Palæarctic Strymonids, the Nearctic species rarely produce "forward" larvæ. They have not been observed in *T. liparops*, *T. edwardsii*, or *T. acadica*, whilst the larvæ of *T. calanus* are noted as feeding up at very different rates, according to latitude, being fullfed in April in the southern States, from May to July in the middle and northern States, whilst even August is not too late for the larva in its most northern habitats, yet, even in the southern parts of its range, it is never double-brooded. All the larvæ of these Nearctic species, too, pass the winter inside the egg, not hatching therefrom till the early spring, although fully developed some months before they leave the egg.

The Strymonid larvæ are markedly cannibalistic in their habits. The way in which the larvæ of *Edwardsia w-album* will attack other larvæ of their own species as soon as they have settled down for pupation has often been noted. Scudder states (*Butts. New Eng.*, p. 890) that the larvæ of *Thecla calanus* is a cannibal, eating its weaker brethren when short of food.

Our ignorance of the larval habits of the species forming the large tribe *Ruralidi*, is colossal, and our knowledge appears to be confined to our two Palæarctic species, *Bithys quercûs* and *Ruralis betulae*. The larvæ of these two species agree pretty closely, in their habits, with those of the Strymonids. They have the same winter-habit of hybernating within the eggshell, the same tree-feeding habit, the same slow gliding movement, the same habit of resting by day and gaining protection by the similarity of their colour and markings to their surroundings, the same external-feeding habit, etc. The larva of *Bithys quercûs* is particularly Strymonid in its habits; when young it buries its head and neck into the felt on the young oak-leaves, clearing out the soft tissue of the leaf as far as it can reach, and even doing some burrowing when in its third stadium. Chapman observes that, when about halfgrown, the larvæ of this species and *Nordmannia ilicis*, one of the Strymonids, have a habit of hiding by burying themselves on the upperside of an oak-leaf, along the midrib, the petiole being too short to count, with the head pushed as far as may be into the axil. In this position they are remarkably invisible, the oak at this stage having both green and red-brown tints to which these larvæ closely assimilate, the larva of *N. ilicis* chiefly green, that of *B. quercûs* brown. The larva of *Ruralis betulae* hides and burrows less than that of *B. quercûs*. From the first, it will eat through the whole thickness of a young leaf of plum or blackthorn, and practically does no boring as do its allies, and from its second instar until fullgrown its feeding-habits and resting-habits are practically identical. It nearly always rests under a leaf, and usually selects an uneaten one on which to rest, and Chapman observes that the difficulty of finding a larva of this species of over ·5in. long, on a little bit of sloe with 20 or 30 leaves, is quite ridiculous. In looking for it, one sees its dorsal ridge in profile, it proves to be a margin of a leaf; one sees its "slope," it is the light shining through a curled portion of a young leaf; one sees it half-a-dozen times in this deceptive fashion before actually spotting it. Then one wonders how one could have missed it so long, it is so obvious, and, taken altogether, not at all like a sloe-leaf; yet any view of the group of sloe-leaves gives several items that are very like portions of the larva. The Ruralid larvæ, as exemplified by these two species, are distinctly slower-feeding than those of the Strymonids.

CHAPTER XI.

FAMILY HABITS OF BUTTERFLY LARVÆ—THE LYCÆNIDS.

The larval habits of our "blue" butterflies are at the present time so little known that it is almost impossible to write any useful notes thereon. The caterpillars of whole groups of the tropical species remain almost absolutely undiscovered, and, in the few isolated cases in which they are known, practically nothing has been recorded of their habits.

The Plebeiids are possibly the most generalised in their larval habits, feeding usually on low, leguminous plants, hybernating in the third stadium, eating out, when young, little patches of the cellular tissue from the undersides (or uppersides) of the leaves, and often producing "forwards." Yet there are many exceptions to all these features, *e.g.*, the larvæ of *Aricia astrarche* and *Polyommatus donzelii* feed on *Geraniaceae*, the latter species and *Agriades corydon* hybernate as eggs, *i.e.*, as fully-formed larvæ inside the eggshell, and many of the species, especially those confined to high latitudes and high altitudes, produce no "forwards" and are entirely single-brooded.

The structure of the "blue" larva, its small head and long, thin neck, suggest it as a boring larva, and this is one of the great family characteristics of the larvæ of the "blues," whether it be the remarkable boring habits of those of the Lampidids and of the Celastrinids, the less marked boring habits of the Everids and of the Cupidids, or the little-developed habit, as exemplified in the Plebeiids. The boring habit of *Celastrina pseudargiolus* is well described by Edwards (*Butts. Nth. America*, ii., Lycæna, pp. 6. 7), who says:—"As soon as hatched the young larva eats a minute hole the diameter of the head into the lower part of the unopened bud just above the calyx, and feeds upon the filaments of the stamens. . . . As the larva feeds, the prothorax is pressed hard against the bud, so as to permit the utmost elongation of the neck; thus it is enabled to eat out the contents of the bud, and only desists when there remains but the empty shell. When so engaged, the anterior segments are curled up and the others rest on the stalk of the plant, but very small larvæ rest wholly on the bud, curving round it. After its first moult, it bores into the sides of the calyx to get at the ovules, but, as the flowers mature and the ovary hardens, the boring is from the top, inside the tube of the calyx, and follows the stalk of the pistil to the ovule." Our Palæarctic form, *C. argiolus*, feeds similarly. When getting pretty large in the 3rd stage, a larva that has just attacked a new bud looks as if resting on the bud, the lateral flange, where it passes round the front of the larva, touching the bud and hiding the head; the head, however, is buried inside the bud, and the body remains motionless, although the larva may be actually feeding; its long, extensile neck enables a bud of holly or ivy to be cleared out so far as is desired. When larvæ of *C. argiolus* feed on holly-leaves, the latter have the appearance of being mined. Of *Plebeius scudderii*, Scudder notes (*Butts. New Engl.*, p. 960) the young larva has a very extensible head and flexible neck; it feeds on the underside of a leaf, piercing the lower cuticle, and making a hole just large enough to introduce the minute head, and then devour the soft tissue of the leaf of *Lupinus perennis* as far as it can reach, giving the appearance of a circular blotch with a central nucleus, the nearly colourless membrane being all that is left; when larger, it feeds on the upper- as well as the undersurface, preferring the under-, but never eats right through, leaving the opposite skin, using its long neck to reach the juicier parts. The young larvæ of *Plebeius aegon* make similar small transparent blotches on the leaflets of *Ornithopus perpusillus*, and, even when of a considerable size, do not eat through the leaf, but only hollow out the soft green tissue. Similarly the young larvæ of *Aricia astrarche* mine out the cellular tissue from the underside of the leaves of *Helianthemum vulgare*, causing the appearance of small flesh-coloured spots on the dark green upper-surface of the leaves, the spots gradually increasing in size, and forming blotches of irregular figure; the larvæ at this time assimilate very closely in colour to the whitish underside of the *Helianthemum* leaves; after hybernation, they again mine out the soft tissue and leave the epidermis, which turns yellow, quite untouched. The young larvæ of *Agriades bellargus* also mine into the leaves of *Hippocrepis comosa*, inserting the head into a small hole of the underside and tunnelling out the soft tissue as far as can be reached, leaving the upper skin untouched, thus marking the leaflets with little whitish dots; in the spring the larva continues this mode of feeding, but, towards maturity, like those of most of its close allies, it eats through the whole thickness of the leaf. The mode of feeding of the young larva of *Polyommatus icarus* is almost identical; it rests upon the underside of a leaf of *Lotus corniculatus*, *Ornithopus perpusillus*, etc., and mines out the soft tissue so as to cause the appearance of little, pale, transparent blotches, and this continues until long after feeding re-commences in the spring. The larva of *P. donzelii* feeds on *Geranium pratense*, the young larvæ forcing a way into the centre of the buds, where they remain hidden, eating small holes in the parenchyma, and, whilst young, finding great trouble to move about on the hairy leaves; when approaching maturity, they remain very sluggish, only shifting their position when requiring food, and show a great predilection in confinement for boring out the fleshy portions of the stalk, forcing their heads beneath the epidermis and consuming the soft portion, causing the leaf to droop and die. The larvæ of *Tarucus theophrastus* are noted by Graves as making furrows, sometimes an inch in length, on the underside of a leaf of a species of *Zizyphus*, on which they feed in Egypt.

It would appear that many larvæ of the more generalised Plebeiid species only adopt the mining-habit when young, thus reminding one of the Ruralid habit (*anteà*, pp. 62, 64), giving it up entirely later and eating throughout the leaf-thickness, *e.g.*, *Plebeius scudderii*, *Agriades bellargus*, etc., and it may be noted that the larva of *Celastrina argiolus*, which, on a flower-bud of ivy, bramble, heath, etc., or young green berry of buckthorn, euonymus, dogwood, or holly, inserts its head and long neck, in order to clear out the contents, follows up the usual family-habit on leaves, mining out the soft cellular tissue of holly, ivy, or vaccinium leaves when young, but eating through the whole thickness of a young leaf when almost adult; Scudder notes that some he reared in confinement made little circular holes from the upper surface of the leaf. Lyman observes (*Can. Ent.*, 1902, p. 127) that the larva of *Plebeius scudderii* (a species allied to *P. aegon*) eats away the parenchyma of the leaf of *Lupinus perennis*, leaving the membrane, as described by Scudder, when young, but, when older, it eats holes in the leaves, sometimes away from, and sometimes at, the edges thereof. Of the larva of *Nomiades lygdamas* (a species allied to *N. cyllarus*) Edwards notes (*Can. Ent.*, 1892, pp. 109-110) that, when young, it feeds on the tender leaves and flower-buds of *Vicia carolinensis*, but, as the larvæ grow older, they feed on the leaves and stems, eating the latter square off. Mathew observes (*Trans. Ent. Soc. Lond.*, 1888, p. 151) that the larva of *Hylochila* (*Lycaena*) *heathi*, which he found in February, 1885, near Sydney, N.S.W., on a point jutting out into Botany Bay, has precisely similar habits to many species already noted, for, the examples he found were feeding upon the flowers, flower-buds, and young leaves of *Westringia rosmarinifolia*, in the latter case eating holes in the centre of the leaf, from beneath, but not penetrating through the upper cuticle.

The young larvæ of *Everes comyntas* are said by Edwards to feed on the tender leaves of various leguminous plants, although, as they become larger, they seem to feed exclusively on the calyces of the flowerets, curving themselves to the surface of the clover, and inserting the head therein. Those of our European *E. argiades*, probably the same species as the American, feed greedily on the seeds of *Medicago lupulinus*, *Lotus corniculatus*, etc., eating through the pod, and devouring the contents; in their last stage, the larvæ, in confinement, feed greedily on the blossoms of common white and red clover, one larva, in confinement, being observed to eat up the whole of the petals of a head of red clover in two days, and appearing to feed almost continuously day and night. The larvæ of *Cupido minima* eat little holes through the calyx and corolla of the flowers of *Anthyllis vulneraria*, in order to reach the immature seed-vessels, leaving one floweret when cleared and entering another. As they get older, their bodies cannot be wholly contained in the corolla, and they may be seen with their heads thrust into the flower, the hinder part of the body hanging out, but still difficult to distinguish among the dense inflorescence of the flower-bud. Sich observes that, when the young larva of *Lycaena alcon* leaves the egg, it bores through its base into the gentian flower-bud on which it is laid, eating the petals quite through, on its way, just as *L. arion* larva will eat into a flower-bud of thyme.

Having thus far traced the mining-habit in the so-called leaf- and flower-eating larvæ of the Lycænids, one readily understands the perfection of the boring-habit attained by the larvæ of some species, *e.g.*, the larva of *Lampides boeticus* that may feed either on, or in, the blossoms of *Spartium junceum*, *Ulex nanus*, etc., but also bores into, and completely enters, the pods of *Colutea arborescens*, *Crotalaria striata*, *C. laburnifolia*, *Phaca baetica*, etc., as well as those of almost all species of cultivated peas and beans, clearing out the seeds, and only leaving the pod for the purpose of pupation. The larva of *Lampides phaseoli*, taken in Claremont Island, off the coast of Queensland, is described by Mathew (*Trans. Ent. Soc. Lond.*, 1889, p. 312) as feeding in the flower-buds of a leguminous plant closely allied to our scarlet-runner. The larva of *Virachola isocrates*, which bores into the fruits of *Randia dumetorum*, *Eriobotrya japonica*, *Psidium guara*, but whose usual food is the fruit of the pomegranate, *Punica granatum*, has often been referred to as a most extreme instance of possessing the boring-habit in the family. The larva is described as having a protrusible long neck, small head and strong jaws, particularly well-adapted for the work required in making its home. When quite young, it bores for itself a little clean-cut round hole, from the outer rind of the fruit of *Punica granatum* to the heart. In this hole it spends its days with its head inside, eating away at the green or ripening pips, and enlarging the hole as it increases in size. Sometimes three or four larvæ may be found in one pomegranate. When at rest it plugs up the outer hole deftly with the shield on its tail (Wylly). When fullgrown, the larva spins a slight, but strong, silken web, with which it binds the fruit to the stalk to prevent its falling off, should it wither before the insect emerges, as it often does; the operation completed the larva pupates within the cavity which it has excavated inside the fruit (Aitken). The habits of the larva of the allied *V. perse* are very similar. It feeds inside the fruit of *Randia dumetorum*, and the two abruptly-cut and flattened anal segments are largely used by the larva, when at rest inside the fruit, to close the orifice through which its frass is ejected. The fullfed larva has the same curious instinct as that of *V. isocrates*, in fastening the fruit to its stalk, and needs it more, for the fruit of *R. dumetorum* withers at once when attacked, and would inevitably fall before its tenant had reached the pupal state, if not artificially supported (Aitken).

As may be surmised from the above notes, the larval movements of the Lycænids are usually extremely slow, and the habits exceedingly lethargic. De Nicéville says that the larvæ of the majority of the Indian species are extremely sluggish, and look, in many cases, more like a *Coccus* or some vegetable excrescence than a caterpillar. The Australian *Hypochrysops delicia* larva is noted by Anderson (*Vict. Butts.*, p. 94) as being very sluggish and retiring in its habits, hiding by day in crevices or hollow twigs, and feeding by night, and this seems a frequent habit with the *Acacia*-, and other tree-,feeding exotic species, as apart from those feeding on low plants. The exceptions to this lethargic habit are comparatively few, one of which appears to be the larva of *Virachola isocrates* noted above, for Mrs. Wylly remarks that the larva of this species differs considerably from those of *Catochrysops cnejus*, *Azanus ubaldus*, and *Tarucus theophrastus*, those of the latter being inert and slow, the former brisk in its movements, etc. The larva of *Celastrina argiolus* is exceedingly sluggish, often not leaving the ivy-umbel on which it was born, and occasionally, apparently, keeping its head fixed inside a bud, and its body absolutely motionless for one or two days. The larva of *Cupido minima* will either get quite inside the corolla, or, if it remain outside, will bury its head into a flower of *Anthyllis vulneraria*, curl its body round the outside of the flower, and remain immovable until it has cleared out the immature seeds, when it removes to the next flower and serves it likewise. Similarly, the larvæ of *Everes comyntas* bury their heads into a clover-flower, and curl the body round the surface of the clover-head, remaining thus until prepared to attack another floret. The young larva of *Plebeius aegon* is stated by Buckler to have powers of locomotion of the feeblest description, whilst he notes the young larva of *Aricia astrarche* as a very sluggish little creature, not inclined to leave the underside of the leaf where it is hatched, even when the leaf has become dry. McDunnough observes that, when the larvæ of *Polyommatus donzelii* are approaching maturity, they remain very sluggish, only shifting their position when requiring food.

The sluggish habit is, however, undoubtedly primarily due to the fact that the larvæ gain a fair share of protection from their cryptic coloration, and that any attempt at rapid movement would immediately betray their presence. Chapman notes, in our preceding volume, p. 64, how a larva of *Lampides boeticus* had placed itself along the upperside of a spine of *Ulex nanus*, with its head close into the axillary hollow, and so, in position, form, size and colouring, it exactly resembled one of the small flower-buds, of which a good many occurred on the branch. . . . The larger larvæ of this species were often easily seen, but often also were very invisible, and this depended a good deal on whether they were amongst flowers or buds, or were moving or resting. From the second instar onwards they closely resembled in colour and texture the calyces of *Adenocarpus intermedius*, a favourite food-plant, and not infrequently disposed themselves so as to look like a flower-bud. These buds, at first greenish, are varied with red-brown, like the seed-vessels, and, like them, are clothed with sticky glands. The larva varies much in colour as it gets older, generally retaining an olive tint, due to a brown overlying green, and, in colour and form, are inconspicuous amongst calyces and young seed-vessels. Another variety of fullgrown larva was dull yellow, obviously well-suited to assimilate with papilionaceous flowers. Bearing on the same point, Sich writes that it is well-known that the calyces of *Thymus serpyllum* are usually of a purple tint and hairy, and the young larva of *Lycaena arion* is also of this colour, and very hairy; when the little larva, therefore, is half buried in a calyx, or, when on the calyx, eating into the corolla, it is difficult to discover even by the aid of a lens. Frohawk further notes that, as the larvæ of this species get larger (in second instar), a remarkable similarity exists between them and the flower-buds of thyme, both in colouring and pubescence; so great is this that it requires very close examination to discern the larvæ, detection being the more difficult as they still generally conceal themselves inside the bloom, only the anal segments protruding. Edwards, referring (*Can. Ent.*, viii., pp. 202-3) to the cryptic resemblance that the young larvæ of *Everes comyntas* bear to their foodplants, remarks that those on *Desmodium* feed on the young leaves and green flower-buds, and are of nearly the same shade of green as the plant, whilst those on clover-flowers are red or reddish, and escape notice by keeping among the flowerets, the colour and habit remaining until maturity, the larger larvæ curving their bodies to the surface of the clover-buds, or burrowing into them. Similarly it may be noted that the larva of *Cupido minima*, among the calyces of *Anthyllis vulneraria*, is almost indistinguishable from its surroundings, even by an entomologist. On the contrary, those Lycænid larvæ which have adopted a habit that requires them to hide by day and feed by night, are active enough, and among the exotic groups there are many striking exceptions to this highly-developed sluggishness. Anderson and Spry (*Victorian Butterflies*, p. 106) describe how the larval habits of *Ogyris olane* have led to their being rather vagrant in their movements. They observe that "the larvæ being, like all other larvæ of the genus, nocturnal-feeders, frequently have to travel considerable distances from their food to find a shelter, under which to hide for the day; this is more especially the case at certain periods of the year, when some trees are almost devoid of loose bark. In the summer months, too, the *Loranthus*, on which they feed, loses most of its leaves, and, consequently, any larva on a piece of the plant to which this happens, would have to travel in search of fresh fields and pastures new. When one considers the small proportion of *Loranthus* to the trees on which it is found, it seems very wonderful that the larvæ should ever reach another patch, and, in fact, these enforced wanderings frequently have a fatal termination, the caterpillars dying of starvation; yet they sometimes display a most wonderful vitality and will frequently complete their transformations after a prolonged abstinence from food, and when only about half the size they should properly attain.; in this case, however, they take a longer time turning into pupæ, and also remain in that stage longer than usual. . . . When, on the other hand, circumstances are favourable, food abundant and succulent, and there is plenty of shelter in the immediate vicinity, the larvæ do not travel far, but feed vigorously, and only take a couple of days to turn to pupæ.

The food-habit of the Lycænid larvæ undoubtedly tends to the choice of leguminous plants in the majority of species. Some prefer shrubby *Leguminosae*, *e.g.*, *Lampides*, etc.; many, however, prefer low-growing herbaceous plants of the order, and various species may choose leaves, flowers, or seeds, respectively as their pabulum. On the other hand, there are many exceptions. *Celastrina argiolus* appears throughout its vast range to choose shrubby *Leguminosae*, but it is equally at home on a host of plants belonging to other orders, of which holly, ivy, dogwood and buckthorn may be specially noted, and these frequently appear, in some districts, to wholly replace the leguminous foodplants, from which this species has possibly spread, and here it may be well to draw attention to the similarity of the "food" selection made by *Callophrys rubi* and this species, full lists of which may be obtained respectively from our account of each species in this volume. The restriction of the larva of *Polyommatus donzelii* and *Aricia eumedon* to *Geranium*, whilst that of *Aricia astrarche* will also accept plants of this order, although, in nature, it seems usually to choose *Helianthemum vulgare*, may also be observed. The larvæ of the true Lycænids also are aberrant in their food-habits, *e.g.*, *Lycaena arion* chooses thyme, *L. euphemus* and *L. arcas* are said to select *Sanguisorba*, *L. alcon*, *Gentiana pneumonanthe*, whilst *Scolitantides* is also aberrant, the larva of *S. orion* choosing *Sedum*, and *S. baton*, *Thymus*. Like so many purely alpine species, *e.g.*, certain Coliads, in which the family larval food-habit also tends to *Leguminosae*, the larva of *Polyommatus optilete* chooses *Vaccinium*. On the whole, though, our knowledge of the food-habit of the family is very infinitesimal. Among the exotic groups, of which the larval food-habits are known, considerable specialisation has been noted. Thus the peculiarly Australian group *Ogyris* appears to be confined, in all its species, to *Loranthus* (mistletoe), and the larvæ are all night-feeders. [See also *Journ. As. Soc. Beng.*, lxix., pt. 2, pp. 198 *et seq.*]

The most remarkable modification of food-habit in Lycænid larvæ is undoubtedly the development of cannibalistic or wholly carnivorous habits. Thus Thwaites remarks (Moore's *Lep. Ceylon*, i., p. 70) that "it is difficult to realise that the larvæ of some species of these lovely Lycænids, such as *Amblypodia*, etc., are carnivorous or even cannibalistic in their habits, and do not hesitate to eat their own brethren of the same brood, when any of the latter are commencing their change into the inactive chrysalis state, with their consequent inability to protect themselves from their voracious kindred, who devour them with avidity." Scudder remarks, that the same carnivorous tendency has been observed in several Nearctic species, and it is certainly common among the European Strymonids (see *anteà* p. 65). Chapman says that *Langia telicanus*, even though supplied with plenty of food, cannot safely be kept in any number together, all those that are ready to pupate earlier than the others being eaten by their later fellows; as soon as they have spun their silken pads and girth they are in danger, both larvæ and pupæ being found with a larger or smaller hole in the skin and the interior gone; now and then the interior is not quite cleared out, the cannibal being apparently fullfed before his supply of unholy pabulum has been finished. It would thus happen that only two or three pupæ resulted out of a dozen or more larvæ, the fate of the others being testified by their remains. So soon, however, as the pupa has become mature and hard it is safe. Edwards notes (*Butts. Nth. Amer.*, ii., Lyc. p. 6) that, in confinement, when food is scanty, the larvæ of *Celastrina pseudargiolus* will prey on each other, burrowing into the body the same way as they do into a flower. Frohawk, referring to the cannibalistic habits of *L. arion* (*Entom.*, xxxvi., p. 58) says that, on July 29th, 1903, he saw a young and small larva of this species with its jaws deeply buried into the side of a rather larger one, apparently sucking, that it had made a deep hole in its side, the surrounding surface being shrunken, and liquid exuding from the wound. The development of this cannibalistic habit into a purely carnivorous diet appears to be quite possible; at any rate the larvæ of several Lycænid species now indulge in the latter, and the feeding-habits of those of *Feniseca tarquinius* which subsist on plant-lice (fully detailed in the preceding volume, p. 37), of *Gerydus chinensis* on aphides (p. 38), of *Liphyra brassolis* (pp. 38-39), of *Spalgis epius* (p. 39), and of *Spalgis signata* (pp. 39-40), need not be here repeated, since reference to our account thereof is so easy. [See also *Journ. As. Soc. Beng.*, lxix., pt. 2, p. 189.]

There appears to be no really fixed family-habit in the hybernating stage of the Lycænids, nor can this be even approximately expected in so wide-ranging a group. The most usual period for hybernation among the Plebeiids, whose larvæ usually feed on low plants, is in the third larval instar, *i.e.*, soon after the second moult, a habit characteristic of *Cyaniris semiargus*, *Polyommatus icarus*, *Agriades bellargus*, *Aricia astrarche*, *Lycaena arion*, etc., yet, among our British Plebeiids, *Plebeius aegon* and *Agriades corydon* hybernate as young larvæ within the egg-shell, as also does *Polyommatus donzelii*, whilst the fact that the Nearctic *Plebeius scudderii*, closely allied to *P. aegon*, also hybernates as a larva inside the egg (*Can. Ent.*, xxxiv., p. 126), suggests that this natural little group—our genus *Plebeius*—may have a fixed habit in this direction. The Cupidids hybernate as full-fed larvæ; Hellins records that larvæ of *Cupido minima*, which were full-fed in July, 1872, did not pupate till June 3rd, 1873. The Celastrinids hybernate as pupæ, resembling in this respect, as in so many other larval habits, the Callophryids. The species of the Nomiadid group proper, *Nomiades melanops*, *N. cyllarus*, and the Nearctic *N. couperi* also all hybernate as pupæ. The hybernation of the Plebeiid larvæ in the third instar, usually commences very early, and the larvæ remain very small, those of *Aricia astrarche* are, at the time of hybernation, only about 2mm. in length, and they appear to hybernate low down on the underside of the leaves of *Helianthemum vulgare* where they remain from mid-November to the commencement of March; Harrison says that they prefer the dead leaves near the base of the stem. Rayward observes (*in litt.*) that larvæ of *Polyommatus icarus*, kept in the open, on a young plant of *Lotus corniculatus*, during the winter of 1906-7, were found early in March, hybernating low down close to the roots, and a sheltered position here is probably almost always chosen; the larvæ of this species rest about the same length of time as those of *A. astrarche*. Those of *Agriades bellargus* are only about 1·5mm. long in December; in a sheltered place, however, the latter seemed to feed a little in January and February, and, on sunny days, were observed by Buckler stretched out along the midrib of the upper side of a leaflet of *Hippocrepis comosa*, so that the hybernating habit of this species appears to be somewhat less complete than that of some of its allies.

Of those that hybernate as larvæ inside the eggshell, we may note that McDunnough (*Ent. Rec.*, xviii., p. 313) obtained a large number of eggs of *Polyommatus donzelii* on the Piz Languard, near Pontresina, at 6200ft. elevation in early August, 1905, that examination of the eggs in September showed the fully-developed larvæ curled up within the eggshells, that they remained thus, at Berlin, till the end of February and early March, by the 10th of which month all had hatched. Buckler observes (*Larvae*, etc., i., p. 113), that some eggs of *Plebeius aegon*, obtained in the summer of 1867, were found to contain living larvæ in February, and that these hatched at various dates from February 28th well on into April, 1868. Lyman notes (*Can. Ent.*, 1902, p. 127) that the Nearctic *Plebeius scudderii* laid eggs between July 23rd-30th, 1899, that the larvæ remained in the eggshell until the end of April, 1900, so that its habit is almost identical with that of *P. aegon*.

Among the "blues" the habit of producing "forwards," in some species, is extremely developed, especially in tropical and subtropical countries, but, as may be expected, in a family with such a world-wide range, the habits are exceedingly diverse, varying even in the same species, in this particular, according to latitude, altitude, etc. Among our European species, *Lycaena arion* appears to be absolutely single-brooded, and so, in central Europe, is *Agriades corydon*, yet, in a few warm spots on the Mediterranean littoral—Hyères, Ste Maxime, etc.—the whole of the eggs of the first brood appear to produce "forward" larvæ and the species becomes double-brooded. Almost all our British species produce some "forward" larvæ, and hence are double-brooded, or partially so, and, in really suitable seasons, the summer examples in their turn may produce "forwards" and thus initiate a partial third brood. Such is the case with *Celastrina argiolus*, whose broods are dealt with at length in the systematic part of our work. The broods of *Everes argiades* are very similar, a large percentage of the larvæ resulting from the spring emergences going "forward," whilst the imagines resulting from these also occasionally produce larvæ that go on to a third emergence in southern Europe. The American form, *comyntas*, is said by Scudder to produce "forwards" developing into a second brood in the Northern States, and these again "forwards," making a third brood in the Southern States. Edwards notes (*Can. Ent.*, viii., pp. 202-3) that the forward larvæ of *comyntas* feed up very rapidly—eggs laid July 9th, 1876, hatched July 12th, first larval moult on the 15th, second moult 18th, the third moult 21st, the fourth 26th, pupated July 31st, imago emerged August 9th. Through southern and central Europe *Polyommatus icarus*, *Cyaniris semiargus*, and *Agriades bellargus*, produce many "forwards," and are largely double- or partially triple-brooded, but, in some unfavourable seasons—*e.g.*, 1888, 1906, etc.—in Britain, *A. bellargus* larvæ resulting from the first brood go into hybernation early, and scarcely a "forward" results. The typical form of *Aricia astrarche* produces "forwards" freely in most parts of southern and central Europe, but, in the higher latitudes and altitudes that it inhabits, fails entirely to do so, and Harrison observes (*Ent. Rec.*, xvii., p. 268), that larvæ from Durham and Fife "resolutely refuse to feed up the same year, even in a hothouse," so completely has the forward habit been eliminated in Scotland and the north of England. Rayward also notes (*in. litt.*) that the larvæ from a large batch of ova of *P. icarus* laid by a Cornish ♀ at the end of June, 1907, all prepared for hybernation early in August, in the third instar, and could not be tempted to continue feeding although kept in a warm room. Prideaux observes (*in litt.*) that, on two separate occasions, larvæ, from eggs laid by the first brood ♀s of *P. icarus*, fed on *Ononis*, refused to feed on, and commenced to hybernate when quite small instead of producing a second brood. On the other hand, he notes that he has bred many *Agriades bellargus*, and never knew summer-feeding larvæ, from eggs laid by ♀s of the early emergence, fail to feed on as "forwards," and produce autumnal imagines.

The Palæarctic and Nearctic Plebeiids, as a rule, then, have winter-feeding larvæ, *i.e.*, larvæ that commence feeding in August and September, and continue for some time, then rest, and begin again in the early spring. Some species do not seem to rest very completely in the winter, for Buckler says that small larvæ of *A. bellargus* are to be found in October on the underside of *Hippocrepis comosa*, that they feed slowly through the winter, and make much larger blotches on the undersurface of the leaves by early February, whilst in March the leaves are eaten from the edge, and often demolished entirely. Even the Plebeiid species that hybernate in the egg-stage disclose their larvæ so early—end of February or early March—that they commence under almost winter conditions, whilst all feed on through the spring months, until at least May, although the absolutely single-brooded species continue until June, *e.g.*, *Plebeius aegon*, *Agriades corydon*, etc., but, in addition, many species produce summer-feeding larvæ that go through their larval life quickly in July-August, and produce imagines in autumn, *e.g.*, *Aricia astrarche*, *Agriades bellargus*, *Polyommatus icarus*, *Cyaniris semiargus*, etc. The Nomiadid species—*N. melanops*, *N. cyllarus*, etc.—have purely summer-feeding larvæ. One suspects that *Polyommatus donzelii* has a purely spring-feeding larva (it hybernates as larva inside egg), but a note by McDunnough (*Ent. Rec.*, xviii., p. 313) states how two, out of a large number of ova found at Pontresina at about 6200ft., disclosed their larvæ during very hot weather towards the end of August, 1905, one of which died, whilst the other fed up well to the 3rd instar (the hybernating stage for most Plebeiid larvæ), and then prepared to hybernate under a dead leaf; the specimen was not observed further.

The most remarkable feature, however, in the habits of the larvæ of the Lycænids, is their association with ants. It is almost safe to say that it is only our ignorance that prevents us from asserting that the larvæ of nearly every Lycænid species is, more or less, so associated. How ancient a habit this is one dare hardly hazard a guess, for the habit is characteristic of the "blue" larvæ in all parts of the world—Australia, Asia, Africa, Europe and America—and, so similar in all cases, that one suspects for it a vast antiquity. The connection between the ants and the Lycænid larvæ is generally supposed to be two-fold and advantageous to both, the ants obtaining from the larvæ a fluid they love, whilst their presence is supposed to keep away enemies that might otherwise attack the larvæ. The general character of the structures, that appear to be intimately connected with this symbiosis, seems to be practically identical in all Lycænid larvæ, (1) a pair of retractile organs or eversible caruncles, one behind each of the spiracles of the 8th abdominal segments, which are, when protruded, surmounted by a series of spiny or feathery branches, and which are supposed to attract the ants; (2) the other, an eversible honey-gland with somewhat thickened lips, on the dorsum of the 7th abdominal segment, from which a drop of sweet fluid is emitted on the solicitation of the ants. The fact that ants consorted with Lycænid larvæ, and were symbiotic therewith, has been known for at least 130 years;

the structure of the caruncles of the 8th, and the honey-gland of the 7th, abdominal segments, as well as the secretion of a fluid by the latter, were first fully detailed by Guenée (*Ann. Soc. Ent. France*, 4th ser., vii., pp. 665-668), as they occur in larvæ of *Lampides boeticus* (see *posteà*, pp. 348-350). But it was not until 1877 that Edwards (*Can. Ent.*, x., pp. 1 *et seq.*) first discovered the true meaning of the connection between ants and Lycænid larvæ. The species in which it was first noted was *Celastrina pseudargiolus*, the North American form of our common *C. argiolus*. He noticed that ants frequented the flower-spikes of *Cimicifuga racemosa*, on which the larvæ of *Celastrina pseudargiolus* were feeding, and observed "an ant running up and down the back of one of the larvæ, drumming and gesticulating with its antennæ, and was surprised to find that the larva, though feeding, did not seem in the least disturbed at the treatment, neither withdrawing its head from the bud nor wincing in the body. . . . A further search showed other ants, and sometimes several of them, busy about other larvæ, running from one to another, on different parts of the spike, and always repeating the same drumming motions, stopping often to lick the surface, as it seemed, and the presence of ants became a sure indication of larvæ." . . . The ants attended most diligently to the last two or three segments, and especially to the back of the 11th (7th abdominal)," etc. But, though Edwards suspected that a saccharine fluid was secreted, and that it was this that the ants sought, he could not demonstrate it, so he sent larvæ to Hagen and Mack, who discovered the three organs previously described, and similar ones in larvæ of *Plebeius argus* and *Agriades corydon*, and, later, in *Everes comyntas*. Hagen also sent to Edwards Guenée's account of the structures, and his observations on the secretion of the honey-gland, as observed in *Lampides boeticus* (see *posteà*, pp. 348-350), and Edwards saw, in this account—that, "from the middle of the opening (on the 7th abdominal) comes forth, at the will of the larva, a sort of transparent hemispherical vesicle, which gives escape to a fluid sufficiently abundant to form a good-sized drop, which reproduces itself when it is absorbed"—the explanation of all his puzzles, and concluded that "the larvæ of several species of Lycænids have one or more special secreting organs, and that one species, at least, is regularly attended by ants for the sake of the excreted fluid," etc. In 1878 he completed the observation and noted (*Can. Ent.*, x., pp. 131-134) the operation in detail: "The ants run over the body, caressing the larva with their antennæ, plainly with the object of persuading it to emit a drop of the fluid from segment 11 (7th abdominal). Most of this caressing is done about the posterior segments, and, while the ants are so employed, or rather while they are absent from the last segments, the tubes of segment 12 (8th abdominal) are almost certainly expanded to their full extent and so remain, with no retracting or throbbing, until the ants come tumbling along in great excitement, and put either foot or antennæ directly on, or close by, the tubes, when these are instantly withdrawn. The ants pay no heed to the tubes, do not put their mouths to them, or to the openings from which they spring, nor do they manipulate that segment. They seek for nothing and expect nothing from it; but they do at once turn to segment 11, caress the back of that segment, put their mouths to the opening, and exhibit an eager desire and expectancy. By holding a lens steadily on segment 11, a movement at the back of this segment will soon be apparent, and, suddenly, there protrudes a dull green, fleshy, mammilloid organ, from the top of which comes a tiny drop of clear green fluid. This the ants drink greedily, two or three of them perhaps standing about it, and they lick off the last trace of it, stroking the segment meantime. As the drop disappears, this organ sinks in at the apex and is so withdrawn. . . . The intervals between the appearance of the globule varied with the condition of the larva; if exhausted by the long-continued solicitings, some minutes would elapse, and the tubes meanwhile remained concealed, but a fresh larva required little or no urging, and one globule followed another rapidly, sometimes even without a retracting of the organ. Six emissions have been counted in 75 seconds. The larva did not always await the approach to the 11th segment, but gave out the drop unsought, and as soon as it was aware of the presence of the ant. Now and then the drop was preceded by a bubble several times larger than itself. . . . When a fresh larva, taken from the house, was placed on the stem, there was an immense excitement among them, and a rush for the last segment, as soon as the ants discovered it. The larva forthwith relieved itself by the excretion of the fluid, and the tubes stood out with domes expanded between the times of secreting; if a fresh larva were placed on a stem on which were no ants, there was no excitement in the larva, no appearance of the tubes, and no movement in the 11th segment, . . . but, if ants were now transferred to the stem, the moment the caressings began the larva changed its behaviour. From what I have seen I am led to believe that these tubes are merely signals to the ants, and that, when the latter discover them expanded, they know that a refection is ready, and rush to the orifice on the 11th segment."

Thus, a century after it had been noted that Lycænid larvæ were attended by ants, and some years after the honey-gland and its secretion had been discovered by Guenée, Edwards was able to show the connection between the two and the symbiotic relationship existing between the ants and larvæ. Other observers were put on the right track, and Saunders noticed (*Can. Ent.*, x., p. 14) the connection between ants and the larvæ of *Plebeius scudderii*, whilst Edwards himself described in detail the connection between the larva of *Plebeius melissa* and its attendant ants (*Papilio*, iv., pp. 92-3).

We are not at all sure when the connection between ants and Lycænid larvæ was first noticed in Asia. In 1881, Moore quoted (*Lep. Ceylon*, i., p. 70) Thwaites as saying that the larvæ of some Lycænid species, *e.g.*, *Amblypodia*, were cannibalistic in their habits, but a protection is found "for these helpless individuals, in the instinct of an ant, *Formica smaragdina*, which, finding a substance most palatable to it, secreted naturally from a defined glandular spot upon the bodies of these helpless larvæ, takes possession of them as 'cows,' surrounding each separate one . . . protecting them zealously and attacking most fiercely any living thing intruding upon them." This was followed up by Doherty in 1886 (*Journ. As. Soc. Beng.*, lv., pt. 2, p. 112), and by de Nicéville and Wylly, in 1888 (*Journ. Bomb. Nat. Hist. Soc.*, iii., p. 164) and supplemented by de Nicéville, in 1890 (*Butts. India*, etc., pp. 7-9), and in 1901 (*Journ. As. Soc. Beng.*, lxix., pt. 2, pp. 187-192). The remarks of the two former we have already noted at length in the preceding volume (*Nat. Hist. Brit. Butts.*, i., pp. 33-34). De Nicéville writes (*Butts. Ind.*):

"Some species of Lycænid larvæ are furnished with certain organs which do not appear to be found in other larvæ of lepidoptera. . . . . They certainly are not found in all Lycænid larvæ, but why some species should be so furnished, and not others, I can offer no confident opinion. I have, however, a theory that these organs exist for the protection of the larvæ, and that when they are absent, other means of protection exist. In the genus *Curetis*, Hb., I have found that the larvæ are furnished with extremely large and well-developed organs on the 8th abdominal segment, larger than in any other Lycænid larva known, whilst the organ on the 7th abdominal segment is entirely absent. The former are in the sub-dorsal region of the segment, of very great size, each consisting of a tall 'pillar' from which, when the larva is touched or frightened, it instantly protrudes a long tentacle, furnished at its head with a brush of long parti-coloured hairs as long as itself; these hairs open out into a rosette, and the tentacle is whirled round with immense rapidity, producing a most curious effect. I believe the *Curetis* larvæ use these tentacles solely to frighten away their enemies, the worst of which are ichneumon flies. I think it probable that these organs were first developed, and the mouth-like opening on the 7th abdominal segment came into existence at a later date. This latter organ, with its sweet-tasting liquid exudation, is greatly affected by ants of very many different species, who, in return for the food they obtain from the larvæ, act as their most efficient guardians. I have found as many as four species of ants attending one species of larva. Ant-tended larvæ are most easily found by looking for the ants; the larvæ are usually coloured like the leaves, buds, flowers and seedpods on which they feed, and are, for other reasons, not easily seen, but the restless red or black ants are very conspicuous. *Curetis* larvæ are not known to be attended by ants, and have not the organ on the 7th abdominal segment, whence the necessity of having the organs of the 8th abdominal in a highly-developed condition. In other larvæ which are attended by ants, the organs on the 8th abdominal are smaller than in *Curetis*, and are, possibly, gradually aborting, because, the ants having constituted themselves their defenders, there is no further use for them for defence, and Edwards probably correctly surmises that, in their aborted condition they serve as signals to the ants to examine the 7th abdominal segment for the sweet fluid emitted by the larvæ. . . . Not only do the ants attend the larvæ from their very first and smallest stages (ants have been found attending larvæ of *Rapala schistacea*, Moore, only ·125in. in length) till they are full-grown, but they often cause the larvæ to change to pupæ within their nests, in this manner protecting them from harm, from the time they emerge as minute caterpillars from the egg to the hour they assume the perfect stage and fly away." It is to be observed that the generalisations here enunciated, are not altogether in accordance with those of Edwards, nor, in some instances, with now well-known facts, and one suspects that more observation on the habits and anatomical examination of the larvæ are necessary before one can safely indulge in such generalisations. Further details of the species of ants that have been found with certain Lycænid larvæ are noted in the body of de Nicéville's volume, *e.g.*, he observes (p. 90) that the larva of *Chilades lutea* is found commonly at Calcutta, during the rains, the ant, *Camponotus rubripes*, Dru., var. *compressus*, Fab., which attends it, betraying its presence; while the larva of *C. trochilus* is attended, in the Calcutta district by the ant, *Pheidole quadrispinosa*, Jerd. The larva of *Zizera lysimon* is, in the same district, accompanied by *Tapinoma melanocephalum*, Fab., that of *Lycaenesthes emolus* by *Œcophylla smaragdina*, Fab., the large red and green ant which makes immense nests of growing leaves in trees, and the larva of *Lampides aelianus* is tended by *Camponotus mitis*, Smith. The larvæ of *Catochrysops cnejus* are attended by large black ants, which Forel has identified as *Camponotus rubripes* var. *compressus*, Fab., in the same way as are those of *Tarucus theophrastus*. The larvæ of this latter species are accompanied by *Pheidole latinoda*, Rog., as well as *Camponotus* var. *compressus*. Mrs. Wylly states that the ants tend the larvæ of this species till they are fullgrown, when they drive them down the stem into a temporary nest which they have set up at the foot of the tree. The larva of *Catochrysops pandara*, at Calcutta, is attended by three species of ants, identified by Forel as *Prenolepis longicornis*, Latr., *Monomorium speculare*, Mayr, and a species of *Cremastogaster*. It is supposed that, as the larvæ swarm at Calcutta on the Cycads, and yet no pupæ are found on the plants, the fullgrown larvæ are driven down the stem by the ants into their nests, in order to undergo their transformations. [See also *Journ. As. Soc. Beng.*, lxix., pt. 2, pp. 190-192.]

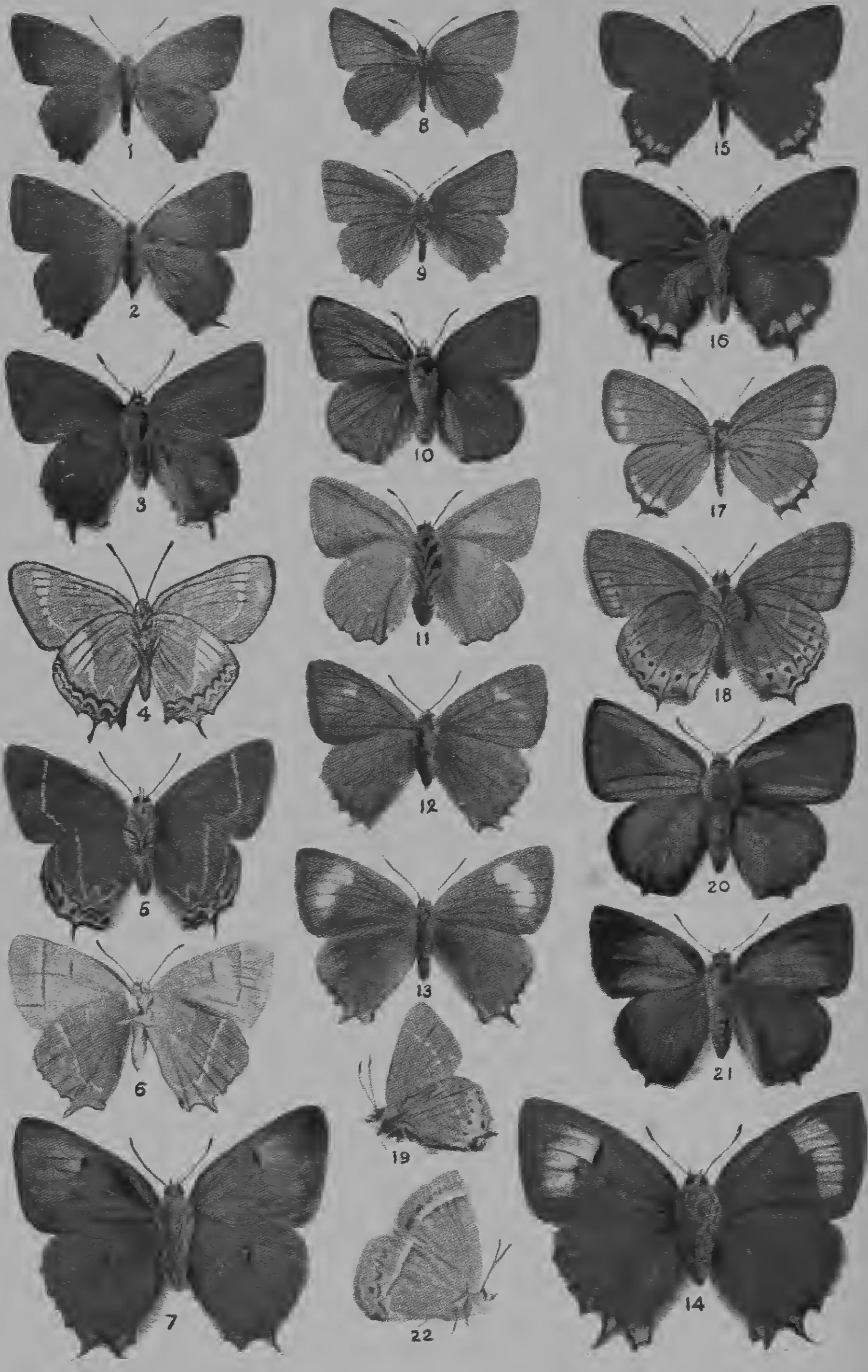
The connection between the Lycænid larvæ and ants of Australia appears to have been first noted by Mathew, who, in 1888, described (*Trans. Ent. Soc. London*, p. 153) the larvæ and pupæ of *Ialmenus evagoras*, found at Parramatta, near Sydney, in October 1884, on *Acacia* (wattle). He observes that "the larvæ and pupæ were attended by scores of small black ants, which continually ran backwards and forwards over them, and appeared to cause them no annoyance. The ants seemed to be attracted by some sticky saccharine matter that exuded from both larvæ and pupæ, and gave them a bright varnished appearance." Upon putting his face close to these ants, Mathew fancied that he detected a faint and rather sickly aromatic odour. The same observer described in detail the connection observed between ants and the larvæ of *Lycaena lulu* (*Trans. Ent. Soc. Lond.*, 1889, p. 312), which he found at Tongatabu in the Friendly Islands. He discovered the larvæ on the clusters of flower-buds at the extremity of a branch, and observed that, wherever there was a larva, there were sure to be half-a-dozen or more red ants, crawling over it and thus betraying its position; moreover the larvæ took no pains to conceal themselves, but fed quite exposed on the buds. They were also accompanied by numbers of small black aphides. He remarks that "upon each side of the anterior part of the 8th abdominal segment, a little above the spiracular line, there is a small whitish tubercle, from which the larva can at pleasure emit a short fleshy tentacle, which is crowned at its summit by a fascicle or whorl of fine bristles. The larvæ would not protrude this organ when breathed upon, touched, or otherwise annoyed, but only occasionally as they crawled along, or when they were feeding with their heads deeply buried in the flower-buds; while so engaged they shoot them out frequently and rapidly. The fascicle of bristles was not expanded until the tentacle was extended to its entire length, and was closed again before it was withdrawn. This organ is possibly a protective weapon against ichneumons, but I do not remember having previously observed it in any other Lycænid larva." It would appear that the "attended" habit has been since observed in many Australian species, and Anderson and Spry, in their little book "Victorian Butterflies," note that *Holochila absimilis*, *Hypochrysops delicia*, *Ogyris abrota*, *Ialmenus evagoras*, *I. ictinus*, etc., are all accompanied by ants, and these authors remark that the ants that are affiliated to the last-named species are particularly large and fierce. [See also preceding vol., pp. 35-36.] One wonders whether the highly-developed gregarious habit, exhibited by the larvæ of *Ialmenus evagoras* (and Indian *Thaduka multicaudata*), has been evolved for the purpose of mutual protection, due to excessive sluggishness, or because of the ease with which the swarms of little black ants that live with them can overlook them. Further observation is needed on this subject.

In Europe, as already noted, the connection between Lycænid larvæ and ants has been known for at least 130 years, but the presence of the honey-gland on the 7th abdominal segment was not demonstrated till 1867. Even then Guenée did not connect his anatomical discovery with the recorded observations of the symbiotic habit existing between the ants and larvæ. Edwards' discovery, however, in 1877, connected the two, and observations on the habits of *Plebeius aegon*, *P. argyrognomon*, *Agriades corydon*, *A. bellargus*, *Polyommatus icarus*, *P. damon*, *P. hylas*, *Aricia astrarche*, *Nomiades iolas*, *Lycaena arion*, *Celastrina argiolus*, and other species, have been detailed at length. (References to these are given, *posteà* pp. 323-4.)

These glandular structures appear to be present in all species that we unhesitatingly regard as Lycænine, and equally wanting in all typical Theclids and Chrysophanids, so that it is hardly going too far to postulate that any larvæ possessing these structures are Lycænines, those without them, though with less certainty, belong to some other group. Thus we may presume *Curetis* to be a Lycænine derivative, and the association with ants, though of so different a character, may even suggest a place here for *Liphyra* rather than with the Theclids.

Chapman notes that, in connection with the apathy shown by the larvæ when the ants are running over them, *i.e.*, apathy, not as regards paying the ants for their services, but as concerns any show of inconvenience due to the sharp claws of the ants on their delicate cuticle, it is not at all improbable that the remarkably complex structure of the hairs with their stellate bases, and their abundance, both most notable in the later instars when their size requires that the ants should crawl over them, are an adaptation of a protective character. The claws of the ants would obtain a good purchase amongst these hairs, and would be held away from the actual skin, so that their sharp tips would rarely, if at all, touch it.

How far the suggestion made by various observers, to the effect that ants accompany certain Lycænid larvæ for the purpose of keeping clean their burrows by devouring their frass, is to be accepted, we do not know. Graves claims that, in Egypt, ants accompany the larvæ of *Hypolycaena livia* for this purpose (*Ent. Rec.*, xvi., p. 203) as also those of *Tarucus theophrastus* (*Ent. Rec.*, xvi., p. 19), whilst Taylor writes (*de Nicév. Butts. of India*, iii., p. 479): "The larvæ of *Virachola isocrates* are attended by the ant, *Formica nigra*, which clear away their droppings and act as sweepers, as well as guard their pupæ." This matter certainly wants further elucidation. Further information on the connection between Lycænid larvæ and ants may be found in our preceding volume, pp. 30 *et seq.*



British Ruralines (Hairstreaks).

The Natural History of British Butterflies, etc., 1907.

PLATE I.

(To be bound facing Plate I.)

BRITISH RURALINES (HAIRSTREAKS).

FIG. 1.—EDWARDSIA W-ALBUM ♂.
FIGS. 2-3.— ,, ,, ♀.
FIG. 4.— ,, ,, ab. ALBOVIRGATA (underside).
FIG. 5.— ,, ,, (underside).
FIG. 8.—CALLOPHRYS RUBI ab. MINOR ♂ (androconial brand not clearly reproduced).
FIG. 9.—CALLOPHRYS RUBI ab. MINOR ♀.
Fig. 10.— ,, ,, ♀.
FIG. 11.— ,, ,, (underside).
FIG. 15.—STRYMON PRUNI ♂ (androconial brand lost in reproduction).
FIG. 16.— ,, ,, ♀.
FIG. 17.— ,, ,, ab. PROGRESSA ♀.
FIGS. 18-19.— ,, ,, (underside).
FIG. 20.—BITHYS QUERCÛS ♂.
FIG. 21.— ,, ,, ♀.
FIG. 22.— ,, ,, (underside).
FIG. 12.—RURALIS BETULÆ ♂.
FIG. 13.— ,, ,, ♀.
FIG. 6.— ,, ,, (underside).
FIG. 7.— ,, ,, ab. MAJOR ♂.
FIG. 14.— ,, ,, ,, ♀.

Superfamily II: RURALIDES (THECLIDES).

Family: Ruralidæ.

Subfamily: Ruralinæ (Theclinæ).

This subfamily, popularly known as the "hairstreaks," comprises within its limits some of the most attractive, as well as some of the most dingy, of the whole of the family *Ruralidae*. The "hairstreaks" have obtained their popular name from the delicate, transverse, striped markings, found on the underside of the wings. The forewings, usually, are remarkably square at the apex, and the hindwings are often provided with one, or even two, fine thread-like tails, whence the name *Armati* that Hübner gave them; the anal angle of the hindwings also is frequently lobed. Like the rest of the Ruralids, they have, generally, marked sexual characters exhibited in their colour or pattern, *e.g.*, *Ruralis betulae*, *Bithys quercûs*, etc., whilst other groups, *e.g.*, *Strymon w-album* and its allies, exhibit, in the ♂, a small, dull, oval spot near the middle of the costa of the forewing, which is filled with androconia, and frequently disturbs the regularity of the nervures at this point. Scudder remarks that the front of the face of the ♂ bears a kind of beard, a bristling tuft of hair-like scales, wanting or very thin in the ♀.

The Ruralines are delicate little butterflies, exceedingly active in their habits, and the freshness of their beauty is readily injured. Gosse says: "They are frisky little creatures, very fond of chasing each other through the air, and tumbling about with surprising quickness of evolution . . . . After a flight, they often return to the same spot from whence they departed, a projecting twig or the topmost leaf of a bush"; whilst Wallace, writing of the South American forms, says that "they all fly very quickly, and settle upon leaves and flowers with the wings erect; they have a very peculiar habit of moving the two lower wings over each other in opposite directions, giving the appearance of revolving discs." This latter habit is common to all the Ruralid tribes, some of the "blues" being particularly noted for this peculiarity. Many of the "hairstreaks" are also very fond of flowers, and the privet bushes in Fontainebleau Forest, covered with active greedy hordes of *Strymon ilicis* and *S. w-album*, are a sight worth seeing. *S. pruni* has the same habit in Barnwell Wold, whilst, on the saxifrage, umbellifer, and thyme flowers, in the alps of central Europe, *S. spini* is sometimes to be seen in dozens. We have also seen *Ruralis betulae* on the flowers of the great Umbellifers, at the foot of the Grand Salève, in the Visp Valley, and elsewhere. The habit of moving the hindwings alternately has been noted in Europe as well as America. Gosse, speaking of the Theclids in general, and *Strymon* (*Thecla*) *calanus* in particular, says (*Lett. Alab.*, p. 37) that, when at rest, they often rub the surfaces of the hindwings upon each other, up and down alternately.

The eggs of the Ruralines, as will be seen by reference to our plate ii, are of distinct Ruralid, and yet of quite specialised, character.

Comparison with plate iii of the preceding volume will show, not only characteristic differences from those of the Chrysophanids, but also distinctly less uniformity in type ; indeed, the differences between the Callophryid (*C. rubi*), Bithynid (*B. quercûs*), and Ruralid (*R. betulae*) eggs, both *inter se*, and, compared with the Strymonid eggs (*S. w-album*, *S. pruni*, etc.), are most marked, and those of the latter group are so peculiarly specialised that they have no very close similarity with those of any other butterflies, so that we see there is much less uniformity in the eggs of the "hairstreaks," than in those of the "coppers" and "blues." Scudder says that they are "echinoid-shaped, studded with numerous projections, connected by radiating ridges, and are laid singly." Doherty, who bestowed much attention to the study of the eggs of the Lycænids of India, subdivided (*Journal As. Soc. B.*, iv., p. 110) the *Ruralidae* or *Lycaenidae* into six groups, on the structure of the egg, the third subdivision, or *Theclinae*, being noted as having—

"The egg fully half as high as wide, convex above, widest close to the base, with coarse, minutely vesicular, reticulations, forming large irregular pits over the surface, and bearing broad depressed tubercles at their intersection."

General statements of this kind, however, give little idea of the remarkable structure exhibited by the eggs of *Strymon w-album*, *S. pruni*, *Laeosopis roboris*, etc. (see plate ii), and Chapman observes (*in litt.*) that the sculpture of the Ruralid eggs appears to be (at least in many, if not all, cases) formed by an outer foamy layer, the true egg within being smooth. This, he thinks, will prove to be the case also with *Limenitis*. Scudder's comparison of the eggs of the three main subfamilies of the Ruralids has already been given in the preceding volume, p. 317, and we may here draw attention to Chapman's statement that the Theclids have their elements more widely distinct than the Lycænids and Chrysophanids, the coppers coming much nearer to the "blues" than to the "hairstreaks;" *Callophrys rubi* and *Thestor ballus*, he says, are unquestionable Theclids; the separation between them and the other "hairstreaks" is an arbitrary boundary, that between them and the "coppers" is a broad neutral boundary, whose inhabitants we do not know. As bearing on this, we may note that, whilst most (if not all) of the Ruralid and Strymonid species go over the winter in the egg-stage, the Callophryids and Thestorids hybernate as pupæ.

The "hairstreak" larvæ have already been diagnosed and compared with those of the Lycænids and Chrysophanids (*op. cit.*, pp. 315 and 317), both in their first and last stadia. They are, perhaps, rather flatter than their nearest allies, and are said to feed chiefly on the leaves of trees and bushes, rarely on low herbaceous plants, but this is only true in part, for the Callophryid and Thestorid larvæ appear to prefer such. Some, however, bore into, and devour, the interior of fruits, for which purpose their marvellously developed neck (intersegmental membrane between head and prothorax) is particularly fitted ; one of the most remarkable of these is the well-known "pomegranate butterfly" (*Virachola isocrates*), described by Westwood (*Trans. Ent. Soc. Lond.*, ii., pp. 1-8, fig. 1), and discussed at length by Nicéville (*Butts. of India*, etc., iii., pp. 477-481). We have already stated (*suprà*) that most of the "hairstreaks" hybernate in the egg-stage, but the larvæ are quite fully-formed within the egg, and it would be as accurate

Plate II.

(To be bound facing Plate II.)

Eggs of Ruralines (Hairstreaks).

Fig. 1.—Thestor ballus on leaf of *Boujeania hirsuta.*
Fig. 2.—Callophrys rubi on leaf of „ „
Fig. 3.—Strymon pruni on twig of blackthorn.
Fig. 4.—Edwardsia w-album on twig of wych-elm.
Fig. 5.—Bithys quercûs on twig of oak.
Fig. 6.—Ruralis betulæ on twig of blackthorn.

All ×20 diameters.

(Photographs by A. E. Tonge.)

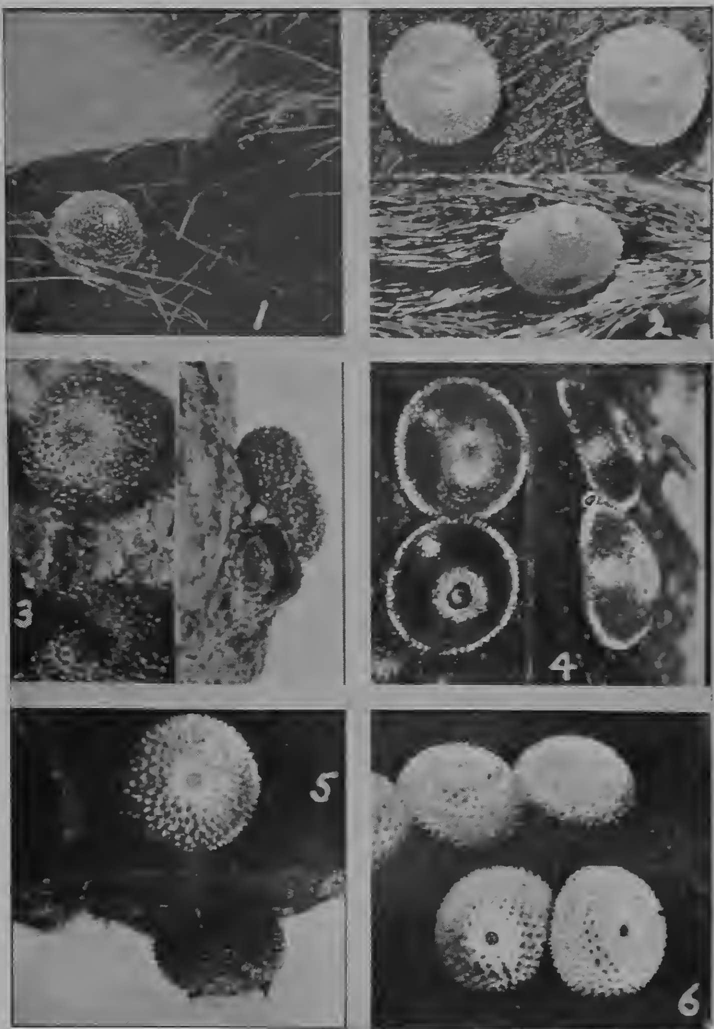


Photo. A. E. Tonge.

Eggs of British Ruralines (Hairstreaks).

The Natural History of British Butterflies, etc., 1907.

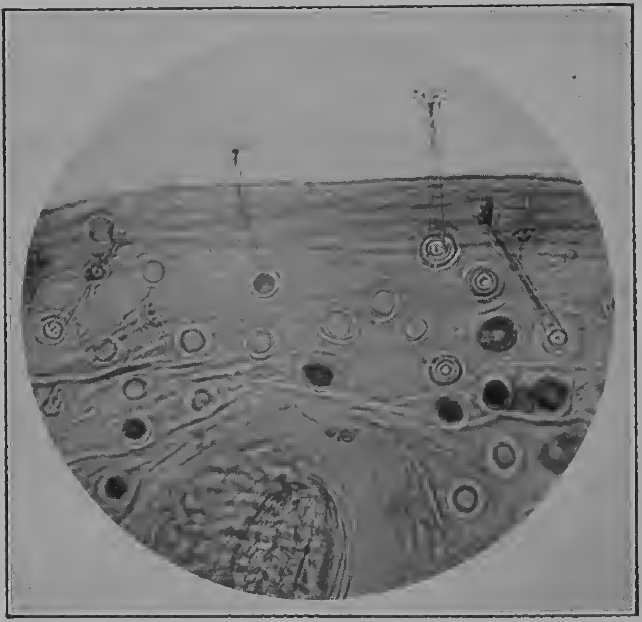


Photo. by F. N. Clark.

1.—Pupal skin and pupal hairs of Strymon w-album. Spiracular region of 3rd abdominal segment right side × 100.

2.—Pupal skin and pupal hairs of Bithys quercûs. Spiracular region of 2nd abdominal segment × 200.

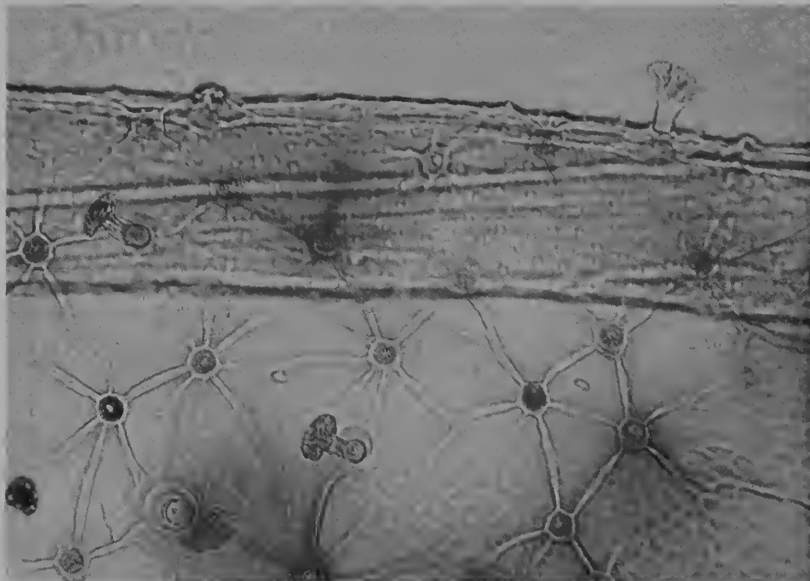


Photo. F. N. Clark.

Pupal skin and pupal hairs of Læosopis roboris, near dorsum of 5th abdominal segment $\times 200$.

Plate XV.

(*To be bound facing Plate XV.*)

Pupal skin and pupal hairs of Læosopis roboris, near dorsum of 5th abdominal segment.

Portion of pupal skin of *Laeosopis roboris* × 200.

Taken from front margin of 5th abdominal segment near dorsum. It shows the most typical fungiform hairs (like those in Chrysophanid pupæ, see vols. i., pls. x., xi., xiv.) yet met with in a Ruraline pupa, the next nearest being those of *Bithys quercûs* (see pl. iii., fig. 2), but these latter are merely ordinary hairs with somewhat developed tips. The fig. shows how the ribs of the network fail at the bases of these hairs, and how they are gathered up at the rosettes at their junctions. These rosettes have a rather elaborate central point, but no radiated structure in this species. The plate shows well, also, how the ribs of the netting divide down into the lines of the surface tessellation (a form of skin-points? or, perhaps, skin-points are rather those of the tessellation due to the dermal cells). It also shows, though not very clearly, how these tessellations towards the margin of the segment change their character to spicular skin-points.

to say that these species wintered as larvæ, only the larvæ are inside, and not outside, the egg-shell. For pupation, most of the larvæ suspend themselves by means of an anal pad and silken body-girth, but a few form delicate cocoons, and appear to do without attachment, *e.g.*, *Callophrys rubi*.

The pupa is of characteristic Ruralid form, short and squat, and has been compared with those of the Lycænids and Chrysophanids in the preceding volume, p. 317. The abundance of lenticles is one of the marked features of the pupa, and most show a highly-developed coating of hairs. There is, however, no such uniformity in these as was exhibited in the "trumpet-shaped" pupal hairs of the Chrysophanids (*anteà*, vol. viii., pls. x, xi, xii, xiv, xv) and the difference between the pupal hairs of *Strymon w-album* and *Bithys quercûs* is most marked (see pl. iii., figs. 1-2). It will be observed that those of the latter species have a genuine trumpet-shaped extremity, but small and more spiculate than in the Chrysophanids, and Chapman observes, that, "like the trumpet-hairs of the latter, they are smaller than the ordinary spiculate ones, *e.g.*, those of *B. quercûs* (fig. 2) are about one-third of the length of the spiculate hairs of *S. w-album* (fig. 1), *viz.*, 0·1mm. in *B. quercûs*, and 0·34mm. in *S. w-album*. In pl. iii., fig. 2, the region shown is near the spiracle, of which a portion is seen, of the 2nd abdominal segment. Five trumpet-hairs and a portion of a sixth appear on the plate. There also appear a number of lenticles, chitinous circles that look as if they ought to carry hairs, but have their lumen merely closed by a faintly dotted membrane. There are also two circles that are almost certainly bases of trumpet-hairs that have been broken away. In the pupa of *Bithys quercûs* these lenticles are very numerous near the spiracles, but very sparse elsewhere, the greater part of, for instance, this 2nd abdominal segment being occupied by the dark stellate points, with connecting ridges, that we saw so well-developed in the pupa of *Thestor ballus* (*Nat. Hist. of Brit. Lep.*, viii., p. 452, pl. xv). In plate iii., fig. 2, the area shown is so small that it does not extend outside the lenticular region of this spiracle, and may leave the impression that the lenticles are a more marked feature of the pupal skin than is really the case. Suggestive as these stellate points are of hairs, they do not here, any more than in the other pupæ examined, appear to belong to the same phylum as the hairs and lenticles, that always occur in the spaces between the ridges, which are attached to the stellate points, but invariably avoid hairs and lenticles. The magnification of pl. iii., fig. 1, is only half that of fig. 2, and the much greater size of the hairs of *Strymon w-album* is very evident. In the latter species, the pupal hairs are a fairly ordinary form of spiculate hair, yet their close relationship with the trumpet-hairs of *Bithys quercûs* is obvious, so that we cannot help concluding from the intermediate forms offered in that species, that the trumpet-hairs are modifications of ordinary spiculate hairs. The hairs in *Strymon w-album* are 0·3mm. to 0·35mm. long, are spiculate for their whole length, and end in a sharp point. We may, perhaps, fancy that there is just a tendency to the trumpet development, in the fact that many of the hairs are thicker at some distance from their extremities than near their bases. The abundance of lenticles round the spiracles is well-shown in the plate, and, the area being larger than in that of *B. quercûs*, there are also included some of the stellate points with their appended ribs, enough to illustrate, what is obvious on an examination of larger areas of the pupal skin, that these points are often connected together by their ribs, but that they always avoid any association with hairs or lenticles; this we found also to be the case in the other pupæ so far illustrated (see preceding volume). In the pupa of *S. w-album* the lenticles are freely distributed over the whole surface (except appendages), and the stellate points and ribs are correspondingly curtailed, differing, therefore, from *B. quercûs*, in which lenticles are abundant only near the spiracles." The most marked character, however, separating the Ruralid (Theclid) pupa from those of its allies is the obsolete 7th abdominal spiracle. In all other butterfly pupæ (including the Lycænids and Chrysophanids), the 8th abdominal spiracle only is obsolete, but, in the Ruralids (Theclids), the spiracles of both the 7th and 8th abdominal segments are obsolete. Of this Chapman writes (*in litt.*): "The few Theclid pupæ I have been able to examine agree in a character, which is quite new to me, not occurring in the pupa of any other group or even single species of which I haveany recollection. Of course, the pupæ I know are few, and, on this point, I have not examined more than a small proportion of these, so that the peculiarity may not really be rare. This peculiarity is the reduction of the spiracle of the 7th abdominal segment to obsolescence, as well as that of the 8th. It is curious that this shouid occur in the Theclids (*Ruralidi*), but not in the Chrysophanids (*Chrysophanidi*) or Lycænids (*Lycaenidi*). So far as I know, the 8th abdominal spiracle is obsolete in all lepidopterous pupæ, but, even in the remarkably modified pupa of *Heterogynis* ♀, the 7th remains functional. The remaining distinctions of Theclid from other Lycænid pupæ are largely matters of degree, and do not always hold good, so that the character now under consideration is a valuable as well as interesting one, whether it proves to apply to all Theclids or only to some one section of them."

Probably no group of the Ruralids is less thoroughly understood than this, and the order in which they are placed in Staudinger and Rebel's heterogeneous genera *Thecla* (*Cat.*, 3rd ed., pp. 69-70), and *Zephyrus* (pp. 70-71), is somewhat amazing. These two groups, no doubt, give a fair grip of the species in the tribes *Strymonidi* and *Ruralidi* respectively, but one wonders what *myrtale*, Klug, has in common with *sassanides* and *rhymnus*, between which it is placed, or whether, indeed, it is not a Callophryid or Thestorid. Bethune-Baker has already very carefully worked out (*Trans. Ent. Soc. Lond.*, 1892, pp. 27-31) the little group consisting of *lunulata*, Ersch., *sassanides*, Koll., *tengstroemi*, Ersch., *rhymnus*, Ev., and *sinensis*, Alph. (*pretiosa*, Staud.), and given us figures of their genitalia. This remarkable little group, the species of which are essentially Strymonid in their upperside facies, and exhibit on their underside many of the characteristic spotted markings of the Lycænids, or "blues," in hardly modified form, indicates clearly how the "hairstreak" markings of the underside are evolved from the ocellated markings of the allied tribes; indeed, because of this peculiar marking, Staudinger, in his earlier *Cat.*, 2nd ed., p. 7, placed one of them (*rhymnus*) with the "blues" in *Lycaena*, which position Bethune-Baker showed to be, on the structure of the ancillary organs, quite untenable.

It is unfortunate that de Nicéville, with his great wealth of material, did not give us some clue to the relationships of the various groups at present tumbled into *Zephyrus*. That *betulae* and *quercûs* belong to quite different sections of this tribe is certain, but only a close study of the more or less subtropical species to which they are allied can put the matter right. Nicéville's "Thecla group" (*Butts. of India*, iii., pp. 14 *et seq.*) contains apparently very divergent material, the Strymonids or Theclids proper, the Ruralids or Zephyrids, the Chrysophanids, and other allied groups. He says (*op. cit.*, p. 296): "The sixth division that I have made in the Indian *Lycaenidae*, I have called '*the Thecla* group,' and it contains eighteen genera, which may be divided into two subgroups, the first containing six genera, which, as a rule, possess one short tail to the hindwing from the termination of the first median nervule, though there are some exceptions, the tail being sometimes absent; the second, containing twelve genera, which all possess two short tails (under half-an-inch in length) to the hindwing in both sexes, though one aberrant genus, *Zesius*, Hb., has three tails in the ♀ . . . . The genera of the first subgroup are—*Thecla*, Fab., *Zephyrus*, Dalm., *Enaspa*, Moore, *Chaetoprocta*, Nicév., *Chrysophanus*, Hb., and *Ilerda*, Dbldy.; of the second subgroup—*Zesius*, Hb., *Dacalana*, Moore, *Arrhenothrix*, Nicév., *Camena*, Hew., *Maneca*, Nicév., *Mota*, Nicév., *Aphnaeus*, Hb., *Tajuria*, Moore, *Suasa*, Nicév., *Thamala*, Moore, *Hypolycaena*, Feld., and *Chliaria*, Moore." Such a grouping as this appears to be of very little value; it is quite clear that most of these genera are quite outside the subfamily *Ruralinae* as we understand it.

Scudder gives (*Butts. of New England*, ii., pp. 798-9) the following general diagnosis of the group:—

Imago.—Colour dark brown. Club of antennæ usually increasing in size throughout most of its extent, very long and very slender, from two to three times as broad as the stalk (occasionally a little more than that), and from five to eight times longer than broad. Patagia very long and slender, usually four or five times longer than broad; third superior subcostal nervure of forewings not forked; tarsi armed beneath with an irregular mass of spines on either side; fore tarsi of the ♂ armed at the tip with a pair of spines, only slightly larger and more curved than the others; paronychia of other legs simple; pulvillus small but prominent. Upper organ of ♂ abdominal appendages with very broad alations, expanded laterally rather than posteriorly; clasps straight, unarmed, tapering generally to a very delicate point; intromittent organ of exceptional length, apically flaring.

Ovum.—Tiarate, about equally truncate above and below, the flat or sunken portion of the upper surface, including, together with the micropylic pit, fully one-fourth, sometimes more than one-half, the diameter of the egg, regularly and very profusely studded with high and rather coarse prominences of varying character, connected by a lower, almost equally coarse, tracery, within which the pit-like cells are situated; micropylic pit very deep with steep walls.

Larva (newly-hatched).—Head smooth, distinctly narrower than the prothorax; thoracic and abdominal segments of about equal width; the hinder segment of the abdomen fused and fully twice as long as those immediately preceding it, furnished a little behind the middle with a large circular coriaceous depression; the prothorax similarly furnished with a lozenge-shaped, laterally-produced, coriaceous shield. Abdominal segments furnished with regular series of tall conical papillæ, bearing spiculiferous hairs, which extend to a certain extent upon the thoracic segments, but on them lose, in part, their serial character; on the abdominal segments there is always found a laterodorsal series, consisting of two or more, bearing long curving hairs directed, to a greater or less extent, backward; while beneath the spiracles is a compound series of from three to five longer and shorter, generally straight and outwardly directed, hairs. Between the laterodorsal series and the spiracles is a lateral series of smooth, hemispherical, naked lenticles, and on the last compound abdominal segment a curving series of four or five similar lenticles of unequal size.

Larva (adult).—Body slightly slenderer than in the other groups; segments scarcely prominent in any part; body covered with hairs, mostly very short, but at the laterodorsal ridge and the substigmatal fold they are two or three times longer, though still short.

PUPA.—Body shorter and stouter, and especially the whole abdomen fuller, than in the other tribes; dermal appendages consisting of cylindrical hairs, which are equal, tapering only at tip, profusely provided with minute spicules, which diverge at a slight angle from the stem.

For the purpose of this work we divide the Palæarctic *Ruralinae* into four tribes—the *Thestoridi*, the *Callophryidi*, the *Strymonidi*, and the *Ruralidi*. Of our British genera *Callophrys* falls in the second tribe, *Strymon* in the third, and *Ruralis* and *Bithys* in the fourth.

Scudder says that the subfamily is about equally represented in the Old and New Worlds; the same is true of the north temperate zones of the two regions considered apart; only one genus (*Strymon*), however, is common to both hemispheres. The tropics of the New World nourish the vast majority of the species most closely allied to those of Europe and North America.

Tribe: CALLOPHRYIDI.

Genus: CALLOPHRYS, Billberg.

SYNONYMY.—Genus: **Callophrys,** Billbg., "Enum.," etc., p. 80 (1820); Scudd., "Hist. Sketch. Gen.," p. 132 (1875); Tutt, "Brit. Butts.," p. 196 (1896); "Ent. Rec.," vii., pp. 220, 300 (1896); Kirby, "Handbook," etc., ii., p. 54 (1896); Grote, "Schmett. von Hildesheim," p. 41 (1897); Reuter, "Ent. Rec.," x., p. 97 (1898); Staud., "Cat.," 3rd ed., p. 70 (1901); Dyar, "List Nth. Amer. Lep.," p. 39 (1902); Lambil., "Pap. Belg.," p. 194 (1902); Wheeler, "Butts. Switz.," p. 46 (1903); South, "Butts. Brit. Isles," p. 147 (1906). [**Papilio-**] **Plebeius,** Linn., "Sys. Nat.," xth ed., p. 483 (1758). **Papilio,** Linn., "Faun. Suec.," 2nd ed., p. 284 (1761); Poda, "Ins. Mus. Graec.," p. 77 (1761); Scop., "Ent. Carn.," p. 176 (1763); Hufn., "Berl. Mag.," ii., pt. 1, p. 82 (1766); Schiff., "Schmett. Wien.," 1st ed., p. 186 (1775); Fuess., "Verz.," p. 31 (1775); Rott., "Naturg.," vi., p. 12 (1776); Müll., "Zool. Dan. Prod.," p. 112 (1776); Bergs., "Nomen.," p. 28, pl. xxii., figs. 8-9 (pl. xxxi., fig. 4) (1780); Retz., "Gen. Spec. Ins.," p. 245 (1783); Geoff., "Ent. Paris.," p. 245 (1785); Schneider, "Sys. Besch.," p. 225 (1785); Bkh., "Sys. Besch.," i., pp. 138, 267 (1788); ii., p. 218 (1789); Lang, "Verz.," p. 47 (1789); Brahm, "Ins.-Kal.," p. 227 (1791); Schwarz. "Raup.-Kal.," p. 47 (1791); Lewin, "Ins. Gt. Brit.," p. 92, pl. xliv., figs. 3-6 (1795); Hübn., "Eur. Schmett.," pl. lxxii., figs. 364-5 (1799); text, p. 55 (*circ.* 1805); fig. 786 (1823); "Raupen," etc., Pap. ii., Gens. A.c.d., figs. 1*a-c* (*circ.* 1800); Herbst, "Nat. Syst.," pt. xi., p. 110, pl. 308, figs. 5-6 (1804); Ochs., "Die Schmett.," i., pt. 2, p. 91 (1808). [**Papilio-Plebeius-**] **Ruralis,** Linn., "Sys. Nat.," xth ed., p. 791 (1767); Fab., "Sys. Ent.," p. 523 (1775); Sulz., "Abgek. Gesch. der Ins.," p. 36, pl. xviii., figs. 11-12 (1776); Goeze, "Ent. Beit.," p. 29 (1780); Fab., "Spec. Ins.," p. 121 (1781); "Mant. Ins.," p. 71 (1787); Bork., "Rhein. Mag.," i., p. 294 (1793); Haw., "Lep. Brit.," p. 39 (1803). [**Plebeius-**] **Ruralis,** Esp., "Schmett. Eur.," p. 279 (1779); pl. xxi., fig. 2 (1777); pl. xcviii. (contd. liii.), figs. 1-4 (1785). [**Papilio-**] **Ruralis,** De Vill., "Car. Linn. Ent. Fn. Suec.," p. 68 (1789). [**Hesperia-**] **Ruralis,** Fab., "Ent. Syst.," iii., pt. 1, p. 287 (1793). [**Papilio-**] **Hesperia,** Ill., "Schmett. Wien.," 2nd ed., p. 278 (1801). **Cupido,** Schrank, "Faun. Boica," ii., p. 218 (1801). **Polyommatus,** Latr., "Hist. Nat. Crust. Ins.," p. 117 (1805); "Gen. Crust. Ins.," iv., p. 207 (1809); "Enc. Méth.," ix., p. 673 (1819); Godt., "Hist. Nat.," p. 206, pl. x., fig. 3, pl. x *sec.*, fig. 5 (1821); Bdv., "Eur. Lep. Cat.," p. 10 (1829); Dup., "Cat. Méth.," p. 29 (1845). **Lycaena,** Fab., "Ill. Mag.," vi., p. 285 (1807); Leach, "Edin. Encyl.," ix., pt. 1, p. 129 (1815); Ochs., "Die Schmett.," iv., p. 27 (1816); R.L., "Jena. Allg. Lit. Zeit.," i., p. 280 (1817); Tr., "Die Schmett.," supp. x., p. 77 (1834); Zett., "Ins. Lapp.," p. 910 (1840); Evers., "Faun. Volg. Ural.," p. 65 (1844). **Hesperia,** Oken, "Lehrb. Zool.," pt. 2, p. 721 (1815). **Zephyrus,** Dalm., "Vet. Ak. Handl.," i., p. 94 (1816). **Heodes,** Dalm., "Vet. Ak. Handl.," i., p. 94 (1816). **Chrysoptera,** Zincken, "Allg. Lit. Zeit.," iii., p. 75 (1817). **Lycus,** Hb., "Verz.," p. 74 (1816-1818); Stphs., "Illus. Brit. Ent. Haust.," app. iv., p. 404 (1835); "List," p. 15 (1856); Dale, "Hist. Brit. Butts.," p. 44 (1890). **Thecla,** Sam., "Ent.

Comp.," p. 241 (1819); Stphs., "Illus. Brit. Ent. Haust.," i., p. 78 (1828); "Ins. Cat.," 1st ed., p. 21 (1829); Meig., "Eur. Schmett.," ii., p. 46 (1830); Wood, "Ind. Ent.," p. 7, pl. ii., fig. 55 (1839); Ramb., "Faun. And.," p. 259 (1839); Bdv., "Gen. et Ind. Meth.," i., p. 8 (1840); Humph. and Westd., "Brit. Butts.," i., p. 90 (1841); H.-Sch., "Sys. Bearb.," i., p. 135 (1843); Stphs., "List," 2nd ed., p. 78 (1850); West. and Hewits., "Diurn. Lep.," ii., p. 486 (1852); Led., "Verh. zool.-bot. Gesell.," p. 19 (1852); Wallgrn., "Skand. Dagf.," i., p. 189 (1853); Sta., "Man.," i., p. 54 (1857); Speyer, "Geog. Verb. Schmett.," i., p. 259 (1858); Ramb., "Cat. Lep. And.," p. 32 (1858); Dbldy., "Syn. Cat.," 2nd ed., p. 2 (1859); Hein., "Schmett. Deutsch.," p. 91 (1859); Staud., "Cat.," 1st ed., p. 3 (1861); Kirby, "Eur. Butts.," i., p. 87 (1862); Snell., "De Vlind.," i., p. 66 (1867); Nolck., "Lep. Fn. Estl.," ii., p. 52 (1868); Newm., "Brit. Butts.," p. 105 (1869); Kirby, "Syn. Cat.," i., p. 398 (1871); Staud., "Cat.," 2nd ed., p. 7 (1871); Curò, "Bull. Soc. Ent. It.," vi., p. 107 (1874); Kirby, "Eur. Butts.," p. 59, pl. xv., fig. 3 (1879); Frey, "Lep. Schw.," p. 11 (1880); Lang, "Butts. Eur.," p. 81, pl. xviii., fig. 3 (1884); Buckl., "Larvæ," etc., i., p. 89, pl. xiii., fig. 3 (1885); Kane, "Eur. Butts.," p. 24 (1885); Auriv., "Nord. Fjär.," i., p. 8, pl. vii., fig. 3 (1888-1891); Dale, "Hist. Brit. Butts.," p. 44 (1890); Barr., "Lep. Brit. Isles," i., p. 53, pl. viii., figs. 4-4*c* (1893); Rühl, "Pal. Gross-Schmett.," pp. 195, 740 (1895); Meyr., "Handbook," etc., pp. 195, 740 (1895).

The group in which *rubi* was placed by Hübner he named *Lyci* (*Verzeichniss*, pp. 73-4), and this formed the first coitus of his *Armati* or "hairstreaks" proper. The genus *Lycus*, however, was preoccupied in coleoptera, and hence let in Billberg's genus *Callophrys*. Billberg gives (*Enumer. Ins.*, p. 80) *vulcanus*, *rubi*, and a MS. species as belonging to his genus *Callophrys*. In 1875, Scudder (*Hist. Sketch*, p. 132) restricted the genus, naming *rubi* the type. Kirby (*Handbook*, etc., ii., p. 54) accepts the limitation, and notes that "the genus differs from the other European Theclids by the absence of a tail, though there is a slight notch before the anal angle of the hindwings." There is only one Palæarctic species in the genus, *viz.*, *rubi*, Linné, but Dyar gives four Nearctic species, *viz.*, *affinis*, Edw. (Utah), *dumetorum*, Bdv. (Rocky Mountains, California), *apama*, Edw. (Arizona), and *sheridanii*, Edw. (Rocky Mountains). There can be little doubt of the close alliance of the Callophryids (as represented by *C. rubi*) and the Thestorids (as represented by *T. ballus*). It is, indeed, quite possible that they have a close tribal relationship.

Chapman discusses this (*in litt.*) as follows: "The close association of *Callophrys rubi* with *Thestor ballus*, evidenced by (1) the coloration of the imago, (2) the close similarity, more than identity of type, of the ancillary appendages, (3) the habits, and other items, appears to hold as regards the eggs. The eggs are, nevertheless, considerably different from each other. They agree in having a large part of the eggshell proper exposed. The adventitious coat that forms the great feature of the mass of Lycænid eggs, is much reduced. In *C. rubi* it is of an ordinary Theclid or Lycænid design, *viz.*, a hexagonal, or rather triangular, network of ribs, with raised knobs at the intersections, but the ribs are low and narrow, and expose, in their meshes, much of the true eggshell. In *T. ballus* the knobs at the intersections are absent, the meshes rather more irregular, and the spaces even wider, so much so that one's inclination is to regard the ribs as not belonging to an adventitious coating, but to be structural elements of the eggshell proper. Indeed, one cannot be positive that this is not so, and it may be that, in all Lycænids, the adventitious coat is built up on an actual ribbing of the true eggshell. Our present point, however, is, that, if the knobs of *C. rubi* could be removed, we should have an egg-shell very like that of *T. ballus*, a result that would not obtain by a similar process in other Lycænid eggs. This is very evident if the underside of the egg of *C. rubi* be examined; there are no knobs here, and the resemblance to *T. ballus* is very strong." He further notes: "The Callophryid larva differs chiefly from those of the other Lycænids examined, in that the hairs above the spiracles are well-developed, smaller, *i.e.*, shorter than the others (setæ on tubercles i, ii, etc.), but still not far from them, as it were of the same series, instead of being very small, or even mere clubs, as is usual." In comparing the pupæ of these species with those of other Ruralids (Theclids) and Chrysophanids, Chapman writes (*in litt.*): "The pupa of *C. rubi* presents the remarkable character of having the 7th abdominal spiracles obsolete as well as the 8th. So far as my (too few) observations go, this is a Theclid character, and does not occur in Chrysophanids or Lycænids, which have only the 8th obsolete, as is the rule in lepidopterous pupæ. Another most interesting point is the origin of the cremastral hooks from the raised points of the surface-network. I supposed this must be a rule in the Lycænids, and asked myself why I had never noticed it before. On going over some specimens, I find that the hooks in *Chrysophanus* arise from a smooth surface, from which all skin sculpture has disappeared. *Strymon w-album* has the hooks abundant, but equally separate from the general sculpture. *Bithys quercûs* has no hooks, and so on. In *T. ballus* only do I find a similar condition. *T. ballus* has no cremastral hooks, but the proper area is covered by the usual network sculpture, with the uniting points. A certain number of these points afford very short batons, about 0·02mm. to 0·04mm. in length, which are no doubt obsolete cremastral hooks. The remarkable conclusion from this observation is that the cremastral hairs are not ordinary hairs modified, but are a modification of a structure that, in the Lycænids at any rate, provides no other description of hair. As regards the ordinary hairs of *C. rubi*, they are almost the same, both in size and structure, as those of *Strymon w-album*, but are much more numerous. Those of *Bithys quercûs* differ by having expanded tips, as if almost belonging to the "umbrella series" (see *Nat. Hist. Brit. Lep.*, pls. x, xi, xii, xiv). *C. rubi* agrees with these in the surface network and connecting points being of very similar size and arrangement. *T. ballus* differs in having the lines of network comparatively very broad, and the skin-points very large and of a stellate structure; at the same time the hairs are apparently absent, really they exist, but are barely 0·01mm. in length. *T. ballus* and *C. rubi* agree in having a pupa that hybernates, and does so underground. The others all have summer pupæ. It would appear that *C. rubi* and *T. ballus* took quite different methods of meeting the dangers of a winter underground. *T. ballus* got rid of hairs and developed the mail-plating of the pupa-skin; *C. rubi*, on the contrary, developed an additional supply of hairs. This difference probably has some relation to *T. ballus* affecting southern dry situations; *C. rubi* being more northern, and, where they overlap, selecting more shady damp situations." As showing further alliance between *Callophrys* and *Thestor*, Chapman notes (*in litt.*) of the ♂ genital appendages: "*Thestor* (*ballus*) and *Callophrys* (*rubi*) are really very close together, and very near to these

LIFE-HISTORY OF CALLOPHRYS RUBI.

Photo. H. Main and A. E. Tonge.

Plate IV.

(To be bound facing Plate IV.)

Callophrys rubi.

Fig. 1.—Ova *in sitû* on *Boujeania hirsuta* ×10.
Fig. 2.—Larvæ on foodplant ×1.
Fig. 3.— „ „ „ ×1.
Fig. 4.—Larva feeding ×1.
Fig. 5.— „ (lateral view) ×1.
Fig. 6.—Pupa (dorsal view) ×2.
Fig. 7.— „ (ventral view) ×2.
Fig. 8.—Imago ♂ ×1.

(Figs. 1, 2, 3, 8 by A. E. Tonge, the others by H. Main.)

come *Strymon pruni* and *S. w-album*. *S. pruni* comes nearer *C. rubi*, perhaps, than *S. w-album* does, at any rate, it is near *S. w-album*. Then at a little distance come the *ilicis*, *acaciae*, and *spini* group. Then, after a wider interval, *Bithys* (*quercûs*), and further on—still further from *quercûs* than *quercûs* from *ilicis*—come *Ruralis* (*betulae*) and *Laeosopis* (*roboris*), these two being much nearer to each other than their wing patterns suggest." Chapman adds that "It does not follow that a correct arrangement will be in line like this, with either end first, but it does give a probably fair measure of the distance apart (from each other) of the several species."

The genus *Callophrys* appears never yet to have been thoroughly described. We are, therefore, greatly indebted to Mr. G. Bethune-Baker for the following diagnosis:—

Imago.—Head largish, thickly clothed with broadish scales, interspersed with many long fine hairs. Face nearly flat, projected slightly in front of the eyes, moderately broad, vertex with a tuft of curved hairs projecting over the sockets of the antennæ. Eyes moderately large and prominent, hairy. Antennæ shortish, inserted at the apex on the outer margin, the full width of the face between them, ending in a gradually tapered club Palpi slender, porrect, not as long as the head, second segment thickly scaled with long hairs below, end segment half as long as the second, smoothly scaled. Patagia long and slender, rather narrow, tapering rapidly for the apical half; hairs long, silky, recumbent. Primaries one-third longer than broad, costa deeply and sharply arched at the base, then straight to the apex, which is very shortly and very slightly depressed; termen with a slight even curve from apex to tornus, inner margin slightly excised about the centre. Neuration: vein 2 from well in front of the lower angle, 3 from just in front of the angle, 4 from the angle, 5 from the middle of the discocellulars, 6 and 7 from the upper angle; in the ♂ vein 7 extends into the apex, in the ♀ it extends to the costa just before the apex, 8 and 9 absent, 10 from the cell near the angle, 11 from about the middle of the cell, 12 a little longer than the cell. Cell broad, not half the length of the wing. Secondaries broad, costa slightly flattened, termen evenly rounded. Neuration, two internal veins, 3 and 4 from the lower angle of the cell, 5 from just above the middle of the discocellulars, 7 from behind the upper angle, *i.e.*, from the cell, 8 short, very highly and suddenly arched near the base towards the costa, with a slight recurve near its end. Legs— ♂ fore tarsi longer than the tibiæ, terminating in a single hook; ♀ about the same length as the fore tibiæ, terminating as the other legs. Mid-tarsi in ♂ nearly twice as long as the tibiæ, armed for the whole length with short fine spines; ♀ tarsi not so long. Tibiæ in both sexes with a pair of short spurs. Hindlegs in both sexes with tarsi longer than tibiæ, armed with fine spines for the whole length; tibiæ with a pair of minute terminal spurs. All the femora heavily haired; tibiæ and tarsi finely and densely scaled. *Genitalia*: Allied on the whole to those of *Strymon w-album*. Clasps of a long wedge shape, tapering gradually to a blunt point. Girdle very broad, rather short, strongly curved forwards, united with an ample tegumen, which has strong long falces, very sharply curved about a third from the coupling joint. Penis-sheath very long and narrow, of almost even width for its whole length, with the orifice very slightly expanded.

Callophrys rubi, Linné.

Synonymy.—Species: **Rubi,** Linn., "Syst. Nat.," xth ed., p. 483 (1758); "Faun. Suec.," 2nd ed., p. 284 (1761); Poda, "Ins. Mus. Graec.," p. 77 (1761); Scop., "Ent. Carn.," p. 176 (1763); Hufn., "Berl. Mag.," ii., pt. 1, p. 82 (1766); Linn., "Syst. Nat.," xiith ed., p. 791 (1767); Fab., "Sys. Ent.," p. 523 (1775); Schiff., "Schmett. Wien.," 1st ed., p. 186 (1775); Fuess., "Verz.," p. 31 (1775); Harris, "Eng. Lep.," p. 2 (1775); Sulz., "Abgek. Gesch. der Ins.," p. 36, pl. xviii., figs. 11-12 (1776); Rott., "Naturf.," vi., p. 12 (1776); Müll., "Zool. Dan. Prod.," p. 112 (1776); Esp., "Schmett. Eur.," pl. xxi., fig. 2 (1777); pl. xcviii. (contd. liii.), figs. 1-4 (1785); Goeze, "Ent. Beit.," p. 29 (1780); Bergs., "Nomen.," p. 28, pl. xxii., figs. 8-9 (1780), etc. **Caecus,** Geoff., "Fourcroy's Ent. Paris.," p. 245 (1785). [N.B.—All other references mentioned under the generic synonymy (*anteà*, pp. 86-87) are referable to *rubi*.]

Original description.—*Papilio Plebeius rubi.* Alis dentato-subcaudatis; supra fuscis, subtus viridibus. [*Fn. Suec.*, 806. Alb., *Ins.*, t. 5, f. 8. Wilk., *Pap.*, 62, t. i*a*, 2. Pet., *Gaz.*, t. 2, f. 11. Habitat in *Rubo aculeato.* Papilio hexapus, alis rotundatis integerrimis; subtus viridibus immaculatis. It. Oel. 7. [Papilio argo similis, alis immaculatis supra cyaneis. Pet., *Gaz.*, p. 6, t. 2, f. 11.] Papilio minor; superne fuscus, inferne viridis.] Descr. Corpus cinereum. Antennæ et pedes nigri annulis numerosis albis. Alæ supra fusco-nigricantes, subtus virides, in alis secundariis, juxta marginem superiorem, punctum album. Oculi ante et postice lineola alba notati. Magnitudo argi (Linné).

Imago.—Anterior wings, 23mm.-33mm. in expanse; unicolorous fuliginous-brown, with black nervures; the androconial brand variable; sometimes trace of orange marginal line near anal angle; the fringes of almost the same tint as the ground colour. Posterior wings of the same ground colour, with crenate outer margin, slightly extended to form anal tail; hind margin finely bordered with dark; fringes in crenulations pale, with dark patches at end of nervures. Underside of all wings green, with a more or less incomplete transverse row of white spots crossing both wings just beyond the middle; sometimes slight trace of white median spot; outer margin of hindwings sometimes edged narrowly with brownish-orange, extending at ends of nervures into fringe; the fringe in the marginal crenulations white or whitish; the anal tip with tuft of darker scales.

Sexual dimorphism.—There is no difference in the colour of the sexes, nor markedly in the shape, although the body of the ♀ appears a trifle stumpier than that of the ♂, and the abdomen is markedly heavier. The ♂, however, is characterised by the presence of a small oval area, filled with specialised androconial scales, placed just within the apical corner of the median cell, as in the Strymonid species. Compared with these Aurivillius says (*Bidrag Sv. Vet. Ak. Handl.*, v., p. 22) "the scales are somewhat broader and shorter, but have the same oblique base and even edge. As in the other species, the wing-membrane is, at the position of the spot, concave on the upper, and convex on the under, side. The similarity of the androconial scales in *w-album*, *pruni*, *rubi*, etc., to ordinary scales, leads one to suppose that the allied species, in which the former have not yet been discovered, may possess such, having been hitherto overlooked because of the similarity." Among our British examples are some with the androconial patch quite black, others greyish-brown, and almost lost in the ground-colour, others quite whitish; the palest we have ever seen characterised a specimen taken at Chattenden, May 19th, 1888, which is of a quite whitish-ochreous tint, and was taken with other examples quite normal in this respect. Of three ♂ specimens, bred February 26th-28th, 1907, one has the "brand" black and dull, another black but shining, whilst a third has it so bright and shining, that, though really black, one would sometimes say it was white. All the specimens are of a brownish ground colour, thus showing up the brand strongly. The androconial brand, therefore, is usually black, but sometimes pale or almost white, but the latter only in some lights. The patch consists of black scales with rounded ends, unlike the other scales, which have serrated ends. A specimen with nearly white patch (in some lights), which presented the pale colour when freshly emerged from the pupa as well as when preserved, showed the tips of these black (?) scales, and sometimes the whole length of the scales, to be devoid of colour (not white), so that sometimes their want of colour showed white, in other aspects the underlying black seen through the transparent scale ends, gave nearly the ordinary tone. These round-ended scales seem to be the androconial ones, as no tasselled or other special forms appear to be mixed with them (Chapman). Blachier observes (*in litt.*) that he has a ♂, taken near Geneva, in which the androconial mark is of a very clear and distinct yellow-ochre colour; this spot, of which the outline is very marked, contrasts strongly with the ground colour; a second example also taken near Geneva, has the mark normal on the left side, and of a clear yellow-ochre colour on the right. A ♂ from Morocco has this spot very black and dense, as also the nervures, and, as the ground colour is of a warm reddish-brown (var. *fervida*) and slightly iridiscent, this spot and the nervures are very conspicuous. Pierce observes (*in litt.*) that the ordinary scales of the fore-wings of the ♂ are four- and five-pointed, ·002in. wide, ·008in. long. The ♀ has similar scales, but whilst they are of the same width, they are about ·006in. long. The androconial patch contains the scales tightly packed together. He further notes (*Ent.*, xxxix., p. 89) that the androconial scales in this patch are readily lost, and observes that, in many specimens, selected for the cabinet on account of the conspicuousness of the spot, one will find that all the androconial scales have been shed, leaving the ordinary scales quite perfect. The androconial scales are rounded at the tips, gradually getting broader towards the base, when they round off to the stalk; ·004in. long, ·001in. wide. On the underside of the wings the scales of both ♂ s and ♀ s are four-pointed, with occasional scales that appear to be halved—otherwise almost peculiar to *Strymon pruni*, *S. w-album*, etc.

Variation.—The androconial mark as just noted is one of the most striking characters in ordinary variation, being usually dark, but occasionally quite pale. This, undoubtedly, is what Wheeler refers to (*Butts. Switz.*, p. 46) when he says: "An aberration with the 'bare' patches on the upperside of forewings ochreous, was taken at Veyrier, by Professor Blachier, who has another (from Morocco) in which they are dark brown (see *suprà*)." There is considerable variation in the size of specimens, apart from sex, and apart from locality, our largest and smallest specimens both coming from Carqueiranne, in the neighbourhood of Hyères, and measuring 36mm. and 23mm. respectively, the average, however, falls between 25mm. and 32mm., those below 25mm. we should certainly consider ab. *minor*, those above 32mm., ab. *major*. [The measurements are made from centre of thorax to apex of wing, and then doubled.] The ground colour of the upperside varies quite distinctly from a somewhat sooty or black tint = var. *suffusa*, through fuscous-brown = the type, to a warm reddish-brown = var. *fervida*, the northern examples being essentially of the fuscous tint, the most southern (from North Africa) of the red-brown. Those from the warmer parts of southern Europe are distinctly intermediate = var. *intermedia*, with a leaning towards the redder tone of var. *fervida*, which is, in some instances, very fully reached. There is some little overlapping, and specimens of the real fuscous tint of the northern type rarely occur in the south, whilst those of the red-brown hue of *fervida* certainly do not appear in the far north. There is also considerable variation in the development of the tail at the anal angle of the hindwings, and in the tail-like extension of the next nervure. Traces of an obsolete outer marginal orange line towards the anal angle of the hindwing are also observable in some specimens. Reverdin mentions (*in litt.*), a ♀, taken near Geneva, with pure white fringes to all the wings, and a small tawny line, 5mm. in length, well-marked, just above the fringes, towards the anal angle of the hind-wings. The fringes vary considerably from being almost uniform with the ground colour to almost pure white, those of the hindwings, as a rule, being lighter than those of the forewings. A very distinct greenish tinge on the costal half of the hindwing is also occasionally observable in some lights. On the underside, the tint of the green varies considerably, that of some being much more brilliant than others. Reuter notes two examples, one from Gamla Karleby and the other from Russian Karelia as bluish-green = ab. *caerulescens*. There is also sometimes a fairly well-developed narrow marginal edge to the hindwings, orange in colour, which is occasionally continued upon the forewings, and appears as a base to the fringes. The quantity of white spotting on the underside of the wings varies greatly. Blachier notes that, at Geneva, the following forms appear :

1. Row of silvery spots well marked on all four wings (very rare).
2. Row of silvery spots on the hindwings only (less rare).
3. Only two silvery spots on the hindwings, one at the costa, the other towards the middle of the wing (common in both sexes).
4. Only a single point, *viz.*, on the costa of the hindwings (not rare).

This latter is, of course, the type form, so far as the spotting is concerned, for Linné says in his description "hindwing beneath green, a white spot near the upper margin." Blachier says that he has never taken the true *caecus* at Geneva. The variation in the white spotting appears to be quite independent of locality, some of the most, and some of the least, marked specimens, in this direction, in our cabinet coming from Carqueiranne. On the whole, however, we should suppose the extreme forms in both directions to be rare. We would distinguish the most marked forms as follows :

1.—Well-developed rows of white spots on all four wings (usually three on forewings and seven on hindwings) = ab. *punctata*, n. ab.

2.—Well-developed row of white spots on hindwings only = ab. *inferopunctata*, n. ab.

3.—Incomplete row of white spots on hindwings = ab. *incompleta*, n. ab.

4.—Two white spots only on hindwings, one at costa, one towards centre of ordinary row = ab. *bipunctata*, n. ab.

5.—One white spot only on hindwings, *viz.*, at costa = *rubi*, Linné.

6.—With no white spots on fore- or hindwings = ab. *caecus*, Geoff.

We are quite aware there are other intermediate forms not noticed here, and we have one example in which the white spots form a continuous line on the hindwings and almost so on the centre of forewings = ab. *connexa*, n. ab. Stephens notes (*Illus. Brit. Ent.*, i., p. 78) a var. β, which he describes as having "the anterior wings with a row of white dots beneath on the costa; the posterior with a strong continuous series, forming a streak." There are sometimes distinct traces of a median discal white spot on the underside of both fore- and hindwings. Chapman observes that, "in the Riviera, a large percentage of the specimens are almost *caecus*, having only one spot on the costa of the hindwing, and this seems to be really the type of the Rivieran race." These examples are also usually of the *intermedia* form in ground colour, and one obtains in southern France, etc., *intermedia-punctata*, *intermedia-inferopunctata*, *intermedia-incompleta*, *intermedia-*

bipunctata, *intermedia-typica*, and *intermedia-caecus* just as, in Algeria, we get *fervida-punctata*, etc., and in Asia, *suffusa-punctata*, etc. Newman states (*Brit. Butts.*, p. 105) that, "in some specimens, the series of white spots is tolerably consecutive across all the wings, and every gradation may be found between such a consecutive series, and a solitary white spot on the costal margin of the hindwings." Barrett says that "specimens from the north of England have the white line on the underside unusually pronounced." Kane says that, "in the Irish specimens, the series of white streaks on the underside of the hindwings is usually wanting wholly or in part, often represented only by a single one on the costa." Bankes observes (*in litt.*) that, on the underside, Dorset specimens appear never to show any white spots on the forewing, and often only a single spot on the hindwing, nor has he seen one with a full series of these spots right across the latter. He adds: "My Arran examples, however, mostly show such a series across the hindwing, and a considerable proportion of them have a similar row of white spots across the green portion of the forewing. In one specimen, from Cannock Chase, there is a full row across the hindwing, and two or three rather faint white spots on the forewing, but Mr. F. C. Woodforde tells me that such a strongly-spotted form is rare in that district." In Algeria, there seems to be some considerable local variation in this direction, for Oberthür says (*Faun. Lép. Alg.*, i., p. 20) that "the form captured at Collo and Oran in March is remarkable in that the white line below is very distinct, wider, and more strongly marked than in French examples," whilst, "at Sebdou, Codet found (*Lép. d'Algérie*, vi., p. 48) scarcely any trace of the white line; yet, on the other hand, in almost all the examples taken near Algiers by Allard and David, the white band of the hindwings is particularly well-developed," as noted above. Specimens taken by Miss Fountaine near Algiers, in March, 1902, are all undoubted *fervida*. The examples are somewhat smaller and redder, and the fringes reddish instead of whitish; the undersides also are of a more reddish tint, and the green is of a decidedly less metallic and somewhat duller hue; the white markings are, in these examples, somewhat ill-developed. Rambur notes (*Cat. Lép. And.*, p. 32) that the Andalusian examples are distinguished by the ochreous tint of their forewings and by the continuity of the white line on the undersides of the hindwings; the last joint of the palpi is also shorter. Beadle says that the specimens from Ullock Moss, in Cumberland, are suffused on the upperside with ochre-coloured scales. Frey states (*Lep. der Schweiz*, p. 11) that the species does not vary either in the mountains of Switzerland, or in those of Norway. Fuchs objects to this (*Jahrb. Nass. Ver. Naturk.*, xliv., pp. 211 *et seq.*) and states that this only means that the specimens from the Swiss lowlands do not differ from those of the mountains and those from Norway in any important particulars; but a Finnish ♀ in his possession was as small as the two smallest that he took in his own district (Lennig), and was well spotted, the forewing only 12mm. in length, as against the average of 14mm.-14·5mm.; the extension at the anal angle is obsolete; the colour of the upperside dark greyish-brown, with no tendency to the yellowish of the German examples, and quite devoid of lustre. The fringes are darker, their base deep blackish-brown (especially below), so that the wings appear bordered. The underside colour is dingy, and it has only one dot on the hindwings, just below the costa (see also p. 129). Rondou states that, in the Pyrenees, at

Collioure, a very small race occurs, and Elwes adds that these Collioure specimens have a remarkably well-developed line of white spots on the underside of the hindwings. The undersides of the wings are occasionally brown instead of green (=ab. *brunnea*, Tutt, *Brit. Butts.*, p. 196). This condition can be brought about artificially by exposure to excessive moisture, and Barrett states that, when the insect newly emerges from the chrysalis, it shows no trace of green on the underside, the latter being golden-brown as is the colour of the upperside, the green developing as the wings expand. Hodgkinson notes a specimen taken at Witherslack, May 11th, with the underside of the hindwings brown, as in *Strymon pruni*. South describes an example taken by Dillon, at Clonbrock, in early June, 1893, as having "the forewings rather narrower than in typical specimens; the upper surface of all the wings fuliginous-brown, and the under surface entirely without the usual green coloration; the white macular line or band very distinct and regular; the sexual mark hardly paler than the ground colour, and very obscure." Blachier describes (*in litt.*) a strange aberration taken at Digne, on May 16th, 1906. The underside of the forewings of an uniform blackish- or very dark olive-grey; the inner margin of the forewings of a paler shade. According to the degree of the incidence of the light falling on it, the nervures of the forewings, especially near the apex and outer margin, stand out in a shiny emerald green tint. Two white points only on the hindwings, one on the costa, the other lower, between nervures 2 and 3. The upperside is very pale brown, slightly reddish, with the androconial spot dense, and of a deep black tint. The following appear to be the only described forms:

α. ab. *pallida*, n. ab. *Rubi*, Mill., "Ann. Soc. Ent. Fr.," p. 216 (1887).—A remarkable example of this species, in perfect condition, was captured on April 5th, 1887, at Cannes, near the Hôtel des Pins, by Madame M. Texier. It is of the same form, size, and wing-outline as the type, but the wings above are of an uniform, very warm, tawny-yellow, less so at the base and below the costa which is pointed with grey. The fringe is quite white on all four wings. The whole of the body, above, participates in the abnormal colour of the wings. These, below, would be of a lively flesh-colour, were they not shot with pale watery-green, particularly at the base. The fringes are, here, of a very undecided golden tint. On the hindwings are three very small white dots, scarcely visible, situated towards the centre and in line. The antennæ are fringed with white and terminated with a lengthened club of a dull purple; the abdomen and the legs are greyish-white (Millière).

It is possible that this specimen should be put among our pathological examples. From the description one suspects it to be an individual in which the pallid patches usually confined to limited areas of the wing, have spread over the whole wing-surfaces, producing an uniform tint.

β. ab. *caecus*, Geoff., "Fourc. Ent. Paris.," ii., pp. 245 (1785). *Immaculata*, Fuchs, "Jahrb. Nass. Ver. Naturk.," xliv., pp. 211 *et seq.* (1891); Rühl, "Pal. Gross-Schmett.," pp. 196, 740 (1895); Tutt, "Brit. Butts.," pp. 196-7 (1896); Wheeler, "Butts. Switz.," p. 46 (1903).—*P. caecus.* L'Argus verte, ou l'Argus aveugle. Long. 6 lig. Larg. 14 lig. P. alis rotundatis integerrimis, subtus viridibus immaculatis (Geoffroy).—Hindwings beneath uniform green, quite spotless; two ♂s from here, one inclining to a yellowish tint above. The observation that this almost universally distributed species varies in the number of white dots on the underside of the hindwings, is not new. Of thirteen examples in my collection—one ♂ from Oberursel, eleven ♂s and ♀s from here (Nassau), and one ♀ from Bodö—I find only four, two ♂s and two ♀s, which have a completely developed row of white dots beyond the middle of the hindwings. In one ♀ (from Nassau) there are seven, the maximum number possible, *viz.*, a dot in each cell; the seven dots vary in shape and size—the first, below the costa, is distinct and roundish, the two next small and indistinct, the next rather larger, the remainder (three) increase in size and alter in shape, being oval and more parallel to the hindmargin, the middle one of the three is the largest, and, as well as the last of all, almost lunular, and so placed, that the curve is towards the base. Some specimens (two) have also three indistinct whitish dots on the forewings as a continuation of the row on the hindwings, placed beyond the centre and towards the middle of the wing, the inner marginal and costal areas remaining quite free. So far as my collection goes, specimens with a fully developed row of spots are rare. The constant tendency to a deficiency of spots operates in a definite manner, *e.g.*, the loss of the two below the topmost (costal) dot, then the one below these, then the one at the anal angle, so that we may find specimens with four, three, or two white dots, in the latter case the costal one, and the one in the second place before the anal angle (this in the form of a very contracted lunule, or merely a white dot). It is not surprising that there should be, in those with incomplete series, a reduction of size in the remaining dots, corresponding with their increasing fewness, but the degradation is not always uniform, and specimens may have only two spots yet both well-developed. Finally, there are specimens in which all the spots have disappeared except the costal one of the hindwing; this alone remains in three out of the thirteen in my collection, in one ♂ from Oberursel, at the foot of the Altkönig, one ♀ from Nassau, and one ♀ from Bodö—specimens from indefinitely distant localities, showing that the diminution is not due to cold, but is of uncertain origin, and only an individual peculiarity. The last described specimens come nearest to ab. *immaculata*, but are not it, this last spot also being absent in this aberration, the hindwings being completely spotless beneath; the name is to be applied literally, and not to those specimens which, although very markedly different from those in which the series of white dots is complete, still have one or more spots present (Fuchs).

Fuchs' remarks show clearly that he had no knowledge, when he was writing this, that the form with the single white costal spot on the hindwings was that described by Linné, as the type, or that the spotless form had been previously named by Geoffroy. On the whole the extreme form without any white spots is rare. Zetterstedt reports having taken a pair of *rubi*, *in copulâ*, in Lapland, the ♂ of the form *caecus*, the ♀ with a striga of more or less obsolete and interrupted white spots crossing the hindwings. Verity says that the ab. *caecus* (*immaculata*) is rare in Lucca, in Italy, in May and June. He notes also one example from Camaldoli. Blachier writes that he has never observed it in the neighbourhood of Geneva. Caradja notes it as occurring rarely among more typical forms throughout Roumania. Dupont states that, in the Pont de l'Arche district, in the Eure dept., the specimens all belong to the ab. *caecus* (*immaculata*), which, therefore, here becomes a local race and not a mere aberration. Rebel also notes that most of the examples from Stolac, in Hercegovina, are of this form. At Dresden, Winckler says that the form occurs rarely among the type; whilst Wheeler records it in Switzerland from the Rochers de Naye and Vacallo. Muschamp says that it is fairly abundant in Majorca. In Britain it somewhat rarely occurs, *e.g.*, Hodgkinson notes one from Witherslack, with the spots on the hindwings entirely absent, etc., and one suspects that it occasionally occurs throughout, at least, the greater part of its European range. [Keynes says that at Lahr, in May, 1906, he took many approaching ab. *immaculata*, by which we presume is meant not *caecus*, but the one-spotted Linnean type.]

γ. var. *borealis*, [Moesch.,] Kroul., "Bull. Soc. Imp. Nat. Mosc.," iv. (new series), pp. 217-8 (1890). *Polaris* [Gerh.], Kroul., "Soc. Ent.," vii., p. 164 (1893); Rühl, "Pal. Gross-Schmett.," p. 196 (1895).—The examples of this species, taken in the Govt. of Kasan, differ only from the type, in the undersurface of the wings being of a rather more yellowish-green, and the ordinary white spots on the underside of the hindwings generally absent. The average size is, perhaps, also a little less. The insect first appears here in the middle of April and disappears at the end of May, or early June (Kroulikowsky).

This eastern Russian form is also reported, by Kroulikowsky, as occurring rarely throughout the govt. of Wiatka, in May. We have been unable to trace Moeschler's name *borealis*, as well as *polaris*, Gerh., to which Kroulikowsky and Rühl both refer it. So far as Kroulikowsky's description is concerned, the form appears to be defined by the underside having a more yellowish-green tint, and the ordinary white spots generally absent. Also occurs in Finland (see p. 129).

δ. var. *sibirica*, Rühl, "Pal. Gross-Schmett.," p. 740 (1895); Tutt, "Brit. Butts.," p. 197 (1896).—The underside of a less vivid green; the hindwings beneath with only a single faint white spot. South Siberia (Rühl).

This appears to be almost a re-description of the Linnean type, except that the underside is of a less vivid green. Here one wants a definition of "less.' At any rate it appears to be identical with *borealis*, Kroul.

ε. var. (ab.) *nordlandica*, Strand, "Nyt. Mag. for Naturvid.," xxxix., pp. 27, 75 (1900).—The white spots fail on the underside; the grass-green of the underside is replaced by a darker, brownish hue, tinged with green. The upperside darker than usual. The antennal club almost unicolorous. The wings rather stumpy; the tails of the hindwings not larger than usual. Size about that of southern examples. Two specimens taken at Langöen, June 10th-23rd, 1900.

ζ. var. *fervida*, Staud., "Cat.," 3rd ed., p. 70 (1901). *Rubi*, Ramb., "Cat. Lep. And.," p. 32 (1858).—Supra multo dilutior, fere brunnea. Iberia mer.; Mauretania; Asia Minor (Staudinger).

This southern form is of a much less fuscous and more golden-brown, almost coppery, tint on the upper surface of all the wings. It occurs not uncommonly in the south of France with var. *intermedia*, but in Algeria becomes the typical form. The specimens of this type that we have noticed in France are usually of quite normal size, but the Algerian specimens in Miss Fountaine's collection evidently form a rather small race. The underside is also, in this form, of a less metallic green, a distinct yellow tint producing the modification here observed. There is some variation in the amount of white spotting present on the underside. It is not, as Staudinger suggests, a summer brood, but the ordinary spring brood, occurring from February to April. There are specimens in the Brit. Mus. Coll. from Granada, Gibraltar, Messina, Lambessa, Greece, Chitral, etc. A very remarkable example of this form, taken by Chapman at Hyères, in April, 1906, is very large, 36mm., has a very narrow, and yet almost continuous, white line on the underside of the wings; has the underside of the antennal club largely red, a character that appears to be very rare, judged by our long series, and we believe not before noticed by any lepidopterist. Blachier notes (*in litt.*) that M. Romieux, of Geneva, captured a ♀ of this form, *i.e.*, of a clear reddish-brown above, green beneath, with two white spots on the hindwings, in the Djebel Mekter, at 1500m. altitude, near Aïn Sefra (in the south of the province of Oran) on April 19th, 1906. He also queries whether all the Moroccan *ferrida* ♂ s have a specially black androconial brand, and strikingly black nervures, as his examples appear to have. Rambur says (*Cat. Lep. And.*, p. 32) that "the Andalusian examples are distinguished from the type by the ochreous tint of the forewings, and by the continuity of the white line on the underside of the hindwings."

η. var. *suaveola*, Staud., "Stett. Ent. Zeit.," 1881, p. 279 (1881); Rühl, "Pal. Gross.-Schmett.," p. 196 (1895); Tutt, "Brit. Butts.," p. 197 (1896); Staud., "Cat.," 3rd ed., p. 70 (1901).—I have altogether nineteen specimens before me from Lepsa and Saisan, of which fourteen are certainly *rubi*, and almost exactly like European specimens, the hindwings rather less toothed, and rather smaller on an average. Four ♂s (including one from Saisan) are, however, so different that they might be a distinct species, or possibly another brood. I call this form *suaveola*, and regret that I have sent away other examples just like them as *rubi* var. These four *suaveola* are all considerably larger than the true *rubi* of the locality, and like very large European specimens. The dark upperside is duller, not so brownish, and the green underside also lighter, more verdigris-green, but this also occurs sometimes in European specimens. It appears also to be quite an unimportant feature that the white dots of the underside are wanting, except one on the costa of the hindwings, since this is also almost always the case with the true *rubi* of this locality; whilst I also consider it unimportant that the oval male spot above the discoidal cell of the forewings is larger, and, in three specimens at least, much lighter in tint and very conspicuous in *suaveola*. Another unimportant character is that the palpi are quite green on the sides, though this is not the case, or only very slightly so, in the ordinary *rubi*. But it is very remarkable that the hindwings in *suaveola* are almost smoothly rounded, *i.e.*, without the tail-like appendage at the anal angle, which *rubi* (also those from the same localities) exhibits very distinctly. Could this be entirely lost there in a second brood? In *dumetorum*, Boisd., from California, which I consider to be certainly only a local form of our *rubi*, it is (in quite good specimens) always present. Careful observations on the spot and a larger amount of material will, perhaps, enable us to decide later whether this *suaveola*, which I doubtfully call a variety of *rubi*, is really a distinct species (Staudinger).

Staudinger seems to have quite satisfied himself of the varietal value of this form, for he no longer queried it in 1901 (*Cat.*, 3rd ed., p. 70), where he diagnosed it as "major, subtus pallidior, alis posticis acaudatis. Tarbagatai Mts., Ala Tau, Fergana." Rühl records it as being "of the size of the largest European examples. The upperside paler, *i.e.*, not so brown; the green underside also paler. The margin of the hindwings entire, and without the small tail-like appendage at the anal angle that characterises *C. rubi*." Staudinger notes the upperside as "darker" (*suprà*). Elwes observes (*Trans. Ent. Soc. Lond.*, 1901, p. 89) that "a specimen from Bloudan in the Lebanon, and another example from North Syria, agree with the var. *suaveola* from Turkestan described by Staudinger." He adds that he has "no Turkestan specimens for comparison, but a pair from North Persia, taken by Christoph, are much like this, whilst one taken by Mrs. Nicholl, at The Cedars of Lebanon, is like the common form."

θ. var. (*et* ab.) *suffusa*, n. ab.—Ground colour blackish-grey (approaching that of *S. w-album*); fringes white—Astrabad, Shakhuh. Another from southeast Altai —Tchuja Valley, nearly black, indistinguishable from *dumetorum* of Yosemite Valley. Other examples from Bagovitza, Podolia (Grum-Grshimailo), Jaicé, 3000ft. (Elwes), the Valais (Anderegg) (Brit. Mus. Coll.).

The nature of the green colouring of the underside of Callophrys rubi.—The fact that the underside of this species is of a brown colour when it emerges from the pupa, and remains so indefinitely if the newly-emerged insect be kept in a damp atmosphere, and only becomes green when the wing dries, has long been known to lepidopterists, and we referred to the peculiar character exhibited by this, and what appeared to be allied "greens" of other species, in *The British Noctuae and their Varieties*, ii., p. xvi, where we pointed out that, if the colour were pigmentary in origin, it showed a quite normal and natural sequence in its changes, and, at the same time, suggested that if it were not so, then it was possible that the presence of vapour deposited on the scales altered the effect produced when the light fell upon them. Perry-Coste says (*Entom.*, xxiii., p. 371) that the use of almost any reagent changed the green of the underside to a brown tint, similar to that normal for the upperside, and hence classed it as "a good instance of retrogressive metamorphosis," or change to original type, in pigments, but, although there is nothing improbable in the conclusion, the data offered do not at all afford sufficient proof that the underside of the wing was originally brown, or that the change has any genetic value whatever. To us, the probability appears to be in favour of considering the change a chemical one, caused by the direct action of the water on the pigment, although, as already noted, it may not be due at all to the presence of a "pigment," or rather "pigment-factor," but to the scales holding the vapour externally, and thus altering the reflective power, and so influencing the ordinary diffraction. On the other hand, if it be a pigment colour, the rapid change brought about by the absorption of water-vapour is very remarkable. In 1892, Freer, Riding, and others, discussed the matter at considerable length (*Ent. Rec.*, vi., pp. 35-40, 83-86, 107-111, 138-140, 204-208, 255-256), and Riding notes (p. 86): "The scales on the underside of *C. rubi* are not arranged in superficial and deep layers, but overlap like the tiles of a roof, and the lower portion of each scale contains less pigment than the upper, whilst the green colour is confined to a little more than the upper half of each scale, roughly speaking. An examination of the scales shows the green to be much more brilliant than one would anticipate. By reflected light, each green scale looks as though dusted over with minute, brilliant, green scales, for a little more than its upper half, and somewhat further down on the sides, whilst below it is pale brownish. When wetted, the green becomes a complementary brilliant red by reflected light. When the same scale is examined by transmitted light, the green vanishes, and there is a pale brownish scale, redder and yellower, where the green had been. Under a $\frac{1}{4}$-inch power, the scale is seen to be finely striated vertically, and, behind the striations, the coloured portion is divided into masses by irregular lines, which, when wetted, seem to swell and become much more distinct, giving a reticulated appearance, and the colour is somewhat paler. None of these reticulations are observed in the brown scales, so that there seems to be some connection between these and the green colour, especially as they are actually seen to change when wetted, and, at the same time, the green changes to its complementary red. We have, therefore—(1) Brown scales, pigmented, slightly paler when wetted. (2) Striated green scales, with a redder and yellower pigment (on the green parts), apparently collected in masses, with intervening spaces, through which water can pass, giving a brilliant green reflection when dry, a brilliant red when wetted." So far, therefore, it seems connected with pigment and structure. The only explanation that offers itself to us is that the green colour of *C. rubi* appears to be a compound one, produced, in part, by diffraction, the result of the striations noted, and partly by the presence of a pigmentary material in the scale. These striations and facets, when wetted, may conceivably lose largely their diffractive and reflective powers, and the result is that the brown or red, or brown and red, pigments then give the colour to the scale, until the wetted surface becomes dry and capable of its normal action again. This view is supported by Prideaux (*op. cit.*, p. 140), who states that, "by delicate focussing, the curious tortoiseshell-like patches observable in the scales of *C. rubi*, are within the substance of the scale and beneath the ribs; the patches certainly seeming to correspond with the broken up coruscations of green colour which one sees by reflected light." Burrows observes (*op. cit.*, p. 139) that a compound of yttrium was examined which presented exactly the effects noted by Dr. Riding in the scales of *C. rubi*, though much exaggerated; by reflected light it gives a brilliant green, but by transmitted light a good red; and, in both cases, there can be no doubt but that the red is the true colour. The green is the effect of the dry pigment by way of reflection." Riding still, however, is inclined to consider that the green is solely due to pigment, and he states (*op. cit.*, p. 205) that "there seems to be green and red pigment in the scales, the green being superficial. When white light strikes these green granules, a great part is reflected from their external surface as white light, which, however, carries with it some green that has been reflected from the posterior surface after penetration. The white light, penetrating deeper, meets with the red granules, but, owing to the dark background, most of it is absorbed. What little red is returned mixes with its complementary green, and forms white light, which slightly diminishes the intensity of the reflected green. When light is transmitted there is much more red light, part of which forms white light by uniting with the green, and the remainder meets our eyes as red. When water is added, the amount of superficial reflected light is very much diminished, because the light passes through water instead of air (a dense medium instead of a rare one), consequently more red light, proportionately, is reflected, part of which combines with the weaker green to form white light, and the rest appears to us as red." He then asks: "Were it connected with the interference of light from the striæ of the scales, would not the colour vary with position as in *Bithys quercûs?*" This is where the matter was left in 1892, and where it stands now. How the change is really brought about we do not definitely know, nor do we know the real nature of the green colour. In 1882, Tyndall wrote: "The question of absorption of light, considered with reference to its molecular mechanism, is one of the most subtle and difficult in physics; we are not yet in a condition to grapple with it, but we shall be by-and-by." It is very doubtful whether we are any nearer doing so now than was Tyndall a quarter-of-a-century ago.

Pathological examples.—The following pathological specimens have been noted :—

1.—A nice example, in which the outer half of all the wings is partially bleached, though more so in the case of the fore- than of the hindwings. Captured Isle of Purbeck, Dorset, June 13th, 1888 (Bankes, *Ent. Mo. Mag.*, xxv., p. 307).

2.—A ♀ taken May 16th, 1883, has the colour before the margin of the forewings (especially round the apex), and the right hindwing of an ashy-grey colour (Fuchs, *Jahrb. Nass. Ver. Naturk.*, xliv., p. 211).

3.—All the wings bleached towards the hindmargin (Webb Coll.) (Mosley, *Nat. Journ.*, 1896, p. 7).

4.—A cream spot on the forewings. Taken at Wrotham, in Kent, in 1901 (Carr).

5.—The upperside of hindwings with a wide border, 2mm. in breadth, of the ground colour, extending round the hindmargin, the remainder of the wings dirty yellow (Rothke, *Gross.-Schmett. v. Krefeld*, p. 18).

6.—The upperside of the hindwings yellow-brown before the border. Taken in May, 1903, near Plauen in Voigtlande (Winckler, *Iris Dresden.*, xviii., p. 25, pl. i., fig. 3).

7.—The base and margin of the upperside of the hindwings bright yellow (Bergstrasser, *Nomenclatur*, pl. 71, fig. 7).

8.—The upper wings, which are usually of an uniform brown, banded with a beautiful pale irregular-edged bar. Captured at Morlaix, Brittany, on May 17th, 1867 (Piffard, *Ent. Mo. Mag.*, iv., p. 35).

9.—All the wings on the upperside, towards the outer margin, light ash-grey, especially marked on the forewings; the remainder of the wings of a typical brownish-black. Taken at Geppersdorf on the Rummelsberg, in the district of Strehlen (Schultz, *Soc. Ent.*, xix., p. 9).

10.—With the forewings above of a pale and golden brownish-yellow (which might be designated cinnamon-brown, pale-chamois or buff, slightly iridescent) at the base, in the cell, and along the inner margin. This colour insensibly shades off into the normal tint as it approaches the apex and outer margin. Blachier Coll. (Blachier, *in litt.*).

11.—♀, with the right forewing pallid (ochreous), except at apex. Algeçiras, March 27th, 1901 (Yerbury) (Brit. Mus. Coll.).

12.—With a pale patch on the outer margin of the right forewing. Taken at Cuxton, May 6th, 1893 (Tutt coll.).

13.—With a plate patch at the anal angle of the left forewing. Taken at Cuxton, May 6th, 1893 (Tutt coll.).

14-15.—Two specimens from St. Leonard's Forest, having a pale spot in each forewing (Boyd, *Proc. Ent. Soc. Lond.*, 1874, p. xix). [Possibly these refer simply to examples with pale androconial patches, and are not pathological examples at all.]

Egglaying.—In 1896, Le Grice discovered the ♀s of *C. rubi* ovipositing on *Helianthemum vulgare* in Folkestone Warren. He observed that the imagines flying over brambles, elder, guelder-rose, etc., were all ♂s, and, following up a ♀ flying low down and evidently on egglaying intent, noticed that she selected the *Helianthemum*, laying the green eggs, usually singly, on the upperside of a leaf, but sometimes on the stalk or flower-bud; this plant seemed, at the time, to be the only one selected. Prideaux later observed the ♀s laying on twigs of *Rhamnus catharticus*, usually, although not invariably, at the base of the calyx. He also notes eggs being laid freely, in confinement, on shoots of gorse. the ♀s being confined with these in a glass jar placed in the sun; eggs laid June 10th, produced larvæ on June 18th. In 1898, Filer also observed eggs being laid on the leaves of *Helianthemum vulgare*, and later on the petals of *Ulex europaeus*. On April 10th, 1906, Chapman imprisoned a number of ♀s on *Calycotome* in a sleeve, but failed a week after to find an egg; he continued, however, with further insects and fresh plants, until, on the morning of April 17th, he obtained some ten or twelve eggs. The butterfly, he says, is very loth to lay, and would not oblige on heath or cistus, which had been placed with the *Calycotome*. Their unwillingness may be due to the unsuitable character of the plants given, owing to the peculiar habit of the ♀ in laying her eggs between two surfaces, for which purpose the ♀ ovipositor, chitinous, wedgeshaped, protrusible for a length of 1mm., free from scales, and with a slight fringe of terminal hairs, is peculiarly adapted. All the eggs were found on a surface, with some object close above it, which always touched and adhered to the upper surface of the egg, though usually only to a small part of it. A favourite place was between two or more flowerheads, but, in several instances, the egg was on a leaf, but with another bit of leaf or something touching it, in one case on the new stem, beneath a bit of dead leaf that adhered to it. In several cases, the egg was so buried as to be nearly invisible, and could not be exposed without separating the portion adhering to its upper surface. Buried like that of *Cupido minima*, which, however, is easily seen by separating flowers, never adhering but by its base, the egg was in no degree deformed by the attachment, as those of many Noctuids are, except as regards the surface sculpture. The egg itself is green, rather flat, the top plate and the sculpture triangular, six ribs radiating from a raised point, but not always going to another point. On April 25th, 1906, Chapman found an eggshell on a twig of *Calycotome;* it was close (2·5mm.) to the thorny point of the twig, and surrounded by three buds, now a little apart, which had, no doubt, grown since the egg was laid, and were then, one feels satisfied, in contact. A scrap of dead material still adhered to the eggshell; this had no doubt lodged between the touching flower-buds at the time of oviposition. Chapman further observes that the eggs turn greyish in colour for at least two days before hatching. Hellins notes (*Ent. Mo. Mag.*, vii., p. 232) that eggs were deposited in confinement on twigs of *Cytisus scoparius*, on June 17th, 1870, and the larvæ hatched out on June 24th. Head says (*in litt.*) that, on the Scarborough moors, the eggs appear to be laid singly, and always close down between the young leaf-stalk and a stem of *Vaccinium myrtillus*, and not always on the top shoots. He observes that the ♀s have a habit of walking down the main stem of the bilberry and feeling about with their ovipositors for a crevice in which to lay an egg, and usually lay one in the joint of each shoot. The eggs, he adds, hatch in from six to fourteen days, according to the state of the weather. Lowe notes (*in litt.*) that, in May, 1903, in Guernsey, he watched a ♀ egglaying on the young soft shoots of the common furze, *Ulex europaeus;* she did not seem to deposit any eggs on the flowers or flower-calyces; the eggs were laid singly, and the ♀ was very decisive and unhesitating in her movements. Head further states that, in confinement, the ♀ will lay her eggs freely on the young leaves of *Laburnum*. Minà-Palumbo says that, in Sicily, though common on *Erica arborea*, this species prefers to oviposit on *Ilex aquifolium* bushes.

Ovum.—The egg is 0·7mm. in diameter, and 0·4mm. high, bun-shaped, flattened below, and, to some extent, flattened on top. The sculpturing is most developed on the sides, but extends also in a weak manner over the base; on the top it becomes smaller and flatter. It consists of a network in triangles with knobs at the angles; according to the exigencies of a curved surface, the triangles are not always equilateral, and even a quadrangle occasionally occurs. The material of which this consists is laid on the outside of the egg proper, and both it and the eggshell are colourless and more or less transparent, the colour of the egg being entirely due to contents. The structure of this ornamentation is difficult to describe. The sides of the triangle are about 0·026mm. or 0·028mm. in length; suppose then that short pillars are erected at this distance apart all over the sculptured surface, and, on top of each of these, a ball, or not very regularly modelled lump, about 0·01mm. in diameter, and more than twice the thickness of the pillar just behind, is placed. From just below this neck, from each pillar to each of its nearest neighbours, a cord, about 0·006mm. in diameter, is hung, so that it falls in a curve between them; again, from the sides of these cords, the enclosed triangle is filled with a surface curved as if hung from them. Let all these cords and hollowed surfaces be solid down to the eggshell, the centres of the hollows being, however, close to, or actually, the shell, and you have a fair idea of the ornamentation (Chapman, April 17th, 1906). The egg is roughly circular in outline, and spheroidal in shape, being depressed or flattened at both poles; the surface is covered with a rather coarse network that is roughly polygonal, the polygons having from five to nine sides, although the greater number are hexagonal. The micropylar area forms a comparatively large depression at the apex, the sides of the depression being much more finely reticulated than the remainder of the egg, but still maintaining its polygonal character. The reticulation, although irregular, suggests a certain amount of vertical arrangement. The egg is uniformly green in colour, the ribbing paler, somewhat transparent, glassy, almost silvery, in hue [Tutt. Description made on May 26th, from egg laid May 23rd, 1898]. Globose, flattened; the micropylar area depressed, covered with a reticulation of raised white lines; the egg of a pale sea-green colour; diameter 0·027 to 0·028 of an inch. In none of my specimens could I find the double white lines described by Hellins; the reticulation was in single lines throughout. [Filer, June 7th, 1898.] About ·75mm. in diameter, the shape of a flattened sphere; finely reticulated, green in colour (Le Grice). [Sich refers the description of the egg, supposed to be that of *Thestor ballus*, *Ent. Rec.*, xv., p. 122, to this species. Compare with his description *Ent. Rec.*, xviii., p. 239, also *Ent. Rec.*, xv., p. 119.]

Habits of larva.—Chapman observes that the larva eats a largish piece out of the top of the eggshell, but does not apparently try to eat the eggshell. It travels steadily but slowly, spinning a silken ladder as it goes, until it reaches an opening bud of the foodplant (*Calycotome*), at the time, or just before the time, when the calyx makes its curious split for releasing the petals, and is about 4mm. to 6mm. long. It here settles down and eats a hole through the calyx. In four days many of the larvæ have acquired the red back with white subdorsal lines. In feeding, the larva buries the head, and often a segment or two of the thorax, but, in no instance observed, did it burrow right into the bud and disappear. So well protected is it, however, when very young, that Chapman notes (*in litt.*) that, on April 21st, at Hyères, he found an empty eggshell on a twig of *Calycotome*, but could not find the escaped larva, but that he brought home the twig, and, on April 25th, he observed it, when it appeared to be about fullgrown in its first instar. After the first moult, the larva continues to feed in the same manner as before, *i.e.*, it burrows with its head and front segments into the side of a partially-opened flower. It appears sometimes to try to form a nest by fastening a few adjacent points—leaves, etc.—together. This was particularly noticeable in a young larva about to undergo its second moult, which had pulled a leaf or two lightly together, forming thus a vague sort of nest, perhaps, however, it meant little more than the moulting-carpet getting an attachment to more than one leaf. The smallness and thinness of the head and prothorax must, one feels, greatly facilitate the thrusting of its head into the flowers when feeding. After the second moult it eats away the flowers much more completely. Some larvæ that Chapman had reared on *Calcyotome spinosus* till after the second moult, at once took to broom and gorse when placed upon them, eating the flowers, and also the leaves of *Erica tetralix*, apparently with equal goodwill. During the third instar it still eats flowers, but much more completely than hitherto; whilst, in the last instar, they ate the flowers of broom voraciously, and grew very rapidly. Prideaux observes that eggs laid on June 10th, 1891, on young shoots of gorse, hatched on June 18th, and were fullfed by July 14th, the whole larval period lasting less than a month. As soon as the larvæ left the eggs they commenced to eat the young undeveloped shoots of the gorse, and concealed themselves with the greatest ease, whilst, later, they attacked *Lotus major*, *L. corniculatus*, and various kinds of clover, eating the leaves when pushed, but preferring the blossoms. Hellins observes that some newly-hatched larvæ that emerged in confinement on June 24th, 1870, were dirty greenish in colour, with the head black, and covered with hairs, which, for the size of the larvæ, might fairly be called long. Being unable to get flowers of broom he had to feed them on young leaf-buds, on which they grew so slowly that, by July 9th, they had attained a length of not more than one-twelfth of an inch, and were very stumpy in proportion, brown in colour, with a darker brown dorsal line bordered on each side by a row of yellowish streaks; soon after this, however, the colour changed to green, and it became much more like the adult larva in general appearance. This difference in the rate of feeding-up of different larvæ reminds one of Esper's note, that he found larvæ in June, July, and up till September, on *Genista*, that they all pupated, but none produced imagines till the following June. The large choice of foodplants selected by the larvæ of this species, gives a very wide difference in their habits. Thus Plotz states that, at Greifswald, the larvæ bore deeply into the tender stalks of the young shoots of *Ledum palustre*. Wood found fullfed larvæ feeding on berries of buckthorn, at Brockenhurst, on July 30th, 1898, and Prideaux observes that, when the young larvæ feed on *Rhamnus catharticus*, they clear out the contents of the immature berries by means of holes drilled in the sides, precisely in the same manner as those of *Celastrina argiolus* do when feeding on ivy. The *C. rubi* larvæ, he says, later, took as readily to the berries of *Cornus sanguinea* when *R. catharticus* was not procurable. In rearing the larvæ of this species previously on *Leguminosae*, such as clover and *Lotus*, the larvæ fed from first to last entirely on the flowers. Joy says that, in early July, 1904, he beat from dogwood, larvæ that he supposed to be those of *Celastrina argiolus*, which, in confinement, fed well on berries, quite ignoring the leaves, and which, in due course, pupated, and proved to be *Callophrys rubi*. The habits of the larvæ on *Vaccinium vitis-idaea* have been noted by Zeller, who says that they range over the flower racemes, devouring the corollæ, stamens, and ovaries of the blossoms, whilst Wolfe and Chapman both record the larvæ as feeding freely on the flowers of *Erica tetralix*, the latter also noting that they eat equally well the leaves of this plant. Head confirms Chapman's observation, that the larva does not eat the eggshell, and observes that, on *Vaccinium myrtillus*, the young larvæ commence to feed at once on the very young leaves of the bilberry, and, after each meal, return again to the leaf-stalk or stem of the plant to rest; as they grow older they descend lower down the plant, and, after their last moult, they usually hide at the root of the bilberry during the day, coming out to feed only in the evening; they attain their full growth, he says, from the beginning of July until late in August, young and fullgrown larvæ often being found at the same time. Filer notes the remarkable protective resemblance of the larva to its foodplant when feeding on *Helianthemum vulgare*. Albin says that the larva feeds on buds of bramble, but this seems not to be very usual, although Wilkes observes that they hollow out the buds of bramble, and Joy exhibited, at the meeting of the South London Ent. Soc., held on July 13th, 1903, larvæ that were feeding on the berries of buckthorn, making holes therein, for the purpose of extracting the contents, and said he had seen others on dog-wood, and yet others that were making holes in the buds of bramble to get at their contents (*Ent.*, xxxviii., p. 261). In the south of

Europe they are usually to be found on the beautiful flowering *Cytisi* that abound there. Mathew says that he has taken the larvæ commonly in July, feeding on broom, and he states that, towards 4 or 5 o'clock in the afternoon, they crawl up to feed on the tips of the young shoots, and are then easily seen, but he adds that bramble appears to be their chief food in most places. Barrett swept the larvæ very freely from *Genista tinctoria*, on June 25th, 1868, and following days, near Haslemere; some were nearly fullfed, others quite small; in confinement they fed up very freely on the blossoms. Some of these larvæ were compared with others obtained on broom at the same time by Harwood, near Colchester, and it was observed that the larvæ from the *Genista* were less brilliant in their markings than those from broom, otherwise they were precisely similar. Hellins further notes that several larvæ found between August 7th-21st, 1877, feeding on flowers of *Ulex nanus*, at Chagford, differed slightly from others feeding on *Genista tinctoria* and *Cytisus scoparius*, in that the former had the head of a darker brown, the dorsal stripe darker, and the markings on the sides of a paler (almost whitish) yellow. Stange states that, much to his astonishment, he once found a larva on dock (*Rumex*), a very strange foodplant for this species, and that he obtained the butterfly from it next spring. Martin notes (*Ent. Zeits. Guben*, x., p. 68) that, in the middle of June, 1895, on the border of a wood, he found a half-grown Theclid larva sitting on a ripe strawberry and eating it; in confinement, it ate only the ripest fruit of strawberry, and refused leaves and unripe fruit, and, on this strange food, matured and pupated in due course. Mühlig, Koch, and others, have oberved that, when short of food, the larva of *C. rubi* becomes cannibalistic and eats other larvæ of its own species.

Larva.—*First instar* (newly-hatched): The newly-hatched larva is a little grey atom, fully 1mm. long when stretched, and broad for its length; the head not quite as broad as the body. The body of fairly equal size from the prothorax to the 8th abdominal segment; there is very little trace of dorsal ridges, a transverse section being fairly rounded above. The larva looks remarkably hairy, with abundant black hairs as long as the width of the larva; seen endways, these hairs fall into certain planes; dorsally, there is first an upright set, then one inclined a little outwards; then a shorter set, rather outwards curled (? iii); then a lateral set (? iv and v), and apparently a set below these. The head is diamond-shaped; the prothoracic plate and anal plate also are black (April 26th, 1906). Four days later many of the larvæ had acquired the red back, with white subdorsal line (April, 30th, 1906). The head is deep brown; the jaws six-toothed; a few fine hairs around the mouth (about 0·05mm. long), two on each side of clypeus at margins, one between clypeus and eyes, another beyond eyes, a longish one (0·06mm.) on cranium, one-third of the way up clypeal margin; other points higher up appear to be without hairs, and the bulk of the cranium is smooth; the labrum has two hairs on it, one on each side, and four on each lateral lappet, directed inwards; there are two on the basal piece of the maxillæ, but, otherwise, labium and maxillæ have no hairs, except at the ends of their palpi. There is a central eyespot and five ocelli in a regular semicircle, all of uniform size. The prothorax has a plate, broad in middle, narrowing to a point at the lateral corners; each side carries four long hairs, one short hair, and a large lenticle; there are thus four along the front evenly spaced, these are the shorter of the longer ones, *viz.*, about 0·22mm. The large lenticle is between and behind the pair of either side. One of the long hairs (0·45mm.) is close behind the lenticle, and the other further back and outward, the short hair (0·1mm. or less) is close to the outer angle. There are three long hairs in a line in front of the spiracle, but well above; another below these, just in front of, and in line with, the spiracle, and two short hairs at the base of the leg. The mesothorax, like all the other segments to the 7th abdominal, carries i and ii on each side on a conjoined base (and about 2·2mm. from opposite pair); the hairs about 0·6mm. long. In front of these, and nearer the middle line, is a short hair (0·2mm.). This seems to be the same hair that, on all the other segments, is in front of, and *exterior* to i and ii; then follows a group of four hairs set four square, apparently representing iii; then a shorter hair and a shorter one still below it, apparently iv and v; then the two fine ones at base of leg. The metathorax has i and ii (0·7mm.) with the accessory in front and outside (0·22mm.); on one side, a second shorter hair is outside this in one specimen; below this is a very large lenticle with minute hair above it, in range with the pair of lenticles on following segment; then two hairs in line of iii, ranging with two similar hairs on all the following segments to the 6th abdominal; then four hairs ranging with the similar four, and representing iv + v on the following segments, and then the two fine ones at base of leg. With regard to i+ii, they are identical on the mesothorax, the metathorax, and the abdominal segments 1 to 6; here, these tubercles are conjoined, and carry long flowing hairs (0·6mm.), the accessory in front and outside (0·12mm.), then there are two lenticles smaller than the one on metathorax, their rims are nearly as deep as high, so that they look very like hair-bases; at this site many larvæ have a surface puckering or depression. Above the spiracle, iii is double, and carries two hairs on separate bases, the front one the upper and longer (0·23mm.). Then comes the spiracle, followed by four hairs, nearly four square, but the lower posterior one is rather lower than this would admit. Below this are two hairs, on a level with each other, on the segments with prolegs, but one above the other on the other segments, and then (vii) carrying two small hairs on base of proleg; on the other segments there is only one minute hair. On the 7th abdominal, i (?) is absent; ii from each side, with the accessory, are combined on one base in middle of segment, together with a large lenticle that may be base of ii; then follows another lenticle, two hairs (iii), then spiracle, then below it four hairs (as usual), a lenticle, and one hair. Abdominal segments 8, 9, and 10 cannot easily be distinguished. Above the spiracle of the 8th abdominal, and between the 7th abdominal and anal plate, are four lenticles placed four square (two on each side); no hairs; below the spiracle is a group of five hairs with their bases very close together, a lenticle, and two hairs. The anal plate is a shield-shaped scutcheon, and behind and beside it are three hairs, each with another approximately beneath it. Behind these the skin-points are finely acuminate. The true legs are ochreous or brown; of the prolegs, each pad has two hooks. The skin-surface is beautifully netted with very fine lines, and, at each intersection, is a little 4-, 5-, or 6-rayed star, the rays having no relation to the lines of netting. *First instar* (fullgrown):

2·2mm. long, 0·7mm. broad, very short and thick; hairs as noted in newly-hatched larva; instead of the colour being an uniform ashy-grey it is now reddish-brown and white. Head now relatively small, black, with some white markings; prothoracic plate dark, but not black; anal plate dark. The colours are red dorsally, between origins of first and second hairs, with paler dorsal line; then white in a broad subdorsal band reaching down to the next row of hairs; thence to the flange red, but mixed with some white in a definite pattern; flange white (April 26th. From larva found wild). The white subdorsal band, seen laterally, is still a band curving over each segment, but, viewed dorsally, it is narrower in front of each segment, and bulges down into a deep curve on the posterior half of the segment; below this is a red-brown area, containing a white patch, with its apex towards the narrower part of the white band, and its divided base towards the pale flange; seen laterally, these patches form a narrow and interrupted line with the white flange below, and the white subdorsal band above; an extremely narrow mediodorsal pale line; the group of three dorsal hairs is at the margin of the white band; the next set of hairs is at its lowest margin. There are no hairs on the lateral red band (or none of any size); four hairs on the white flange, two above and two below; the hairs are black, and the larva does not look so hairy as when they were crowded together in the newly-hatched larva. Below, the larva is pale, with redder marblings towards the incisions; the pale is not white, nor is the red as dark as that above (April 30th. The larva still feeding and now very fat). *Second instar:* The colours are less marked than before moult; the white is rather yellow, and the red-brown nearer terracotta. The hairs are more numerous. The subdorsal white, on each segment, carries a group of somewhat radiating hairs (black), twelve or thirteen in number, hardly encroaching on the dorsal brown band. The next brown band has a few hairs, and, again, there is a radiating group on the pale flange; length 2·6mm. (May 2nd, 1906). [May 5th, this larva has now grown to 5·0mm.] The hairs now look less crowded. There is a group on yellow band, encroaching a little on dorsal red band; this, and those of the lateral flange, are so spread as to almost amalgamate with each other by certain intermediate scattered hairs, that form one or two intermediate rows. The yellow band is very bright, with the lower border sloping, on each segment, so as to be much lower at posterior margin; between this and the yellow flange is a pale reddish region, with a yellowish mark in it on each segment; a portion of this band, whence the hairs (v) arise, looks brightly silvery in certain lights (May 5th, 1906). In this (second) instar the hairs are very numerous. There are about twenty on each side in front of the prothoracic plate; this plate is dark, with median pale line (suture); it carries two lenticles on each side, and may have a fine hair or two; the spiracle is a high cone; no separate group of hairs is definable. On the mesothorax is a patch of short hairs a little way above the leg; it contains several small lenticles; the rest of the hairs (about 0·4mm. long) are placed continuously across the segment, most densely, and with the longest hairs, dorsally, thirty to forty on either side, with a mediodorsal lenticle. The metathorax is much the same, except that the hairs collect to some extent into groups like those on the abdomen; there is the mediodorsal lenticle, and several others lower down. On the abdomen is, on each segment, on each side, a dorsal group (i + ii) of seven or eight very large (0·42mm.) hairs, with smaller ones, making about fifteen; below this, are six or eight hairs, above and behind spiracle, and not widely separated from those above; below the spiracle, a group of twelve or fourteen hairs (about 0·3mm. long) and two groups of paler hairs follow; the groups are even less distinguishable on the latter segments. Between the dorsal warts (they are too large for warts and are rather groups of independent hairs), is, on each segment, a lenticle (never two), sometimes median, sometimes on one side, sometimes the other; group i+ii has a lenticle on its anterior aspect; there is another on front of segment, between this and the supraspiracular group, two just above spiracle, and one or two lower. The prolegs have five hooks on each pad. The hairs are finely spiculated as in first skin. Their bases deserve a word, for they are conical, but with curved outline; reversing them, and regarding the hair as a stalk, they are like a salver-shaped flower, a convolvulus or petunia, the margin being divided, by lines or sutures running up, into seven or eight divisions, the margin of each division convex, like a separate petal. The skin-surface is finely reticulated. It is to be noted that the hairs, though so much more numerous, are not only relatively, but actually, shorter than in first instar. *Third instar:* 9mm. long. The most notable feature, which existed somewhat, but only slightly, before, is that the mesothorax, as it were, forms a deep fold behind and above prothorax, somewhat overlapping it; the appearance is as if the mesothorax formed the front of the larva, and the prothorax was a small appendix in front and below; this smallness and thinness of the prothorax must facilitate thrusting the head into flowers, which is still its habit, though it eats them away now more completely. The prothoracic plate is small, brown, with median pale line or suture. The lateral line may still claim to be yellow, and is narrow and rather well-defined, and occupies the prominent margin of the lateral flange. The general colour of the larva is green, most marked on the site of the old subdorsal white mark or band. The spiracles are also on a very green line; above and below these are reddish shades; the double dorsal band is also fairly marked, of a dull reddish or pale brown; these colours vary much according to the angle of view, being apparently some distance beneath the cuticle, as is so common in Lycænid larvæ. The larva is 2·7mm. wide, and about 2·5mm. high, and narrower at either end, but the mesothorax and 8th abdominal segment are still very wide, and the greatest narrowing is done forwards in the rounded prothorax, and behind in the last three segments, which are very short, and almost without trace of incisions. The head is nearly black, polished; the labrum and antennæ nearly white. The dorsal ridges are wide and very rounded, so that they can hardly be called ridges; the incisions are deep, and each segment presents a large dorsal boss, a fairly pronounced lateral boss, and, in addition to these two (the dorsal and lateral flanges), there is, above the spiracles and between the other two, a smaller boss. Each of these bosses possesses a number of nearly black hairs that radiate from it as separate sets (the larva moulted into third instar May 7th, and was described May 9th, 1906). The colouring of the larva was rather brilliant in the second instar; most are now green, but with the yellow of second instar, as a paler green, looking like a boss on the side of the dorsum of each segment, stretching downwards along the posterior side of the segment. The lateral line is also paler. The outlines and aspects of the colours and bosses are very variable, according to the angle of observation, due to the essential colouring having a site some way beneath the skin. Others are more coloured, and a richly-coloured one is even handsomer than in second instar. The back, seen from above, has a marking, outlined with rich yellow, broad along the posterior margin of segment, but narrowed in front, the edge being oblique at an angle of 45°; down the centre of this is a double, rich, dark olive, band divided by a pale mediodorsal line, and there is a rich pink centre to the yellow extensions; the lateral line is dull yellow, and the olive above this is paler round the spiracles, but forms a dark margin to the yellow dorsal marks (showing them up well), and a darker band above the lateral line that is almost reddish. The prothorax is almost entirely olive, and the last segments are less clearly marked. The hairs are a ruddy brown, and add somewhat to the colouring. On the paler larvæ the brown hairs look nearly black by contrast. I have only one richly-coloured larva as above noted, and only one or two nearly green; the rest just show the markings distinctly by variations of tint, being chiefly green, with a pale lateral line, the darker markings of the dark larva having a greater or less tendency to be olive. *Fourth instar:* The larva in this, its last, skin, is much as in the third instar as to hairs and colouring; even the greenest show a faint yellow oblique line as outer margin of the yellow zigzag band. [They eat the flowers of broom most voraciously, and grow quickly.] A fullgrown one is 18mm.-20mm. long, 5mm. wide, and 4·5mm. high; the colouring and transparency of the subcutaneous region make it difficult to observe the "cushioning" accurately, but there seems to be a deeply depressed line, running from below the spiracle, backwards, upwards, and forwards, the last portion not very far from, if not coinciding with, the oblique yellow line. The prothorax is still at a lower level than the mesothorax, which hangs over it in a large fold or roll, and places the prothoracic plate in an angular hollow, very similar to that of the larva of *Thestor ballus* at this stage. The plate itself is a triangular piece, with a narrower prolongation from the middle of the front edge, about 1·00mm. from back to front, and 0·7mm. from side to side, pale pinkish-brown, with a median yellow line (May 20th, 1906) (Chapman). *Final instar:* 15·75mm. in length, gains nearly 3mm. when stretched out in walking; thick in proportion, and somewhat onisciform in shape, flattened beneath; the head very small and retractile; pro- and mesothorax rounded above; the other segments to the 6th abdominal, with a dorsal hollow, having an eminence on each side of it, which slopes thence to the lateral ridge; the last three segments rather flattened above. The ground colour bright yellowish olive-green, the hollow of the back a darker full green, and down its centre runs the pale olive-green dorsal line, which gradually widens and suddenly contracts on each segment throughout its course, and becomes dark on the last three segments, where it is bordered by a yellowish stripe on each side; from each eminence on the other segments, a thick bright yellow streak slants backwards and downwards, bounded beneath by an equally thick streak of deep full green, most intense at its beginning on each segment; the lateral ridge has a stripe of yellow, beginning at the mesothorax, and running continuously round the anal extremity; parallel to this, and above the spiracles, is a faint indication of a stripe, a little yellower than the ground colour. The head is pale-brown, with darker brown round the mouth; the appearance of the larva is velvety, caused by minute raised points bearing fine short bristles (Buckler).

Variation of larva.—Buckler observes that, when young, the yellow markings are less distinct, and, in two of the larvæ found on *Genista*, they scarcely appeared, even to the last. Hellins notes that several larvæ, found in 1877, on flowers of *Ulex nanus*, at Chagford, differed from others feeding on *Genista tinctoria* and *Cytisus scoparius*, in that the former had the head of a darker brown, the dorsal stripes darker, and the markings on the sides of a paler (almost whitish-) yellow. Chapman says that his descriptions show that the larva varies from a pale green to a larva richly varied in red, yellow and olive, in the third and last instars (see notes thereon, *anteà*, p. 108).

Foodplants.—The foodplants of this species cover a considerable field. Among those recorded are—*Rubus aculeata* (Linné), buds of *R. fruticosus* (Wilkes), *R. idaeus* (Richter), blossoms and green fruit of *Cornus sanguinea* (Schmid), immature berries of *Rhamnus catharticus* (Prideaux), *R. frangula* (Glitz), the flowers of *Vaccinium vitis-idaea* (Zeller), *V. myrtillus* (Freer), flowers of *Erica tetralix* (Wolfe), also leaves of *E. tetralix* (Chapman), *Erica arborea*, *Ilex aquifolium* (Minà-Palumbo), *Helianthemum vulgare* (Frey), young shoots of *Ledum palustre* (Plötz), *Rumex* (larva reared to maturity) (Stange). Leguminous plants appear to be frequently chosen, *e.g.*, clovers of various kinds (*Medicago lupulina*, etc.), *Lotus corniculatus*, *L. major* (Prideaux), *Trifolium* species (Meess and Spuler), *Genista* (Esper), *G. anglica* (Harwood), *G. tinctoria*, *G. germanica* (Koch), *G. sagittalis* (Freyer), *G. anglica* (Barrett), *Ulex nanus* (Hellins), *U. europaeus* (Prideaux), *Spartium* (*Sarothamnus*) *scoparium* (*vulgaris*) (Kleemann), *S. junceum* (Lambillion), *Cytisus* species, *C. austriacus*, *C. nigricans*, *C. capitatus* (Schiffermüller and Denis), *C. laburnum* (Lambillion), flowers of *Calycotome spinosus* (Chapman), flowers of *Onobrychis sativa* (Schmid), *Hedysarum onobrychis* (Brittinger). The chief foodplant in the Riviera is undoubtedly *Cytisus* (*Calycotome*) *spinosus*; in Argyllshire it is largely *Ulex europaeus*; its preference is apparently for shrubby *Leguminosae* (Chapman). [*Sedum vulgare*, or *palustre*, is noted by Frey, and *Sedum* species by Meess and Spuler. Is *Sedum* a mistake for *Ledum?*] [Birch is noted by Carrington (*Ent.*, xii., p. 208). This wants verifying.] [Kaltenbach's statement (*Pflanzenfeinde*, etc., p. 109) that "the larva most prefers sloe-leaves as food, but has also been found on the almond (*Amygdalus*)," etc., also wants careful verification.]

Pupation.—Newman describes the pupa after Hübner, as having a distinct belt round the waist and apparently an attachment at the anal extremity, and Lewin describes it similarly, but Barrett says that they pupate without attachment, and Buckler confirms this. Bowles says that the pupa is unfixed and emerges quite well when kept loose in moss, whilst Wolfe notes that the larvæ spin a few loose silken threads, beneath which they pupate without further attachment, the threads being very delicate and easily breaking away. Barrett says that, when fullfed, in confinement, the larvæ (of which he had many) found their way into the thickest part of the bunch of stems of the foodplant, and there lay without web or attachment, whilst others lay hidden at the bottom of the flower-pot also without fastening of any kind. The larvæ were very hardy, even in the quiescent period preceding pupation, when shrivelled and almost ready to change, for one or two were accidentally dropped on the floor in removing their food, but they cast their skins as though nothing had happened, and became as perfect pupæ as the rest. By July 10th, three dozen larvæ had assumed the larval state, but not one imago appeared until the following spring. He adds that not one pupa was attached or suspended in any way, either by the anal extremity or by a silken band round the middle, and suggests that, probably, in nature, its habit is to lie near the ground among the thickest grass and herbage. Buckler says that the larva enters the earth, but only just beneath the surface, to undergo pupation; the appearance of the pupa would assimilate very well with pellets of earth. Prideaux observes that, when fullfed, the larvæ pupate upon the earth provided (but never beneath it), others on the sides or corners of the cage, spinning a few threads in no definite direction, but just enough to hold the pupa in the spot selected, from which, however, it is easily dislodged. Rössler says that the larva pupates on the ground beneath fallen leaves and moss, and that the pupa hybernates. Head says that, near Scarborough, pupation takes place usually at the roots of bilberry, but often also in a dead curled-up leaf. Greene records that a pupa of this species was once found under moss on a log of wood in Bucks (*Zool.*, 1856, p. 5384). Chapman notes of some larvæ reared at Hyères, in 1906, that "the most forward larva was fullfed and stopped feeding on May 21st, and commenced to grow smaller and darker. Being supplied with some loose earth, it went down into it almost at once, and in the morning could not be seen; the others, in turn, went down, the last on May 30th; all of them went beneath the soil to pupate, and the pupa has no attachment to anything, except the very slightest to the cast skin." He adds that "on either side of the anal area are about fourteen pale brown cremastral hooks, with a double anchor-shaped hooked extremity; they are quite dissociated from true hairs, of which several are mixed up with these cremastral ones. The pupa has, therefore, a definite cremastral structure, though I have not found it making any attachment to anything." Lambillion observes that it is difficult to find the pupa, which is usually attached very low down to a rootlet of the plant on which it has fed, or to some object placed on the soil, sometimes lying freely on the earth, and that, owing to its form and colour, it resembles very much a small piece of earth. The pupal state lasts from July and August till the following May or June. Barrett notes that, of a considerable number he reared in 1868 (see *suprà*), all the pupæ passed the winter and emerged the next spring except one, and this passed another winter and emerged the second spring. Gauckler states (*Illus. Zeits. für Ent.*, 1868, p. 183) that the pupæ of this species can be forced in spring, but respond better to increased temperature (14°R.-20°R.) applied shortly after pupation, than if first exposed to severe frost and then submitted to the above temperature.

Pupa.—The pupa is very deep brown, almost black, and has a coating of brown hairs everywhere, except on the appendages. The hairs are about 0·4mm. long dorsally, and about 0·2mm. ventrally. In form it exaggerates the usual Lycænid outline, with bulbous abdomen and narrower front portion. It is nearly globular posteriorly and narrow forwards, the extent of this being from 5·3mm. at the 3rd abdominal segment to 3mm. at the base of the maxillæ, and 3·9mm. at the wing-spine. These positions are in a pupa 9·8mm. long, in which the base of the maxillæ is 1·3mm., the wing-spine 2·0mm., and the 3rd abdominal segment 6·0mm. from the front. In a lateral view, the lower surface is very little rounded from before backwards, all the curvature, except at the extreme ends, being dorsal. At 3·2mm. from the front the height is 4·0mm., it continues the same for 1·8mm., then rises to 5mm. at the 3rd abdominal segment; of this 5mm. the ventral line only affords 1·0mm. between the extreme front and back. The wings extend to 8mm. from the front. The face is so bent under that the posterior border of the antennæ at the vertex is visible ventrally. The eyes form a distinct depression in one specimen, not in others; the antennæ extend to the end of the wings; the first leg reaches the antenna, the second is very narrow, and neither much exceeds 2mm. in length; the maxillæ are 3mm. before disappearing between the antennæ, which run side by side for 3mm. more to their termination. The general surface is elaborately reticulated with a raised network. It also looks, and is, very hairy. The length of other pupæ under observation later is 10mm. to 11mm. Selecting one of 11mm. the transverse diameters are:—

From front.	Transverse Diameter.	From anal extremity.
1mm.	2·5mm.	10mm.
2mm.	3·5mm.	9mm.
3mm.	4·5mm.	8mm.
4mm.	5·0mm.	7mm.
5mm. (Thoracic-abdominal incision)	5·3mm.	6mm.
6mm.	5·5mm.	5mm.
7mm.	5·5mm.	4mm.
8mm.	5·4mm.	3mm.
9mm.	4·8mm.	2mm.
10mm.	3·0mm.	1mm.

For 8mm. from the front, the ventral median line is nearly straight, and the front flat to the end of the wings and antennæ. The abdominal surface, for the remaining 3mm., inclines upwards, at a very slight angle, so that the cremaster, if there were one, would be about 0·6mm. from the surface of attachment. The variation, therefore, of dorso-ventral diameters, is almost entirely dorsal (as, indeed, is the case in most butterflies). The dorso-ventral measurements are similarly:—

From front.	Dorso-ventral Diameter.	From anal extremity.
1mm.	2·8mm.	10mm.
2mm.	3·9mm.	9mm.
3mm.	4·0mm.	8mm.
4mm.	4·2mm.	7mm.
5mm.	4·5mm.	6mm.
6mm.	5·0mm.	5mm.
7mm.	5·0mm.	4mm.
8mm.	4·7mm.	3mm. (End of wings)
9mm.	4·3mm.	2mm.
10mm.	3·5mm.	1mm.

These measurements show how the abdomen is very slightly longer than if it were a sphere, to which the thoracic portion is attached in front, the gradation from one to the other being somewhat abrupt. On the lateral view, nevertheless, the anal apex is nearly a right angle; viewed from behind, and a little above, it also has a trace of angularity. The dorsal line is so steep posteriorly, that the anal extremity is hardly visible from a directly dorsal view. The face is very ventral and the suture across the base of the maxillæ and first legs is about 2·5mm. from the front. The maxillæ (there is no trace of labium) extend down for about 3·3mm., whence, for another 3mm., the antennæ, side by side, continue to the end of the wings. The first legs are very broad and short (about 2mm. long), the second legs are about 2mm. long, narrow, each end tapering to a point; the upper apex is shut out from the eyes by first leg by about the same distance as the lower is from the ends of the maxillæ (about 0·6mm.). The labrum and mandibles are three small portions, of about equal size (some 0·22mm. long), the labrum triangular, with blunt, rounded apex, the mandibles with apices opposed in a straight line of about 1·8mm. in length. The wings show no definite "Poulton's line." In the specimen examined, the 7th and 8th abdominal spiracles are both abortive, and the 8th, 9th, and 10th abdominal segments are so fused together as to be one piece, no sutures between them being discoverable. Examining the anal area of this specimen, a ♂, there is, ventrally, a very short bit of suture, apparently that between the 8th and 9th abdominal segments; behind this is a small, smooth, or faintly-wrinkled, area (0·5mm. in diameter); at the front of this is a small longitudinal mark, and, behind it, the anal scar, with a good deal of darker chitin; on either side are about fourteen cremastral hooks scattered irregularly. These hooks are pale brown (chitinous), about 0·1mm. or 0·13mm. long, and have a double, or anchor-shaped hook at the extremity. They have this special peculiarity that they arise from the skin-points (from which elsewhere no sort of hair arises), these skin-points being united by ribs as in other situations, and quite dissociated from true hairs, of which several are mixed up with these cremastral hairs. *C. rubi* has, therefore, a definite cremastral structure, though I have not found it taking any attachment to anything. In the living pupa a good deal of the surface-sculpturing can be made out, and some of the coloration, but it is not till the empty case has been rendered transparent (as by "Canada balsam") that it is quite easy to see it to be of two tints, a paler brown chitinous ground-colour and a darker one in spots, somewhat scattered on the wings and appendages, but more massed elsewhere, especially dorsally, when the spots become fused into large patches. The hairs are universally distributed, except over the front of the head, the appendages, and the medioventral portions of the 5th, 6th, and 7th abdominal segments. They are long (about 0·35mm.), black (*i.e.*, deep brown), of fairly uniform diameter from end to end, acuminate at point, and armed with minute spicules, which stand out almost at right angles to the stem of the hair. They are wanting on the basal third or half of the hairs. Round the spiracles especially are many lenticles, nearly always distinguishable from a hair-base that has lost its hair, by its smaller lumen, sometimes apparently closed by dark chitin, but the larger ones closed by a finely-dotted membrane. The third structure, which appears to occur on nearly all Lycænid pupæ, is the series of skin-points, not altogether un-

Pl. V.

Photo. F. N. Clark.

Pupal skin and pupal hairs of Callophrys rubi. Spiracular region of the 5th abdominal segment × 100.

The Natural History of British Butterflies, etc., 1907.

Plate XII.

(To be bound facing Plate XII.)

Callophrys rubi.

Portion of cremastral area of pupa × 100.

Shows both sides of fracture (due to forcing pupal-skin to flat surface for purpose of photographing). The plate illustrates three points:—

1. The well-developed anchor-hooks of pattern usual on cremaster of "hair-streak" pupæ, apparently of functional capacity, but not known to be used.

2. That the anchor-hooks are developments from the points that exist at the crossing of the skin reticulations, and therefore have no direct relationship with ordinary hairs.

3. The occurrence, among the cremastral anchor-hooks, of ordinary hairs, much longer than the hooks, and unattached to the reticular ribs, suggesting that the hooks are not used for purposes of attachment, as the hairs would probably much embarrass, if not prevent, their proper function, if its exercise were desired.—*T. A. Chapman.*

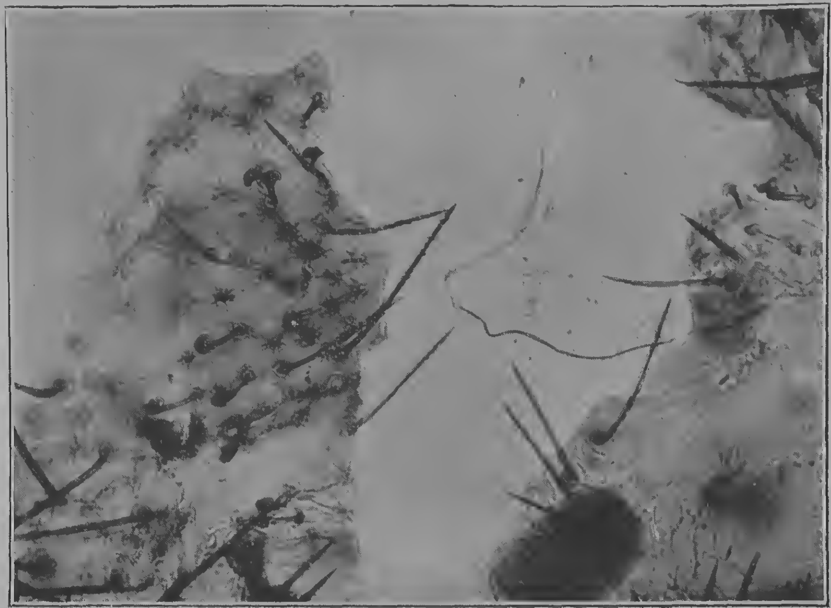


Photo. F. N. Clark.

CALLOPHRYS RUBI—PORTION OF CREMASTER OF PUPA $\times 100$.

The Natural History of British Butterflies, etc., 1907.

like small lenticles from which radiate raised ribs. These usually join adjacent points together, but always die out, rather than link up to a hair or lenticle, and thus raising a very marked distinction between these points and those structures. They are most abundant and characteristic some way above the spiracles, where there are fewer lenticles to interfere with them; they are also well-developed on the thoracic dorsum. The points are much smaller than in the pupa of *Thestor ballus*, being only about 0·02mm. in diameter; they appear to have a central point, but any stellate structure as in *T. ballus* is not obvious. The appendages have neither hairs, lenticles, nor points, but look much as if the ribs connecting the latter had thus their full liberty to develop into a complete and continuous network of a pattern of pleasing sinuous lines, much finer than the broad, patchy-looking ones of the pupa of *T. ballus*, but rather thicker than in that of *Bithys quercûs*. The glazed eye has a dark curved line, over which, and interior to which, for a total width of about 0·4mm., is a finely irrorated area, with hexagonally-disposed points. Interior to this is an ordinary skin-area, with points, ribs, and one or two hairs. Outside it, the surface has narrow ridges, radiating from the glazed eye. The prothoracic spiracle (cover of) is a rounded ridge, 0·4mm. in line of suture, 0·2mm. across, with a very finely tesselated surface, of which the cells tend to be arranged across the ridge. It is situated unusually far from the antenna, nearly two-fifths of the way from it to the dorsum (Chapman). Very short and thick, especially about the middle of the abdomen, rounded and blunt at the anal tip; the wingcases nowhere projecting, but smooth and large in proportion, and, like the rest of the surface, unpolished. In colour it is of a dark, dull, purplish-brown, and is thickly clothed with short, dark-brown bristles, excepting only the wing-covers, which are blackish-brown and have none. Its appearance would assimilate well with pellets of earth (Buckler).

Pupal dehiscence.—The thorax separates from the head, and the antennæ separate to some distance from the wings, and a division occurs down the dorsal line of the thorax. Through the opening thus afforded, the butterfly escapes, but the several portions, by their elasticity, at once spring back to their places, and it is not very obvious from the appearance of the pupa that emergence has taken place; later, however, as the shell dries, it curls to some extent, and, the free edges bending in, destroy the undisturbed appearance. On examining the empty shell it is found that, where no separation has taken place, the parts still cohere very slightly; the head-cover, with the eye-plates, separates from the appendages, the antennæ from the wings, the pro- and metathorax from the mesothorax with wings, and the metathorax and wings from the abdomen, except in front. All these separations seem to occur by fracture, no trace of intersegmental membrane being displayed where they take place. It is different with the abdominal segments. The living pupa seems to be solid and without movable parts, but the dehisced pupa shows always some separation of the 4th from the 5th abdominal segment, and very little violence opens all the other abdominal incisions from 1-2 to 7-8, and, in each case, intersegmental membrane, fully developed as belonging to both the segments concerned, remains and attaches the margins together, looking just as if all these incisions were intended to be movable during the life of the pupa, and certainly implying a capacity for opening slightly, if required, during emergence. Similar relations of the different parts of the pupa are more or less present in other Lycænid pupæ, differing from those of the Piero-Nymphalids and Papilios, and suggesting a closer relationship of this superfamily to more primitive ones than occurs in other butterflies (Chapman).

Stridulation of the pupa of Callophrys rubi.—Kleemann, in 1774 (*Der Naturforscher*, iv., p. 123), noticed that, coming from the pupa of this species (that feeds on *Spartium scoparium*), one could, when one placed the pupa near the ear, distinctly hear a cracking noise, but whence it proceeded and by what means it was produced, he could not determine. Esper quotes this (*Schmett. Eur.*, i., p. 281), calling the noise, "a humming sound," and so does Werneburg (*Beiträge*, etc., i., p. 370), but no further observations seem to have been made till 1877, when Schilde (*Stett. Ent. Ztg.*, xxxviii., p. 86) recorded some original observations as follows: Turning some 25 pupæ of *C. rubi* upon a sheet of paper, he distinctly heard a peculiar noise which came from the pupæ. Watching them closely and separately, he satisfied himself that the pupa of *C. rubi*, without any perceptible motion, produces a slight short chirp, but, in order to hear the sound distinctly and continuously, it is best to place a number of the pupæ together. In the evening, he says that he could distinctly hear the chirping of the 25 pupæ through the gauze, which covered the vessel in which they were. He then writes: "On examining the pupæ individually, I found that, in the thicker ones, which were probably ♀s, I could hear the sound distinctly, whilst in the more slender ones, which were probably ♂s, I could hear nothing. I also noticed that, after a copious watering of the earth on which they rested, all the pupæ were mute, but as soon as they were dry they began to chirp again. My first idea was that this sound was an expression of uneasiness, because a slight disturbance of their repose, by touching or blowing on the pupæ, seemed to make the chirping demonstration more general, but the silence of the pupæ suggested another cause, *viz.*, that the sound arises from the air being pressed and drawn in through the tracheæ on the abdomen and behind the eyes; perhaps, if the dense clothing of fine bristles is for the purpose of conducting moisture inwards, it is possible that, with the same object, a more lively respiration takes place when the pupa is dry, but, on the other hand, ceases when this is no longer the case." He adds that, "in individual pupæ the noise sounds clearly, in short, quick 'tempi,' almost as though a little stone were shaken in an empty pupa-skin. This impression is produced all the more readily, because, if one moves the pupa quickly backwards and forwards close to the ear, the sound is the more distinctly audible." A similar sound made by the pupa of *Bithys quercûs*, was observed in July. 1880, and reported by Parish (*Ent.*, xiii., p. 186).

Time of appearance.—This common little butterfly is a most interesting creature. Hybernating in the pupal stage, its time of appearance is largely determined by the kind of spring weather to which itsparticular habitat may be subjected, and, whilst it is absolutely a single-brooded species, at least in central Europe, a continuance of cold weather in a certain season may cause its time of emergence to be spread over a long period, and a comparison of different years may give an idea of double-broodedness. Gauckler states that the pupa may be forced in a warm room (*Illus. Zeits. für Ent.*, iv., p. 183), and Chapman had several emerge in a warm living room between February 26th and March 6th, 1907, at Reigate, from pupæ reared from ova and larvæ obtained at Hyères. Usually, it appears on the wing in Britain about the middle of May, and such years as 1893, when it was well out by the first week of April, and over by the end of the month, and 1888, when it appeared in May, and then, owing to the continuance of the cold weather, struggled on in single appearances until the end of July, must be looked upon as quite exceptional. Still, even in 1893, when the imagines were over in April, and the larvæ were fullfed before the end of May, there was no attempt at the production of even a partial second-brood, and Barrett notes that several dozens of larvæ obtained near Haslemere in June, 1868, pupated by July 10th, yet not one emerged as a second-brood example in August, all going over the winter and producing imagines from April 20th on through May, 1869, whilst Buckler notes a similar experience. This direct response, as it were, to the climatic influences of spring, is well exhibited in the Mediterranean district, where, in some spots, in favourable seasons, emergence commences at the end of January and early February and is over by April, whilst, in less well-situated spots, and in unfavourable seasons, at no great distance, March, April, and even May, are the months in which it will occur. Still, in countries such as Algeria, and Morocco, February and early March form its normal time of appearance, and, at Hyères, March is quite late enough for good specimens, as it is at Collo, Oran, etc., although at Aïn-Sefra, in Algeria, Romieux obtained it as late as April 19th, 1906. At Cannes and Grasse, and most other places along the Riviera, however, the whole of March and early April are the normal times. In the mountains of central Europe, only very early examples occur in May, June and early July, according to elevation, being the normal time of appearance, whilst, at a height of 6000ft., below Saas Fée, single specimens have been taken up to August 10th. Wheeler and Frey note it as occurring in the Swiss valleys as early as March and April, but in the mountains till the end of July, only, however, single-brooded. In high latitudes, too, it appears later, and is recorded from Lapponia-Umeå as occurring between May 27th and June 15th (Zetterstedt), whilst, in south Norway, at Vallö and Larkollen, it occurs in early May; also at Aal, chiefly in May, but extending into July; at Kongsberg, captured May 17th, 1899, in Boten, May 26th, Odenmark, June 5th, and near Klovimaen (in Nordland), June 30th, 1899; whilst near Bolkisjö it was also taken at the end of June, 1899 (Strand). In southern Finland, it occurs from the first week of May to midsummer, rarely later (Reuter). Some of the Italian lepidopterists make it double-brooded, *e.g.*, Stefanelli ("Lep. Rop. Tosc.," *Bull. Soc. Ent. Ital.*, xxxii., p. 328), but, along the Italian, as in the French, Riviera, it appears to be single-brooded, occurring abundantly from March to early May (Tutt), whilst at Chiavari, near Spezia, in the "Riviera di Levante," Blachier took it on May 23rd, 1903 (see *infrà*). It was, however, quite over on April 23rd, 1901, at Argostoli, in Greece (T. B. Fletcher). One suspects that, in southern, as in central, Europe, a second-brood example is, indeed, a very great rarity. It is recorded as occurring in the very early spring only, in the Pamirs (Grum-Grshimailo), and Elwes obtained it in the Tchuja Valley, up to about 4000ft., during the first half of June, 1898. It is particularly late in the Altai—at

Biisk, Ongodai, and the Tchuja Valley—as already noted, since it appeared between June 2nd and June 19th, 1899, the birches only just beginning to break into leaf on the first-named date at Biisk (Elwes). Evans captured ten examples on April 23rd, 1901, in the northwest Himalayas, in Chitral, in the Kesu nallah, at 6000ft. elevation. In the Channel Isles, as in the British Isles, its normal time of appearance is in May and June (Luff). In France, it appears in the north much as in the south of England, but in the south much earlier. In the Berry and Auvergne districts it occurs from April to mid-May (Sand); in the Gironde, it is continuously on the wing from April to June (Trimoulet); in April and May in the Haute-Garonne, and in July up to 2000 mètres (Caradja), also in April and May in the Doubs (Bruand); from the end of February to April in the Alpes-Maritimes (Millière), in April and May in the Saône-et-Loire (Constant), from April to the commencement of June in the Pyrenees (Rondou), the last fortnight of April and the first fortnight of May in the Vosges, Moselle and Meurthe depts. (Cantener), in April and commencement of May in Brittany (Griffith), in the Aube dept, April 20th-May 20th—May 10th is the usual time for the species (Jourdheuille). In Corsica, it occurs everywhere from March to May (Kollmorgen). In Belgium it appears from April to June, and Lambillion adds "early August to end of September," which one doubts, especially as Snellen only gives May and June for the Netherlands. In Italy, it occurs from February to April along the Italian Riviera (Tutt); in Lombardy, it frequents flowers, in May and June (Turati), in the Madonie Mts., in Sicily, it is to be taken from March to July, according to elevation 400m.-1700m. (Failla-Tedaldi). In the Roman Campagna, the Alban Mountains, &c., it occurs from April to June (Calberla), whilst, at Aosta, it is to be found in May, and at Promontogno, below the Maloja, was captured in June (Fountaine). In Spain, near St. Roque, Walker has observed it as early as February 28th, and it is quite over here, he says, by the first week in April. As to Germany (and central Europe generally), Fuchs concludes that, in the Rhine Provinces—even in the hot Loreley district—although an occasional late specimen occurs, it belongs to a single brood, and, in more bleak and higher localities, *e.g.*, Dickschied, in the upper Wisper Valley, it flies regularly far into June, but all the specimens belong to a single brood, whilst Gillmer is as emphatic as ourselves as to the single-broodedness of this species in Germany, and the general records support him; thus, in East and West Prussia, Schmidt observes that the species occurs from about April 23rd to June 4th, being particularly abundant from the commencement of May until early June; Hering, gives April and May, for Pomerania; singlebrooded, occurring from April to June in Mecklenberg [Stange reared the species from larvæ found in June, but no imagines appeared till the following spring] (Gillmer); April to June at Eutin (Dahl), May and June in Lübeck and the Schleswig-Holstein district (Boie, Zimmermann, and Laplace), April and May in Hanover (Glitz and Rehberg), April to June in the Rhine Provinces (Weymer, Stollwerck), end of April to mid-June in Waldeck and Hesse (Speyer, Fuchs, &c.), from April to June in Thuringia (Krieghoff), also from April to the end of June, single-brooded only, in Anhalt and Brunswick (Gillmer); April to June in Brandenburg (Kretschmer), May and June in Posen (Schultz), end of

April to June in Silesia (Wocke), and April and May in the kingdom of Saxony (Steinert); from end of April until June in Bavaria (Schmid); abundant in the spring months in Baden (Gauckler). Of those who suggest a second brood, appearing in July-August, in Germany, are Speiser, in East and West Prussia, "very scarce," contradicted by Schmidt for this district; Hering, for Pomerania, who says "also rare as a second brood," but he only notes April and May as the months of capture in his more detailed notes. Rothke notes it as occurring at Crefeld in April-May "and June-July," a view not accepted by Maasen, Stollwerck, Weymer, and others, who consider the June and July specimens to be simply late examples of the only brood. Rössler also says that it flies in April and May, and "again in July," in Waldeck and Hesse, but Fuchs categorically denies that it does so in this district, and Speyer, Limpert, Röttelberg, Schenck, Glaser, and others have no knowledge of second-brood examples here, whilst Wocke also states that no second brood is known in Silesia; Schneider is said to have caught a specimen in Saxon Upper Lusatia on July 15th, 1877, possibly only a late example (Schütze); Kranz notes it as occurring in April and May at Munich, and again "doubtfully in September"; his notes on the life-history do not snpport this view, and it is contradicted for the district by Schmid, Freyer and others. Meess and Spuler say it is abundant in Baden up into the higher mountains, and give April and May, and "mid-June till mid-August," but, as Gauckler only finds it single-brooded, occurring in the spring, one suspects the late examples on which the supposed second-brood is based, to be merely late emergences at a higher altitude. In Switzerland, Frey notes April and May in the lowlands, flying until late in July high in the mountains; Wheeler adds that it sometimes appears in March in the valleys, *e.g.*, March 17th, 1899, at Veytaux. Blachier gives as extreme dates for Geneva, April 7th to June 4th, without interruption; whilst Rehfous has found worn examples on the Salève as late as June 26th, and Lowe found it in the Swiss Juras, at Eclépens, whilst Courvoisier found it in July on the Simplon road between Bérisal and the 4th refuge. The records from Austria, on the whole, also suggest a single brood, the great difference of altitude being, perhaps, entirely responsible for the great variation in recorded appearances. This was the view of Höfner, who notes the species as having a single-brood, appearing from April-July. Hüttner records it as abundant at Carlsbad in May "and September" (with no facts, however, to support the latter); whilst Nickerl says that, in Bohemia, it appears only in May and June, and, similarly, Schneider gives May, and "again in September," at Brünn, in Moravia, but Fritsch says the recorded dates are—at Brünn, April 9th to May 4th; Mistek, June 2nd; Neutitschein, May 18th-30th; Rottalowitz, April 22nd-June 11th. Similarly, Fritsch himself states that it is double-brooded in Upper Austria, the first brood in spring, the "second in July," but the only records he gives are—April 15th-May 15th, at Freistadt; April 17th-June 6th, at Kirchdorf; April 9th-May 28th, at Linz, and July 5th, at Linz; it appears to be this latter record alone on which he bases his generalisation of a second-brood. In Lower Austria, Rossi doubts there being any second-brood, and Fritsch gives as dates of appearance —April 4th-May 11th, at Gresten; April 14th-May 22nd, at Melk; April 11th-21st, at Vienna, with the latest appearances between May 28th-June 13th. In Salzburg, too, Richter gives the end of April until June;

whilst Fritsch notes that specimens have been taken from March 31st-May 19th, the latest recorded appearances being June 3rd-13th. In the Tyrol, the dates vary tremendously—at Bludenz, March 12th-May 10th; at Bregenz, as early as March 28th; at Innsbruck, February 23rd-April 15th: whilst in the Val Fondo, Wheeler notes it as continuing into July. Höfner distinctly states that there are two broods in the lowlands of Carinthia, the first from April till the beginning of June, the second in July and August, but only one brood in the mountains in June and July; but Fritsch simply gives as actual dates April 4th-May 8th, at Hausdorf; and April 18th-May 7th, at St. Jakob. Zeller also notes it as abundant towards the end of May, at Coritenza, and Mann only gives it as single-brooded in Carniola, from beginning of May till the middle of June. Kroulikowsky says that, in the Kasan district of Russia, the earliest specimens are seen about the middle or end of April, and the latest disappear about the beginning of June, and in the Wiatka govt. it appears in May; Bartel also gives May for the southern Urals. Nolcken notes that, in the Baltic provinces, it appears in early years in April, but is abundant in May, occasional late specimens lasting until June. In Bulgaria, in the neighbourhood of Sofia, it occurs in May, according to Bachmetjew; whilst Rebel says that throughout Bulgaria, Bosnia, and Hercegovina, the insect is double-brooded, but only notes it as occurring from mid-May to early July; whilst in Roumania, Caradja says it occurs from May to August in one continuous brood, which is what one suspects to be true of the adjacent countries. The following actual dates may prove interesting:—Continental: July 5th, 1860, at Mayenwand (Jäggi); May 17th, 1867, at Morlaix (Piffard); abundant at Tangier in March, 1868 (Blackmore); April 12th, 1870, at Bex (Murray); April 6th, 1871, in Guernsey (Luff); July 15th, 1877, in Saxony (Schütze); April 16th-May 2nd, 1878, at Port Baklar (Walker); June 28th-July 5th, 1878, on the Riffelberg above Zermatt (Jordan); April 23rd-30th, 1880, at Cintra (Eaton); May 11th, 1881, May 12th, 1882, April 12th, 1883, May 9th, 1884, May 11th, 1885, in Guernsey (Lowe); end of June, 1886, at Zermatt (Jones); May 3rd, 1887, at Bex, and on May 10th, above Bex, in crowds at level of snow (Hutchinson); May 28th, 1887, at Fermain Bay and Moulin Hoult Bay (F. A. Walker); June 1st, 1887, at Lugano (A. H. Jones); June 4th, 1887, at St. Brelade's Bay, in Jersey, and also abundant on the Corbière, in the extreme southwest of the Island; June 14th, 1887, at St. Peter's, Guernsey (Hawes); March 26th-April 16th, 1887, and February 28th-April 19th, 1888, at San Roque (Walker); May 3rd, 1888, at Carqueiranne; May 5th, 1888, in the Île de Porquerolles (Jones); abundant in May and first half of June, 1888, at Wiesbaden (Prideaux); May 8th, 1888, in Guernsey (Lowe); April 22nd-May 19th, 1889, at Hyères (Norris); June 14th-16th, 1889, at Tancarville (Leech); April 30th, 1890, in Guernsey (Lowe); exceedingly abundant May 13th-17th, 1890, in Guernsey (Luff); May 30th-June 6th, 1890, worn in Guernsey (Hodges); June, 1890, at Digne (Lemann); June 5th-20th, 1890, at Digne (Jones); June 13th, 1891, at Trieste (de la Garde); late August, 1891, at Biedenkopf (Jäger); April 22nd, 1892, at Tivoli (Rowland-Brown); June, 1892, at Budapest (Lemann); April 4th, 1893, in Corsica (Coleby); abundant April 24th-30th, 1893, on the slopes of "The Gouffre," in Guernsey (Hodges); June 8th-21st, 1893, worn, near Blocksberg (Nicholson); June 14th-24th, 1893, at Vizzavona (Standen);

June 23rd, 1893, worn, at Tattone (A. H. Jones); July, 1894, at Vernet-les-Bains (Lemann); July 20th-26th, 1895, worn, at Campiglio; July, 1895, at Mendel (Lemann); June, 1896, at Saeterstoen (Chapman); February 27th, 1897, at Cannes (Chapman); April 6th-21st, 1897, at Veytaux (Wheeler); April 16th-23rd, 1897, at Digne: July 19th, 1897, a worn specimen at Fontainebleau (Tutt); April 17th, 1897, at Villefranche (Mathew); April 29th, 1897, very worn at Le Paradis, Hyères (Buckmaster); July 14th-21st, 1897, at Wolfsberg (Lemann); March 30th-April 26th, 1898, in the Cannes dist. (Tutt); March 3rd, 1899, abundant at Mouans Sartoux and Auribeau (Chapman); March 17th, 1889, at Aigle (Wheeler); April 3rd, 1899, in Guernsey (Lowe); May 17th, 1899, at Kongsberg; May 26th, 1899, at Boten; June 5th, 1899, at Odenmark; June 30th, 1899, at Klovimaen (Strand); May 21st, 1899, on the rough dry slopes of the Vitoch, near Sofia; May 23rd, 1899, in a little rough valley among the vineyards near Slivno; June 26th, 1899, in the Rilska valley (Nicholl); June 7th, 1899, at Nantois (Turner); March 6th, 1900, first of the year seen at Cannes (Chapman); March 23rd, 1900, at Tangier, in excellent condition (Meade-Waldo); May 5th, 1900, at Hvalöerne; June 5th, at Skien; June 10th-23rd, 1900, at Langöen; June 28th-July 7th, 1900, at Lödingen (Strand); May 20th-30th, 1900, on the Lebanon, between Ain Aata and The Cedars; June 2nd, 1900, on the Djebel Chekif, above Bloudan (Nicholl); June 21st-28th, 1900, at Salzburg; July 3rd-9th, 1900, at Budapest (Lang); July 8th, 1900, on the Stelvio at 7000ft. (Rowland-Brown); March 26th, 1901, in north Morocco (Meade-Waldo); April 22nd, 1901, one worn ♀ at Argostoli (T. B. Fletcher); worn, May, 1901, at Kalávryta (Fountaine); May 3rd-6th, 1901, at Larkollen, near Kristianfjord; May 14th-17th, 1901, at Odnes and Vallö, near Tonsberg (Strand); June 1st, 1901, at the top of the Rochers de Naye (Wheeler); June 20th, 1901, at Botzen; July 8th, 1901, on Mt. Pilatus Kulm (Lowe); March 13th, 1902, in north Morocco (Meade-Waldo); March 15th, 1902, at Jerez de la Frontera (Lang); March 31st, 1902, at the Pont du Gard; April 5th, 1902, swarms on the hillsides at Digne (Rowland-Brown): April 21st, 1902, at Vernayaz (Wheeler); May 15th-17th, 1902, at Fredrikstad; May 18th-22nd, 1902, in the Hvalöerne, near Bolingsharn; June 26th-July 1st, 1902, near Sireosen; July 1st-12th, 1902, near Siredal (Strand); May 27th, 1902, at Les Avants (Barraud); June 23rd, 1902, abundant, fine, and fresh at Pesio; July 1st, 1902, abundant at Courmayeur (Lowe); June 27th, 1902, at Martigny (Sheldon); July 5th-30th, 1902, above Gryon (Moss); March 28th-April 2nd, 1903, abundant among the heavily-flowered genistas at Hyères, Costebelle, and Carqueiranne; April 5th, 1903, at Grasse; April 6th, 1903, very abundant at Auribeau; April 7th, 1903, in the Esterel, near Le Trayas; in the Esterel behind Agay on the 11th; April 12th-14th, 1903, at Alassio; April 13th, 1903, at Albenga (Tutt); April 11th-20th, 1903, at Menaggio (Sich); April 12th, 1903, in Guernsey; in April and May, 1903, at Broussa (Fountaine); abundant April 24th, 1903, at Remoulins; April 27th, 1903, at Digne (Sheldon); May 3rd, 1903, at Gex (Mongenet); May 23rd, 1903, at Chiavari, near Spezia (Blachier); June 26th-29th, 1903, between Engleberg and Schwand (Keynes); July 13th, 1903, worn, at Vizzavona, in Corsica; a few ragged ones July 26th, 1903, between St. Martin Vésubie and Venanson (Rowland-Brown); April 12th, 1904, at Aigle (Wheeler); April 21st, 1904, at Aigle (Sloper); fairly abundant during Easter week at Majorca (Muschamp); May 29th, 1904, in the Val de Bronsette, 1800m.; June 4th, 1904, at Panticosa (Burr); June 1st-August 3rd, 1904 (a worn specimen), at Bernau, near Berlin (Dadd); June 19th, 1904, worn, at Macolin; June 3rd, 1904, at Grindelwald (Lowe); July, 1904, at Zermatt (Lemann); August 10th, 1904, between Saas Grund and Saas Fée (Cochrane); April 24th, 1905, at Costebelle, worn; April 30th-May 2nd, 1905, at Draguignan; May 5th, 1905, at the Pont du Gard (Tutt); June 17th-27th, 1905, at Vernet-les-Bains (Standen); June 25th-July 5th, 1905, at Arolla, in fine condition (Pearson); odd specimens, worn, July 12th-25th, 1905, at Pontresina (Lowe); March 31st-April 7th, 1906, in the French Riviera (Reverdin); April 19th, 1906, at Aïn Sefra, in Algeria (Romieux); May 16th, 1906, at Digne (Blachier); June 12th, 1906, common and worn, at Caux; June 16th, 1906, common and generally worn, at Eclépens; July 9th, 1906, worn, in the Laquinthal; July 15th, 1906, at Fusio; July 19th, 1906, at Reazzino, near Locarno, probably second brood, not in bad condition (Lowe); July 9th, 1906, at Pailly (Mongenet); bred February 26th-March 3rd, 1907, from pupæ obtained in 1906, from eggs laid in the Riviera (Chapman); March 24th, 1907, etc., at Hyères (Chapman). British: J. C. Dale gives the earliest and latest dates over half a century as April 24th, 1834, and August 3rd, 1813, worn; May 8th, 1858, at Banff (Edwards); June 20th, 1863, at Portscatho (A. H. Jones); June 17th, 1865, in great abundance near Plymouth (Bignell); May 20th, 1866, at Witherslack (Hodgkinson); May 24th, 1866, on the Cotswolds (Longstaff); May 28th, 1886, in Blean Woods (A. H. Jones); June 28th, 1867, in the Black Wood, Rannoch (White); May 1st, 1868, at Steyning (White); May 2nd, 1868, abundant at Cirencester (Harman); May 3rd, 1868, on Painswick Hill (Watkins); June 19th, 1868, in north Cornwall (A. H. Jones); bred April 20th-May 17th, 1869, from Haslemere larvæ and pupæ (Barrett); bred April 25th-May 9th, 1869, from Colchester and Haslemere larvæ (Buckler); June 5th-26th, 1869, at Brockenhurst (Capper); June 1st-10th, 1870, on Garinish Island (Lawless); July 7th-8th, 1870, just appearing at Bolt Head (Mathew); May 4th-June 6th, 1871, abundant near Killarney (Stevens); June 1st-10th, 1871, at Galway (Lawless); May 6th, 1872, at Aberfoyle, one (Evans); June 8th, 1873, at Stow Maries (Raynor); end of May, 1874, in the New Forest (Cooper); April 24th, 1875, at Great Malvern (Edwards); June 6th-26th, 1875, at Rannoch (A. H. Jones); April 28th-May 28th, 1876, common in Abbott's Wood (Dale); May 5th, 1879, at Dutton (Hodgkinson); June 30th, 1879, on the Cotswolds (Fox); May 11th, 1880, at Cuxton (Bower); May 30th, 1881, on Box Hill (Bower); May 4th-11th, 1882, abundant on the moss at Witherslack (Hodgkinson); May 11th, 1882, on Box Hill (Bower); June 5th, 1885, at Cuxton (Bower); June 5th, 1886, in the Isle of Purbeck (Bankes); June 15th, 1887, on Box Hill (Bower); June 17th, 1887, near Ely (Archer); early July, 1887, near Wellington, Somerset, early July being noted as average time here (Milton); May 16th, 1888, on Box Hill (Bower); May 19th, 1888, in Chattenden Woods (Tutt); June 13th, 1888, in the Isle of Purbeck (Bankes); June 23rd, 1888, in Delamere Forest (Arkle); May 23rd, 1889, on Barone Hill, Bute (Dalglish); May 24th, 1890, at Churchill (Johnson); May 24th, 1890, in the Isle of Purbeck (Bankes); May 26th, 1890, on Holly Hill, near Snodland (Tyrer); May 26th, 1890, at Lockerley (Burrows); May 26th, 1890, in the Brighton district (McArthur); May 31st-June 6th, 1890, at Brockenhurst (Ogden); June 9th, 1890, at Fairlight (Ford); June 24th, 1890, at Lyndhurst (Alderson);

June 24th, 1890, on the hills near Dursley, but worn (Griffiths); June 26th, 1890, in south London (Hawes); bred April 2nd, 1891, at Watergate, Emsworth (Christy); May 20th, 1891, on Cannock Chase (Freer), May 24th, 1891, at Rothesay (Dalglish); May 30th-June 6th, 1891, at Brockenhurst (James); June 5th, 1891, at Lochgoilhead (Dalglish); first seen April 10th, 1892, kept on appearing till mid-June intermittently, on Cannock Chase (Freer); April 12th, April 14th, June 8th, 1892, in the Isle of Purbeck; May 30th, 1892, at Wareham (Bankes); May 21st-June 7th, 1892, in the New Forest (Ridley); June 4th-16th, 1892, in the New Forest (Robbins); June 7th, 1892, at Oxton (Studd); June 18th-26th, 1892, at Folkestone (James); July, 1892, at Chatham; July 3rd, 1892, between Cobham and Maidstone, worn (de la Garde); July 1st-14th, 1892, at Salcombe (Prideaux); March 27th, 1893, in co. Cork (McArthur); early April, 1893, in abundance at Sutton Park (Abbott); April 3rd, 1893, at Eynsford (Carpenter); April 10th, 1893, on Haresfield Hill (Davis); April 18th, 1893, in Worcester Park, Surrey (Kaye); April 19th-22nd, 1893, at Guildford (Grover); April 21st, 1893, in Abbott's Wood (Esam); April 24th, 1893, at Colchester (Harwood); April 26th, 1893, at Keswick (Beadle); May 1st-7th, 1893, at Newbury (Kimber); May 3rd-13th, 1893, at Oxton (Studd); May 5th, 1893, at Colwall, near Malvern (Turner); May 6th, 1893, common, at Cuxton (Tutt); May 6th, 1893, at Watergate, Emsworth (Christy); May 8th, 1893, at the foot of the Twm Barlwyn mountain (Knights); May 10th, 1893, on Holmwood Common (T. B. Fletcher); May 15th-June 15th, 1893, at Instow (Hinchliff); May 21st, 1893, at Brockenhurst (Tremayne); May 31st, 1893, worn, at Brockenhurst (Freer); April 25th, 1894, at Salcombe (Turner); April 30th, 1894, on Cannock Chase (Freer); April 30th, 1894, at Ashtead (Prideaux); May 11th-15th, 1894, in the New Forest (Tremayne); May 12th, 1894, several, at Callander (Evans); June 1st-10th, 1894, at Kilberry (Cottingham); June 1st, 1894, at Lochgoilhead (Dalglish); June 9th-12th, 1894, at Glynde (James); July 1st, 1894, in Alum Chine, Bournemouth (Bromilow); May 9th, 1895, in the Isle of Wight; July 11th, 1895, in south Devon (Prideaux); May 14th, 1895, at Glen Falloch (Dalglish); May 23rd, 1895, in the Isle of Purbeck (Bankes); June 1st-7th, 1895, in north Devon (Baylis); June 9th, 1895, near Reading (Clarke); April 24th-May, 1896, at Aberfoyle (Evans); May 5th, 1896, at Ashford (Wood); May 10th-17th, 1896, at Folkestone (Le Grice); in 1896, scarce at Guildford, the first example seen on May 11th (Grove); May 11th, 1896, at Hazeleigh (Raynor); May 16th, 1896, at Milngavie (Dalglish); abundant on May 18th, 1896, at Rugeley (Freer); May 23rd, 1896, at Churchill, near Lough Neagh (Johnson); May 23rd, 1896, just appearing at Lyndhurst (Tremayne); June 5th-26th, 1896, in the New Forest (Capper); scarce at Guildford in 1897, the earliest seen May 17th (Grover); May 17th, 1897, at Hazeleigh (Raynor); June 26th, 1897, very worn in the Kimble district (Rowland-Brown); May 7th-June 13th, 1898, at Swansea (Robertson); May 10th, 1898, at Balcombe (Image); June 2nd, 1898, at Milford-on-Sea (Barraud); June 6th-11th, 1898, at Oxton (Studd); June 11th, 1898, at Reigate (Turner); July 20th, 1898, one worn, at Brixham (Hamm); May 28th, 1899, near Llangurig (Tetley); June 3rd, 1899, on Aldbury Down (Barraud); June 11th, 1890, near Reigate (Prideaux); June 12th, 1899, on Wyre Common (Fletcher); June 14th-18th, 1899, at Westwell (J. E. Gardner); May 7th, 1900, at Ringwood (Fowler); May 24th, 1900, at Dover (Stockwell); May 26th-June 9th, 1900, in the Kimble district (Rowland-Brown); May 27th, 1900, at Horsley (Kaye); June 2nd, 1900, in Chattenden Woods (James); June 2nd, 1900, in the Frensham district (Bingham-Newland); June 3rd, 1900, at Luss, on the shores of Loch Lomond (Dalglish); June 3rd-4th, 1900, at Westwell (J. E. Gardner); June 4th, 1900, at Sutton Park (Redmayne); June 4th, 1900, at Hazeleigh (Raynor); June 4th-16th, 1900, near Guildford (Pickett); June 4th, 1900, on Aldbury Down; June 9th-14th, 1900, in the Farningham district (Barraud); June 11th, 1900, at Shoreham (Bower); June 17th, 1900, at Oxton (Studd); June 18th, 1900, at Slad, near Stroud (Watkins); June 23rd-July 1st, 1900, in Abbott's Wood, worn; August 22nd, 1900, at Loughton (Carr); July 8th, 1900, at Ashford (Wood); June 28th, 1900, in Abbott's Wood (Blenkarn); five specimens (one ♂ and four ♀ s) captured in a lane near Newtown, in August, 1900 (Tetley); on the Cotswold Hills, in May, 1901 (Jefferys); May 12th-June 6th, 1901, in the Dorking district (Oldaker); April 15th-May 19th, 1901, at Oaklands (Barker); May 14th, 1901, on Ranmore Common (Oldaker); May 15th, 1901, at Danbury (Raynor); May 18th, 1901, in the Kimble district (Rowland-Brown); May 21st, 1901, in Clackmannan Forest (Evans); May 21st, 1901, at Shoreham; May 24th, 1901, at Riddlesdown (Bower); May 25th, 1901, on Aldbury Down (Barraud); July 1st, 1901, near Bude (James); in early July, 1901, in south Dorset (Prest); July 13th-August 13th, 1901, a few belated examples on the hillside at Brendon, north Devon (Prout); in Aberdeenshire it rarely occurs until about the middle of May; on September 9th, 1901, I caught a single fresh specimen at Alford, but saw no others (McLean); April 27th-June 1st, 1902, at Scarborough (Tetley); May 12th, 1902, abundant at Dorking (Oldaker); May 23rd, 1902, at Churchill, in co. Tyrone (Greer); May 24th-June 7th, 1902, in the Dorking district (Oldaker); May 24th, 1902, at Eston, Yorks (Sachse); May 26th, 1902, at Shoreham, Kent (Bower); May 27th, 1902, near Stroud (Davis); June 16th, 1902, on the bogs around Glencar (Kaye); June 22nd, 1902, at Esher (Fleet); June 8th, 1902, in the Isle of Purbeck (Bankes); June, 1902, in the Isle of Arran (Smith *teste* Bankes); July 1st-7th, 1902, at Hopton Wagers, near Clevening Mortimer (Boxer); May 19th, 1903, at Hazeleigh (Raynor); May 21st, 1903, at Cudham (Bower); May 22nd, 1903, at Oxton (Studd); May 23rd, 1903, at Tring (Barraud); May 23rd-June 21st, 1903, at Scarborough; June 6th, 1903, near Maentwrog (Tetley); first seen May 23rd, 1903, at Ranmore (Oldaker); May 23rd, 1903, on Aldbury Down (Barraud); May 23rd, 1903, in the Kimble district (Rowland-Brown); May 24th, 1903, on Thundersley Common (Whittle); May 30th, 1903, at Clandon; June 2nd, 1903, at Folkestone, worn (Pickett); June 5th, 1903, at Wilton, near Salisbury (Carr); June 6th, 1903, common, in Delamere Forest (Arkle); May 14th, 1904, at Scarborough (Tetley); May 20th, 1904, at Shoreham (Bower); May 23rd, 1904, at Westwell (J. E. Gardner); July 9th, 1904, in north Cornwall (Rothschild); May 18th-25th, 1905, in the Black Wood, Rannoch (Cockayne); May 18th-June 3rd, 1905, at Scarborough (Tetley); May 26th-30th, 1905, at Aldeburgh (Image); May 30th, 1905, at Hazeleigh (Raynor); June 2nd, 1905, in the Kimble district (Rowland-Brown); June 10th-13th, 1905, at Westwell (J. E. Gardner); mid-June, 1905, at Hailsham (Sich); June 15th, 1905, at Wareham (Bankes); June 17th, 1906, in the Kimble district (Rowland-Brown); only once seen in Monmouth, *viz.*, on July 9th, 1906, at Landogo, flying round a bramble-bush (J. F. Bird).

Habits.—This is a most interesting little species, one of the earliest of our newly-emerged butterflies to appear in the spring. It abounds in some seasons in its favourite haunts, whilst in other seasons it is comparatively rare. It prefers, as a rule, in the sunshine, to fly fairly high about trees and bushes, and to rest upon green leaves, but still often deserts these to seek the nectar of its favourite flowers. It flits with considerable swiftness from one place to another, and quickly gets out of reach if disturbed. Blachier says that it is very common around Geneva and on Mt. Salève, flying about the bushes with a short, rapid, and zigzag flight, settling repeatedly on the leaves, particularly on those of oak-bushes, which have not yet lost their leaves, although, when the season is more advanced, they are freely attracted by bramble-blossom. Rowland-Brown notes that, on the Buckingham chalkhills, its chief flight coincides with the early green of the hawthorn, on which it rests, almost invisible, but is easily disturbed by shaking the branches; when settling, it folds its wings so that the green alone is visible, and lies sideways on the spray, so that it is practically indistinguishable. Like *Bithys quercûs*, this species is fond of soaring, sometimes to a considerable height, and battling in the air. He further adds that, in June, 1899, at Digne, it appeared in countless thousands, especially affecting the broom, which was then going out of flower, and, in early April, 1898, it was very abundant at Costebelle, resting on the broom flowers, and persistently attacking the ♂s of *Thestor ballus*, whilst, at Digne, in April, 1897, we noted it as the most abundant species observed, swarming about the *Prunus* flowers, flying everywhere swiftly over the genistas, on which the eggs are frequently laid, whilst we have seen it abundant also on the blossom of the hawthorn-bushes growing on the chalk slopes between Cuxton and Halling; in 1893, the imagines were observed swiftly flying round the beeches in this latter locality, and resting on the leaves where they were excellently protected, thus contrasting markedly with Barrett's statement that when resting on the leaves of *Vaccinium myrtillus* on Cannock Chase, the species is particularly conspicuous. Bignell observes that, near Plymouth, on a sheltered undercliff, on June 17th, 1865, hundreds of this species were skipping about and alighting on the fronds of the common bracken, the beautiful green of their undersides so like the colour of the fronds, that it was only with difficulty that the one could be discerned on the other, and Tetley says that, on the moors near Scarborough, its resemblance to the whortleberry leaf, on which it prefers to rest, is very striking. Esper believes that Linné's reference to *Rubus aculeata*, does not mean that he knew this to be the foodplant of the species, but that it flew amongst and rested thereon, a habit noted by Blachier, Le Grice, and others. Head observes (*in litt.*) that the butterflies only fly in the bright sunshine, except on very warm days, when they fly a little if there be no wind, even if the sky be overcast. Their favourite position on which to alight is, on the heaths near Scarborough, upon the young leaves of birch and bilberry, and the moment they alight they turn sideways to the sun, with their wings closed, and lie over so that one side of their wings perfectly faces the sun, and so secures the full force of the sun's rays; in this position they are most difficult to see, the bright green of the underside harmonising so closely with the green leaves. They seem to be especially attracted to young green leaves on the low branches of birch, and will return to the same spot time after time, darting off to attack another of their kind (or even a specimen of *Ematurga atomaria*, should one approach), when they will fly off together, gambolling for some distance, and returning again a minute or two later. They also frequently settle on the flowers of furze, apparently to feed and sun themselves, for, he adds, he has never noticed them egg-laying thereon. Grover observes that, at Guildford, the species flies round the tops of tall bushes of whitethorn and elder in the woods, whilst, in 1898, at Sutton Park, Imms said it abounded at the flowers of the holly-trees, and, in May, 1882, Perkins observed it, at Wotton-under-Edge, resting on hazel-bushes, and being thence attracted to the flowers of the common bugle. In May, 1902, at Churchill, in Co. Tyrone, Greer observed it frequenting the birch-trees, around which it flitted, in the sunshine, whilst Rowland-Brown records that, as late as July 26th, 1903, between St. Martin Vésubie and Venanson, a few ragged examples were observed on the stonecrop, flowering on the wayside walls. The profusion of this species at Mouans-Sartoux, Auribeau, and Agay, in fact all over the Esterel district, is usually very noticeable, even in a district where it is always extremely abundant. In the bogs around Glencar, in Ireland, Kaye saw the species in mid-June, 1902, swarming on the lousewort flowers, and, in May, 1901, it was very abundant on elder flowers on Ranmore Common (Oldaker). The difference in the habits of the imagines when freshly-emerged, and a little later, appears to be most marked. When fresh, the sexes fly together, sporting freely round the bushes, settling on the leaves, or feeding at the flowers of hawthorn. Later, the ♀s often leave the males, the latter still maintaining their habit of flitting from leaf to leaf on the bushes, whilst the ♀s fly low down near the ground, seeking a variety of herbaceous plants, although not disdaining the flowers of buckthorn and dogwood, on which to lay their eggs. When thus engaged, those that choose the low-growing plants become the companions of *Nisoniades tages*, *Aricia astrarche*, and so on, but, as soon as the work is over, they return to the bushes, and usually choose a place thereon to sleep. On the Riffelberg, at some 8500 feet elevation, Jordan noticed the imagines in early July, 1878, frequenting the flowers of *Rhododendron ferrugineum*. Le Grice says that the imagines occur freely in Folkestone Warren, flying generally over the brambles which abound here, but not despising the elder, mealy guelder-rose, whitethorn, and other bushes . . . . The specimens flying over brambles were found, by examination of many examples, to be all ♂s, the ♀s flying low down on the grassy slope, seeking plants of *Helianthemum vulgare* for the purpose of oviposition. Wright observes that, in early May, 1890, the species was very abundant on Cannock Chase, and here, towards evening, it settled down on the heather, where it rested for the night, whilst Johnson also observes that, it occurs at Churchill, on a heathy bog, where, too, it also chooses heather as a resting-place. McLean mentions (*in litt.*) that, at Alford, in Aberdeenshire, the butterfly is fond of settling on stunted birch-trees on the hillsides, and, late in the afternoon may be beaten therefrom in hundreds; in this locality it lays its eggs on the cranberry. Watkins says that, in Gloucestershire, it is much more abundant in some years than others, *e.g.*, on Painswick Hill, in 1868, and on Haresfield Hill, in 1893, whilst the partiality of the species for resting on juniper-bushes here is most marked. In Connemara, Birchall notes its preference for resting on furze-bushes, and says that, on dull days, it may be taken resting thereon in hundreds. Jones writes that, at Lugano, in 1887, it preferred to rest on the leaves of young chestnut-trees. Spiller observes that, at Chinnor, about mid-May, 1890, it appeared in great numbers, frequenting the whitethorn bloom, or fluttering in merry groups in the beech glades. Lee records that he observed it near Cambridge, flying abundantly over *Rubus caesius*, and Mathew notes that he has seen the ♀ s laying their eggs on the young flower-buds of bramble, etc., from the middle of May to the middle of June. Lambillion observes that, in Belgium, the imagines usually choose a resting-place that is green, where they are well hidden, *e.g.*, the stems of the broom, the leaves of bushes, and even those of trees. He adds that, on one occasion, near Versailles, where this species is very common, shaking the young limes, on which they rested, resulted in dislodging dozens, which hastened to settle on the green silk of the butterfly-net. Cockayne notes that several specimens were observed in May, 1905, on the bare and rocky top of the hill at Rannoch, where the bearberry grows, hanging over the rocks in long trailing masses; they rested on the blossoms of the bearberry, whilst, in the Black Wood itself they were in abundance, settling on the clumps of whortleberry (*Vaccinium vitis-idaea*). Hudd says that it is sometimes common in Gloucester and Somerset at blossoms of bramble, nettle, wild medlar, etc. In the Pyrenees, it loves to rest on the green shoots of the bushes of bramble, broom, etc. (Rondou), and, in the Vosges district, it prefers to rest on bushes in blossom (Cantener). The habits of this species are evidently similar over all its area of distribution. In Germany, Boie notes that, in Holstein, it prefers to rest upon the leaves of trees, whilst Tessmann observes that it loves to settle on pines, but, in the Wisloer Moss, shows a partiality for settling on flowers of *Cardamine.* Near Oberursel, Fuchs says that it particularly loves to rest on birch leaves, and is sometimes very abundant on the willow-catkins on the outskirts of woods. Glaser notes that it is common in Waldeck, preferring to settle on young pines, on the needles of which it walks about with its wings closed over its back. Schultz says that, in Posen, it loves to sit on the young pine shoots, where it is difficult to see, owing to the similarity of its green coloration, whilst Kranz notes that, at Munich, young birches and pines are selected on which to rest. In Upper Lusatia, it haunts more especially raspberry and bramble bushes; whilst Gillmer says that, near Nürnburg, he observed the imagines resting on the yet unopened flower-buds of *Thymus serpyllum*. In Chitral, in India, too, it loves the flowers, for Evans' examples were taken at the end of April in the Kesu Nallah, at 6000 feet elevation, frequenting a little bush with small red flowers. Barrett says (*Ent. Mo. Mag.*, vi., p. 37) that "the imagines emerge about 9 a.m., and, when just out, before the wings spread, show no trace of the lively green colour of the underside, that part being golden-brown like the upperside; as the wings expand, the green appears; probably this arises from the green scales being all edged with brown, and, in the unexpanded state, the edges alone being visible; a fact which will account for the golden-brown shade being visible over the green in some positions." Chapman observes (*Ent. Rec.*, xviii., pp. 168-9) that, at Hyères, he noticed that when *C. rubi* settles, it instantly makes a curious little twist and twinkle, and that he carefully watched the same movement made both by this species and *Thestor ballus*. He adds: "The movement, which is almost part of the process of settling, places the insect at once, with one side (without preference for either) towards the sun, the wings closed, and the sun vertical to the exposed undersurface: *T. ballus* will settle on the ground, but, by preference, on some portion of a plant, and *C. rubi* invariably on the leaves of some tree or shrub. Such, at least, was the case at Hyères, where the butterfly was abundant in some places. At Ste. Maxime, however, a little later, where it was equally common, it was rather fond of settling on stones and pathways. I feel confident that this difference of habit in the species at the two localities was real, and not due to any serious defect of observation, though it is possible that, occasionally, a *C. rubi* on the ground may have been mistaken for *T. ballus*. Had the absence of *T. ballus* at Ste. Maxime anything to do with the different habit of *C. rubi?* When on the ground, *T. ballus* secures no cryptic advantage, but both species certainly do when on vegetation, though there is also a maximum exposure to the sun as well as a maximum of display. Neither insect ever shows the upper surface when resting, not even the coloured *T. ballus* ♀. The paradox, that this attitude secures both the maximum of display and a large amount of cryptic effect, I find difficult to deal with, nor can I form any opinion as to whether the butterfly is more or less conspicuous owing to the special orientation, but certainly one side of the insect secures a vertical exposure to the sun's rays." Prout observes (*op. cit.*, p. 214) that, on June 5th, 1906, at Westwell, in Kent, he chanced to get a specimen of *C. rubi*, which he had netted, to "settle" on his forefinger, and to remain there a minute or two. He adds: "Noticing the 'twist and twinkle' resulting in vertical exposure of the undersurface to the sun, it occurred to me to move my finger gently in such a way as to reverse the conditions, *i.e.*, to expose the butterfly horizontally to the sun. Immediately, though without undue haste, it turned round to regain the position it had chosen. I repeated the experiment six or eight times before it finally flew away, and each time with the same result. This convinces one that the attitude is one of real importance, and to incline to the view that it is cryptic in effect, and it is, at least, interesting that *C. rubi*, resting among leaves where it has little to fear from its own shadow, settles in a position quite antithetical to that assumed by certain ground-resting Satyrids, and others, which reduce their shadows to insignificant dimensions." Of the movements of the hindwings when at rest, Swinton notes (*Ent. Mo. Mag.*, xiv., p. 210) that he observed, on two occasions, an example sitting on a bramble leaf, with shut wings, when it lifted its underwings alternately, and, in a leisurely fashion, rubbed them backwards and forwards over the forewings. He suggests that the movement may be a stridulatory one, and observes that, in *C. rubi*, the scales on the overlap of the forewing are supplanted by a patch of hair, whilst, just above, the anal vein is bare and raised. This bare raised portion is crossed at uniform distances by pronounced striæ, which indicate internal diaphragms, and constrict the tube into a series of bead-like formations, whose surface, in common with that of the other forewing veins, is pitted, or bears a row of obsolete tubercles resembling those constituting a musical organ in certain *Acridiidae*

. . . . He notes, however, that any friction, caused by these bead-like constrictions or their tubercles moving over the costal vein of the hindwing, would be slight, and that he failed to detect any sound accompanying the movement in *C. rubi*. Chapman says (*in litt.*) that this species emerges from 7 a.m.-10 a.m., and further notes that, when the butterflies appear, the green of the underside is of a deep rich brown, and remains so as long as the insects are kept in a moist atmosphere; as soon as the wings are allowed to dry they become green; the effect can be produced in a damping-box, but the tint is neither so rich nor clear as in the newly-emerged insect. Head observes that the usual time of flight is from 7 a.m. or 7·30 a.m. until about 4 p.m., and sometimes a little later. Pairing, he says, takes place between 10 a.m. and 3 p.m., and the duration of copulation lasts generally from one to two hours. The ♂ s live from six to fourteen days, the ♀ s usually from one to three weeks. Swinton adds that this species pairs at noon.

Habitat.—From the southern shores of the Mediterranean to beyond the Arctic Circle, from the Atlantic Ocean to the Pacific, and from sea-level to above 7000ft. in the Alps of Central Europe and the Western Himalayas, gives, as one may suppose, a variety of habitats for this common little butterfly. The north of Morocco and Algeria seem to be its most southern haunts, for it does not appear to go back far towards the desert area, whilst in the north it occurs in the Sydvaranger between 69° and 70°N. lat., where it was found by Sparre-Schneider. In the south of Europe, it swarms on the bush-covered slopes at Digne, Nîmes, Hyères, Grasse, etc., indeed, throughout the lovely Provençal and Languedoc country, where the great bushy brooms and genistas are such a pleasing feature of the landscape, the species occurs in amazing profusion, flitting rapidly in the sunshine, setting its body so that the sun shines vertically on one of its green undersides, and so becoming hardly discernible among the greenery, by which it is surrounded. Among the Italian lakes its habitats are rather more like those in the south of England, and woodland paths edged with hawthorn bushes are a favourite resort. In the mountain valleys it haunts the rough bush-covered slopes at the foot of the cliffs, whilst even high up the mountains, it still shows its preference for the bush-covered patches that here and there clothe the mountain-sides. In the British Islands, it haunts our woods, hill-sides, heaths, moors, and bogs, indeed, it is one of the most likely species to be met with in its proper time in almost any part of the country. On the continent, the woods and moors of Scandinavia, and the broom-clad slopes of southern Europe, are alike its home, whilst over most of its area in central Europe little appears to come amiss to it. In Kent, it haunts the wood-ridings, preferring, however, the clearings in which the bushes are not growing too closely together, or rough pastures on the outskirts of woods, whilst, on the open chalk-hills, it is also most frequent on the outskirts of the woods, choosing again those portions where bushes of dogwood, spindle, buckthorn, rose, and birch are scattered sparingly about. On Cannock Chase, and other similar places, it haunts the bleak heather-clad moors, and this also is so in many Devon localities—Teignmouth, etc., whilst, in Ireland, the heath-bogs are a favourite resort. Kaye reports it from the bogs around Glencar, and Miss Lawless states that it is very abundant in the same localities as *Coenonympha typhon*, *i.e.*, on the bogs and hills of Connemara and Mayo, but not extending so high in the hills, occurring in May and the beginning of June. Mrs. Battersby says that it is frequent on the moors in the west of Ireland, and Kane on the bogs at Tullamore. In Scotland, it is frequently also a moss species, being recorded from the famous Methven and Birnam mosses in Perthshire, but it is also found in the Black Forest, Clackmannan Forest, and other well-known wooded areas, whilst it occurs all round Luss, on the shores of Loch Lomond. It is common on Ullock Moss in the Keswick district (Beadle), and Bland says that it is abundant on the moors at the top of the glens, running down the cliff-like line of hills which form the boundary of the Vale of Conway on the west side, whilst at Bernau, near Berlin, it occurs in the pinewoods with a thick undergrowth of bilberry (Dadd). Barrett notes it as occurring freely on a boggy heath in Devonshire, where *Eriophorum angustifolium* grew in profusion, and where, among it, these charming green butterflies were flitting about in plenty. This locality, he says, was very different from one where the species was observed a few years ago, high up on one of the hills of Cannock Chase, and where it was evidently quite at home on the extensive patches of *Vaccinium myrtillus*. Tetley notes that, at Scarborough, it is one of the commonest of the moorland butterflies, but very local, and may generally be found where the dales run up to the moortop, and adds that it flies freely over the whortleberry bushes that grow up the sides of the little "ghylls" that form the top end of the dale. It also occurs freely on the sunny downs between Guildford and Dorking (Swinton), on the heaths at Kings Lynn (Atmore), all over the moors at Rannoch (A. H. Jones), whilst, in Cumberland, it frequents bilberry-covered banks in and near woods (F. H. Day), and it is abundant on the moss at Witherslack (Hodgkinson). At Haslemere, Barrett found it on a rough pasture sloping down to a little stream. In some places it is noted rather as a coast species, *e.g.*, Piquet records it as common all along the coast of Jersey, frequenting more particularly the blackberry bloom; Prideaux says it occurs on the coast near Salcombe; and Jones, that it is abundant on the coast of North Cornwall, frequenting flowers. Near Plymouth it occurs in sheltered nooks under high cliffs, on an old landslip, where the ground is very rough (Bignell). On the other hand, near Aldeburgh, it frequents the hedges (Image), and flies in the forest glades of Delamere, chiefly, however, where there is a growth of heath and birch (Arkle), and the New Forest (Ridley), similarly also in woodland glades at Tivoli, in Italy (Rowland-Brown), and throughout the forest-zone in the Pamirs at considerable elevation (Romanoff), in the Black Wood, at Rannoch (White), plentiful in one of the woods and also on an open, heathy, hillside near Wellington, in Somerset, in early July, 1887 (Milton), and common in all the woods of Herefordshire (Bowell), also on the Chiltern Hills among the scrub and in the beech woods (Rowland-Brown), whilst, in June, 1899, Carr notes that it appeared in the "*fuciformis* wood," near Newark, after not having been observed in the county for many years. Speyer says that, throughout Europe, its favourite habitats are—the edges of forests, among shrubs and bushes, and by hedges, and that it occurs in the central Alps of Europe, the mountains of France, Spain, and Italy, of the Balkan Peninsula, and the Harz mountains, in some places up to 6000ft. In

Scandinavia, it is one of the commonest forest and moorland species, whilst it occurs throughout northern and middle Finland to 66° N. lat., and Reuter observes that the only specimen in the series of the Helsingfors Museum, with white spots on the underside of the fore- as well as the hindwings, was taken at Gamla Karleby, 63° 50′ N. lat., on the west coast of Finland, June 18th, 1879. He also notes that the var. *borealis*, Kroul., with the underside tint yellowish-green, also occurs with specimens of typical green hue throughout south Finland, as far north as Kemi, about 65° 40′ N. lat., whilst the type with purer green colour goes to 66° N. lat. The most northerly Finland locality for ab. *caecus* is about 60° N. lat. The species also reaches a considerable elevation in Central Europe, for, on May 10th, 1887, Hutchinson records it as occurring in crowds close up to the level of the snow above Bex, whilst Wheeler notes it at 7000 feet on the top of the Rochers de Naye, and its localities at Arolla, Saas Fée, etc., reach this elevation. Caradja says that it occurs everywhere on dry slopes in Roumania, whilst, at Tschachleu, he records it as occurring on the tops of the mountains. Jordan captured it on the Riffelberg in early July, 1878, and Standen at Bolkesjö, 70 miles northwest of Christiania, at 1700ft., a good height for this latitude. It also goes up some distance in the Pamirs, and, in the Himalayas of northwest India, in Chitral, has been captured at 6000ft. In Norway, however, it is also recorded, by Standen, as occurring on the railway-banks between Disenaen and Saeterstoen, where, on each side of the single line of rails, were broad sloping banks, densely draped with many kinds of greenery, where *Equisetum sylvaticum* and two other species were in great abundance, the smallest looking, at a little distance, like a long piled carpet on the uppermost edge of the bank, and creeping even under the rails and in between the sleepers, where *Pyrola media P. minor*, and *P. uniflora* (*Moneses grandiflora* of the *London Catalogue*) were seen for the first time alive, where the delicate *Smilacina bifolia* was common, and large white patches of *Galium boreale* occurred here and there . . . . whilst dazzling beyond everything else were broad clusters of the rich crimson-purple *Lychnis viscaria*. Here *C. rubi* was common with *Papilio machaon*, *Aporia crataegi*, *Euchloë cardamines*, *Leptidia sinapis*, *Colias palaeno*, *Chrysophanus hippothoë*, etc. Strand says that it is very common in open, elevated, sunny woods, in Aal, in South Norway. In Lapland, Zetterstedt notes the species as occurring in woods, fields, and by roadsides, in all the wooded areas, sometimes not unfrequently, *e.g.*, at Karungi and Wittangi; it also occurs in Lapponia-Torneå and Lapponia-Umeå; whilst, as we have already noticed, it occurs to almost 70° N. lat. in the Sydvaranger district. In Belgium it occurs almost wherever its foodplant occurs—in arid places, the edges of woods, uncultivated spots, etc. (Lambillion). Wheeler says that its locality, at the top of the Rochers de Naye, on June 1st, 1901, was just then a mass of gentians, large and small, anemones of various kinds, yellow auriculas and purple violas; whilst its locality in mid-June, 1900, about 500ft. above Sta. Maria della Luso, near Susa, is described as meadows filled with the pheasant-eyed narcissus, *Ornithogalum nutans*, and other beautiful flowers. It is also recorded as occurring in the woods of Ficuzza and Marraccia (Marott), and by the shores of Lake Fruilani (Senna), Lang observes that, at Jerez de la Frontera, in

Andalusia, he found the insect in a small forest of gigantic umbrella-pines, in March, 1902. In France, in the Gironde, it haunts the bushes of broom, etc., on the edge of pine- and oakwoods (Trimoulet), in Berry and Auvergne, in fields where broom grows (Sand), in fields, hedges, plantations, and small woods in the Doubs (Bruand), in the open woodlands, and by hedgesides in the Alpes-Maritimes (Millière), by hedges and in the woodland glades and clearings in the Saône-et-Loire (Constant); in the Vosges district it haunts the wooded slopes of the Hohandsberg, the borders of the canal at Strasburg, the forest of Neuhoff, and the St. Agathe woods, near Voipy (Cantener); in Brittany, it prefers gardens, settling on currant bushes, hawthorn hedges, and bramble thickets (Griffith). In the Channel Isles, it sometimes abounds on the slopes of the Gouffre, in Guernsey, which are, at the time of its appearance, covered with flowering gorse and dog-daisies (Hodges). In Germany, its habitats are much as in Britain; it occurs in the plain, hilly, mountain, and subalpine regions, haunting the outskirts of woods, among bushes, by hedgerows, etc. In East and West Prussia, it is found about woods of deciduous trees; whilst in Pomerania, as in the British Isles, it is abundant on the mosses, *e.g.*, the mosses at Kieshof, Potthagen, etc.; near Lübeck, it specially favours pinewoods and pastures; in Hanover, it occurs in woods, and, in the Rhine Provinces, deciduous woods again are specially noted, particularly glades and clearings exposed to the sun, whilst similar spots are recorded for Waldeck and Hesse, Fuchs adding that it also haunts meadows on the outskirts of woods, whilst Glaser mentions plantations of young trees, particularly those of young pines, whilst Koch says they prefer the clearings and little used ridings of the woods in the Taunus, etc. In Anhalt, woodland glades are again noticed, whilst in Posen the hedges bordering young plantations of pines are mentioned. In the Lahr district, is is reported to be confined almost entirely to the clearings of the Black Forest and its immediate outskirts. In the Trebnitz mountains, the slopes covered with birch bushes are a favourite haunt, whilst woods are given for Upper Lusatia, the kingdom of Saxony, Bavaria, etc. In Austria, the localities are similar—woodland groves, plantations of young trees, and gardens, are given for Bohemia, and the whole woodland district of Moravia, the glades of woods for Lower Austria, and the bushes, hedgerows, and clearings in woods from the lowest valleys to the subalpine region are mentioned for Salzburg; whilst Zeller notes that it was abundant in the pinewood of Coritenza, in Carinthia; and, in the Tyrol, Weiler and Heller mention it as abundant in the valleys, and occurring singly up to the alpine pastures at 7500ft. In Bulgaria, it is recorded by Mrs. Nicholl from the rough dry slopes of the Vitoch, near Sofia, and, also, as occurring in a little rough valley among the vineyards in Slivno. In Syria, she says that it is common to above 6000ft. on the Lebanon, Antilebanon, and Mount Hermon ranges, also on the Djebel Chekif, above Bloudan. In the Baltic Provinces, Nolcken says that it is common in woods, on heaths, and turf moors; whilst, in the Kasan district, Kroulikowsky reports that it is generally found along paths or by the edges of woods near ponds, or in open spaces in woods, especially in pinewoods and woods of deciduous trees; whilst it is also met with less frequently in fields and gardens, and appears never to be found in the open country; and Bartel states that it prefers the edges of woods in the southern Ural. Elwes records it from the Altai mountains, at Biisk, which appears to be peculiarly arctic in its climatic conditions, the birches and poplars only just breaking into leaf on June 2nd, 1899, and hardly an insect stirring, *C. rubi* being one of the first. It also occurred at Ongodai, between June 10th and 14th, and in the Tchuja Valley, up to the Tchuja Steppe, which is also described as having a peculiarly arctic aspect.

British localities.—Very strangely localised in England, Ireland, and Scotland, abundant in some counties, apparently quite absent in others. Aberdeen: coast districts (Esson)—Fyvie, Tarland (W. Reid), Banchory (McAldowie), Alford, common (McLean). Argyllshire: locally abundant—Kilmartin (Vaughan), Kilberry (Cottingham), Tarbert, Lochgoilhead (Dalglish), Loch Long district—Dunoon, etc. (Chapman), Holy Loch (Ord), Ardrishaig (Gibbs), Islay (W. B. Jones). Ayr: Auchincruive (Duncan). Banff (Edwards). Berks: widely distributed, sometimes common (Hamm)—Reading (Clarke), Bagley Wood (Geldart), Newbury (Kimber). Bucks: generally abundaut (Elliman)—Chiltern Hills—Kimble district, Missenden, etc. (Rowland-Brown), Halton (Stainton), Drayton Beauchamp (Rothschild). Buteshire: Bute—Barone Hill, Rothesay (Dalglish), Isle of Arran (McArthur), Kilmorie (Weir). Cambridge: near Ely (Archer), near Cambridge (Lee). Carmarthen: not common—Oaklands Drive, Pendine (Barker). Carnarvon: near Bettws-y Coed, abundant (Gardner), Conway Valley, common (Bland), Llandudno (Walker), near Deganwy (Gardner). Cheshire: Delamere Forest district, Sandiway, and Abbott's Moss (Collins), Tarporley (Stock). Clackmannan: Clackmannan Forest (Evans). Cork: Bandon, Glengariff, etc. (Kane), Skibbereen (Wolfe). Cork (McArthur), Glandore, Dunmanway (Donovan). Cornwall: occurs throughout the north (Rothschild), locally common in the east, rather scarce in the middle, and rare in the west—Millook, Launceston, Trebartha, Saltash, Whitsand Bay, Liskeard, Looe, Boscastle, Lostwithiel, Bodmin (Clark), Polperro, Truro (Rollason), St. Agnes (Snell), Godolphin (Spiller), near Penzance (Marquand), Hayle (Clark), etc., Portscatho (A. H. Jones), Bude (James). Cumberland: locally plentiful (Day)—Carlisle district (Hodgkinson), Orton (F. H. Day), Burgh (Dixon), Gelt, Hayton Moss (Routledge), Keswick—Ullock Moss, etc. (Beadle). Denbigh: Llangollen, near Ruthin (Gardner). Derby: Dovedale, common, Alderwasley (Payne), Breadsall Moor (Jourdain). Devon: Lynmouth district, common (T. H. Briggs), Brendon (Prout), Torrington district, common (Doidge), Silverton, common (Heald-Ward), Paignton district (Goodale), Torquay district (Crocker), Brixham (Ham), Teignmouth district, abundant (Rogers), Honiton district, common (Riding), Exeter district—Oxton (Bower), Salcombe (Prideaux), near Plymouth (Bignell), Instow, Barnstaple, Bideford, Lustleigh, Totnes, Dartmouth, Plymouth, Bolt Head, etc. (Mathew), Sidmouth, Stoke, Morthoe (Vic. County List), Bickleigh Vale (Briggs), Chagford (Buckler). Dorset: locally common—Carne Wood, common (Bogue), Sherborne (Douglas), Hod Hill, Hambledon Hill (Fowler), Blandford, common (Stainton), Isle of Purbeck, Wareham, Studland (Bankes). Dublin (Birchall). Dumbarton: locally abundant—Glen Falloch, Luss, Milngavie (Dalglish), Bonhill (Malloch), Helensburgh (Ord). Elgin (Brown). Essex: common and generally distributed—Colchester, etc. (Harwood), Maldon (Fitch), Thundersley Common (Whittle), Colchester (Harwood), Harwich district (Mathew), Epping (Doubleday), Chingford (Lane), Loughton (Carr), Witham, rare (Burnell), Beeleigh, Danbury, Hazeleigh, Stow Maries, Woodham Ferris (Raynor). Flint: Ashgrove, Overton (Perkins), Valley of the Dee, near Overton (Gardner). Galway: abundant (Kane)—Clonbrock, common (Dillon), Connemara (Birchall), Galway (Lawless). Glamorgan: Swansea district—Sketty Park, etc. (Robertson). Gloucester: generally distributed—Stroud district, Haresfield Hill, etc. (Davis), Slad, Painswick Hill, etc. (Watkins), Gloucester (Marsden), Woodchester, near Stroud (Mackey), Lower Guiting (Greene), Cirencester (Harman), the Cotswolds (Fox), Stonehouse (Nash), Wotton-under-Edge (Perkins), Bristol, common (Stainton), Dursley (Griffiths). Hants: generally distributed—New Forest (Cox), Brockenhurst (James), Ringwood (Corbin), Stubby Copse (Lockyer), Lyndhurst (Alderson), Fleet (Russell), Bournemouth—Alum Chine (Bromilow), Portsmouth district—Grange Wild Grounds, Browndown, Gosport, Stakes Wood, Eastney (Pearce), Andover (Stephens), Ashford, near Petersfield, Forest of Bere (Hawker), Basingstoke (Hamm), Lockerley (Burrows), Milford-on-Sea (Barraud), Winchester district, not common—Crabbe Wood, etc. (Hewett), Frensham district

(Bingham-Newland), Emsworth (Christy), Isle of Wight—Bembridge (Stainton). HEREFORD: Hereford district (Bowell), Leominster district (Hutchinson), Tarrington (Wood), Colwall (Turner). HERTS: generally abundant (Elliman)—Hemel Hempstead (Piffard), Aldbury (Cottam), near Pitstone (W. Rothschild), Tring (Elliman), Hertford (Gibbs), Bricket Wood (Perkins), Oxhey Wood, very rare (Rowland-Brown). HUNTS: scarce throughout the north and northwest parts of the county (Hall)—Monk's Wood, Warboys Wood (Tebbutt *teste* Thornhill), INVERNESS (F. B. White). KENT: throughout—Shooter's Hill, Bexley Wood, Darenth (Fenn), Strood and Chatham districts, Cuxton, Halling, Chattenden, Cliffe, Shorne, etc. (Tutt), Shoreham, Cudham (Bower), Canterbury district—Blean Woods (A. H. Jones), Folkestone district, Ashford district, Dover (Wood), Margate (Barrett), Sevenoaks district, common (Holmes), Westwell (J. E. Gardner), Longfield, near Gravesend (Jennings), Tunbridge, Pembury (Cox), Frinsted (Mathew), Tenterden (Stainton), Lower Fant, Maidstone (Golding), between Cobham and Maidstone (de la Garde), Eynsford (Carrington), Darenth Wood (Stephens), Wrotham (Carr), Farningham (Barraud), Holly Hill, Snodland (Tyrer). KERRY: Killarney (Stevens), Bere Island (Kane), Garinish Island (Lawless), Glencar (Kaye). KINCARDINE: coast districts (Esson). KING'S COUNTY: Toberdaly, Tullamore (Kane). LANARK: Glasgow (Stainton). LANCS: local but not uncommon—Lancaster district—Clougha, Quernmore, Methop (Forsythe), Manchester, Preston (Stainton), Strafford Park (Chappell), Dutton, Grange (Hodgkinson), Witherslack district (Forsythe), Haverthwaite (Murray), Silverdale (Melvill), Holker Mosses (Crabtree). LIMERICK (Neale). LINCOLN: Louth district (Goulding), Owersby, Bishopsbridge (Lees), Gainsborough district (Burton), Haverholme Priory (Coward). MAYO: Crossmolina (Kane). MERIONETH: Harlech (Graves), Maentwrog (Tetley), Festiniog (Bairstow), Twm Barlwyn mountain (Knights). MIDDLESEX: Harrow district—Kingsbury (Bond), Wealdstone (Ollet), Acton Lane (Godwin). MONMOUTH: Monmouth (Palmer), Llandogo (Bird), Pontnewydd, common (Conway). MONTGOMERY: Llangurig, Montgomery (Tetley). MORAY: Mill of Birnie, Shoggle, Oakwood, near Elgin, Cawdor (Gordon), Forres, Altyre Woods and district (Norman). NORFOLK: Norwich, St. Faith's, Swanington, Stody, Merton, Thetford, Broome Heath, Cawston (Barrett), King's Lynn (Atmore). NORTHAMPTON: throughout, common in some localities (Goss)—Ashton Wold, very rare and local (Rothschild)—near Oundle (Bree), Peterborough (Stainton), Castor (Thornhill), Wakerley, Wansford (R. N. Douglas), NOTTS: Sherwood Forest, Mansfield (Goss), near Newark (Carr). OXFORD: Oxford, common (Stainton), Boar's Hill (Hamm), Chinnor (Spiller). PEMBROKE: Tenby district (Puckridge). PERTH: Earn, Gowrie, Perth and Rannoch districts not uncommon—Blackwood, Kinnoull, Methven, Birnam (F. B. White), Aberfoyle, Callander (Evans). RENFREW: Greenock (J. Gray). ROSS: Strathcarron (Hinxman). RUTLAND: Oakham district—Burley wood, rare (W. B. Gordon). SHROPSHIRE: Shrewsbury (Stainton), Hopton Wafers, near Cleobury Mortimer (Boxer). SLIGO: Sligo, Markree (Kane). SOMERSET: generally distributed and locally common (Hudd)—near Wellington (Milton), Yeovil, rare (Parmiter), Shepton Mallet district—West Compton, Burford Beacon (Bogue), Neroche Forest, near Taunton (Stansell), Taunton district, common (Doidge). STAFFS: North Staffs—Leek, etc. (Hill), Maer Wood, Craddock Moss (Daltry), Cannock Chase (Freer), Burnt Wood (Chappell), Downsbanks, Stone (Bostock), Cheadle (Johnston). STIRLING: Fintry (Eggleton), Strathblane (Dalglish), Loch Lomond—Island of Inchmoan (Ord). SUFFOLK: generally distributed and not uncommon (Bloomfield)—Woodbridge (Waller), Aldeburgh (Image), Assington Thickets (Gaze), Stowmarket (Stainton), Preston, near Lavenham (Gaze). SURREY: not uncommon throughout—Ranmore and Holmwood Commons, Dorking, Polesden (Oldaker), Reigate district (Tonge), Box Hill, Oxted (Sheldon), Riddlesdown (Bower), Croydon district (Hall), Sheep Leas, West Horsley, between Horsley and Shiere (Briggs), Haslemere (Barrett), Ashtead (Prideaux), Worcester Park (Kaye), Guildford (Swinton), Lingfield (Thomas), Clandon (Pickett), Esher (Fleet). SUSSEX: not uncommon—Hailsham district—Glynde (James), East Sussex, not uncommon, Brighton, Hayward's Heath, Isfield, Crowhurst, Battle, Guestling (Jenner), Eastbourne district (Bromley), Worthing, Lewes (Stainton), Hastings and St. Leonard's district (Bloomfield), East Grinstead (Thomas), Steyning (White), Balcombe (Image), Abbott's Wood (Dale), Polegate (Blaber), Fairlight (Ford), Frant (Cox). SUTHERLAND (*teste* Adkin). TYRONE: rare—Lissan, Churchill, on Lough Neagh, etc. (Greer). WARWICK: local—Sutton Park, common (Wainwright), Edgehill (Baly), Wolford (Wheeler), Allesley (Bree). WATERford: Cappagh (Kane). Westmeath: Cromlyn, abundant on the bogs (Battersby), Killynon (Reynell), Mullingar (Middleton). Westmorland: common locally, Kendal district (Moss), Benson Knott, near Kendal (Littlewood), Witherslack district—Windermere (Hodgkinson), Ambleside (*Int.*, ii., p. 84). Wicklow: Powerscourt, Tinahely (Bristow). Wilts: Salisbury district (Gummer), Wilton (Carr). Worcester: Worcester (Stainton), Great Malvern (Edwards), Wyre Common, Croft Wood, Oddingley (Fletcher). Yorks: Askham Bog (Prest), Wharfedale, Bardon Moors, rare (Butterfield), Pickering Valley (Rowntree), Langwith Common (Anderson), Pontefract (Hartley), Sheffield (Doncaster), Helmsley, common (Emsley), Skelmanthorpe, Huddersfield, scarce (Morley), Eston (Sachse), York (Stainton), near Scarborough (Rothschild), Cleveland district—Battersby, singly (Sachse), Glaisdale, common, Basedale, Lonsdale (Lofthouse).

Distribution.—Throughout the whole Palæarctic (and western part of the Nearctic, if *dumetorum*, Bdv. = *rubi*, Linn., be admitted) area. Africa: Canary Isles—Teneriffe (Crompton), Morocco, common throughout—Tangier (Blackmore); Algeria—Algiers (Fountaine), Collo, Oran (Oberthür), Sebdou (Codet), Ain-Sefra (Romieux), Lambessa (Elwes); Tunis (Staudinger). [America; Personally we have little doubt that *dumetorum*, Bdv., is specifically identical with *rubi*, Linn. For this Dyar gives—California—Rocky Mountains.] Asia: ? Japan (Leech), Corea (Fixsen); Amurland—Amur (Maack), by the Onon (Radde), Nikolajewsk, Chabarofka, Pokrofka (Graeser); Altai mountains—Biisk, the Tchuja Valley, etc. (Elwes), Ongodai (Jacobson), southwestern Altai (Kindermann); Thian Shan and Kuldja district (Alphéraky); Tarbagatai and Ala Tau (Haberhauer); the Pamirs (Grum-Grshimailo), Lenz (Herz), northwest Himalayas—Chitral, Kesu Nallah, 6000 ft. (Evans); north Persia (Christoph), northeast Persia (Fixsen), Astrabad Shakhuh (Christoph); Asia Minor—Amasia (Prinkle), Tokat (*teste* Speyer), Rhodes (Zeller), Syria — common to 6000 ft. — Mount Hermon, Lebanon mountains, Djebel Chekif, above Bloudan, Ain Aata, the Cedars of Anti-lebanon, etc. (Nicholl), central Asia Minor — Angora (Hofmann), Broussa (Fountaine). Europe: Austro-Hungary: Everywhere and not rare (Höfner) —Bohemia, rather abundant — Prague, etc. (Nickerl), Carlsbad (Hüttner), Moravia abundant—Brünn, Mistek, Neutitschein, Rottalowitz (Fritsch), Upper Austria — Freistadt, Kirchdorf, Linz (Fritsch), the Inn, Traun, and Muhlk valleys — Buchenau, etc. (Himsl), Lower Austria, common — Wienerwald district (Schleicher), Hernstein district up to the subalpine region, Semmering, on the Hohe Mandling, on the Hocheck (Rogenhofer), Gresten, Melk, Vienna (Fritsch), Salzburg, up to the subalpine region, not rare (Richter)—Salzburg, etc. (Fritsch), Tyrol, abundant to 4300 ft. (Hinterwaldner)—Glockner district, in the Möllthal, near Botzen, Trient (Mann), Dolomite district, Val Fonda, abundant (Mann and Rogenhofer), Campiglio, Mendel (Lemann), near Innsbruck up to 7500 ft., common, Taufers valley, common (Weiler), common in the lowlands, only singly in the alpine region, Franzenshöhe, Höttinger-Alp (Heller), Bludenz, Bregenz (Fritsch), Carinthia, throughout, abundant in the lowlands (Höfner), Styria—Wolfsberg (Lemann), Coritenza woods (Zeller), Hausdorf, St. Jacob, etc. (Fritsch); Carniola — Upper Carnia, very common (Mann), Trieste (Mathew); Dalmatia (Mann) — Hungary, common everywhere — Budapest, Budafok, Nagyvárad, Kalocsa, Belényes, Parád, Pécs, Szaár, Györ, Pozsony, Eger, Tavarnok, Verebély, Selmeczbánya, Rozsnyó, Kocsócz, Gölniczbánya, Igló, Eperjes, Kassa, Ungvár, Máramarosmegye, Kolozsvár, Elöpatak, Nagyszeben, Nagyág, Mehádia, Orsova, Vinkovcze, Lipik, Josipdol, Fiume (Aigner-Abafi), Blocksberg, etc. (Nicholson). Balæaric Isles: Majorca (Muschamp). Belgium: Widely distributed—Namur, Bouge, Fond d'Arquet, common, Vecquée, Haute- and Basse-Marlagne (Lambillion), Dinant, common (Lenoir), Hastières, Waulsort, etc. (Bodart); Warnant, Yvoir, Valleys of the Molignée and the Bocq (Lambillion), Ciney, Ardennes, Charleroi, Loverval (O. Castin), Florennes, Virton (Cabeau), Rochefort and district (Sibille), Walcourt and district (Verheggen), Ortho (Slégers), etc. Bosnia and Hercegovina: common throughout, up to 1100m. above sea-level—Dervent (Hilf), Sarajevo (Mitis), Trebevic (Winneguth), Kalinovik (Schreitter), Jablanica (Hilf), Mostar, Blagaj, Gabela, Stolac (Winneguth), Volujak (Apfelbeck). Bulgaria and East Roumelia: Found throughout the Balkans, near Sofia, Dobrudscha (Bachmetjew), the Vitoch, near Sofia in the Rilo, in Danubian Bulgaria, near Rustschuk, in east Roumelia (Rebel), near Slivno, common (Nicholl), Jaicé (Elwes). Channel Isles: Jersey, common—the Corbière, St.

Brelade's Bay (Hawes), Guernsey, rather common—St. Peters (Hawes), Fermain Bay, Moulin Hoult Bay (F. A. Walker). CORSICA: common throughout (Kollmorgen)—Vizzavona (Standen), Tattone (A. H. Jones), etc. DENMARK: Generally distributed (Lampa)—Jutland (Elwes), Skovene, North Sjaelland and Jylland—Veile, Horsens, Rye, Silkeborg, Hald (Bang-Haas), Zealand, etc. (*teste* Speyer). FINLAND: common throughout the south and centre, its most northerly recorded locality is Kuusamo, 66° N. lat. (Reuter). FRANCE: throughout (Guenée and Villiers), very abundant throughout the Riviera (Tutt); Ain—Gex (May 3rd, 1903), Pailly (July 9th, 1906) (Mongenet); Aisne—St. Quentin, common (Dubus), Allier—Moulins (Peyerimhoff), Alpes-Maritimes, throughout (Millière), Villefranche (Mathew), St. Martin Vésubie to Venanson (Rowland-Brown), Aube, common (Jourdheuille), Aude, common (Mabille), Basses-Alpes — Digne, etc., very abundant (Rowland-Brown), Basses-Pyrénées, throughout (Rondou), Brittany, common (Griffith) — Calvados, throughout (Fauvel), Charente-Inférieure—Royan (Salis); Cher—St. Florent (Sand)—Creuse—Guéret (Sand), Côtes-du-Nord — Nantois (Turner), Dordogne, throughout (Tarel), Doubs, throughout (Bruand), Eure—Elbeuf (Coulon), Pont-de-l'Arche (Dupont), Eure-et-Loir (Guenée), Finistère — Morlaix (Piffard), Gard — Pont-du-Gard (Rowland-Brown), Remoulins (Tutt), Gironde, common—Pessac, Merignac, etc. (Trimoulet), Haute-Garonne, commonly throughout to 2000m. (Caradja), Haute-Marne (Frionnet), Hautes-Pyrénées, generally (Rondou), Haute- Savoie, throughout (Blachier), Indre—wood of la Brande, Nohant (Sand), Brenne (Martin), Loire-Inférieure—Nantes, Savenay, la Chapelle-sur-Erdre, wood of Touchelaye (Deherman-Roy), Maine-et-Loire (Delahaye), Manche—Cherbourg (Nichollet), Marne—Rheims district (Demaison); Nord (Paux), Pas du Calais—Boulogne-sur-Mer (Timins), Pyrénées-Orientales—Vernet (Lemann), Collioure, etc. (Rondou), Puy-de-Dôme (Sand), Saône-et-Loire—common throughout (Constant), Savoie — throughout (Blachier), Seine — Paris district — La Varenne, St. Maur (Ragonot), Seine-et-Marne—Fontainebleau (Tutt), Seine-Inférieure, Tancarville (Leech), forest of Arques (Moore), Seine-et-Oise — Pontchartrain, near Versailles (Lambillion), Var — Hyéres, Costebelle, Carqueiranne, Draguignan, Le Trayas, Cannes, Auribeau, Grasse, Agay, etc. (Tutt), Antéor, Pardigon, Cap Nègre (Reverdin), Ile de Porquerolles (A. H. Jones). GERMANY: Almost everywhere, in the hill, mountain, and subalpine regions (Speyer), East and West Prussia, abundant—Cranz, Capornsche Haide, Dammhof, Gross-Raum, Königsberg, Löwenhagen, Frisching, Tapiau, Wehlau, Insterburg, Rastenburg, Bartenstein, Braunsberg, Mohrungen, Osterode, Allenstein, Divitten, Gr. Bertung, Bischofsburg, Thorn, Graudenz, Elbing, Danzig, etc. (Speiser), Pomerania, common—Demmin, Kieshof, Potthagen (Paul and Plötz), Mecklenburg, throughout—Neustrelitz, Sülz, Wismar, Schwerin, Parchim, Waren, etc. (Gillmer), Lübeck, Hamburg, Lauenburg and Schleswig-Holstein—near Lübeck, Weslower Moss, Weslower Tannen, Travemünde (Tessman), Eutin, generally rare (Dahl), Sachsenwald, near Hamburg (Tessien), Bahrenfeld, etc., abundant (Laplace), Hanover—Lüneburg, rare (Machleidt and Steinvorth), Hanover, abundant (Glitz), Hildesheim district—Härtling, on the Galgenberge, near Alfeld (Grote), Bremen, abundant (Rehberg), Rhine Provinces, not rare—Linn, Uerdingen, Brühl, Trier, not rare (Stollwerck), Neuenahr (Maassen), Crefeld, common, Hülserbruch, Forstwald, Fred, etc. (Rothke), Waldeck and Hesse—Oberursel (Fuchs), Hanau, common (Limpert and Röttelberg), near Wied-Selters (Schenck), Frankfurt-on-Main, Taunus, Odenwald, near Wiesbaden, Oberhessen, Cassel (Koch), Mombach, Mainz, etc. (Rössler), Thuringia—in both plains and mountains (Krieghoff), Langewiesen (Gillmer), Gotha, etc., widely distributed (Knapp), Gera, abundant, Erfurt (Keferstein and Werneburg), Steigerwald and Willrodaerforst (*Ent. Verein Erfurt*), Zeitz (Wilde), Biedenkopf (Jäger), Saxony, Anhalt and Harz—Dessauer Haide, common (Stange), near Kochstedt, not abundant (Richter), Hirtenhau, the Möster Laub, very abundant (Amelang), the Wörnitz (Gillmer), Wernigerode, very common, the Harburg, Lindenberg (Fischer), northeast Hartz, not rare (Reinecke), Göttingen, abundant (Jordan), Brunswick, not rare (Heinemann), Brandenburg, common—Berlin, Erkner, Jungfernhaide, Finkenkrug, Grunewald, Grünau, Bernau (Bartel and Herz), Frankfurt-on-Oder, the Kunersdorfer Forst, near the Tzschetzschnower Faulen See (Kretschmer), Posen, abundant—in Hohensee (Schultz), Silesia, abundant throughout, common in the plains and mountains (Wocke)—the Trebnitz mountains (Nohr), Glogau (Zeller), Upper Lusatia, common (Möschler), Sprottau district—Muckendorf, Küpper, Sprottischwalden, Ebersdorf, Wichelsdorf, Oberleschen, Sagan (Pfitzner), Kingdom of Saxony, widely distributed and abundant—near Plauen in Voigtlande, Dresdener Haide (Winckler), Freiberg (Fritsche), Chemnitz (Pabst), Saxon Upper Lusatia (Schütze), Leipzig (Verein Fauna), Bavaria—Regensburg (Hofmann and Herrich-Schäffer), Munich. abundant (Kranz), Augsburg (Freyer), Dutzenteich, near Nürnberg (Gillmer), Kempten (Kolb), Württemberg, abundant—Stuttgart, Tübingen, Reutlingen, Neckar valley, Jaxt-and-Kocher-valleys, abundant (Seyffer), Baden, abundant—Karlsruhe, Baden, Bruchsal, Durlach, Ettlingen (Gauckler), Lahr (Keynes), Alsace, throughout (Peyerimhoff)—Colmar, the Hohlandsberg, Mülhausen, Strasburg, Neuhoff, Metz, St. Agathe, near Voipy, etc. (Cantener), Rhine Palatinate, throughout (Bertram), Loreley district, Dickschied, etc. (Fuchs). Greece: Argostoli in Kephallenia (T. B. Fletcher), Kalávryta (Fountaine), Athens (Elwes coll.). Italy: abundant throughout, including the islands (Verity)—throughout Tuscany, common (Stefanelli), Tuscan Appenines—Vallombrosa, Camaldoli (Verity), Mantua, rare (*teste* Speyer), Florence (Elwes), Tivoli (Rowland-Brown), Lucca, common (Verity), throughout Lombardy (Turati), Emilia—Modena, S. Faustino (Carrucio), Ficuzza, Marracia (Marott), Chiavari, near Spezia (Blachier), Lake Fruillani (Senna), Piedmont—Courmayeur, Certosa di Pesio, Sta. Maria della Luso, near Susa (Lowe), Aosta (Fountaine), Liguria—the Italian Riviera—Alassio, Albenga, Laigueglia, etc. (Tutt), Roman Campagna, Alban mountains, Abruzzi, etc., Livorno, Florence, Valdarno, Siena (Calberla), Menaggio (Sich), Sicily—Madonie mountains, from 400m.-1700m.—Castelbuono, Ferro, Gonato, plains near Battaglia, Columello (Failla-Tedaldi), Osimo (Spada), Caronia, Etna, Palermo, Monreale, S. Martino, Ficuzza (Minà-Palumbo), Nondello (Giorni), Scala, Mermeriza, Messina (Zeller). Portugal: Cintra (Eaton). Roumania: Near Tschachleu, to the tops of the hills (Caradja), Dulcesti (Hormuzaki), Comanesti (Leon), Turn-Severin (Haberhauer). Russia: North Russia (Günther *teste* Elwes), Russian Karelia (Reuter), Baltic Provinces, throughout (Nolcken), Transcaucasia, throughout (Romanoff), Urals (Grum-Grshimailo), Volga district—Kasan provinces, Orenburg, Saratov, Sarepta, etc. (Eversmann), South Urals (Bartel), Wiatka govt. (Kroulikowsky), St. Petersburg, Caucasia (up to 1400m.) (*teste* Speyer). Sardinia (*teste* Speyer). Scandinavia: Norway—common in the south and centre, everywhere near Christiania, Odalen, in part of Loiten Hedemark, Folkstuen, in the Dovrefjeld, Naes Vaerk, near Bergen, some years common (Siebke), Saltdalen, Smaalenene, Akershus, Kristiania, Buskerud, Bratsberg, Jorlsberg, Laurvik, Nedenaes, Lister, Mandal, S. Bergenhus, Romsdal, S. Trondhjem, N. Trondhjem, Nordland, Finmark (Schöyen), south Norway—Vallö, near Tonsberg, Larköllen, Fredrikstad, Hvalöerne, near Bolingshavn, Sireosen, Siredal, Aal, Stevsöln, Kongsberg, Boten, Odenmark, Klovemaln, Bolkisjö (Strand), Koppang, etc. (Jordan), Sæterstoen (Chapman), Disenaaen, (Standen), Arctic Norway—Sydvaranger 69°-70° N. lat. (Schöyen), Vefsen, Lödingen, Langöen (Strand), Lapland, throughout (Zetterstedt), Sweden, generally distributed (Lampa). Spain: Andalusia—Granada, etc. (Rambur), Jerez de la Frontera (Lang), San Roque (Walker), Gibraltar (Elwes), the Cork Woods (Becher), Algeçiras (Yerbury), Aragon, common (Nicholl), Spanish Pyrenees—Val de Bronsette, 1800m., Panticosa (Burr). Switzerland: Generally distributed and abundant up to 7000 ft., Zürich, valleys of the upper Engadine—near Bergün, abundant, Grisons—Weissenstein, sparingly, at Stelvio, on the Franzenshohe (Frey), Pontresina (Lowe), throughout the Rhone valley, the lateral valleys—Martigny, Fully, Mt. Chemin, Mt. Ravoire, Plan-Cerisier, Saillon, Riddes, Isérables, Sion, Evolène, near Montanaz, near Sierre, etc. (Favre), Mayenwand (Jäger), Gryon (Moss), Les Avants (Barraud), Martigny (Sheldon), Vernayaz (Wheeler), Bex (Murray), Aigle—Veytaux, Veraye gorge, Rochers de Naye, etc. (Wheeler), Sépey, Rossinières, Val d'Hérens, Visp valley (Tasker), Macolin, Grindelwald, Mt. Pilatus Külm (Lowe), Engleberg, Schwand (Keynes), Meyringen (Horsley), Berisal, and the 4th refuge on the Simplon, in July (Courvoisier), Laquinthal, Fusio (Lowe), Arolla (Pearson), Zermatt (Lemann), on the Riffelberg (Jordan), between Saas-Grund and Saas Fée (Cochrane), Lake district—Locarno, Ronco, etc. (Tutt), Reazzino (Lowe), Lugano (A. H. Jones), in the Swiss Jura to 3000 ft. (Speyer)—Neuchâtel district, common everywhere (Rougemont), Eclépens, etc. (Lowe), Geneva district—Salève, etc. (Blachier), Promontogno, below the Maloja (Fountaine). Turkey: Port Baklar, near Gallipoli (Walker).

Tribe: STRYMONIDI (THECLIDI).

The species in this tribe comprise the small black, or blackish-brown, "hairstreaks," usually with one or two delicate tails to the hindwing, of which *Strymon pruni* and *Edwardsia w-album* are our only British representatives. They were first grouped, with one or two quite heterogeneous species, by Hübner, as the *Strymones* (*Verzeichniss*, p. 74), from which they derive their modern tribal name. They are principally confined to the north temperate zone of the Old and New Worlds, in each of which they extend across the entire continent, the number of species being very considerable, Staudinger and Rebel noting (*Catalog*, etc., 3rd ed., pp. 69-70) 16 species for the Palæarctic, and Dyar (*List Nth. Amer. Lep.*, pp. 37-38) 26 for the Nearctic, region. Both these authors place the mass of the species included in this tribe in the genus *Thecla*, Fab., which we have already shown (*anteà*, viii., p. 313) falls as a synonym of *Ruralis*, [Linné,] Barbut. De Nicéville records (*Butts. Ind.*, iii., pp. 65 and 298) two Strymonid species as Indian, *viz.*, *sassanides*, Koll., which has apparently spread into the northwest Himalayas from Persia, Bokhara, Fergana, etc., and *sinensis*, Alph., which he includes among the Lycænas, and which, he says, "is thoroughly isolated in the genus *Lycaena*, and must take its place in the small group formed by some very heterogeneous species—*rhymnus*, Ev., *tengströmi*, Ersch., and *anthracias*, Chris."

That this mode of grouping is very unsatisfactory, is evident even from a mere cursory examination of the species in their various stages. The eggs exhibit a great variety, compare those of *pruni* and *w-album* (pl. ii., figs. 3, 4), which, in turn, are quite different from that of *spini*. Similarly, the larvæ show considerable structural differences, especially with regard to the lenticles, which are so characteristic of the group. The pupæ, too, show considerable difference; especially does that of *pruni* differ from the others, so that one feels at once constrained to look upon *pruni*, *w-album*, and *spini*, as representatives of three groups within the tribe, and possibly several others will be noted when the structure of the early stages of the Strymonid species is sufficiently well-known. We may here note that Chapman's remark, *re* the characters offered by the ♂ genital organs (*anteà*, pp. 88-89), points in the same direction.

The general superficial characters of the Strymonids are clearly indicated. All the imagines are of moderate size; the hindwings generally furnished with one or two rather short, thread-like, tails on the outer margin, and towards the anal angle; the forewings of the ♂ usually with a well-defined, oval, androconial patch, as in the Callophryids; the neuration of the ♂ modified owing to the development of this patch; the underside remarkable for the possession of a transverse white line, from which the popular name, "hairstreak," has been derived. The development of this line from the typical Lycænid ocellated spots, can readily be followed by a careful study of the Asiatic group represented by *ledereri*, *lunulata*, etc. De Nicéville notes (*Butts. Ind.*, iii., p. 298) that, "the difference in the neuration of the forewing, in the opposite sexes of the species of this group, is considerable, and appears to be entirely due to the presence of the secondary sexual mark of the ♂." Strangely, the Indian species, *sassanides*, described on the same page is without the sexual brand.

This sex-mark has been described and figured by Aurivillius, with the neuration of the ♂ and ♀ for this portion of the wing, as it is found in *Edwardsia w-album* (*Kong. Svensk. Vet.-Akad. Handl.*, v., p. 21, pl. ii., figs. 13-14). He also figures (*op. cit.*, figs. 12, 15) the androconia (much magnified), and the mode of attachment of an androconial scale to the wing-membrane. We may here note that the peculiar half-scales which are noticeable on the underside of the Callophryid species (*rubi*) (*antea*, p. 91), are also present in the Strymonid (*w-album*, *pruni*, etc.), but are quite wanting in the Ruraline, species (*quercûs*, *betulae*, etc.).

We have already noted the specialised characters of the eggs; it may be here remarked that, in most, if not all, of the Strymonid species, both Nearctic and Palæarctic, the egg goes through the winter; the larva, however, is quite fully-formed within the egg-shell during the greater part of the hybernating period, and can be removed therefrom in January, at least in some species, and continue to live dormant, outside the shell, for a considerable time. As with our own species, the eggs of *liparops* and other Nearctic species are laid on a branch or twig near a leaf-bud, or at the base of a leaf-scar, that of *liparops* on *Amelanchier canadensis*, etc. This special mode of hybernation in the egg, of the Strymonid species, is to be contrasted with the Callophryid (*Callophrys*, *Incisalia*, etc.) method of hybernating as pupa. In its mode of hybernation, however, the Strymonid group agrees with the Ruralid (*sens. restr.*).

The Strymonid larvæ are somewhat oval, seen from above; the ventral area is flattened, the dorsal ridges exceedingly well-marked, higher in front than behind, the anal segments somewhat flattened, the larva generally green in colour, with oblique lateral stripes. They are remarkably supple, and have a peculiar gliding motion, and mostly live on the leaves of forest trees, woody shrubs, etc., although there are, perhaps, some exceptions. Scudder notes the New England species *liparops* as feeding on whitethorn and plum, *calanus* and *edwardsii* on oak, *acadica* on willows, etc. The larval stage is a comparatively short one, March to June being, perhaps, the usual length of larval life, and the species are almost all absolutely single-brooded. The change of colour that one notices in the larvæ of most of our European species just before pupation, is paralleled in North America, where we learn that *liparops* changes from green to pinkish-brown, whilst the grass-green of *acadica* becomes purplish, etc. The larvæ of our British species will eat newly-formed pupæ of their own species with avidity. Scudder observes that the larva of *T. calanus* is a cannibal, and will, when short of food, devour its younger and weaker brethren. The gliding movement of the larvæ, noted above, is common to the species of both the Old and New Worlds, and one is much reminded of our own species by Scudder's remarks of the larvæ of *acadica*, *viz.*, that they are very supple in their movements, their body curving like that of a snail, as they pass from one leaf to another, or from the upper to the under surface.

The pupa is plump, rounded anteriorly and posteriorly, the thoracic segments making one large swollen mass dorsally, and the abdominal segments another, the 1st abdominal segment forming a conspicuous waist, separating the two bulging areas from one another; they are abundantly studded with short, slender, serrated, and pointed, hairs (see pl. iii., fig. 1), very different from the Ruraline, trumpet-shaped, type, as repesented by those of *Bithys quercûs* (pl. iii., fig. 2); they are also abundantly supplied with the characteristic lenticles. The cremaster is not, as a rule, well-developed, but the pupæ are suspended by means of an anal pad and central girth. Scudder notes that the larva of *liparops* takes a comparatively long time, after spinning up, before pupation, *viz.*, from two to four days, and that the girth, which is placed by the larva between the meso- and metathorax, then slips backwards into the incision between the 1st and 2nd abdominal segments. As with our species, the natural position for pupation is, for most of the species, on the upper or under surface of a leaf. It is remarkable how distinctly, in the resting-period preceding pupation, the development of the pupa beneath the larval skin can be traced, the separation of the thorax and abdomen, the wings, etc., all being very clearly marked.

Scudder gives the following detailed diagnosis of the tribe, under the generic name *Thecla* (*Butts. of New England*, ii., pp. 868-870):—

IMAGO.—Head small, densely clothed with scales, and above with short hairs; on the front, the hairs are exceedingly short and sparsely scattered. Front not at all prominent, almost flat, barely surpassing the front of the eyes, slightly sunken down the middle above, below very slightly tumid; twice as high as broad . . . . Eyes rather large and full, very sparsely and very briefly pilose, excepting on the upper third. Antennæ inserted with the hinder edge of their bases just in front of the middle of the summit, and separated from each other by three-quarters the width of the antennal pit; about half as long again as the abdomen, consisting of from 28 to 30 joints, of which from 11 to 14 form the cylindrical club; usually the latter is very gradually thickened, always but slightly, being scarcely twice as wide as the stalk; . . . . the tip very bluntly rounded. . . . . Palpi rather slender, fully half as long again as the eyes, the terminal joint about three-quarters the length of the penultimate and clothed with recumbent scales, the other heavily clothed, especially beneath, with long scales closely compressed in a vertical plane. Patagia exceedingly long and slender, arched and very slightly convex, three or four times longer than broad . . . . Forewings about half as long again as broad, the costal border pretty strongly convex and almost bent on the basal fourth, the middle half straight, the apical fourth very gently curved backward, the outer angle more than a right angle, scarcely rounded . . . . Costal nervure terminating just beyond the tip of the cell; subcostal nervure with three superior branches; the first arising at, or a little beyond, the middle of the outer four-fifths of the cell; the second midway, or a little further, between this and the apex of the cell (♀), or less than one-third the distance to the same (♂); the third at, or just beyond, the tip of the cell (♀), or midway between the origin of the first, and the tip of the cell (♂), the main stem beyond the origin of the second branch either straight (♀), or strongly arcuate. convexity downward, to a little beyond the tip of the cell, and then straight (♂); cross-vein closing the cell transverse, very feebly developed, excepting next the main subcostal nervure . . . . Hindwings with the costal margin rather full and convex, a little straightened in the middle, curving backward roundly at the tip, joining the curve of the outer margin, which is a little full at the middle subcostal nervule, especially in the ♂, but beyond that pretty regularly and broadly rounded, more or less obscurely angulated at the lower median nervule, where there is always a long and slender thread-like tail . . . . there is also a secondary very slight projection at the tip of the middle median nervule; the inner margin is rather broadly convex, more strongly next the base, and just before the tip, angularly, though but little, emarginate. Submedian nervure terminating on the outer border, just by the anal angle; internal nervure terminating beyond the middle of the inner margin. Androconia slender, sublanceolate, about four times as long as broad, subequal, but tapering slightly on apical half, the apex broadly rounded, the stalk very long. Fore tibiæ about three-quarters the length of the hind tibiæ; the forelegs similarly developed in the two sexes, excepting at the terminal tarsal joint, and, with the same exception and the nakedness of the tibial spurs, resembling the other legs very closely; fore tarsi but little shorter than the tibiæ, the last tarsal joint either developed as in the other legs (♀); or very small, similar to the preceding joints, bearing at its unenlarged extremity simply a pair of slightly curved spines, differing in no respect from the others behind, and having its upper surface thickly covered with extremely short hairs (♂). All the femora of ♂ (and this sex only) heavily fringed beneath with long hairs. Middle tibiæ . . . . armed beneath with a very few short and slender spines, and at tip with rather long, tapering, scaly spurs. First joint of tarsi more than equalling the rest taken together, the others nearly equal, all furnished beneath on either side, with a clustered mass or row of small, not very slender, crowded spines, a single one on either side of the apex of each joint being longer, spur-like. Claws small, strongly compressed, tapering to a fine point, strongly curved or bent before the middle, with a small, basal, triangular, laminate tooth beneath; paronychia simple, slender, nearly equal, curving a little in the opposite direction to the hook, than which it is a little shorter; pulvillus very minute, thrust forward, nearly circular. MALE ABDOMINAL APPENDAGES: The upper organ with such broad alations as to leave in the middle behind, a broad, deep, notch, the bottom of which is squarely cut; the alations tumid, well-rounded, of about equal length and breadth; lateral arms very long, slender, tapering, finely pointed, strongly recurved, and wholly concealed next the inner surface of the alations; clasps about as long as the upper organ, straight, and rather slender, a little gibbous on the basal half, beyond tapering, but very bluntly pointed.

OVUM.—Depressed echinoid-shaped, as broad at base as at summit, a little depressed and infundibuliform at the middle of the summit, covered everywhere with greatly and abruptly elevated prominences, connected with all about them by heavy, well-defined ridges, scarcely disposed in rows, leaving between the ridges deep hollows with abrupt sides, above becoming smaller and confused, the openings between the ridges assuming more the form of pits on an otherwise uniform surface. Micropyle sunken in a not very deep pit, obscure, consisting of a few rather large, oval cells, around a minute, central, circular cell, and surrounded by a very few roundish cells of about the same size, their walls faint, but not very delicate.

LARVA (newly-hatched).—Body of nearly equal diameter throughout. The last compound segment tapering and rounded at the tip, flattened on the dorsal area up to the laterodorsal line; below this sloping to the somewhat laterally produced infrastigmatal margin. Laterodorsal series of hairs consisting, upon the abdomen, of larger, centrally situated, curving hairs, about as long as two segments, and outside, and a little posterior to them, similar, but shorter and more recumbent, backward-directed hairs, one of each to a segment in each row. The hairs below the spiracles consist of three on each side, on each segment, one very long, central one, and two shorter, anteriorly placed, the upper the longer. Midway between the laterodorsal, hair-bearing, papillæ and the spiracles, but nearer the former, is a series of round, smooth, hemispherical lenticles, situated in the middle of the anterior half of all the segments, both thoracic and abdominal, excepting the large first thoracic segment. The laterodorsal and substigmatal series of hair-bearing papillæ are also repeated on the third thoracic segment, and, to a certain extent, on the others, with certain changes of position, and the addition of others. No laterostigmatal series of hair-bearing papillæ. On the last compound abdominal segment, the hairless lenticles of the lateral row form one of a series of five on either side: three larger equidistant ones placed in an open curve, diverging posteriorly from the opposite set, and two smaller ones posterior to these, one behind, and a little outside the other, in the laterodorsal region.

LARVA (adult).—Head small, smooth, rather appressed in front, rounded, a few long hairs about the ocelli; broadest above the middle, well rounded below; triangle half as high again as broad, reaching about two-thirds way up the front. Second joint of antennæ broader than long, cylindrical but tapering, the third as long as the second, but only half as broad, cylindrical, barely tapering; fourth a minute wartlet by the side of a long, slightly curved hair. Ocelli six in number, three above nearly touching each other in a slightly curved row, its convexity forward and upward, in front, three in a straight row along the base of the antennæ, the upper being the anterior one of the previously mentioned row, situated at a distance from each other, less than the diameter of one of them; and a sixth behind the lowest of the last row, so far as to form a right angle with it and the uppermost of all the ocelli; all of equal size, the sixth flat, the others convex. Labrum pretty large, fully twice as broad as long, the front roundly excised to a moderate depth in the middle, either lateral half well rounded in front. Mandibles short and quite broad, the edge slightly wrinkled and sinuous, scarcely denticulate. Maxillary palpi with the basal joint bearing an inner and an outer palp, the basal joint of the outer cylindrical, broader than long; second cylindrical, twice as broad as long, and two-thirds as stout as the preceding, the apical joint similar to it, but only half as broad and tapering slightly, the inner palp consisting of two joints similar to the apical two of its neighbour, but a little smaller. Spinneret small and linear. Labial palpi apparently consisting of a single cylindrical, very slender, joint. Body marked with longitudinal and oblique stripes and bands, pretty regularly arched longitudinally, but elevated more anteriorly than posteriorly, and sloping almost uniformly over the whole abdomen, but more rapidly on the last two segments; viewed from above elliptical, the anterior border broadly rounded, broadest on the middle of the thoracic segments, tapering posteriorly very gently to the 7th abdominal segment; behind, narrowing to a more sharply rounded tip; dorsal area narrow, flat or slightly sulcate; sides pretty high, tectiform; substigmatal fold rather prominent, uniform; segments not at all arched or prominent. Skin delicately shagreened, the whole upper surface covered uniformly and somewhat frequently with minute warts, emitting short, erect, inconspicuous hairs; upon the summit and anterior portion of the first thoracic segment they are twice or thrice as long and stouter, and there is also a series of similar hairs upon the laterodorsal ridge and the substigmatal fold, a good many hairs to each segment. The short hairs are of uniform thickness throughout, smooth, and round tipped; the long ones taper very slightly, are not delicately pointed, and are uniformly, distantly, and very delicately spiculiferous. Spiracles very small, almost round, or a very little ovate. Legs very small, tapering, the last joint very slender, the claw minute, delicate, curving considerably and regularly. Prolegs very short, rather stout, each furnished at tip with a double pad, and each pad with a double crescentic row of rather slender claws.

Pupa.—Viewed from above the outline of the body is a little more than twice as long as broad, composed of two longitudinally contiguous, broad and short ovals, one about five-eighths of the whole, formed by the abdomen, and one by the parts in front; the latter is considerably shorter, and but slightly narrower, than the former, scarcely narrowing behind at its junction with the abdomen, narrowing somewhat, and well arched, in front, the prominence of the head scarcely causing any lack of regularity in the curve, the basal wing-tubercle scarcely perceptible; the abdomen quite regular and equal in its curve, the posterior end being pretty broadly rounded. Viewed laterally, the division between thorax and abdomen is marked by only a small, rounded hollowing; the thorax is most prominent just behind the middle of the mesothorax, and curves forward with a full and rather rapid, pretty regular, downward arch, the same curve continued backward posteriorly with perfect regularity; the abdomen is roundly and regularly arched, highest, and slightly higher than the thorax, at the 3rd and 4th segments, the posterior end of the body sloping about as rapidly, though generally a little less than the anterior, the apical half of the 9th abdominal segment being perpendicular. Transversely, the middle of the thorax is well arched, but considerably and rather broadly hollowed in the middle of each of the sides, the summit well rounded; transversely the middle of the abdomen is very broadly and regularly rounded, forming a scarcely depressed semicircle. Three-fifths of the tongue exposed, the inner sides of the legs having the tongue interposed between them. Basal wing-prominences consisting of exceedingly slight, transverse, oblique, low ridges. Posterior border of the wings straight. Whole body covered with an interlacing, delicate network of raised lines, distinct under a lens, their points of intersection generally raised a little, and bearing a little wart; other independent warts in the cells, broader than high, give rise to spiculiferous hairs, generally rather short, sometimes very short. Hooklets short and very slender, the stem equal, curved somewhat at the tip, bearing a sudden lenticular expansion, which is bent downward almost upon the stem, the lateral portions a little produced downward, the expansion three times as broad as the stem.

Of the species in this tribe, Bethune-Baker writes (*in litt.*): "The group of hairstreaks, including *pruni*, *w-album*, *spini*, *sassanides*, *tengstroemi*, *lunulata*, etc., occurs throughout the Palæarctic and Nearctic regions; it also extends just within the Indian region, for Watson took a single specimen of *sinensis*, Alph., at Gunduk, northeast of Quetta, in the Sarakola Pass. De Nicéville created the genus *Neolycaena* (*Butts. Ind.*, iii., p. 64) for this species, which agrees absolutely in its general characters with the rest of the Strymonids. The neuration is the same in all; the palpi, eyes, and legs, in like manner, present no differential features, whilst the genitalia are also of essentially the same type. A considerable number of species occur in China, several of which I have not been able to examine structurally, but are evidently closely allied to others which have been examined, and certainly belong to this group.

"Before dealing with the sections into which the various Strymonid species fall, it is necessary to mention separately two species, which, though belonging structurally to this group, nevertheless form a close connecting link, with the little group of eastern 'coppers,' centering around *phoenicurus*, Led. The two species, to which reference is here made, are *ledereri*, Bdv., and *caspius*, Led., of which the former has generally been considered a Theclid, and the latter a Chrysophanid, but the structure—neuration, etc.—is identical with that of *ledereri*, and shows that *caspius* also belongs to the Strymonids. Examination of the undersides of these species will show that *ledereri* has here the pattern in the form of spots similar to those obtaining in the ordinary "coppers," whilst the upper surface is that of the "hairstreaks." In *caspius*, the spots of the underside are much more fully developed; beneath, the primaries have developed a certain amount of coppery or orange colour, whilst the upper surface has a purplish tint similar to that of *Chrysophanus sarthus*, Staud., or *C. phoenicurus*, Led. It may be here noted that Staudinger's var. *transiens*, *Stett. Ent. Ztg.*, 1886, p. 201; *Cat.*, 3rd ed., p. 75, does not belong to *caspius*, but to *sarthus*, the neuration of the two species being different, whilst the pattern is also nearer to *sarthus* than *caspius*. *Ledereri* and *caspius* must, therefore, form a separate subsection of the "hairstreaks," connecting them with the "coppers" proper through a subsection of the Chrysophanids containing *standfussi*, Gr.-Gr., *sultani*, Staud., *sarthus*, Staud., and *phoenicurus*, Led.

"I have examined the androconia of the ♂ s, and find in the '*pruni*' and '*w-album*' groups it is similar. The scales are much finer, very closely set over each other, and, in brilliant sunlight, under an 1·in. objective, have absolutely no colour beyond the dead neutral grey. The other wing-scales are much larger and more loosely set, and are metallic bronzy. I tried to get colour by displacing the androconial scales, but without success. In *tengströmi*, the androconia are more loosely set, and are dark brown; they are smaller than the ordinary wing-scales. In *lunulata*, the androconia are loose, like those of *tengströmi*, or even more loosely set, and are colourless grey. In *sinensis* and *rhymnus*, there is scarcely more than a thickening of the nervures at the end of the cell. In *sassanides*, there are no androconia; *acaciae* has practically none, and *ilicis* also practically none."

Omitting for the moment the consideration of the early stages, and dealing only with the perfect insects, the whole group appears to fall into the following main subsections:—

(1) *Pruni*, *w-album*, *spini*, *acaciae*, *ilicis*, together with the great majority of the Chinese species. In this section, *pruni*, *acaciae*, and *ilicis* stand somewhat isolated from their allies at the beginning and end.

The two latter may always be recognised by the fact that they have no sexual brand on the upper surface of the primaries, though there is a slight thickening of the scales near the end of the cell at the upper angle. In this character they lead into the *lunulata*, and *tengstroemi* section.

(2) *Lunulata, tengstroemi, sinensis, rhymnus, ledereri, caspius.*

Lunulata is not a tailed species, as are all the preceding, whilst the markings of the underside differ decidedly, and approach closely to those of *tengstroemi* and *sinensis*; the small Russian species, *rhymnus*, appears to close this section; whilst the two remaining species, *ledereri* and *caspius*, lead this group into that of the 'coppers.'"

Our own studies lead us to accept the leading features of Bethune-Baker's grouping, and his further help, together with a close study of the material in the British Museum collection, has led us to consider that there are, at least, two main sections, each with a species, full-spotted in the Lycænid (*sens. lat.*) form, at its base. These we have for our own reference noted as the Lycænid and Chrysophanid Strymonids respectively. Strangely these group themselves, in their broad characters, as the sections with and without the oval ♂ androconial brand, and a tentative grouping has been made for working purposes as follows:—

A. Lycænid Strymonids—with ♂ androconial oval patch at apex of cell—

Sect. α.—Stout typically built, Strymonid species—

1. With two rows of spots on underside of the Lycænid type; untailed = FIXSENIA—*herzi*, Fixs. (type).
2. With two rows of spots, nearly as in 1; band suggesting form in *pruni*; tailed = LEECHIA—*thalia*, Leech (type).
3. With the spots modified into one marginal row along the orange band, and the inner marginal white edging of the other row developed into separate line; tailed = STRYMON—*stygiana*, Butl., ♀ (= *mera*, Jans., ♂), *rubicundula*, Leech, *pruni*, Linn. (type).
4. As in 5, but with the space on hindwing between the white lines on the inside and outside of orange band, modified into series of roundish spots of dark grey colour towards costa; tailed = FELDERIA—*lais*, Leech, *eximia*, Fixs. (type), *fixseni*, Leech, *oenone*, Leech, *grandis*, Feld., *ornata*, Leech.
5. With the spots reduced to linear edging of orange band; white transverse line of W shape; tailed = EDWARDSIA—*w-album*, Knoch (type), *fentoni*, Butl., *patrius*, Leech, [*v-album*, Obth., *percomis*, Leech].
6. With the underside markings reduced to white transverse line; abbreviated orange band; and large blue anal spot; tailed = KLUGIA—*spini*, Schiff. (type), *melantho*, Klug, *latior*, Fixs.
7. Strongly marked on the underside of both wings, suggesting a marked approach to the Bithynid type; tailed = KOLLARIA—*sassanides*, Kollar (type), *deria*, Moore, *mirabilis*, Ersch.

Sect. β.—Delicate, slender, untailed, Plebeiid-looking species, with slighter androconial brand—

1. With underside spotting suggesting origin of lines in 2—ERSCHOFFIA—*lunulata*, Ersch.
2. With the underside markings of delicate white lines, remnants of margins of rows of spots; the hindwings also more or less obsolete spotting = NEOLYCÆNA, Nicév.—*rhymnus*, Ev., *tengstroemi*, Ersch., *tangutica*, Gr.-Gr., *iliensis*, Gr.-Gr., *sinensis*, Alph. (type), *pretiosa*, Staud.

B. Chrysophanid Strymonids—without oval ♂ androconial patch—

1. Strongly spotted on the underside in characteristic Chrysophanid form; untailed—BAKERIA—*ledereri*, Bdv. (type), *caspius*, Led.
2. The underside spotting largely reduced to a few marginal orange

spots; the white transverse line broken; tailed = NORDMANNIA—*myrtale**, Klug (type), *acaciae*, Fab. [*ilicis*, Esp.] [*prunoides*, Staud.].

Our ignorance of the early stages of the greater number of the species belonging to this group is absolute. So far as our material goes in this direction, the groupings suggested above are upheld, although the tabulation is quite tentative, and one suspects that some of the details will require considerable modification with greater knowledge.

De Nicéville strangely observes (*Butts. Ind.*, iii., p. 298) that all the species of "hairstreaks," so far as he knows, are found in the perfect state on trees and bushes, from which they may be disturbed by beating, seldom settling on the ground or on low plants and flowers, also that they have a rapid flight, but seldom fly far, and rest with closed wings on the upperside of a leaf. This is all pretty generally true of the Ruralines, especially those of the Bithynid branch, but is, very strangely, untrue, not only of the Palæarctic, but also of the Nearctic, Strymonid species, which, beyond all things, love flowers, and where alone, in the imaginal stage, the Strymonids can be obtained in numbers. We have seen hundreds of *Edwardsia w-album* at privet blossom in Chattenden Woods, also of this species and *Nordmannia ilicis* in Fontainebleau Forest; privet is the most attractive flower to *Strymon pruni* in Monk's Wood, Hunts; whilst the bloom of thyme and certain saxifrages attract swarms of *Klugia spini* in the valleys of the alps of Central Europe. *Nordmannia acaciae*, too, only could be found on flowers in the alpine meadows above Allos, in the Basses-Alpes, or flitting rapidly over the sloe-bushes. We should say that the Strymonids were, before all things, lovers of nectar. That this is also true of the American species appears certain, for Scudder notes *liparops* as being fond of the flowers of sumac (*Rhus*), *calanus* and *edwardsii* as being found on flowers of *Symphoricarpus*, *Asclepias*, *Rhus*, *Castanea pumila*, etc. The mode of rubbing the hindwings over the forewings has been already noted (*anteà*, p. 81). Scudder observes that "the flight of *liparops* is quick and nervous, and that, whilst settling itself after flight, it rubs its hindwings together like its allies. It was to *calanus* that Gosse was specially alluding when he wrote (*Lett. Alabama*, p. 37) that, when at rest, they often rub the surfaces of the hindwings upon each other, up and down alternately." Scudder says that, in the observations he has been able to make on *edwardsii*, when they have rubbed their wings, it appeared as if both hindwings were moved together over the forewings and not alternately, etc. The resting-position of the butterflies generally brings about a close resemblance to something with which the butterfly is quite nearly connected, *e.g.*, the underside of *Strymon pruni*, with its wings well drawn down, closely resembles half-faded privet flowers. The peculiar mode of walking, too, is very interesting—the antennæ are generally alternately raised and depressed, the short front pair of legs of the ♂ moving alternately and constantly, in the usual manner of walking, although often quite failing to reach the ground if the insect be moving on a plane surface, whilst, when at

* Owing to imperfect material, we made a very hasty and inexact criticism *re myrtale* (*anteà*, p. 84). It is quite clear that *myrtale* has no definite Callophryid leanings, and that Staudinger's arrangement is more logical than there suggested.

rest, the two hinder pairs of legs only are used. On the other hand, when walking on a perpendicular surface, all six legs are generally used. The butterflies are of an active and pugnacious disposition, the ♂ s much more so than the ♀ s, which are usually rather retired in their habits, and would, were it not for the often fatal attraction of flowers, rarely be captured. The latter habit, however, brings them into nearly as prominent notice as the more assertive and fearless ♂ s. Scudder states (*op. cit.*, p. 897) that the ♂ *edwardsii* is quite equal to darting after and attacking a passing grasshopper.

Genus : Edwardsia, n. gen.

Synonymy.—Genus : **Edwardsia**, n. gen. [**Papilio-Plebeius-**] **Ruralis**, Knoch, "Beitr.," ii., p. 85, pl. vi., figs. 1-2 (1782); Lang, "Verz.," i., p. 46 (1789); Brahm, "Ins. Kal.," i., p. 372 (1791); Herbst, "Nat. Syst.," xi., p. 103, pl. 308, fig. 12 (1804); Haw., "Lep. Brit.," p. 38 (1803). **Papilio**, Bork., "Besch. Schmett.," ii., p. 216 (1789); "Rhein. Mag.," i., p. 296 (1793); Lewin, "Ins. Gt. Brit.," p. 92, pl. xliv., figs. 1-2 (1795); Hübn., "Eur. Schmett.," i., p. 58 (*circ.* 1805); pl. lxxv., figs. 380-1 (1799); Ochs., "Die Schmett.," i., pt. 2, p. 109 (1808). **Thecla,** Oken, "Lehrb.," ii., p. 722 (1815); Stphs., "Illus. Brit. Ent.," i., p. 77 (1828); "Ins. Cat.," 1st ed., p. 20 (1829); Meig., "Eur. Schmett.," ii., p. 52 (1830); Bdv., "Icon. Chen.," i., pl. i., figs. 1-5 (1832); Wood, "Ind. Ent.," p. 7, pl. iii., fig. 11 (1839); Bdv., "Gen. et Ind. Meth.," i., p. 8 (1840); Zett., "Ins. Lapp.," p. 909 (1840); Humph. and Westd., "Brit. Butts.," i., p. 88 (1841); H.-Sch., "Sys. Bearb.," i., p. 135 (1844); Dup., "Cat. Meth.," p. 28 (1845); Stphs., "List,"' 2nd ed., p. 17 (1850); Westd. and Hewits., "Diurn. Lep.," ii., p. 487 (1852); Led., "Ver. zool-bot. Gesell.," i., p. 18 (1852); Wallgrn., "Skand Dagf.," i., p. 187 (1853); Stphs., "List," p. 15 (1856); Sta., "Man.," i., p. 53 (1857); Speyer, "Geog. Verb. Schmett.," i., p. 263 (1858); Dbldy., "List," 2nd ed., p. 2 (1859); Hein. and Wocke, "Schmett. Deutsch.," pp. 92-93 (1859); Staud., "Cat.," 1st ed., p. 3 (1861); Kirby, "Eur. Butts.," i., p. 85 (1862); Snell., "De Vlind.," i., p. 65 *footnote* (1867); Nolck., "Lep. Fn. Estl.," p. 50 (1868); Newm., "Brit. Butts.," p. 108 (1869); Kirby, "Syn. Cat.," p. 397 (1871); Staud., "Cat.," 2nd ed., p. 7 (1871); Curò, "Bull. Soc. Ent. Ital.," v.-vi., p. 106 (1874); Kirby, "Eur. Butts.," i., p. 59 (1879); Frey, "Lep. Schweiz," p. 10 (1880); Lang, "Eur. Butts.," p. 77, pl. xvii., fig. 3 (1884); Buckl., "Larvæ," etc., i., pl. xiii., fig. 1 (1885); Kane, "Eur. Butts.," p. 22 (1885); Auriv., "Nord Fjär.," i., p. 8 (1888-91); Dale, "Hist. Brit. Butts.," p. 41 (1890); Barr., "Lep. Brit. Isles," i., p. 45, pl. viii., figs. 1-1c (1893); Leech, "Butts. China," ii., p. 358 (1894); Rühl, "Pal. Gross-Schmett.," pp. 181, 734 (1895); Meyr., "Handbook," etc., p. 343 (1895); Tutt, "Brit. Butts.," p. 206, pl. ii., figs. 1-2 (1896); "Ent. Rec.," vii., p. 300 (1896); Kirby, "Handbook," etc., p. 51 (1896); Grote, "Lep. Hildes ," p. 41 (1897); Reut., "Ent. Rec.," x., p. 97 (1898); Staud. and Reb., "Cat.," 3rd ed., p. 69 (1901); Lamb., "Pap. Belg.," p. 187 (1902); Wheeler, "Butts. Switz.," p. 48 (1903); South, "Butts. Br. Isles," p. 144, pl. 94 (1906). [**Zephyrus-**] **Aurotis**, Dalm., "Vet. Ac. Hand.," i., p. 91 (1816). **Lycæna**, Ochs., "Die Schmett.," iv., p. 28 (1816). **Strymon,** Hb., "Verz.," p. 74 (1816-18); Stphs., "Illus. Brit. Ent. Haust.," iv., app. p. 404 (1835); Butl., "Cat. Diurn. Lep.," i., p. 192 (1869); Dale, "Brit. Butts.," p. 41 (1890). **Polyommatus,** Latr., "Enc. Meth.," ix., p. 648 (1819); Bdv., "Eur. Lep. Cat.," p. 10 (1829); God., "Hist. Nat.," i., p. 188, pl. ix., fig- 3, ix *tert.*, fig. 2 (1821).

Having already shown (*anteà*, vol. viii., p. 314) that Scudder and other authors had not followed the historical restriction in naming the type of their genus *Strymon*, and having further (*Ent. Rec.*, xviii., p. 131) made *pruni* the type of the latter genus, it becomes necessary to find a new name for the group, of which *w-album*, Knoch, and *patrius*, Leech, are characteristic species, and restrict that of *Strymon* to the group, of which *pruni*, Linn., *mera*, Jans. (=*stygianus*, Butl.), etc., are well-known forms. For this purpose we have suggested

Photo. H. Main and A. E. Tonge.

EDWARDSIA W-ALBUM.

Plate VIII.

(To be bound facing Plate VIII.)

Edwardsia w-album.

Fig. 1.—Ovum at base of wych-elm bud $\times 5$.
Fig. 2.—Ova $\times 10$.
Fig. 3.—Larva on elm-leaf $\times 1$.
Fig. 4.—Larva spun up for pupation $\times 1$.
Fig. 5.—Pupa, from larva shown in fig. 4 $\times 1$.
Fig. 6.—Pupa (dorsal view) $\times 2$.
Fig. 7.—Pupa (ventral view) $\times 2$.
Fig. 8.—Imago $\times 1$.

(Fig. 2 by A. E. Tonge, all others by H. Main.

(*anteà*, p. 142) *Edwardsia* for the name of this genus, and proposed *w-album* as the type.

Not only is there a great difference in the egg as exhibited in *w-album* and *pruni* (pl. ii., figs. 3-4), but the pupa of *pruni*, with its remarkable bosses, is quite different in structure from the smooth one of *w-album*, a difference noted by Freyer three-quarters of a century ago. In order to accentuate these differences, and to make the characters as definite as possible, we have sought the aid of Bethune-Baker, who has kindly given us the following detailed imaginal diagnosis :

Head largish, hairy, vertex with a short tuft of hairs between the antennæ. Frons broad, thickly hairy with short hairs; palpi porrect, barely as long as the frons, scaled, second segment shortly fringed with fine hairs below, end segment of moderate length. Eyes large, very hairy. Antennæ from sockets fixed well back on the vertex, and as far apart as possible, longer than half the wing, tapering into a moderately long club. Collar with a broad, projecting tuft of longish hairs. Patagia ample and spreading, tapering rapidly. Legs scaled throughout, with femora hairy; fore-legs of ♂ imperfect; tarsi not aborted into a single hook, but developed to apparently within a stage of clasping use. Wings: primaries broad, costa rapidly arched at base, then straighter, very slightly and shortly depressed at apex; termen very slightly arched, secondaries rather small, costa highly arched at base, then falling off gently to vein 6 on the termen, termen evenly rounded to the angle, highly scalloped between veins 2 and 3 in front of the tail. Sex-mark of ♂ at the upper end of the cell, small but prominent, composed of smaller and finer scales than the ordinary wing-scales, very closely appressed on to each other, entirely colourless beyond their own dead neutral tint. Neuration: primaries with vein 2 from just beyond the middle of the cell, 3 from directly in front of the angle, 4 from the angle, 5 from above the middle of the discocellulars, 6 from the upper angle, 7 from well in front of the angle, with its base slightly appressed towards the cell, this portion being also slightly thickened (presumably on account of the androconia of the upper surface), 8 and 9 absent, 10 from about a quarter before the angle, 11 from just beyond the middle of the cell. Secondaries with two internal veins, vein 2 from the middle of the cell, 3 from directly before the angle, 4 from the angle, 5 from below the middle of the discocellulars, 6 from the upper angle, 7 from a third before the angle, 8 very highly arched, almost from the base, towards the costa, then evenly curved. Genitalia: clasps subtriangular, the apex extended into a long finger-like extremity; tegumen narrow at vertex, rapidly expanding laterally into ample side covers, with girdle short and narrow; falces moderately strong, sharply curved at a third from the sockets, then evenly arched to the tip, tips rapidly tapering at a quarter. Penis sheath long, with trumpet-shaped orifice, which is provided with terminal teeth.

The group included (*anteà*, p. 142) in *Felderia* is very close to *Edwardsia*, and the details of the life-histories of these species must be worked out to show their proper relationship.

Edwardsia w-album, Knoch.

Synonymy.—Species: **W-album**, Knoch, "Beitr.," p. 85, pl. vi., figs. 1-2 (1782); Brahm, "Ins. Kal.," i., p. 372 (1791); Bork., "Rhein. Mag.," i., p. 296 (1793); Hb., "Eur. Schmett.," p. 58 (*circ.* 1805); pl. lxxv., figs. 380-381 (1799); Ill., "Ill. Mag.," iii., p. 206 (1803); Herbst, "Nat. Syst.," xi., p. 103, pl. 308, fig. 12 (1804); Ochs., "Die Schmett.," i., pt. 2, p. 109 (1808); Oken, "Lehrb.," ii., p. 722 (1815); Dalm., "Vet. Ak. Handl.," i., p. 91 (1816); Ochs., "Die Schmett.," iv., p. 28 (1816); Hb., "Verz.," p. 74 (*circ.* 1816); Godt. and Latr., "Enc. Méth.," ix., p. 648 (1819); Godt., "Hist. Nat.," i., p. 188, pl. ix., fig. 3, ix tert., fig. 2 (1821); Bdv., "Eur. Lep. Cat.," p. 10 (1829); Stphs., "Ins. Cat.," 1st ed., p. 20 (1829); Meig., "Eur. Schmett.," ii., p. 52 (1830); Bdv., "Icon. Chen.," pl. i., figs. 1-6 (1832); Wood, "Ind. Ent.," p. 7, pl. iii., fig. 11 (1839); Bdv., "Gen. et Ind. Meth.," i., p. 8 (1840); Zett., "Ins. Lapp.," p. 909 (1840); Humph. and Westd., "Brit. Butts.," i., p. 88 (1841); H.-Sch., "Sys. Bearb.," i., p. 136 (1843); Evers., "Faun. Volg.-Ural.," p. 67 (1844); Dup., "Cat. Méth.,"

p. 29 (1845); Stphs., "List," i., p. 17 (1850); West. and Hewits., "Diurn. Lep.," ii., p. 487 (1852); Led., "Ver. Zool.-bot. Gesell.," i., p. 18 (1852); Stephs., "List," p. 15 (1856); Wallgrn., "Skand. Dagfalt.," i., p. 187 (1853); Sta., "Man.," i., p. 53 (1857); Speyer, "Geog. Verb. Schmett.," i., p. 263 (1858); Doubleday, "Cat.," 2nd ed., p. 2 (1859); Hein. and Wocke, "Schmett. Deutsch.," p. 92 (1859); Staud., "Cat.," 1st ed., p. 3 (1861); Kirby, "Eur. Butts.," i., p. 85 (1862); Nolck., "Lep. Fn. Estl.," ii., p. 50 (1868); Butl., "Cat. Diurn. Lep.," i., p. 192 (1869); Newm., "Brit. Butts.," p. 108 (1869); Kirby, "Syn. Cat.," i., p. 397 (1871); Staud., "Cat.," 2nd ed., p. 7 (1871); Curò, "Bull. Soc. Ent. Ital.," p. 106 (1874); Kirby, "Eur. Butts.," i., p. 59 (1879); Frey, "Lep. Schw.," p. 10 (1880); Lang, "Butts. Eur.," p. 77, pl. xvii., fig. 3 (1881); Kane, "Eur. Butts.," p. 22 (1885); Buckl., "Larvæ," etc., i., pl. xiii., fig. 1 (1886); Auriv., "Nord. Fjär.," i., p. 8 (1888); Dale, "Brit. Butts.," p. 41 (1890); Kroul., "Bull. Mosc.," iv., p. 216 (1890); Staud., "Rom. Mém.," p. 147 (1892); Barr., "Lep. Brit. Isles," i., p. 45, pl. viii., figs. 1-1c (1893); Leech, "Butts. China," pt. ii., p. 358 (1894); Rühl, "Pal. Gross-Schmett.," pp. 181, 734 (1895); Meyr., "Handbook," etc., p. 343 (1895); Tutt, "Brit. Butts.," pp. 206-208 (1896); "Ent. Rec.," ix., p. 292 (1897); Kirby, "Handbook," etc., ii., p. 50 (1897); Reutti, "Ent. Rec.," x., p. 97 (1898); Staud. and Reb., "Cat.," p. 69 (1901); Lambill., "Pap. Belg.," p. 187 (1903); Wheeler, "Butts. Switz.," p. 48 (1903); South, "Butts. Brit. Isles," pp. 144-146 (1906). **W-latinum,** Lang, "Verz.," i., p. 46 (1789). **Pruni,** Lewin, "Ins. Brit.," i., pl. xliv., figs. 1-2 (1795); Haw., "Lep. Brit.," p. 38 (1803); Stphs., "Ill. Brit. Ent. Haust.," i., p. 77 (1828); "Ins. Cat.," 1st ed., p. 20 (1829).

Original description.—*Papilio Plebeius Ruralis w-album. Pap. Pleb. Rur.* alis bicaudatis supra furvis; posticis subtus W albo notatis, fascia arcuata aurantia saturatiore. Long. lin. 7, lat. $4\frac{3}{4}$. Descr.—Palpi (*Pap.*, tab. vi., fig. 1) porrecti latere interno nivei, externo niveo nigroque varii. Oculi rubricosi, margine albi. Antennæ nigræ, capitulo apice et subtus fulvo. Caput nigrum. Thorax et tergum furva. Pectus albo-cærulescens; venter cinereus. Alæ subtus cinereo-fuscæ (Tab. vi., fig. 2), superiores linea transversa recta alba versus latus tenuis curva; inferiores caudis binis nigris apice albis, supra puncto in angulo ani aurantio vix conspicuo; fimbria utrinque albescente; margo subterminalis infra nigricans intra quem fascia arcuata transversa margine nigro. Pedes nigro alboque variegati. [Varietas *Pap. ilicis*, Esp., an diversa species ?] In this species the palpi are porrected, quite white on the inner side, but exteriorly only at the base, the rest being black. The eyes are reddish-brown, and have a white border. The antennæ are black, ringed with white; the club reddish-brown beneath and at the tip. The head is quite black. The thorax and abdomen often shade dorsally into brownish-black. The pecten is bluish-white. The abdomen ventrally ashy-grey. The upperside of the wings of a sooty colour, more deeply black towards the hindmargin. The inner margin of the hindwings is of the same tint, but rather paler. The cilia at the anal angle of the hindwings consist of long black hairs, above which is an ill-defined orange spot. Between the anal angle and the two tails the margin is white, and, at the extreme tip, black. The underside of the wings is umber-brown, varied with a little reddish-brown, and ashy-grey towards the hinder angle; near the middle of the forewings is a white transverse stripe, which at first inclines towards the hind margin, but is afterwards curved upwards. The hind margin of the hindwings, and the outer margin of the border, is white; above this runs a black line, which has another white line above it; next to the black anal angle stand two triangular spots, above which runs an arched, dark orange-, almost red-lead coloured, transverse band, which is lost in the ground colour towards the front angle. It is bordered below by the black spots, and above by a similar line, which is separated by a slender white streak from the ground colour. Both run at equal distances from the band. Four white stripes, three of which are edged above with a very fine black border, form a large Latin W. The first on the left (and the last on the right) wing, if the butterfly is held upside down, run quite straight up to the middle of the costa. The outer stripes on the opposing sides terminate in the middle of the hind margin. The legs are white, with scattered spots and dots, and the joints of the tarsi are ringed with white. Although this butterfly bears much resemblance to *Papilio pruni*, L., and to the male of *P. ilicis*, Esp., it is obvious at a glance that it cannot belong to the former species. It is more nearly allied to the latter, but is also essentially different, in that the tail is double and much longer. The head is black in this, but brown in the other, species. There is no black on the thorax, abdomen, or upperside of the wings in *P. ilicis*. *P. ilicis* has an orange spot at the anal angle of the hindwings, whereas this species has a scarcely perceptible dot. The underside of the wings is also much paler, and the white stripe of the forewings is very strongly interrupted; it is placed much lower down, and does not extend either to the costa or to the lower margin. But the underside of the hindwings differs most, for the extreme edge of the hind margin is not white, but pale brownish; the black triangular spots are quite absent; instead of the transverse orange band there are six pointed spots of similar, but much paler, colour. The white almost zigzag stripe above is altogether unlike a Latin W. *Papilio ilicis* is not rare in this locality, but our white W has not yet been found here, and comes from the neighbourhood of Leipzig (Knoch).

Imago.—29mm.-34mm. All the wings deep brownish-black, the nervures black, the fringes grey, except at anal angle of hindwings, where they are white, edged with black, as far as the upper, ill-defined, caudal appendage; the hindwings with two small caudal appendages; the lower small, black, with white point, the upper, ill-developed, indicated by a few black and white scales; a small orange-red spot at anal angle, edged by black fringes at the extremity of anal angle, and with white along the inner margin; the forewings with an oval, grey, androconial patch at apex of discal cell. The underside brown-grey; a conspicuous, white, transverse line across forewings, broken by nervures, tending to obsolescence towards inner margin, being curved considerably inward before continuing down to margin; on the hindwings is the characteristic white W; a marginal orange band made up of united lunules, edged internally with black, the black also finely edged in its turn with white, the latter continued as a slender white streak edging the lower part of inner margin; a slender white marginal edge inside the fringes, between which and the lunules, and filling in the hollows of the latter towards the anal angle, is a black line, ending in a black spot edged superiorly with white.

Sexual dimorphism.—The ♀s appear to be on the whole rather larger than the ♂s, although there are many ♂s larger than the smaller ♀s; they also appear to be rather less black in colour; the orange-red spot at the anal angle of the hindwings is usually more brightly marked, the lower caudal appendage better developed, and the upper caudal appendage rather more marked in the ♀s than in the ♂s. On the underside also, so far as the specimens in the British Museum collection are concerned, the white markings of the underside are usually more heavily marked in the ♀. The ♂ has a clearly-defined, oval, androconial spot at the upper corner of the discoidal cell, and near the middle of the costa of the forewings. Pierce says (*in litt.*) that the ordinary wing-scales of the ♂ are five-, six-, and (rarely) seven-pointed, slightly wider at the tip, ·002in. wide, ·005in. long; those of the ♀ similar but larger, ·003in. wide, ·006in. long. The androconial scales are rounded at the tip, sometimes showing a tendency to make three rough points, broadest in the middle, and forming two shoulders before the stalk, ·001in. wide, ·004in. long. The tendency to shed the androconial scales noticed in *Callophrys rubi* (*anteà*, p. 91) has not been observed in this species. The ordinary scales of the underside are similar in both sexes, five-pointed, and possess, also, the curious half-scales peculiar to this group. Aurivillius writes (*Bidrag Sv. Vet. Ak. Handl.*, v., p. 21): "The sexes are similar in colour, but in the ♂ one sees, at the front corner of the middle cell, a small, elliptical, pale, grey spot, which shows up plainly against the dark ground colour. The area is clearly visible on a desquamated wing, on account of its yellow-brown colour, and the crowded condition of the pits, in which the androconial scales are situated. It includes the front main nervure, from the point where the 8th nervure rises to the corner of the median cell, but the greater part of it lies outside of this, between the bases of the 6th, 7th, and 8th nervures, and upon the same. On comparison of these nervures (fig. 13) with the corresponding ones of the ♀ (fig. 14), one finds that its presence has brought about an entirely different arrangement of the 7th nervure, which, in the ♀, starts from the front corner of the median cell, but, in the ♂, is pushed towards the base of the wing, so that it starts close to the 8th nervure, which, in both sexes, occupies the same position. The scales (fig. 12), which are found in this spot, would attract little attention by themselves, as they have only a slightly peculiar appearance. They are equally broad, with rounded, or a trifle pointed, ends, and complete even edges, the base slightly oblique, and with plain striations." Pierce takes objection (*in litt.*) to this statement, observing that they are broadest in the middle, forming two shoulders before the stalk. Aurivillius also notes: "Their length is 0·15mm. Although they differ little from the normal scales, it may be looked upon as a fact that they have the same significance as the "feather tuft" scales ("Federbuschschuppen"), and similar structure ("Gebilde"). This is emphasised by their arrangement, and by the fact that they are only found in the ♂. Similar scales appear on no other part of the wing or body of the ♂ s, and nowhere on the ♀." Rühl notes the ♂ s as having "a prominent androconial spot near the centre of the costal edge of the forewing; the androconia being grey in colour; the tails of the hindwings shorter in the ♂ s, much longer in the ♀, whilst the latter also have a red spot, bordered externally with black at the anal angle of the hindwing." Both sexes, of course, have this spot. The underside, he says, is browner in the ♂, whilst the W-mark of the hindwing is more clearly defined in the ♀; he adds that the ♀, too, has the dark brown fringes lighter on the underside.

Variation.—The upperside of this species offers practically no variation in the colour, but there is sometimes considerable difference in the size of the specimens; and Newnham notes (*Ent. Rec.*, vi., p. 33) that a ♀, reared from a larva fed on ash, was only ·875in. in expanse. The influence of food on the size of imagines reared in captivity is very great; a good supply of the freshest possible food being necessary, if the specimens are to be reared of anything like full size. As a result, almost all reared examples are more or less dwarfed, owing to the tendency for the food to wither in confinement, and the fact that the larvæ also, as a rule, mature much more rapidly. There is also a certain amount of difference in the size of the small orange-red spot at the anal angle of the hindwing noticeable, but the difference is usually slight. The eastern races appear to be considerably larger than the western. There are, in the British Museum Collection, two very large ♂ s, taken June 14th, 1866, on the Parnassus (Merlin Coll.); a normal sized ♂ and large ♀, taken in the Caucasus in June, 1882, by Bramson (Elwes Coll.); and a large ♀ from Macri, labelled "*Isis*, 1847, p. 7 (Zell. Coll.)." In the size variation, we should call all specimens less than 28mm.=ab. *minor*, n. ab., and those above 35mm.=ab. *major*. Those with the little orange-red anal spot entirely absent might be called ab. *obsoleta*, n. ab. On the underside, however, there is considerable minor variation, noticeable—(1) In the shade of the ground colour, varying from fuscous-brown to fawn-brown. (2) In the width of the white transverse line, especially towards the costa of the forewing, and in the amount of its obsolescence towards the inner margin. (3) In the failure of the white W on the hindwings, especially towards the lower angular points. (4) In the width of the orange band. (5) In the intensity of the colour of the orange band. (6) In the amount of black edging to the orange lunules. (7) In the amount of white scales present in the black marginal arches towards the anal angle. The actual amount of variation, however, on the whole, is small, and the form with the white W more or less obsolete at the lower points is the only named aberration, having been described as *butlerowi* by Kroulikowsky. Raynor says of the Hazeleigh specimens: "Instead of being uniform in width, the transverse white line on the underside of the forewings is occasionally much broader in its upper part, where it touches the costal margin." Bromilow notes examples with a broad white line on the underside of the hindwings, taken at Nice, Cannes, etc. An occasional aberration, however, occurs, in which the median area of the hindwing, between the outer edge of the transverse white line forming the W and that edging the orange band, is filled with white scales, making a white median transverse band across the hindwing, as suggested in pl. i., fig. 4. This has been already described by Bellier. We may here note the description as :

a. ab. *albovirgata*, n. ab. *W-album* var., Bell., "Ann. Soc. Ent. Fr.," p. 704 (1858); Newm., "Brit. Butts.," p. 108, fig. 3 *var.* (1870).—This accidental aberration is one of the most remarkable that I have ever seen, and one is astonished to meet with it in a species so little given to variation. The four wings present below a wide white band, on which the nervures show clearly, and which occupies, on the hindwings, the whole space comprised between the white line and the fulvous band; on the forewings it has an equal width. The upperside is typical. Captured June, 1857, in the Forest of Bondy, by M. Blondel (Bellier).

Webb is stated by Mosley to have an example of this form, taken in the Old Hall Wood, Ipswich, in 1859 (see also Newman, *British*

Butterflies, p. 108, fig. 3). There is, however, a still more remarkable aberration in the British Museum Collection, labelled "*w-album* var., Königsberg (Sauter). 'Zell. Coll., 1884.'" This form we may call:

β. ab. *semialbovirgata*, n. ab.—The right wings (considered from the upperside) with the white markings below almost normal, except for a slight widening towards the costa of forewing (making the marks somewhat wedge-shaped); the left pair of wings, with the white marks much modified, those of the left forewings greatly extended in the direction of the outer margin, towards the costa, and those on the hindwings, filling up the whole area between the outside stroke of the W and the internal black edging to the orange band on the hindwings, so that the outer half of the hindwing has a broad white band from the costal margin to the first bend of the W, with the brownish nervures crossing it.

The appearance of this aberration, of the *albovirgata* form on one side (see pl. i., fig. 4) and typical on the other (see pl. i., fig, 5), is very remarkable.

There are also examples in the British Museum Collection, from Sutschan, in one of which the orange band on the underside of the hindwings is particularly incomplete towards the costa, but with specially heavy white scaling in the black marginal arches towards the anal angle of the hindwings. One doubts whether these Sutschan examples are not a distinct species, and we observe a note against the examples in the British Museum Collection, by Elwes, also expressing a doubt as to whether they do not constitute a separate species. At any rate, they must be considered a strong local race, and may be described as:

γ. var. *sutschani*, n. var.—Black (with a greyish tinge); fringes white; large, oval, grey androconial patch; tails similar to those of *w-album*, well-developed in both sexes; smallest possible trace of orange dot at anal angle; ♀ larger than ♂; underside rather lighter and greyer than *w-album*, white line continuous, and strongly developed from costa to inner margin of forewing; hindwings also strongly marked with white; orange band, obsolete beyond middle, very bright in colour, margined on upper edge with black and then white; a large grey spot near anal angle; intensely black spot at anal tip, another conspicuous black spot at base of lower caudal appendage, also a very strongly-developed white marginal line. ♂ and ♀. Sutschan. Captured by Dorries.

Staudinger notes (*Rom. Mém.*, 1892, p. 147) that "a couple caught by Christoph, at the end of July, near Vladivostok, and one small ♂ found by Dorries in Askold, tally almost exactly with German specimens of this species, as also do examples reared by Dorries on the Bikin. In a ♂ reared by Dorries from a larva found at Sutschan, however, the W mark on the underside of the hindwing is almost effaced." This is remarkable when one considers how heavily the Sutschan examples are usually marked with white. He adds that "the Corean form, *eximia*, Fixsen, consists of large specimens," and he "also received a smaller example from north China." We have no doubt whatever that *eximia*, Fixsen, is a quite distinct species as treated later by Staudinger in his *Catalog*, 3rd ed., p. 69, and we do not consider that *eximia*, Fixs., belongs strictly even to the *w-album* group. Staudinger also notes (*Hor. Soc. Ent. Ross.*, vii., p. 304) that the examples taken on the Parnassus are larger than, but otherwise not differing from, German examples (*anteà*, p. 149). Rühl states that, "on the underside of the hindwings, a grey or light blue line edges interiorly the fulvous band, whilst, at the anal angle, the 'eyespot' is of a deep dark blue; besides this there is a light blue spot, followed by a black one." This so-called blue is surely only the light effects due to white scales being on a black ground. Other named forms are:

δ. ab. *butlerowi*, Kroul., "Bull. Mosc.," iv., p. 246, pl. viii., fig. *d* (1890); "Soc. Ent.," vii., p. 163 (1893); Rühl, "Pal. Gross-Schmett.," i., p. 181 (1893); Tutt, "Brit. Butts.," p. 206 (1896); Wheeler, "Butts. Switz.," p. 18 (1903).—Ab. minor; macula fulva in alis posticis supra minima vel subnulla; subtus linea transversa alba in alis posticis abbreviata, a margine antico in medium alæ tantum producta, literam W non referente. ♂ 16mm.-20mm.; ♀ nondum inveni. Volat rarissime sub finem Juni et Julio in provincia Casanensi (Kroulikowsky).

Kroulikowsky's original types were small ♂ s, in which the orange spot on the hindwings are either very small or altogether absent; whilst. on the underside of the hindwings, the white transverse line is abbreviated, reaching only from the front margin to the centre of the wing, so that the usual W is not represented. Kroulikowsky later notes (*Soc. Ent.*, vii., p. 163) that the ♂ ab. *butlerowi*, in which the white mark on the underside of the hindwings does not form a letter W, has been found at Malmisch, in the Wiatka govt. Wheeler notes (*Butts. Switz.*, p. 18) a specimen with the white line on the underside of the hindwings so interrupted as not to form a W, taken with typical examples on the Sépey Road, July 22nd, 1901. Staudinger diagnoses it as "subtus al. post. linea alba litteram W non formante." The name has more recently been applied to all those forms with an incomplete W on the underside, irrespective of size, and even if not showing a tendency for the usual small orange spot on the hindwings to be obsolete, *e.g.*, South notes that he has several ♂ s of the *butlerowi* form, some without and some with the orange spot above.

ε. var. *fentoni*, Butl., "Proc. Zool. Soc. Lond.," p. 854 (1881); Waterh., "Aid Indentif.," ii., pl. 115, fig. 2 (1890).—Nearly allied to *S. w-album* of Europe, but quite as large as *S. spini*; under surface like the latter species in tint, but with almost the pattern of *S. w-album*; the discal line of the primaries, however, is more arched and continuous, that of the secondaries is more transverse, and, therefore, does not run inwards in the direction of the base; the submarginal spots are more dome-shaped, of a bright orange instead of red colour; there is a distinct submarginal white line. Expanse of wings 1 inch 5 lines. Shiribetsu, Hokkaido. August. Coll. M. Fenton (Butler).

In the British Museum collection there is a series of four ♂ s and one ♀, from Yesso, of the *fentoni* form, as well as the type (in poor condition). Of these one ♂ has the androconial cell of the ground colour, and difficult to locate without careful observation, the others have it much more distinct. In size they appear to be a shade smaller than average British examples, and three of the ♂ s exhibit a suspicion of straightening (or rather hollowing) of the outer margin of hindwings so well-marked in *mera*, Janson. The underside is fairly typical, except that the angles of the W mark on the hindwings are not quite so sharp as in European specimens.

Felderia eximia.—The original description of this eastern species, which appears to us very distinct from *w-album*, and was at first treated as a var. of the latter species by Staudinger, and later as a distinct species, is added for comparison with *w-album*:

Felderia eximia, Fixsen, "Rom. Mém.," 1887, p. 271 (1887); Leech, "Butts. China," ii., p. 359 (1894); Rühl, "Pal. Gross-Schmett.," p. 734 (1895); Staud. and Reb., "Cat.," 3rd ed., p. 69 (1901). *Affinis*, Staud., "Rom. Mém.," v., p. 148 (1889).—This form stands in the same relation to *w-album* that *latior* stands to typical *spini*. The two ♂ s before me are a third larger than European specimens. Forewings = 21mm. The ground colour is of a darker brown, edged by a fine white margin; only at the outer margin of the hindwings, in cells 2 and 3, is there evidence of a marginal line. (In European specimens this is absent.) The brown-red spot, which is situated in the lobular appendage at the anal angle of the hindwing is brighter, and in the female larger, than in *T. w-album*. This is thickly edged outwardly and inwardly with white cilia, which, below are black. Not only is the usual tail covered with glossy white cilia, but so also is the ill-developed tail-like continuation of the fourth nervure. The underside is of a silky glossy grey-brown colour; the marginal fringes of a pale whitish. The white Theclid marking of the underside is edged with darker internally, and, looked at sideways, appears glossy. A series of intercostal spots on the forewings between the margin and transverse line, the spots increasing in size towards the anal angle. On the hindwings, the imaginary extended series ends in lunules, which, outwardly, towards the margin, incline to black. (In the European *w-album* this is only faintly indicated.) The zigzag line forming the W does not complete the formation of the lower angles of the letter W; the points are broken partly by the ground colour, and partly by the red-brown at the anal angle, mixed with a bluish band, which encroaches here on the ground colour. At first sight this difference causes the insect to look quite different from *w-album*. Between the red-brown band and the blackish-brown margin is a silvery-white line. In the band, in cell 3, the black spot is very developed; above it, towards the inner angle, isolated spots are placed marginally; these become gradually paler and smaller, and are quite absent in European *w-album*. Flies from August 13th-18th (Fixsen).

Pathological examples.—The following are the only pathological examples of which we can find any record:

α. An example bred in 1886 or 1887 from a larva found at Hazeleigh with semitransparent hindwings (Raynor *in litt.*).

β. ♂. The right hindwing with a slightly pallid patch towards the outer margin, and occupying the outer third of the wing. The underside of this wing pallid towards the outer margin, giving the orange band on this side quite a yellow coloration, the band on the left hindwing being normal in tint. [(Brit. Mus. Coll.) Labelled "Zell. Coll., 1884."]

Egg-laying.—The egg is laid on the twigs of wych elm, most frequently, perhaps, at the junction of the current and preceding years' growth, though this is by no means always the case, as, in some instances, it is deposited at the base of a bud, and, occasionally, in the fork of a main twig and a lateral shoot. It is, apparently, seldom laid on a quite smooth surface of the bark, and the roughened and wrinkled lines at the junction of two season's growth of wood are probably so frequently chosen because the egg is there not only better concealed from view, but also because the roughness provides a secure "foot-hold," and reduces the risk of the egg being dislodged by winter storms. The female would appear to be not infallible in her choice of place for ovipositing, for I found an egg last autumn, which was laid at the base of a leaf-stalk in such a position that it must almost certainly have fallen to the ground with the leaf when the latter became detached from the twig. Mature, flowering, trees are probably generally selected for ovipositing, as most of the ova I have found have been taken from such trees, neighbouring younger trees and saplings yielding very few ova in the autumn or larvæ in the spring. The embryo is mature before the end of the winter, and an egg opened on January 13th, 1907, showed a fully-developed larva lying in a compact ring inside the eggshell. The caterpillar, when it was removed for examination, showed no disposition to walk, and, when released from an enforced extended attitude, quickly resumed the curved position it occupied when in the egg (Rayward, *in litt.*, January 19th, 1907). Newman says that the eggs are laid on the twigs of *Ulmus campestris* and *U. montana* in July and August, being oblate-spheroid in shape, of a whitish or putty colour, and firmly attached to the bark by the underside, remaining thus all the winter; the shell resembles porcelain in appearance, is insoluble in water, resists any amount of wet, and also effectually preserves the contained larva from the effect of frost or other climatic influences. We note (*Ent. Rec.*, ix., p. 292) that the eggs are laid above, or directly below, an aborted leaf-bud, and harmonise so exactly with the colour of the elm-twig on which they are placed, that only an entomologist could possibly detect them. They appear to be placed on the old, and not on the growing, twigs, and are laid either in couples or singly. McDunnough observes that, in July 1906, he sleeved a couple of ♀ s, and found that they laid eggs without difficulty when placed in the sun in a glass jar containing elm twigs. The ova were deposited (usually singly) at base of bud, although at times up to twelve were deposited in a group around twig. The rate was five to six per day, and each ♀ continued laying during a period of two weeks, kept alive on sugar and water. The larva makes its escape through the micropylar area by means of a regular and circular hole, the remainder of the egg-shell not being eaten.

Ovum.—Represented pl. ii., fig. 4 (two different views, one from above and the other lateral). Remarkable in appearance, owing to a prominent whitish belt that runs round its equator (or, rather, base). A side view gives a distinct idea, even under a lens of moderate power, that it is minutely hairy. Looked at from above, the egg presents the appearance of a whitish rim, extending beyond a dark central portion, which is heaped up cone-like, but flattened on the top with a circular depression at the apex [like a jam-tart with a prominent crust, the jam heaped-up centrally, and then flattened on the top]. The white rim consists of the upper (and protruding) layers of pointed cells, of which the basal portion (or sides) is formed, the lower rings of these cells decreasing in size until the point of attachment is reached, the whole forming a shallow basin in which the central part of the egg is placed. The central part of the egg forms a flat truncated cone, dark reddish in colour, minutely pitted, and suggesting towards the lower part of the cone a polygonal structure. A large number of points also arise from the surface, and there is a suspicion that these bear minute hairs. The micropylar area is very conspicuous and well-defined. It consists of a circular basin, in the centre of the flattened apex, the sides of the hollow almost perpendicular, the micropyle proper appearing as a minute depression in the centre of its base, and surrounded by concentric rings of tiny cells (Tutt, July 17th, 1897). Rayward doubts whether the living egg is ever really reddish in colour. He observes that, of some 25 eggs taken by himself last autumn (1906), all—with, he thinks, two exceptions—were leaden-grey; the exceptions were leaden-black, and these eggs failed to hatch. In none was there any apparent shade of red. Just before hatching, the egg changes slightly in appearance, becoming lighter in colour probably due to the larval skin being removed from contact with the inside of the shell (*in litt.*, May 9th, 1907). The shell is very translucent, though not transparent. The egg is not simply bun-shaped, but below the widest flange-like margin, it is full below, something after the fashion of the egg of *Cerura erminia*. The width is 0·84mm., the height 0·26mm., from apparent margin, but about 0·38mm. if the lower protuberance be got into view. The simple bun-shape is also departed from, in that, above the marginal zone of the egg, the side does not at once rise, but first falls in giving a sort of circular groove or hollow just above it. But this departure from the bun-shape has again to be partially or wholly explained away, because the swollen zone round the margin which produces it, is not altogether part of the egg itself, but chiefly, if not entirely, projecting processes such as do not exist at a higher level. The inner dome-shaped portion of the egg is smooth with regular scattered hairs. These are about 0·014mm. long, shorter on top, disposed in hexagonal alignment, and 0·03mm. apart. They are, in fact, all that appears of the theoretically present hexagonal network, with knobs or spicules at the angles; these are the spicules. At the marginal protuberance these change, practically suddenly, but with just enough transition to show that it is so, into four or five rows of long yellow processes, which, seen from above, seem part of the solid egg. They are about 0·03mm. in length, and are expanded terminally into four conjoined knobs. In these specimens these are (like the fine hairs) straw colour. They are too long and too close together to permit the surface below to be well seen, but there is, at any rate, a yellow raised line at least in the zonal direction from one to the next. The undersurface appears to have hairs something like the upper surface, but connected together by a network of raised lines. The collapsed egg happens to afford evidence that the hairs, etc., are not part of the egg proper, but form a superficial layer, as in places it has scaled off, and, at the margin of the bare places, this superficial portion is partially raised and loose. [Two eggs received March 22nd, 1906, from Mr. Tutt, both unfortunately dead. One of them a good deal collapsed. The other with a hole in the top, through which a young larva, especially its true legs, can be seen, but shrunk and dead, obviously after having made an attempt to emerge; both have black and pale portions, the result of where a black (or black portion of a) larva underlies the shell or a pale portion of larva, or a cavity exists.] (Chapman). Newman describes the egg as being "shaped something like an orange, but more depressed on the crown" (compare pl. ii., fig. 4, with this description, which evidently did not belong to the species).

Habits of larva.—The larva leaves the egg towards the end of March, March 18th, 1907, at Reigate (Chapman), March 20th, 1907, at Berlin (McDunnough), having been quite fully-formed within, and capable of existence outside, the egg for some weeks. It appears at once to crawl between the flowering-buds, and seemingly lives there in its earliest stages, and this possibly explains the repeated mention, by different observers, of the marked partiality of the larvæ, in some places, for branches bearing fruit. Bird observed a larva, May 21st, 1907, hiding between two of the seed-vessels of wych-elm. Newman's remark that the young larvæ leave the egg in April and May appears to be largely guess-work, for, certainly, in average seasons, May, and possibly the greater part of April, is much too late a date. The larva at first grows slowly, and is rarely noticed in nature until in its penultimate skin, when it usually rests on the underside of a young leaf, and is somewhat difficult to detect, even on the lower branches of elms that are well within the range of vision. In confinement, in their first stadium, the larvæ at once commenced eating circular holes of considerable depth into elm-buds, and, in order to moult, retired to the base of the bud, spinning a small cushion of silk, to which they attached themselves very firmly

(McDunnough); in the second and third stadia the larva prefers resting on the leaf-buds, to which it clings most tenaciously, using its long neck for the purpose of burrowing, thus clearing out a bud whilst it remains immovable on the outside, to which its mottling of red on the green ground colour bears a considerable resemblance. Rayward observes (*in litt.*) that ova taken on wych-elm, on October 27th, 1906, were kept during the winter in a warm room, that the first larva emerged on March 14th, 1907, followed on March 21st by the second, March 23rd by the third, and on March 31st by the fourth, and that, on April 28th, three ova still remained unhatched. The first larva, on being placed on the flowers of wych-elm, disappeared between the buds, and, on March 18th, was found to have eaten a hole in the side of a bud, though it made no attempt to bury itself, and, on the following day, was found exposed on the outside. Flower-buds and flowers were given as long as obtainable, followed by green seed-pods, through which the larva ate small round holes. It was afterwards provided with expanding leaf-buds, on which it fed without apparently making any attempt to burrow amongst them. The similarity in colouring between the larva after the second moult and the purple-tinged expanding leaves is remarkable and would appear to show that the larva is at this stage—as it probably is from its hatching—an external feeder. The time occupied by the larva in escaping from the egg after the shell has been pierced is about 24 hours, and sometimes longer. The work is not continuous, however, and the actual process of eating a way out is varied by long periods of repose. Bird says: "The larva of *w-album* is found on the underside of a leaf of wych elm, and seems to prefer the young ones, and, when at rest, it holds by its anal claspers to the midrib at the bottom of a leaf growing at the end of a twig, the body resting on the leaf alongside the midrib, which is exactly the same position as that taken by a young folded leaf of the wych-elm, and, at first glance, you can hardly tell one from the other. The oblique lines on the larva look like the depressions between the veins, and the ridges divided by the dorsal line resemble the serrated edges of the young folded leaf." In the same year (1905) he further notes (*in litt.*) that, by May 20th, the larvæ were half-grown at Llandogo and Tintern, and that, by May 26th, the smallest larvæ were at least 15mm. in length; of eighteen found on the afternoon of May 25th, fourteen were at rest in the position, or very nearly in the position, described in the above note, but several of these were round the other way, that is to say with their heads close to the base of the midrib. He also noticed that when the larvæ were on a large leaf they preferred to hold on to a vein, no doubt finding the midrib too large to grasp comfortably, and adds, "I think these larvæ must feed at night, as all were found resting quietly, and very often some way off any signs of eating. Pupation of the latest this year took place by June 17th." Our own observations lead us to believe that, in nature, the larva always rests on the underside of a leaf, but Newman says that, "in the middle of June, when it is fullfed, it rests indifferently on the upper- or underside of the leaf, or on the twigs which are then young and green, with its head, legs, and claspers entirely concealed; nevertheless, in crawling or rather gliding, for its motion exactly resembles that of a slug, the anterior part of the head is just visible peeping from beneath the shield-like margin of the prothorax." In June, 1904, we observed of some larvæ in confinement that they walked with a slow gliding movement, very snail-like, crawling over the surface of a leaf. The larva, at this time, eats through the whole substance of a leaf, and from any part of it, cutting out round or oval holes in the centre, or curved pieces at the side, the head tucked underneath, and quite hidden by the protuberant prothorax, whilst eating. In confinement, it appears to eat freely, both by day and night, but still appears to prefer to rest on the underside of a leaf, where its position, owing to the play of light and shade on the striped sides, makes it most difficult to detect in nature. We have, after a very windy night, occasionally seen larvæ crawling up the trunks of an elm-tree, where they form most conspicuous objects. Concerning this, Thornewill notes that, on June 13th, 1888, he found a large number of larvæ, near Burton-on-Trent, a large proportion fullfed, and some already turned brown. Many were found climbing up the trunks of trees, principally, of course, of the wych-elms, but several on larch, one on ash, and one on a frond of fern, whither it had probably dropped from an elm above. They seemed most to favour such trees as were somewhat exposed to the rays of the sun, and especially such as had seed hanging on them; and on one of this kind he says that he took nearly twenty larvæ. A high wind had been blowing the day before, which might partly account for the numbers found crawling up the trees. All, however, were ascending, not descending. May this, he asks, be an indication of the fact that they pupate towards the top of the tree? Marowski notes (*in litt.*, 1905) that, in the neighbourhood of Berlin, he finds the larvæ solely on elms, and only on those of which the south side is in the shade. The larva, he says, "rests on the underside of the leaves, and its coloration and markings are so adapted to those of the underside of the leaf, that it is only possible for the trained eye to find it when it is situated on the lower branches. When the larva is thrown from the tree by the wind, or other mechanical causes, it draws its body, as it lies on the ground, into a half turn like a screw, through which it so much resembles the calyces of the elm-blossoms, which cover in thousands the ground under the elms in May, as to be confused with them. Then, when after a little time it considers the danger past, it retakes its normal shape and creeps towards the elm trunk and up this again." Voelschow's remarks (*Ent. Jahrbuch*, v., p. 155) are very remarkable, and his conclusions highly improbable. They are to the effect that, when he first discovered the larvæ at Schwerin, there were two in company, both already in the umber-brown stage preceding pupation; both crawled quickly up an elm-trunk, closely, one behind the other, and, when placed in a breeding-cage, proceeded again in single file. The fact that he had also found pupæ in nature, more often in twos than singly, spun closely together against a branch, and that, in each case, the hinder was a ♂, led him to suppose that the fullfed ♀ larva possesses a certain sexual attraction, which incites the ♂ larva to follow it. We suspect this to be merely a matter of chance, especially as the larvæ so rarely pupate on anything but the underside of a leaf in nature, and one suspects pupæ found on branches had been formed from larvæ that had been disturbed (by wind, etc.) when fullfed. Borgmann notes that at Cassel, the larvæ can be obtained freely by beating the elms, where the avenue known as the "Rasenallée" crosses the "Lindenburg," but that they are also frequently found after having been dislodged by a heavy rain or high wind. He also notes the oft-observed tendency of larvæ in confinement to feed up quickly and produce small imagines, owing to the difficulty of keeping the food sufficiently fresh. One wonders whether the larvæ do preferably choose the lower branches of elms, as noted by Krieghoff, Stange, Kretschmer, etc. One suspects they are as abundant in the upper branches, although one cannot reach them. Greene observes that, when the seeds of the wych-elm are nearly ripe, the larva is fully grown. He suggests taking an open umbrella, placing it on the ground, and then, he says, grasp a branch, thrash it well over the umbrella, and, if the insect occurs in the same plenty as at Playford, you will rarely fail to find from three to as many as ten larvæ. Dixon strongly animadverts on this form of obtaining larvæ, and notes (*Ent. Rec.*, x., p. 131) that the destruction to the elms by this kind of collecting is deplorable, and that any keen collector can always get as many larvæ as he needs for scientific purposes by careful searching. For the man who requires scores for business purposes—trade or exchange—and destroys other men's trees in the attempt to exterminate the insect, he expresses his hearty contempt. Raynor states (*in litt.*) that the larvæ are sufficiently abundant in the larval stage, on wych-elms, at Hazeleigh, for one to get, generally, 30 or 40 in an afternoon, towards the end of May, at the same time that the larvæ of *Mellinia gilvago* are to be obtained in numbers on the same trees; he adds that they are usually fullfed by the last week in May or first week in June, and feed on the common, as well as the wych, elm. Thornewill notes finding larvæ at Calverhall, near Whitchurch, actually feeding on the seeds of wych-elm. We have repeatedly found fullfed larvæ, in confinement, whilst seeking a place for pupation, that have come across a newly-formed pupa on their travels; in such cases they invariably eat the pupa before settling down for their own pupation. The following dates will give lepidopterists some idea of the time at which fullfed larvæ are to be found:—Larva in May, 1901, in the Piazza Beccaria, Florence (Tolemei); larvæ received from near Berlin, April 10th, 1907, well grown in the second and third stadia. In Britain we note—towards the end of May, at Hazeleigh (Raynor); June 1st-6th, 1857, near Playford (J. G. Greene); larvæ in June, 1857, in West Wickham Wood (Tugwell); May 23rd, 1858, in West Wickham Wood (Bryant); a hundred larvæ, June 4th, 1858, in Maltby Woods, near Sheffield (Batty); ninety larvæ, June 2nd, 1858, at Roche Abbey (Smith); several, mid-May, 1859, in West Wickham Wood (Barrett); May 21st, 1859, in Maltby Woods (Batty); larvæ abundant in June, 1870 and 1871, at Coombe Glen, Bristol (Wheeler); larvæ common, middle of May, 1872, at Wofferton (Lucas); larvæ abundant, May 30th, 1874, in Chattenden Woods (A. H. Jones); larvæ, June 7th, 1876, in Chattenden Woods (Bower); larvæ, May 16th-18th, 1880, in Chattenden Woods (Porritt); June 10th, 1882, in Chattenden Woods (Mera); abundant, June 13th, 1888, mostly fullfed, at Burton-on-Trent (Thornewill); larvæ, April 29th, 1893, in Chattenden Woods (Tutt); larvæ, May 12th, 1893, in Chattenden Woods (Bower); larvæ, May 27th, 1893, at Newball (Carr); larvæ, June 1st-18th, 1894, at Lydney (Stanger-Higgs); about the middle of June, 1894, a nearly fullfed larva at Church Stretton (Newnham); larvæ, June 5th-10th, 1895, at Chattenden; larvæ abundant last week of May, 1896, in Hunts (Battley);

larvæ, July 4th, 1896, in woods near Lincoln (Pearson); May 24th, 1898, larvæ of all sizes at Hazeleigh (Raynor); larvæ and pupæ, July 2nd, 1898, in Leicestershire Woods (Dixon); larvæ abundant between Esher and Ripley first week in June, 1900 (Richards); June 4th, 1900, two fullfed larvæ at Stroud (Davis); larvæ and pupæ unusually abundant, June 16th, 1900, in Owston Wood (Kaye); larvæ, May 28th, 1901, at Calverhall, near Whitchurch (Thornewill); larvæ very abundant in June, 1901, at King's Lynn (Atmore); larvæ on May 31st, 1902, at Esher (Fleet); fullfed larvæ June 1st, 1902, at Ashton Wold (N. C. Rothschild); June 3rd, 1904, at Llandogo, pupated June 11th, emerged July 2nd, 1904 (Bird); May 20th, 1905, and following days, several taken at Llandogo and Tintern, they had all pupated by June 17th (Bird); young larvæ, May 19th, 1905, at Hazeleigh (Raynor).

Larva.—*First instar:* This little larva is very like that of *S. pruni* in colour, general outline, and facies, but differs in hairs and lenticles. Like it, it is a dark brown (harmonising well with the colour of elm twigs and buds), not 2mm. long, unless stretched, or after feeding. The head is black, with brown jaws and pale mouth-parts and antennæ. There is one hair a little way above antennæ (possibly others not detected), but, broadly, the head is smooth, and polished, and hairless. The dorsal crest of hairs consists of the setæ of tubercles i and ii on the meso- and metathorax, and on the 1st-6th abdominal segments, with that of i (or ii) on the 7th; i is a long curved hair (spiculated) about 0·4mm. long, upstanding, but bent backwards, ii is shorter, 0·28mm. long, and is directed more backwards (posteriorly) so that its end is parallel with the larva; these are accompanied by a minute hair (not more than 0·05mm.) directly in front of ii. There are no skin-points between the bases of i and ii, but they are not conjoined; the tall bases spread out against the larval surface, with a certain amount of division, into separate little flaps. On the mesothorax are a pair of hairs towards front margin, about 1·6mm. long, right away from, and internal to, i; they are, however, possibly the same hairs as the small accessory on other segments, as, on the 3rd thoracic, the accessory is longer (0·11mm.) than those behind, and rather further forwards in relation to i, *i.e.*, it has some little approach to the size and position of the special hair on the mesothorax. As associated lenticles, there are, on the mesothorax, one in front of i and ii, or, otherwise, below and a little behind the accessory already described; on the 3rd thoracic and 1st-6th abdominal segments is a similar large lenticle below i, but rather nearer to it than to the spiracle. If the correspondence of the accessory hair on the mesothorax be accepted, the lenticle on that segment would correspond with these, bearing much the same relation to the accessory, but differently placed as regards i and ii. On the 1st abdominal segment this lenticle is accompanied by another below and behind it. No other segment has any trace of this second lenticle. These lenticles may represent iii, but probably do not; iii is, therefore, quite wanting, no trace of hair or point being discoverable. On the abdominal segments, below the spiracle, are four flange hairs, two on middle of segment, one above the other, with hairs nearly 0·2mm. long; the other two, one above and in front, the other below and behind, the upper of the two median ones; these have shorter hairs, little more than 0·1mm.; below these are the two small hairs above the legs; these are on the same level and close

Plate VI.

(To be bound facing Plate VI.)

Newly-hatched Ruralid Larvæ.

Fig. 1.—Newly-hatched larva of *Edwardsia w-album* × 33. [One side only is shown.]

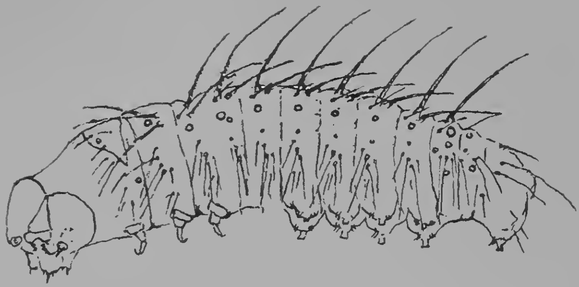
Fig. 2.—Newly-hatched larva of *Strymon pruni* × 33. [The dorsal hairs of both sides are shown, but those of the near side are cut short to avoid confusion, the hairs on scutellum are also omitted.]

Fig. 3.—Newly-hatched larva of *Ruralis betulae* × 33. [On prothorax the whole of the scutellum is shown, and on the mesothorax the dorsal hairs of the further side.]

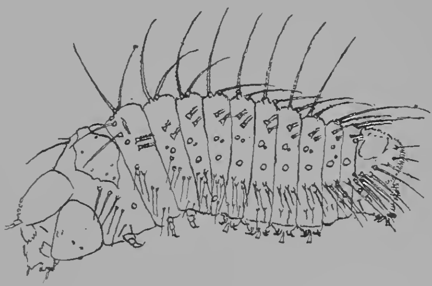
Fig. 4.—Newly-hatched larva of *Bithys quercûs* × 33. [Treated in the same way as fig. 3. One hair of further side is also shown on the metathorax.]

These figures are from camera sketches of larvæ, not actually alive, as they are then difficult to examine, but freshly placed on slides in Farrant's medium. No attempt was made to show the abundant dark skin-points which are characteristic of all these larvæ in the first instar, but are wanting afterwards, being then possibly represented by the minute, rounded, and uncoloured eminences of the same order of size as the skin-points; nor are the fine spiculæ of the hairs more than indicated. The elongation of the "neck," due to a little pressure in mounting and most marked in fig. 1, exceeds that shown here when the larva is feeding and pushing its head into narrow openings, almost mines, in leaves and buds, but is absent when the larva is at rest or walking. The feature is even more marked in the Lycænid larvæ.

(From Camera Sketches by T. A. Chapman.)

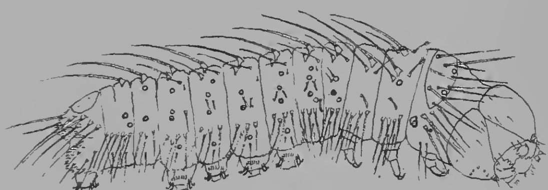


1.



2.

Strymonid larvæ.



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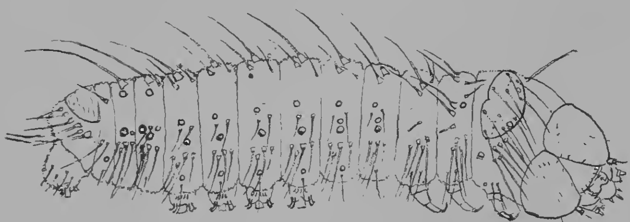

4.

Ruralid larvæ.

Strymonid and Ruralid larvæ in 1st instar.

(1. *Edwardsia w-album* × 33. 2. *Strymon pruni* × 33. 3. *Ruralis betulae* × 33. 4. *Bithys quercûs* × 33).

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together. The prothorax has a plate, with sharp outer angles projecting in front, but rounded; it has, on either side, a large lenticle in front, near the middle, a hair on either side of this, and one behind. These are the three hairs in front of the plate along its outer angle. The lower of these, together with a fourth, might be described as in front of the spiracle. The meso- and metathorax have the four flange-hairs much as on the abdominal segments, with a fifth hair above them, in a position nearly corresponding with the spiracles, but a little more to the front of the segment. The 7th abdominal segment has only one pair of long dorsal hairs (i ?). Immediately outside this is a large lenticle, apparently of the series on segments in front, then a hair about 0·15mm. long, on middle of segment, which can hardly be the accessory from front of i, which has, however, no other representative, nor is it easy to say what else this hair can be; below and behind this is another lenticle, well to the front of which, and a little below, is the spiracle. This segment also has a large lenticle below the four flange hairs. On the 8th abdominal segment are four large dorsal lenticles, placed trapezoidally, then the spiracle, a little to the front. Below it a group of six hairs, one of which is very long, then a large lenticle, and then the lower pair of hairs, apparently a pair here, though on the 7th abdominal there is only one. It may be that, of the six subspiracular hairs, some belong to the 9th abdominal, as the divisions between the 8th, 9th, and 10th abdominal segments are invisible; similarly, the two posterior of the four dorsal lenticles probably belong to the 9th abdominal. The dark anal plate is triangular, with two minute spots (abortive hair-bases ?). Along the flange, behind this, are seven hairs—two long, three rather less, and two short ones. The skin-points are numerous, black, connected with each other by stellate extensions of each point, continued by fine dots to extensions of its neighbours, the result being to remind one, probably justly, of the points and ribs of the pupal surface (Chapman, March 16th, 1907). *Second instar* (fullgrown): At rest, 3·5mm. long, rather more when crawling. Head black; body green, with a red lateral patch on either side of the 2nd and 3rd abdominal segments, a red dorsal patch on the 7th abdominal segment, and long red dorsal patches on either side of the 7th-9th abdominal segments. The body rapidly raised anteriorly to the 2nd abdominal segment, gently sloping posteriorly to the 7th abdominal segment, the last three segments forming a somewhat flattened area dorsally. A mediodorsal depression, with a well-defined raised ridge on either side, extending from mesothorax to 7th abdominal; the segmental incisions here deeply cut; the 8th, 9th, and 10th abdominal segments are somewhat welded, and not distinctly divided into segments, forming a sort of flat plate covered with very long spiculate hairs, with a number of quite black hairs in the median line, quite at the end of the anal flap; the sides with well-defined traces of a lateral ridge. The mediodorsal depression, the segmental incisions, and the lateral flange area, of a deeper green than the other areas, the mediodorsal depression carrying a red mark on the 7th abdominal; the lateral flange shows red patches distinctly on the 2nd and 3rd and 7th-9th abdominal segments. The sides of the segments from the mesothorax to 7th abdominal with a rather dark green oblique line, not markedly developed yet into stripes, but rather in the form of a slight depression confined to each segment. The prothorax and the sides of the body with a fringe of protuberant hairs. The body is covered with hairs, white, generally somewhat curved, amongst which the true tubercular setæ stand out as much longer, stouter, and better-developed hairs. The dorsal tubercles carry long, backward-projecting, spiculate setæ, situated on the apices of the dorsal ridges, dark in some lights, sparkling like silver in others, and the lateral setæ are somewhat similar; the dorsal setæ on the 1st-8th abdominal segments appear to be much stronger and coarser than any others, except those on the lateral flange and anal segments. The spiracles are small, directly above the marginal flange, almost flesh-coloured in tint, that on the 8th abdominal rather higher, and with the prothoracic more conspicuous than the others. The prothorax protuberant, with a pale mediodorsal plate towards the posterior edge. The true legs dark greenish, with dark hooks, the prolegs green (Tutt, April 18th, 1907). [For details of structure of larva, in third and fourth stadia, see "Addendum" at end of our account of this species.] *Penultimate instar:* (1) At rest, 7mm. long; 3mm. wide at broadest part. Head wholly retractile in prothorax, and latter also in part in mesothorax, presenting the mesothorax as a rounded front (from which the prothorax partly protrudes); the anal segments tapering slightly, but broad at end. The body slopes upwards at sides from lateral flange to longitudinal dorsal ridge, which is double and slightly depressed between thet wo parts; in front, the body also slopes upwards to the 1st and 2nd abdominal segments, which are the highest and widest part of body. The general ground colour is of a pale yellowish-green, shading off to quite yellow at the anal segment; a conspicuous mediodorsal line of a darker green tinge runs from head to anus, between the two elements of the dorsal ridge, single on the thoracic and anal segments, double from the 1st to 6th abdominal segments, and being very dark tinted on the mesothorax and 9th and 10th abdominals. The colour, under a lens, resolves itself into a yellow ground colour with oblique green lines running from front to back from the mediodorsal line, through the spiracle, over three segments, and ending on the lateral flange; seven of these oblique lines are distinctly marked, those commencing on the metathorax, and the1st to 6th abdominals; in front and behind they are less defined. The lateral flange is subspiracular, rather paler in colour than the ground; the venter is flat, appressed closely to resting-surface. The surface of the skin is covered with minute glassy-looking points, giving rise to short pale hairs, whilst the dorsal tubercular areas carry darker ones. The segmental incisions are deeply cleft. *Frontal view:* Head small, oval, shiny black; mouth-parts blackish-brown, with a pale transverse line separating mouth-parts from frons and cheeks, antennæ black with pale base; several fine pale hairs on front part of face, head-part quite smooth. Prothorax green, the retractile portion in front largely free from hairs; a well-raised transverse ridge across the middle plentifully beset with longish pale hairs; at back edge of prothorax a chitinous-looking pad, placed medially, flesh-coloured, shaded with brown on edges. The prothoracic spiracle is small, flesh-coloured, and placed far back on the prothorax towards the segmental incision. *Dorsally:* The outline is in the form of an oval, rather wider in front; the larva also much thicker at widest part (1st and 2nd abdominals); each segment distinctly hooped; the lateral flange on either side somewhat glassy-looking, cut up by the segmental incisions into a number of curves, so as to give a crenulated appearance; the sides sloping steeply upwards therefrom to the dorsal ridge, and showing conspicuously the small, shiny, flesh-coloured spiracles; the dorsal ridge on either side with a raised tubercular area carrying i and ii, and occupying almost all the area of this part of the segment from front to back; the main tubercular hairs, i and ii, long, white, with dark tips; many other hairs similar but much smaller; it is just possible that a well-marked supraspiracular hair, a little more forward than the line of spiracle, represents iii, and there is a small brush of postspiracular hairs, but, without tracing these from their predecessors in first skin, their homologies are doubtful; iv and v appear to be situated on a common pad on the lateral flange; the long hairs here white; the dorsum between the longitudinal ridges much flattened and depressed; the dark green double mediodorsal line beneath skin; skin-surface covered with tiny points carrying white hairs; the lateral flanges continued round the anus, to which the 9th and 10th abdominal segments slope rapidly; the anal area covered with long hairs, forming at edge a sort of fringe. *Laterally:* The main feature is the pale lateral longitudinal flange, from which the sides slope upwards to the dorsal ridge, on the edge of which the long setæ, i and ii, stand out conspicuously, ii being longer than i, the small hairs on the tubercular pad of i and ii standing up from a sort of cushion, each separated from the others by the segmental incision. The tiny flesh-coloured spiracles are conspicuous, the prothoracic very low down on the lateral flanges, the others well above, but the seta of iii appears not to be traceable as a separate hair; iv and v appear to be on a common pad, beneath the spiracle, on longitudinal flange, whilst two more pads placed more ventrally carry vi and vii, the latter multiple-haired, all the hairs, however, white and slightly serrated; the prolegs placed still further under. The lateral view shows clearly the projection of the 10th abdominal with its fringe of hairs extending well out (as a sort of cover) above the anal prolegs. *Ventral view:* This is very striking; the projecting edge of the prothorax forms a continuation of the lateral longitudinal flange, the whole forming, with the ventral surface, a flattened oval with crenulated edge, from which a hairy fringe extends, the hairs on the sides being connected with the tubercles iv and v, those in front the dorsal row of the prothorax, and at the back the projecting tubercular hairs of the anal segment. From the flattened venter project the prolegs, rather more glassy-green and less yellow-green than the ground colour of the body; outside the prolegs are a series of similarly-tinted glassy-green cushions carrying the tubercular hairs of vii, whilst towards the front the retractile head and black true legs show as a rough horseshoe-shaped black mark on the same level as the ventral surface; the withdrawal of these is very remarkable. The glassy-white flange of the foot of the prolegs is divided into two areas, a front and back, plentifully supplied with exceedingly minute brown hooks (Tutt, May 22nd, 1905). (2) A larva in penultimate skin, 8mm. in length. In form it corresponds with our ideas of a typical Lycænid larva in having a lateral margin or flange all round, two lateral slopes with a median narrow dorsal level, these combining on the 7th, 8th, 9th, and 10th abdominal segments into one surface, sloping in all directions to the flange, and narrowing somewhat equally backwards; the front maintains its width to nearer the extremity owing to the bending down of the prothorax, across which the flange runs, and the ventral position (in most attitudes) of the head. The dorsal "level" extends from the 2nd thoracic to the 6th abdominal segment, is widest on thorax, and consists, on each segment, of a central greenish line, then a brown or reddish line, wider posteriorly, and, outside this, a yellow line on the ridge separating the "level" from the "slope." This yellow line is a little oblique, further from the central line at the posterior margin of each segment than at the front, owing to the brown mark being wider behind. This yellow line is on a ridge, and the centre of the "level" is really depressed, but the coloration makes this look much more than is really the case. On the mesothorax the red (or brown) takes a median position, and is nearly wanting on metathorax, and, on the 6th abdominal segment, it is much darker, and fills the whole space between the yellow lines; it is repeated on the front margin of the 7th abdominal segment, and on the 9th and 10th is a median line. The "slope" is green, with two oblique yellow lines on each segment, so placed that the lower is in line with the upper one of segment in front; the upper line is hardly divided by a narrow shade from the marginal yellow of ridge of "level." At more than one point on each segment, but especially at one between the yellow lines, is a depression as if the skin were tied down at a central point. The lateral flange has an upper rounded, and a lower sharp, margin, and seems uncertain whether to be brown or yellow, a pinkish-brown being marked on front and on the last abdominal segments. The prothorax has the "flange" passing across its front, where it is very broad: the segment is green, verging to yellow at the lower margin of the flange, and having, centrally to its hindmargin, a small ochreous diamond, the prothoracic plate, the only item of this colour on the larva; it is depressed, as if tied down or buried in the swollen ordinary skin about it. The head is quite black. The legs fuscous but not black. The head is easily extended to the front in ordinary position, but is usually sunk into what is really the front, but in position is the ventral aspect of prothorax; when so sunk, the yellow margin of the hollow ranges with the lower flange at the base of the prolegs, and there is a perpendicular front between this and the margin that ranges with the marginal flange of the larva, which is the upper member of the usual double lateral flange, as visible on most larvæ. When at rest, the front of the mesothorax stands up above the depression caused by the prothoracic plate, and the prothorax (seen laterally) looks like a round ball against the lower half of the front of the larva. The larva is clothed with fine hairs, which are longer and most abundant along the longer marginal flange and the dorsal ridges; on the latter are, especially, two longer ones, directed backwards and forwards, that may very well represent i and ii; these are pinkish-brown; the fine hairs on the "slopes" are colourless. No lenticles are definitely made out, though there are some circular areas that may represent them. The spiracles are nearly of the same colour as the prothoracic plate, but rather brighter; they are just above the hollow above the marginal flange, that on the 8th abdominal segment is larger and much more dorsal in position; on the 7th abdominal, just behind the brown (pink?) mark, is a transverse depression, with parallel marginal line or fold, that represents, and though not seen in action, probably is, the dorsal gland of the Lycænid larvæ. The undersurface is of a more translucent green than the uppersurface. The prolegs have crochets at the anterior and posterior ends of the inner margin (Chapman, June 2nd, 1905). *Larva laid up for moult in penultimate instar:* Length 7mm., width at 2nd abdominal 2·7mm., height 2·5mm. Seen from the front the dorsal ridges are far apart; the space between the dorsal setæ (i or ii) about 1·0mm.; the "slopes" flat, about 1·8mm. across, and the dorsal and lateral ridges rather sharp. Seen dorsally, it narrows a little, 2·7mm.-2·0mm. from the 2nd-7th abdominal segments, and continues the same narrowing to the 9th abdominal, the rounded end involving little more than the 10th abdominal; in front, narrowing also, the rounded end involving the pro- and mesothorax. Seen laterally, it slopes from the 2nd abdominal backwards, but less rapidly at first. In front, the mesothorax overhangs the prothorax, so as to make the prothorax seem of a different set from the other segments, protruding beneath it, much as the head does below prothorax, and is to some slight degree retractile in the same manner. From the 2nd to 6th abdominal segments, the incisions, dorsally, are deep, each segment standing up as a rounded eminence. The colour is green, with darker green down the dorsal flat (or groove) almost yellow on the dorsal ridges, on the first oblique line, slightly on the second oblique line, behind spiracles, and on the lateral flange. The separation of the dorsal ridges forwards is not marked, and has to be looked for. The hairs are numerous, generally distributed, and short; they are more numerous and dark along dorsal ridge, less abundant in spiracular region. They are paler, longer, and more numerous along the lateral flange, and form a fringe to larva as seen from above. There are, also, on the summit of each segment, one on each side, a series of longer hairs on the dorsal ridges, dark, and curved inwards and backwards (about 0·5mm. long), another, two-thirds the length of this, is a little way in front of it. The general surface hairs are about 0·1mm. long. Seen dorsally, the colour scheme might be described as greenish-yellow, with a green dorsal line, and a green oblique line on each segment. This green line is below the ordinary first oblique line, which is in the yellower portion. True legs black (Chapman, May 24th, 1906). *Final instar* (about halfgrown): Very similar to previous skin, but markings much more pronounced, in sense of being darker, lighter, and more crisply outlined. Present length 11mm. when at rest, widest at the 3rd and 4th abdominal segments, where it is about 3·5mm. wide; very nearly the same width from 2nd thoracic to 5th abdominal (can draw itself up so that it is only 8mm. long and 5mm. high, so that relative dimensions differ greatly). The prothorax gives rounded semicircular end in front, and it tapers to the other end to the round semicircular end of the 10th abdominal, which is only about 1mm. wide, whereas the prothorax is 2·5mm. wide. Head quite underneath in this attitude. *Lateral view:* The larva slopes more gradually behind than in front; the 7th, 8th, 9th, and 10th abdominal segments slope behind; in front of this the dorsal margin has a serrated edge, each segment carrying one element thereof; these are less pronounced and more rounded in front, until the 2nd thoracic is rounded and almost flat; the height at the 7th abdominal 1·8mm., at the 5th abdominal 3·5mm., at the 3rd abdominal 3·5mm., and at the 3rd thoracic 2·5mm. On this lateral view one notices the yellow lateral line at about 1mm. from lower edge, or the surface on which resting, this lateral line along upper, and most projecting, margin of lateral flange; below it is the remainder of the lateral flange, consisting (1) of the upper element forming the marginal flange of these Lycænid larvæ, on each segment, this is a rounded green cushion, and below this again (2) is the next element of the lateral flange (which in many larvæ consists of three consecutive elements). In this half-fed larva this presents, on each segment, a rounded, almost flat, lappet, with the segmental incisions very deep between them; below this, on the middle segments, are the broad bases of the prolegs. The yellow lateral line or upper border of the marginal flange forms, of course, the lower edge of the lateral slope. The prothoracic spiracle large and whitish, is, in many attitudes, just in line with this, the abdominal spiracles 1-6 are about one-fourth of the way up the slope. Immediately above each of the abdominal spiracles is an oblique pale band, above this another pale band, broader in front, and further up, at the extreme margin of serration, narrow, and so bright as to be distinctly yellow. These pale bands are so arranged as to form continuous stripes downwards and backwards, *e.g.*, the yellow tip on the 1st abdominal segment is continued on the 2nd abdominal down the median band, and on the 3rd abdominal segment by the one immediately above the spiracle. Immediately above the yellow line, and in some degree involving it, and appearing below it also, is a reddish patch on the 6th and 7th abdominal segments. *Dorsal view:* The dorsal level band, which is banded laterally by the yellow tips of the serrations, as seen from the side, is additionally centrally grooved; the slopes up from the bottom of this groove to yellow tips, of a deep purple-brown from 1st-5th abdominal segments; on the 6th and 7th they coalesce across the middle line; the same purple marking forms a broad central line from the middle of the 8th abdominal segment backwards, and similarly in front on mesothorax; the median line of the ground colour. Seen dorsally, there is a slight pinkish tinge outside the yellow tips of the dorsal ridges. From this view it is more evident that the space between the two upper oblique lines on each slope is yellower, whiter, and more solid-looking, whilst below it is greener and more transparent. *Hairs:* The whole larva is clothed with very fine, numerous, mostly deflexed hairs; these are slightly more conspicuous in spiracular region, though immediately in front and below the spiracle is a small patch almost devoid of them. All along the lateral flange, just below yellow line, they are more numerous and longer, arranged somewhat fanwise, some half-dozen on each segment, and more than twice as long as others, *i.e.*, about ·5mm. in length. There are, similarly, a number of longer hairs on lower element of lateral flange. On the pro- and mesothorax these longer hairs are more widely distributed and abundant, covering the prothorax in front of plate, and forming a marginal *chevaux de frise* along the anterior margin of the 2nd thoracic. These are, in fact, portions of what may be called the dorsal set of hairs, the dorsal prominences all carrying a set of hairs nearly, but not quite, as long as those on lateral margin. On all the pale areas the hairs are white or colourless, except on the dorsal groove or central part of dorsal level, where they are dark brown or black, the same as on the brown markings. All the hairs apparently very finely serrated. The prothoracic plate angulated, small, has a posterior broad projection, a lateral wing on each side, and a narrow point stretching out in front, it has a whitish (almost silvery) aspect, and looks as if it were a thin scale of something that could be easily picked off. There are two longitudinal black lines on the posterior projection, and, in the centre of each lateral wing, there is a small black circle, which is, no doubt, a lenticle; nothing else in the way of lenticles or of primary tubercles is to be detected. About one-fourth from the posterior margin of the 7th abdominal segment is, dorsally, a transverse line of full width of dorsal level; this has the appearance of being a gland. Head: When feeding, this appears to be black, owing to lower margin of clypeus and eye-region being of that colour; the jaws are dark brown; the labrum and first antennal joint nearly white, the rest of head, when exserted, is pale ochreous, the upper part of clypeus nearly white, but when fully stretched forth the back part is seen to be dully green. True legs: Terminal joint slightly ochreous, the claw darker, the rest green. Prolegs: These possess a large inner pad, divided into anterior and posterior portions, each of which projects, with a rounded margin, but which are just continuous and not two separate things. Round the inner margin of these, forming two semicircles in certain positions, there run what appear to be three rows of hooks, or crochets, the first, or inner row, all but obsolete, so that one at first does not realise that they are actually the inner ends or bases of the crochets of next row; the next two rows appear to be parallel and well-developed, and consist of thirteen or fourteen crochets in each portion. Really, these are all in one row, but of two different lengths, with considerable regularity in the alternation of the hooks of different sizes, and numbering some 26 or 28 hooks to each pad. In the angle between the two portions of the pad, and just outside, is a pale white extensile element, without any crochets of any sort. Towards the posterior edge of the dorsum of the 8th abdominal segment, and on the edge of the continued ridge, are two tiny depressed points, almost of the ground colour, hence most difficult to see. These seem to mark the seat of the eversible glands, but whether obsolete or functional I am quite unable to say, as they are never seen to be in action (Tutt, June 10th, 1905). *Fullgrown in final instar:* (1) In many respects, like the larva of *Strymon pruni*, especially in the sharpness of each segmental element of the dorsal ridge, in the pronounced oblique lines, and in general form and outline. With a length of 15mm. it is 5mm. wide and 4mm. deep. The mesothorax overhangs the prothorax. The 1st, 2nd, 3rd, 4th, and 5th abdominal segments have the acuminate points of dorsal ridge; the metathorax and 6th abdominal are lower and rounder, but still belong to this series. The width between the flanges is about 1mm., and the slope is 3mm. The slope is quite flat in a plump larva, still feeding, but nearly finished; in one larva, having finished feeding and searching for a place for pupation, it is actually concave. As to colour, one specimen was almost entirely green, but now it is looking out for pupation the green has become a dingy grey-olive, and the other colours and markings stand out strongly, though previously hardly visible. The ridges are hardly marked on mesothorax, but thence to the 7th abdominal are equidistant and parallel (not wide in front like *betulae*). Between them, in this specimen, is dark olive-brown, the actual ridge yellow (converging at front of each segment); the oblique lines (faded yellow) proceed as in *pruni*, *viz.*, posterior portion of dorsal ridge, the lower side of triangle on segment behind, then line above (and here including) spiracle; this lower portion in this specimen is pale olive, between, darker olive; lateral line yellow; undersurface still green. The tail narrows hardly appreciably from the 3rd abdominal, more rapidly from the 7th abdominal. The upper surface of the 7th, 8th, 9th, and 10th abdominal segments is flat, sloping backwards. Head black, well extended in ordinary larval manner in this wandering example. (2) Another specimen is still in proper plumage, and has a finer coloration than usual. It is green and yellow in the usual arrangement. The red-brown is, however, more extensive and picturesquely placed than usual. Thorax green, except a median ruddy band. The dorsal ruddy band, between ridges, thence onwards, has a median yellow line. The 6th abdominal segment is almost entirely red, contrasting markedly with the two preceding segments, which are normal, except a red spot at posterior angle above lateral line; the 6th abdominal segment has some yellow, inclining to rather deep orange, in situations of triangle (*i.e.*, between dorsal flange and oblique line); the 7th is the same as 6th, except that the yellow is more distinct in posterior part of triangle, where it is continuous with the yellow and greenish-yellow of the 8th, 9th, and 10th abdominal segments; segments 8 and 9 have margin red, the dorsal band also runs unbroken down the 7th, 8th, 9th, and 10th segments; the lower part of slope of the 1st and 2nd abdominal segments are red, as are the adjacent portions of the metathorax and the 3rd abdominal; on the 1st abdominal segment, the outer aspect of the dorsal ridge is also red, and joins the lower portion by a crooked band running down below oblique line. The green band below oblique line begins with a red spot on metathorax, and, on the 2nd, 3rd, 4th, and 5th abdominal segments, this is hardly pronounced enough to invalidate the general normal colouring of these regions. As it sits feeding the 2nd, 3rd, 4th, and 5th abdominal segments are strongly crested or acuminate. The metathorax only rounded, and the 6th and 7th abdominal segments are so bent down as to make the rounded top or ridge the posterior margin of a rather flat-topped segment. Altogether this is a very handsome larva (Chapman, June 4th, 1905). The head is very small, glabrous, and completely retractile within the 2nd segment, the semicircular margin of which projects beyond it. The body is of that shape usually described as onisciform or woodlouse-shaped, or, perhaps, more correctly speaking, shaped like the genus of shells called *Chiton*, some of which may be occasionally found on all our seaside rocks. The segmental divisions are clearly marked on the dorsal area; the anterior margin of each is elevated; the posterior margin is decidedly waved, and overlapping the anterior margin of the next following segment; the lateral margin of each segment is produced, and the union of the ventral and dorsal areas takes place almost on a medio-ventral line; there is a mediodorsal furrow or channel which bisects the elevated anterior margins of the dorsal segments, causing each segment, from the 4th to the 11th, to bear two humps, or tubercles; these pairs of tubercles, seven in number, seem to bound the medio-dorsal furrow, and render it more conspicuous; every part of the dorsal area emits delicate hairs, which are more especially visible when the larva is viewed sideways; the head is black and shining, except a pale whitish interspace between the lateral divisions; the dorsal area of the body is dingy brown, approaching to red-brown on the sides, and to green in the interspaces of the segments; the ventral area is also greenish; on each side of each segment are two oblique and very ill-defined stripes of a paler shade, and, when the larva is at rest, the upper of these meets the lower one on the next following segment, thus producing the appearance of its having eight oblique stripes on each side; the legs and claspers are pale dingy green, obscurely diaphanous (Newman).

Variation in larva.—The larvæ usually appear to be bright green until the penultimate instar, then bright green or yellowish-green, with occasional rufous points in the penultimate instar, finally becoming somewhat variable in the final instar. Of eight larvæ under observation (June 1st, 1905) no two are exactly alike. Shortly, the more marked forms may be noted as follows:

(1) Ground colour bright green; the raised points of the double dorsal ridge, the lateral flange, and oblique lateral stripes of a pale yellowish tint (making the ground colour itself appear as dark lateral stripes between the true pale lateral stripes, to the naked eye); the median area, in the depression between the dorsal ridges, and its extensions anteriorly and posteriorly, of a dark sap green, with a pale, narrow, mediodorsal line traversing it on abdominal segments 1-6; the lateral flange slightly tinged with reddish on the 6th, 7th, and 8th abdominal segments.

(2) Ground colour rather paler green than in 1; the projecting points of dorsal ridges, of lateral flange, and lateral oblique stripes pale whitish- (rather than yellowish-) green; the median area between the dorsal ridges, and its extensions in both directions, of a deep chocolate-red with a narrow green mediodorsal line (on abdominal segments 1-6, where the dark markings take the form of chevrons); lateral flange tinged with red on the 6th and 7th abdominal segments.

(3) Ground colour green, the projecting points of the dorsal ridges and the lateral oblique stripes red-brown, edged throughout with yellow; the lateral flange almost crimson in tint; the median area between the dorsal ridges, and its extensions in both directions, dark red-brown, with a faint yellow mediodorsal line from abdominal segments 1-6; the prothorax reddish; the anal segment green, divided medially by the dark median line.

(4) Ground colour yellow-green; the sides made up of alternate streaks of reddish (which seem to be overlying the green ground) and yellow; the tips of the dorsal ridges yellowish; the median area between the dorsal ridges and its extensions reddish-brown, with a paler thin rufous median line; the lateral flange yellowish, overlaid with red; the anal flap yellowish-green, with a very dark extension of red median series traversing it.

(5) The yellow-green ground colour almost entirely masked by a bright red tint, which alternates with the pale yellow-green oblique lateral lines, occupies the prominent parts of the dorsal ridges, fills in the depression between the dorsal ridges, and quite covers the lateral flange, and some little distance above and below it; the median line (of chevrons and continued lines forward and backward) very bright red-brown. Except for the anal flap and segmental incisions laterally, there is little distinct evidence of the ground colour. The outside of prolegs is tinted (also in the other forms) similarly to the lateral flange, *i.e.*, of a rather more rosy or crimson tint than the other red markings.

Colour change of larva during resting-period preceding pupation.—Réaumur first noticed (*Mém.*, i., p. 450) the change in the colour of the larva of this species before pupation. Crewe says that the larva of this insect entirely changes colour a day or two before spinning up, losing its beautiful primrose tint and becoming reddish-brown. This is only partly true, for, although the larvæ all change colour, there is considerable difference in the tint that accompanies the darkening. The two commonest forms of larva—(1) yellow-green, (2) bright grass-green—appear to undergo quite different colour-changes in the resting-period preceding pupation. The following notes may prove interesting:

(1) *Yellow-green form* (two examples almost exactly alike in tint and markings; described May 27th, 1905). Head red-brown rather than black; ground colour yellow-green; prothoracic segment with a bright red-brown tinge across the prominent part transversely, the whole segment being inclined to an orange tint; the sloping sides yellow-green, the lateral flange and downwards to prolegs tinged with red-brown, inclining to bright red on the 6th, 7th, 8th, and 9th abdominal segments, where the red lateral line is very marked, the red line going round the anal flange, and being prominent as a patch on the outside of the anal prolegs. The oblique lines on sides slightly darker than ground colour of side. The dorsal line on mesothorax dark (almost blackish), the median depression between the two elements of the dorsal ridge, filled in with a number of bright red-brown chevrons (the point of each to the front), on each segment from metathorax to 7th abdominal, that on the 7th ill-developed; the series thinning off into a dark line, ending in a dark brown patch on the anal segment; the reddish chevrons are more or less subdivided by a pale greenish line; the tops of the ridge-points are also faintly tinged with reddish, and there is the slightest reddish tinge about the lateral oblique lines which have a slightly transparent appearance compared with the more opaque ground colour between them; the longer tubercular hairs, and also the shorter white secondary hairs, show very clearly against the darker areas of the ground colour. The area below the lateral flange, the areas carrying tuberles vi and vii, and the upper outside segment of prolegs, also tinged with red. Altogether a very pretty form.

These larvæ stopped feeding on May 29th, and, on May 30th, were in the resting-positions in which they intended to pupate. They turned to a distinct and somewhat uniform red during the period from May 31st-June 2nd, and pupæ were observed on the morning of June 3rd.

(2) *Bright green form* (described May 26th, 1905): The whole of the body bright green, with no darker areas whatever; the apices of the segmental sections of the dorsal ridges whitish-green; the oblique lateral lines whitish-green; the lateral flange whitish-green; the mediodorsal line of a deeper tint of green than the ground colour. The coloration of the larva made up entirely of different shades of green.

This larva ceased feeding on May 27th, 1905, and took up resting-position. On the 28th, the bright green areas had turned dark grey; the length had contracted to 9mm.; the apical points of the raised segmental sections of the dorsal ridge paler; pale lines running therefrom partly down the sides between the abdominal segments; a very pale mediodorsal line from the 1st-7th abdominal segment. The tumid prothorax and the lower parts of meso- and metathorax along the lateral flange green. On May 29th, these green thoracic areas were very marked and evidently developing into the pupal wings; the spiracles pale; the anal segments so withdrawn that the 8th, 9th, and 10th occupy little space. On May 30th, the green thoracic areas occupy full space of pupal wings. On the morning of May 31st the pupa was observed.

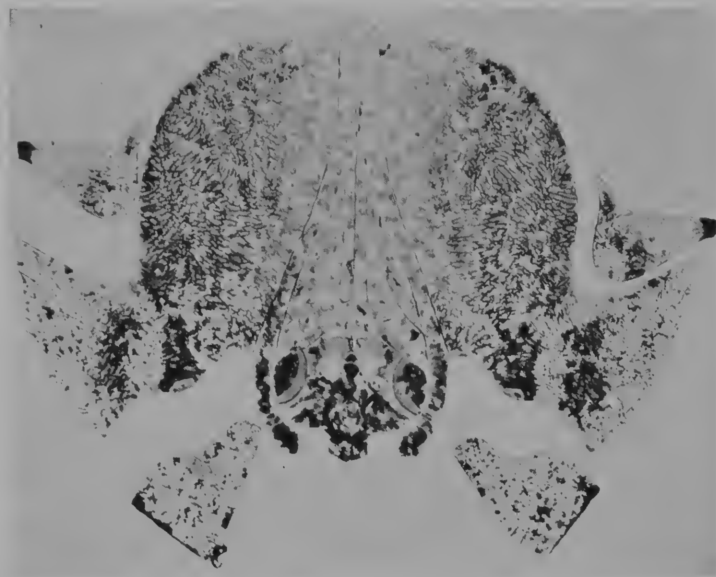
Foodplants.—*Ulmus montana* (Newman), seeds (Thornewill), leaf-buds and leaves (Tutt), *Ulmus alba* (Hering), *Ulmus campestris* (Hering, Möschler, Kranz), *Ulmus suberosa*, a variety with a curious corky bark to the small branches, found at Leuk (Lowe). Ash (*Fraxinus excelsior*) [Newnham notes (*Ent. Rec.*, vi., p. 33): "About the middle of June, 1894, I obtained a nearly fullfed larva off an ash-tree. I fed it for some days on ash, until it pupated; the imago emerged on July 10th."] [Meess and Spuler note the larva on "elm, lime, and oak." The *Verein Fauna in Leipzig*, records that a "larva was found on *Salix caprea*, and the imago reared on this food." We think that "lime," "oak," and "sallow" all require confirmation.] [Mühlig beat the larva in June, 1853, near Hochstadt, from sloe (*Prunus spinosa*) and elm (*Ulmus campestris*) (*teste* Kaltenback, *Pflanzenfeinde*, etc., p. 536). "Sloe" as a foodplant requires confirmation.]

Parasites.—*Perilitus scutellator*, Nees (V. R. Perkins *teste* Buckler).

Pupation.—The larva usually makes a loose cocoon, *i.e.*, it draws a leaf or two together, or gets into one somewhat curled, and tries to draw it together; but the threads used are few. It generally does this so that it is on the underside of the leaf. It then spins a firm silken platform, and a somewhat slender silken girth, and thus attaches itself for pupation. Newman says that, when fullfed, the larvæ, in confinement, spin rather elaborate scaffolding of silken threads on the surface of the twig or branch, on the leaves of which they may happen to be feeding, and by means of other silken threads they attach themselves to this scaffolding—some two, three, or four at the anal extremity, and one, two, or three passing round or over the body. The number of these belts varies in different individuals. The character of the silken scaffolding to which they are attached is best seen, he says, by allowing the larva to spin on the surface of glass, *e.g.*, of any glass vessel in which it may be confined. Réaumur gives (*Mém.*, i., pp. 450-454) an excellent account of the spinning done by this larva before pupation (see "Addendum" *posteà*). Bacot notes that, in a specimen under examination, the body girth falls in the incision between the 1st and 2nd abdominal segments, although the lowest point of the pupal waist is between the metathorax and 1st abdominal segment. This particular larva, also, had formed the ventral portion of a loose cocoon out of a small leaf, with its attaching stalk, and a fragment of another attached with silk. A considerable number of silk threads are also used, the whole composing a shallow boat-shaped structure, which covers in the entire ventral area. The girth is composed of at least six or seven separate strands, and two of these on one side do not join the girdle until well up on the dorsal area; this may be accident, but it would seem a fortunate one, as the effect of these two anterior and posterior tie ropes must be to afford greater security, and also to keep the belt in position. Rayward says that the larva almost invariably spins up for pupation on the underside of a leaf of wych-elm, and adds that, when the colours of the pupa are matured, they closely resemble a dark brown, crumpled, shrivelled portion of a leaf, whilst it is also to be noted that, in the fully-developed pupa, the girth is normally about the centre of the pupa, whilst its position on the larva during the quiescent stage preceding pupation is much further forward. Dixon urges (*Ent. Rec.*, x., p. 131) that the pupa is best found by searching. He says that one should stand under the outer edge of the lower branches of the wych-elm tree to be searched, and, if the pupæ are there, one sees what appears to be a beetle resting on the underside of a leaf; the branch should then be pulled down with a hooked stick, and a pupa will usually result. When the sun is shining, you may even see the shadow of a pupa through the leaf, when the larva has pupated on the upper, instead of the lower, side of the leaf, which, however, it rarely does. He adds that a little practice makes one quite an adept at finding them, and one can usually get about a score in an hour by searching. Many pupæ are, of course, out of reach, but plenty may be discovered at a height from 7ft.-14ft., and, of those out of reach, a knife blade, fastened with string to an ash sapling, at an angle of 30°, will enable one to sever the leaf-stalk, when the leaf with its pupa will come sailing quietly down to the ground or to the net waiting to receive it. Pearson adds (*op. cit.*, p. 230) that he found pupæ of *w-album*, at Lincoln, on July 12th, 1898, the pupæ being spun up on the underside of leaves of wych-elm, near the footstalk, and adds that they closely resembled the elm-buds, forming, in fact, a splendid imitation of the terminal brown bud, both in colour and shape. Marowski notes (*in litt.*) that, when the larva is fullfed, it chooses, in the breeding-cage, a corner on the ground, or just above it, for pupation. In the open, he found pupæ in the crevices of elm-bark, and he observes that the pupal stage lasts only from ten to fourteen days. Voelschow also records (*Ent. Jahrbuch*, v., p. 155) finding pupæ at Schwerin, spun up on branches of elm, more often by twos than singly. This appears to be unusual, for Schröder found pupæ also at Schwerin, as we do in England, spun up on the undersides of elm-leaves. Tyrer notes (*Ent. Wk. Int.*, viii., p. 124) finding, attached to a hard fungus growing on the trunk of a tree, at Eye, a pupa, which produced an imago in due course.

Colour changes during maturation of pupa.—The newly-changed pupa is of a very rich, almost red-brown, tint, clothed with abundant, but scattered, short white hairs. On the metathorax and abdominal segments there is a darker mediodorsal band; the dorsal plane is bounded by two pale, faintly ochreous, hardly yellow, lines (the dorsal ridges), from which, on the first five abdominal segments, oblique lines of the same colour reach outwards and backwards, the "oblique lines." The lateral flange is preserved, but, though the markings of the dorsal plane and ridges exist, there are no actual ridges, the dorsum being rounded. As the pupa matures, it loses largely the paler and oblique lines, and becomes altogether darker. It is of a rich, deep, brown, darker on the head and appendages, and with a dorsal band from the metathorax backwards. There are no hairs on portion of face inside glazed eye. The prothoracic spiracle-cover is a little white line at some (unusual) distance from antenna; the cover is reticulated with very minute pits. The hairs are about 0·3mm. long, and are all very similar, colourless, and very finely spiculated (pl. iii., fig. 1). The general surface is beautifully marked by a network of raised lines, which, on the abdomen, radiate from raised points, the lines of different points not always meeting. They are independent of the hairs, and, in the spaces, are many minute lenticles, especially round the spiracles. The wings have a beautiful network, with no hairs, lenticles, or raised points. Seen from the ventral aspect, the smooth appendages, or, perhaps, more strictly, the head, has an aureole of hairs, *viz.*, those of the prothorax, which fits down very closely over the head, making it quite ventral; the hairs form a sort of *chevaux de frise* fitting down into surface of attachment. The appendages, other than the wings, are transversely wrinkled. When fully mature, a week after change, the colour is darker, and the yellow dorsal and oblique lines are lost in the general deep brown; the abdominal dorsal band remains dark, and the appendages also. The arrangement of the head and prothorax is very remarkable, the underside of the front of the pupa being the dark, flat, hardly convex, smooth head, of which the darker antennæ form a margin. Round this, for about a semicircle, there is the anterior border of the prothorax as a pale boundary, but curved round so as to be ventral, and looking as if the head had been squeezed up into it. The rest of the prothorax is in front, and is hairy (Chapman).

PL. VII.



PUPAL HEAD AND THORAX OF EDWARDSIA W-ALBUM × 8 (SPREAD OUT). *Photo. F. N. Clark.*

The Natural History of British Butterflies, 1907.

PUPA.—Length 9mm. Of the same form as that of *Rumicia phlaeas* and many other Ruralids (Lycænids); flat ventrally; dorsum rounded in two portions—the longer, wider, and higher eminence formed by the abdomen, the lower by the thorax. Width of thorax 3·5mm., abdomen 4mm.; height of thorax 3·8mm., abdomen 3·9mm., nearly identical. Colour brown, deeper on wings, and in a broad dorsal line down abdomen, which has, on either side, a paler line (the yellow of larval ridges); subdorsally, almost laterally, is also some dark marbling, almost amounting to a band on thorax. More minutely examined, the paler brown has everywhere amongst it numerous fine dark dots and spots. The darkness of the wings is due to these darker marks coalescing and leaving only dots and spots of the ground colour. The appendages are similarly marked. The glazed eye is pale, the included space dark, as well as patches on face, antennæ, maxillæ, and legs. Ventrally, appendages reach down to 7mm. from front (2mm. from posterior end). The first legs extend broadly some way down antennæ; the second legs follow them, and extend down to 5mm. from front; just beyond them, as if guided inwards by their outer margins, the antennæ pass over the maxillæ and meet in the middle line, extending side by side for the further 2mm. to end of wings. The whole pupa is covered on the exposed surface by numerous (hardly, perhaps, crowded) red-brown hairs, about 0·3mm.-0·35mm. in length. These hairs are spiculated, and arise from the larger of two sets of raised dark points on the surface, the smaller of which are connected together by a raised dark tracing of network. The appendages have no hairs, but have a minute tracing of raised dark ridges with depressions in the spaces. These pupal hairs (plate iii., fig. 1) are a fairly ordinary form of spiculate hairs, yet their close relationship with the trumpet-hairs of *Bithys quercûs* (pl. iii., fig. 2) is obvious, so that we cannot help concluding, from the intermediate forms offered in that species, that the trumpet-hairs are modifications of ordinary spiculate hairs. As just noted, the hairs are 0·3mm. to 0·35mm. long, are spiculate for their whole length, and end in a sharp point. We may, perhaps, fancy that there is just a tendency to the trumpet development, in the fact that many of the hairs are thicker at some distance from their extremities than near their bases. The abundance of lenticles round the spiracles is well-shown in the plate, and, the area being larger than in that of *B. quercûs*, there are also included some of the stellate points with their appended ribs, enough to illustrate, what is obvious on an examination of larger areas of the pupal-skin, that these points are often connected together by their ribs, but that they always avoid any association with hairs or lenticles; this we found also to be the case in the other pupæ so far illustrated (*anteà* vol. viii). In the pupa of *E. w-album* the lenticles are freely distributed over the whole surface (except appendages), and the stellate points and ribs are correspondingly curtailed, differing, therefore, from *B. quercûs*, in which lenticles are abundant only near the spiracles. The 9th and 10th abdominal segments are difficult to distinguish ventrally owing to the silk entangled in the cremaster (there seems to be also a sort of loose cocoon), but a circular area of about, or just over, 1mm. in diameter, has, against the 8th abdominal, a smooth area with several nodules, the genital area, and round this it is rough and darker, with especially very short (0·07mm.-0·08mm. long), thick hairs with dark bent ends, hardly hooks, and rather sharp tips (Chapman, June 4th, 1905). The pupa is of the normal Lycænid form; the ventral area much flattened, the line between head and anus along the medioventral area being almost level. The dorsal area much swollen and exaggerated. The body consists of a very large globular abdomen and an equally swollen, but actually smaller, thoracic region, viewed dorsally. The major portion of the thorax is made up of the mesothorax, but the prothorax is also large, and retains, to a considerable extent, its larval aspect as regards its hood or shell-like shape. There is a marked constriction between the thoracic and abdominal regions; this is chiefly dorsal, but, to a slight extent, lateral as well. The waist is deepest at the junction of the metathorax with the 1st abdominal segment, but the silken girdle, in the specimen under examination, lies in the incision between the 1st and 2nd abdominal segments, at a slightly higher elevation. The measurements of the pupa are as follows: Length, 10·50mm.; width at 4th abdominal segment, 5·50mm.; at mesothorax, 4·50mm. Thickness or height is about the same at both mesothorax and 4th abdominal, nearly 5mm.; at the waist, only about 4mm., or very slightly over. From the head to the tips of the antenna-cases and wings is 8mm., and from the tips of the wings to the anal end 2·5mm. The wings and antenna-cases extend to the posterior edge of the 4th abdominal segment. All the segments are fused, at any rate, prior to emergence. By lamplight, and with a 1″ objective, I cannot distinguish any special hooks or processes on the anal armature; there seems to be a number of the short, more or less trumpet-shaped, bristles, but these are so numerous, and set at such varying angles, that they would probably afford ample means of attachment to the silk. The spiracles are but slightly raised, and form a slit-like opening on a smooth, hairless, pale-coloured swelling. The dorsal area, and well round the lateral area also, is thickly set with stout, slightly-curved, minutely-serrated, bristles, mostly of a pale, semi-transparent brown hue. These hairs are absent from the ventral area. The whole surface of the pupa, except the wings and appendage-cases, are closely studded with small star-shaped processes (lenticles). The wings, and to a less extent the appendage-covers, have, in place of the above, a closely-set netting of fine black veins. The colour is dark umber, shading off into a pale red-brown. Traces of a black dorsal band are present on the upper abdominal segments; this is replaced on the almost black thorax with a mediodorsal band of red-brown. The head and wing-cases are very dark, all but black at the margins of the wings and the base of the haustellum, but lighter on the ventral area, and towards the end of the antenna-cases and wings, where the dark brown is much mottled and suffused with pale brown. The prothoracic spiracles show up as raised, white, slit-shaped spots. The haustellum-case and portions of two pairs of legs form the central shield below the head, the tips of the former extending to about two-thirds of the distance towards the tips of the antennæ. The eyes are rendered quite conspicuous owing to a portion of their surface being so highly polished (Bacot, July, 1906). The pupa is obese and moth-like, without angles; the head rounded, and the anal segment incurved and invisible from above. The cases, covering the head, antennæ, legs, and wings, are smooth, but not glabrous; they are without hairs, while those covering the thoracic and abdominal segments are hairy, the hairs for the most part standing out straight from the surface of the body. The colour of the dorsal, or hairy, area is reddish-brown, with a rather broad mediodorsal stripe, commencing behind the thorax and extending to the anal segment; on each side of the dorsal surface of each segment is an oblique whitish mark; these frequently appear to be united to a narrow whitish margin of the dark mediodorsal stripe, but such white markings are by no means constant or distinct. The colour of the ventral or smooth portion of the pupa is olive-green at first, but gradually becomes darker and almost black (Newman).

Time of appearance.—In Kent, the average time of appearance of this species is the first week in July, occasionally occurring, however, in early seasons during the last week of June, and, in late seasons, not until the third week of July. It results, therefore, that in early seasons the species is quite over by mid-July, whilst in late seasons it is to be found until mid-August. Raynor also notes (*in litt.*) that the first week in July is the average time for its first appearance in Essex. These times appear to be almost the same for central Europe—Germany, Belgium, France, Switzerland, North Italy, and Russia—the records showing some little difference, however, for increased altitude, *e.g.*, it was fully out in Fontainebleau Forest during the last week of June, 1897, whilst worn specimens were found at some 5500ft. elevation between Allos and the Lac d'Allos, on August 11th, 1906, and yet Millière gives May and June as the ordinary time of appearance for the Alpes-Maritimes; similarly, whilst May and early June are noted for Florence, in Italy (Verity), July 24th-August 6th, 1892, is given for the Certosa di Pesio district (Norris), and, whilst May and June are given for Geneva (Blachier), and the last fortnight of June and July is usually given for lowlying parts of the Valais [as early as May 30th, 1874, along the Sépey Road (A. H. Jones)], August 2nd-5th, 1885, is recorded for the Vallée des Ormonts (A. H. Jones), and August 8th-9th, 1901, between Hergiswyl and the summit of Pilatus (Keynes). In Corfu, it appears towards the end of May (de la Garde), throughout June, in Hungary (Nicholson); whilst in Bulgaria it was observed from June 8th, in the Narenta Valley, to July 25th, 1898, on the Igmán, near Illidze (Nicholl). In Greece, it occurs at the end of June (Staudinger). In Transcaucasia, it occurs in June and July (Romanoff), whilst, for the Casan district, and Wiatka govt., July is recorded (Kroulikowsky); the end of June at Segewold, although usually July 10th onwards in the Baltic Provinces (Nolcken). It is noted as occurring in June and July in Scandinavia, by Wallengren, but Siebke gives "July and early August." In Germany, June is given for Hanover (Glitz), and Nassau (Rössler); June for Pomerania (Paul and Plotz), but July (Hering); June and July for Thuringia (Krieghoff), the Province of Saxony (Stange), Brandenburg (Pfützner), Silesia (Wocke), the Kingdom of Saxony (Winckler), Bavaria (Schmid and Gillmer), and the Lower Elbe district (Zimmermann); July and early August in East and West Prussia (Speiser); between July 8th-20th, near Danzig (Schmidt); from the end of June to August (11th), at Schwerin (Gillmer); mid-June to mid-August, in Baden (Meess and Spuler). Kaltenbach says that he captured a specimen, near Assmannshausen, as late as September. In France, it is noted as occurring in May and June at La Verrerie (Millière), in early June at Nice (Bromilow), both in the Alpes-Maritimes, yet we ourselves took it, on August 11th, 1906, above Allos, in the Basses-Alpes; end of June and early July, near Paris (Villiers and Guenée), June 10th-July 1st, in the dept. Indre (Sand), in June, in the Haute-Garonne (Caradja), and in the Gironde (Trimoulet); June and July, in Saône-et-Loire (Constant), in the Basses-Pyrénées (Rondou), June 10th-July 25th, in the woods at Brenne (Martin). Millière, as noted above, states that the imagines appear in May and June in the Alpes-Maritimes, but then erroneously continues that "the larva is to be found in June and July," *i.e.*, after the imagines have appeared in May and June, a certain error since the species hybernates as egg. In Austro-Hungary, June is given for Upper Austria (Brittinger), and Lower Austria (Rossi), mid-June for Carinthia (Höfner); June and July for Salzburg (Richter); early July for Moravia (Schneider); July for Bohemia (Hüttner); Himsl gives July and August for the Inn Valleys of Upper Austria. Aigner-Abafi says that it occurs from the beginning of June to mid-July at Budapest, whilst at Eperjes it appears from mid-June to mid-July. Oberthür notes a ♂ taken in August in the Isle of Askold. The following actual dates of capture may prove interesting: Continental records.—June 2nd, 1861, at Wiesbaden (Rössler); June 14th, 1866, on the Parnassus (Brit. Mus. Coll.); imagines along the Sépey Road, near Aigle, May 30th, 1874 (A. H. Jones); June, 1882, in the Caucasus (Bramson); August 2nd-5th, 1885, in the Vallée des Ormonts (Jones); July 10th, 1889, in the forest of Raismes (Paux); June 10th, 1890, at Nice (Bromilow); May 24th, 1891, at Corfu (de la Garde); July 24th-August 6th, 1892, in the Certosa di Pesio district (Norris); June 8th-21st, 1893, at Budafok (Nicholson); bred June 27th, 1894, at Schwerin, from a wild pupa (Schröder); July 25th, 1895, at St. Cergues (Reverdin); June 18th-26th, 1897, abundant in Fontainebleau Forest (Tutt); June 20th-24th, 1897, at Sierre (Postans); quite fresh on July 22nd, 1897, but worn by the 28th, on the road between Aigle and Sépey (Wheeler); June 8th, 1898, up the Narenta Valley; July 25th, 1898, on the Igmán, near Illidze (Nicholl); July 2nd-18th, 1900, on the Sépey Road (Wheeler); July 12th-20th, 1900, at Herculesbad (Lang); July, 1900, abundant in the Fribourgeois Alps (Muschamp); July 24th, 1901, at Leysin (Blachier); July 30th, 1901, just beyond Sépey (Lemann); August 8th and 9th, 1901, on the slopes of Pilatus, between Hergiswyl and the summit (Keynes); June 1st, 1902, at Florence (Verity); June 25th, 1902, near Moulins (Rocquigny-Adanson); July, 1903, at Sépey (Lemann); June 20th, 1904, at Charpigny (Wheeler): July 30th, 1904, and on August 11th, 1904, a worn ♀ in Schwerin (Busack); June 12th, 1905, at Rüdersdorf (Dadd); June 20th, 1905, fresh, but not common, at Bex; June 28th, 1905, abundant, but worn, at Leuk (Lowe); July 28th, 1905, at Iselle (Moss); June 18th-21st, 1906, in fine condition, near Lahr (Keynes); June 28th, 1906, at Éclépens (Lowe); July 4th, 1906, at Gex, at the foot of the French Juras (Blachier); July 10th, 1906, abundant in the Forest of Compiegne (Sheldon); July 30th, 1906, in the woods at the foot of the Salève, Geneva (Muschamp); August 11th, 1906, worn, between Allos and the Lac d'Allos, at 5500ft. (Tutt). British records.—August 6th, 1827 (Henderson); occurred plentifully in 1832 and 1837, at Witham, without any being seen in the intervening seasons (Burnell); July 9th-30th, 1833 (Blomer); July 16th-31st, 1837 (J. C. Dale); July 27th, 1856, in Maltby Wood (Laycock);

July 18th, 1857, about half a mile from the Sudbury and Wembley Station, N.W.R. (Hind); July 20th, 1857, near Chesham, Bucks (Browne); bred July 1st-2nd, 1857, from near Ipswich (Bree); July 6th-20th, 1857, from near Chatham (Crozier); July 16th-August 1st, 1857, in the Forest of Dean (Langley); August 1st, 1857, abundant at Deddington, swarming on blackberry blossom (Mitchell); bred June 15th, 1858, from larvæ taken in West Wickham Wood, on May 23rd (Bryant); [August 24th, 1858, at Cove, near Aldershot (Heap);] June 25th-July 6th, 1859, near Tintern (Piffard); bred July 11th, 1860, at Eye (Tyrer); July 17th, 1864, at Chertsey (A. H. Clarke); June 22nd, 1865, at Powick, near Worcester (Hearder); July 1st, 1868, at rest, at King's Mill, Painswick; on the wing, July 17th, 1871, near King's Mill (Watkins); July 22nd, 1873, at Mountsorrel (Rowley); July 10th, 1874, at Dry Drayton (Walker); July 14th, 1874, thirty specimens were taken at St. Lawrence, Essex (Mills); in great abundance at Four Elms Hill, Wainscot, July 1st-5th, 1875 (Tutt); common July 4th-31st, 1875, in Chattenden Woods (Tugwell); July 9th, 1875, near King's Mill (Watkins); July 4th-13th, 1881, in great abundance, "thousands," at Hemel Hempstead (Piffard); worn on August 5th, 1882, in Edlington Wood (Porritt); August 7th, 1882, near Banbury (Perry); imagines, July 18th, 1883, in Chattenden Woods (Bower); August 10th, 1883, abundant at Wotton-under-Edge (Perkins); July 27th, 1887, at Swithland (Rowley); June 16th-18th, 1888, at Upton St. Leonard's (Stanger-Higgs); August 1st, 1889, on the banks of the Wye (Patten); July 16th, 1890, near Reading (Clarke); July 29th, 1890, at Monmouth (Palmer); August 5th, 1892, at Tintern, worn (Lowe); August 6th, 1892, at Newball (Carr); July 11th, 1893, near Sapperton (Davis); imago emerged July 10th, 1894, from larva found at Church Stretton, middle of June, on ash (Newnham); August 18th, 1894, in Savernake Forest (Alderson); July 3rd, 1895, near Reading (Clarke); bred June 16th, 1896, from larvæ found in Suffolk (J. A. Clark); abundant, but quite *passé*, July 6th-10th, 1896, at Church Stretton (Newnham); July 11th, 1897, and following days, at Hazeleigh (Raynor); August 2nd, 1897, at Shere (Tremayne); imagines, July 13th, 1898, from larvæ found in Leicestershire (Dixon); July 20th, 1898, at Conington, Cambridgeshire (Peed); July 22nd, 1898, and following days, at Hazeleigh (Raynor); July 11th, 1899, in Chattenden Woods (James); July 12th, 1899, at Painswick (Watkins); July 10th-16th, 1899, at Symonds Yat (Peed); July 12th, 1899, and following days, at Hazeleigh (Raynor); August 9th, 1899, at Malvern (Sich); commencement of August, 1899, common, but worn, in the Wye Valley (Fountain); very abundant, in South Nottinghamshire, in 1900 (Simmons); abundant, in 1900, in Surrey (Barrett); swarmed, in 1900, in some places, near Bristol; June 4th, 1900, two fullfed larvæ, these produced imagines—♂ June 29th, ♀ June 30th, 1900 (Davis); July 4th, 1900, at West Wickham (T. B. Fletcher); July, 1900, at Bishops' Stortford (Mellows); July 10th, 1900, at Hazeleigh (Raynor); July 13th, 1900, near Box Hill (Turner); July 15th, 1900, at Tubney, near Abingdon (Hamm); July 25th, 1900, in a garden at Larkfield, Maidstone (Saxby); July 27th, 1900, at Marlow (A. H. Clarke); August 2nd, 1900, at Tring (N. C. Rothschild); August 11th, 1900, in Kilton Woods (Lofthouse); very common, in 1901, near Bristol (Davis); very abundant, in South Nottinghamshire, in 1901 (Simmons); abundant, in Monkswood, in 1901 (Keynes); July 2nd, 1901, and following days, at Hazeleigh (Raynor); August 1st-15th, 1901, near Watford (Arkle); August 3rd, 1901, at Marlow (A. H. Clarke); bred June 28th, 1902, from larva found on Box Hill, and that pupated June 10th (Oldaker); July 10th, 1902, at Ashton Wold (Rothschild); July 12th, 1902, and following days, at Hazeleigh (Raynor); July 16th, 1902, in Chattenden Woods (Burrows); July 20th, 1902, at rest, near Painswick; on July 31st, 1903, a fresh specimen, near Painswick (Watkins); August 3rd, 1903, and following days, at Hazeleigh (Raynor); August 9th, 1903, worn, at Box Hill (Goulton); bred July 2nd, 1904, from larva taken at Llandogo, on June 3rd; also July 6th-15th, on the wing, at Tintern and Llandogo (Bird); July 9th-11th, 1904, at Cwrt-yr-alla (Shelley); July 17th, 1904, and following days, at Hazeleigh (Raynor); July 24th, 1904, at North Fambridge (Whittle); July 31st, 1904, on Ranmore Common (Alderson); bred June 25th to July 7th, from larvæ obtained May 24th to June 3rd, 1905, at Chalfont Road (Rayward); bred June 24th to July 4th, 1905, from pupæ obtained at Llandogo and Tintern; also seen, at large, throughout July, and several times in August, but no actual dates recorded (Bird); bred June 27th to July 3rd, 1905, from larvæ obtained in Chattenden Woods (Burrows); July 5th, 1905, and following days, at Hazeleigh (Raynor); July 5th to August 6th, 1906, common, at Tintern and Llandogo (Bird); July 16th, 1906, at Bushey Heath (Barraud); July 15th, 1906, at Hazeleigh; August 15th, 1906, at Stoke Dry (Raynor).

Habits.—Bird notes (*in litt.*) that, "apparently, the ♂s are the first to emerge; nineteen pupæ obtained in 1905, at Tintern and Llandogo, resulted as follows: June 24th, 1 ♂; June 25th, 1 ♂; June 26th, 2 ♂s and 1 ♀; June 27th, 3 ♂s; June 28th, 2 ♂s and 1 ♀; June 30th, 1 ♀; July 1st, 1 ♂ and 1 ♀; July 2nd, 2 ♂s and 1 ♀; July 3rd, 1 ♀; July 4th, 1 ♀; total, 12 ♂s and 7 ♀s." When newly emerged, one sees this species, on bright sunny mornings, sometimes flying in numbers round the topmost boughs of the elm-trees, on which the larvæ have fed up, or far above, usually from about 8.30 a.m. - 10.0 a.m., but they soon descend to the most attractive flowers in their district, especially if the weather be at all windy, and, with their wings drawn up over their backs, settle down to drink greedily of the nectar provided. From thence on, till the early afternoon, and in the full sun, they remain, frequently immovable, or flitting rapidly from one blossom to another, if not disturbed; if frightened, however, they soon disappear among the trees, and do not quickly return. When the sun goes off the flowers, they fly up into the surrounding trees to roost, and may often be disturbed therefrom towards sunset, especially if tall ash-saplings be in the vicinity. Except when thus feeding, the insects are retiring in their habits, and may often be completely overlooked. This tendency not to recognise their presence in any place is increased by the uncertainty of the appearance of the species, in some years being in great abundance, in others exceedingly rare. Bird says (*in litt.*): "On dullish days *Edwardsia w-album* keeps to, and occasionally flits quietly about, the upper branches of the taller trees, usually selecting the wych-elm. In bright weather it does not remain so continually high up, and is seen more often on various trees, including the nut, ash, or oak, in the vicinity of its foodplant, preferring medium-sized trees rather than very tall ones. It will then frequently descend to feed at the blossoms of blackberry and also, during the latter part of July and in August, at those of *Eupatorium cannabinum* growing near by, visiting only such plants as may be in the sun. If not disturbed, it will stay for a considerable time about a flowering bramble, or a clump of *Eupatorium*, crawling from flower to flower, and occasionally flying round to choose another cluster of blossom. I am not certain, but am inclined to think, after watching specimens of which the sexes had been, or were afterwards, ascertained, that the males and females differ somewhat in their habits when frequenting tree-tops. When alighting, the male will do so on the upperside of a leaf, and will then, as a rule, twist round and walk to the edge and sit erect, with wings closed, almost, if not quite, facing the sun, ready to dart out and fight any other male, or pursue any female that may pass by. But they do not always sit in this manner, for I have noticed that they (probably both the sexes) sometimes rest in the middle of a leaf, and then lean right over, almost lying flat on their sides. When they do this, I do not think they pay any especial regard to the whereabouts of the sun, for I have seen them, when settled sideways to it, incline themselves away, and when settled on the upper part of a curled-up leaf, towards the sun, and also with their tails in that direction. The females, too, generally settle on a leaf, but will also do so on the twigs. They appear to be of a more restless disposition than the males, and may usually be seen walking about the leaves and twigs, rarely remaining perfectly still. I at first thought, when seeing one of these butterflies crawl about a twig, that it was a female intent on egg-laying, but have since noticed that they do so on other trees besides their foodplant, for instance, the nut, which seems to be the next most favoured after the wych-elm. When a male is pursuing a female, the pair will circle rapidly round one another, and slowly ascend to quite a considerable height above the tree-top, perhaps twenty feet or more, when they will part, and return to the tree at full speed, often meeting there again and repeating these tactics. Although I have observed this species at various times of the day, I have never seen one expand its wings when settled, and therefore imagined that they must always, when not using them for flight, keep them closed above their backs, but one reads, in Barrett's *Lepidoptera of the British Isles*, that it has been noticed 'sometimes, in the afternoon sunshine, walking about the leaves, high up, opening and shutting its wings.'" We have seen many hundreds of examples of this species, but do not remember seeing the insect fan its wings in the manner described. It is difficult to observe high up on the trees it haunts, and, when on the flowers, it usually appears to be almost too busy to desist from feeding, and, in July, 1875, on the outskirts of Chattenden Woods, we saw literally hundreds of this species, on flowers of bramble, and also at the end of June, 1897, in Fontainebleau Forest, on flowers of privet, with *ilicis*, greedily sucking at the flowers, the wings perfectly still, coming to rest suddenly with a quick closure of the wings, and flying off just as quickly if disturbed, and mounting at once far out of reach. Lewin notes the butterfly (under the name of *pruni*) as being not common, and first seen on the wing about mid-July, flying about bramble blossoms, and settling on them to feed. Stephens observes that, in July, 1827, it occurred in boundless profusion in the vicinity of Ripley, Surrey, the hedges for miles being enlivened by myriads, that hovered over every flower and bramble blossom. So abundant were they that, without moving from one spot, nearly 200 were taken in less than half-an-hour, as they approached a bramble-bush near which he had taken up his position. Our own first experience, just noted above, was somewhat similar, for, in the first week of July, 1875, the bramble-bushes, then in full flower, at the end of the long avenue of elm-trees leading from Four Elms Hill into Chattenden Roughs, swarmed with the insect. The first one seen appeared to have just completed drying its wings on a grass-culm, under an elm-tree, about 9 a.m., but by 10.30 a.m. there were hundreds of specimens flying around the tall elms, and coming down to suck the nectar of the flowers, when they fell an easy prey; since then, we have only seen a similar sight on three or four occasions, thus confirming Stephens in his statement as to the irregularity and uncertainty of the appearance of the species in quantity, although it is present every year in fewer numbers in those localities where we have ourselves occasionally seen it in such great abundance. Raynor observes (*in litt.*): "The first time I ever saw this butterfly was on the flowers of *Epilobium angustifolium*, in a cottage-garden, at Danbury, in July, 1871; there were several specimens (I forget exactly how many), but curiously enough, although I have grown the plant here, at Hazeleigh, for many years, I have never seen a single specimen of this butterfly frequenting it. During the sunny hours of the day it may nearly always be found feeding on bramble flowers, either in the hedges lining lanes, or on the outskirts of woods. I have also occasionally seen it settled on lucerne flowers, as is the case with most other butterflies occurring in the neighbourhood. Towards evening it flies up into elm-trees, there to spend the night, being thus safer from its enemies than if it rested on the bramble flowers which it frequents by day. It is not abundant every year, and I have not yet discovered what sort of season suits it best. The ♀s will lay freely in confinement if sleeved on their food-plant in the sun." As to its uncertainty, it is noted that, in one spot in the Leicester district, it was plentiful in July, 1873, 1874, 1876, and 1877, and literally swarmed in July, 1875, whilst in 1878, 1879, and 1880 it was practically absent, and not observed at all (Scott, *Ent.*, xiii., p. 278). Clarke states that it was very abundant in one place in South Oxfordshire, in 1868, and again in 1888, when the imagines preferred to congregate in a large clearing in a beechwood where plenty of bramble grew, the butterflies being attracted to the flowers of these bushes; he adds that wych-elm grows sparingly among the beech in one part of the wood. Mills observes that, in July, 1874, thirty specimens were taken at the flowers of a lime-tree at St. Lawrence, in Essex, whilst feeding on the flowers, and were very easily caught. Burrell says that it occurred plentifully in 1832 and 1837 at Witham, without any being seen in the intervening seasons. It was common in 1901, but swarmed in 1900, in some places near Bristol (Davis); the species was also abundant the last week of July, 1896, at Church Stretton, settled on, and flying over, sprays of bramble bloom (Newnham). Piffard says (*Ent. Mo. Mag.*,) that, between July 4th and 13th, 1881, he saw the species in thousands in a lane near Hemel Hempstead, between Felden and Bovingdon, commencing to fly about

10 a.m., flying and fluttering among the boughs of various trees, hovering over the tops of the hedges, and settling on the Umbellifer flowers that skirted the meadows. James notes that he found the species fairly common, in July, 1899, at Chattenden, on the blossoms of privet and bramble, during the middle of the day, but that, later, they showed a marked predilection for resting on the small ash-trees, and a fair number were shaken therefrom after sunset. Crotch notes (*Ent. Wk. Int.*, ii., p. 165) that, in Somerset, he found *w-album* careering over oak and ash-trees, after the fashion of *Bithys quercûs*. We have often noted their fondness for the tops of tall ash-saplings ourselves in Chattenden Woods, especially in the afternoon. Jones notes it as occurring freely on May 30th, 1874, at privet blossom along the Sépey Road, near Aigle; he also captured it at rest, on the flowers of Umbellifers, in the Vallée des Ormonts, in August, 1885. Walker records it as being common in July, 1901, on privet blossom, in the Forest of St. Germain, and on wild thyme in Parc Maison Lafitte, and Kane says that it specially haunts the flowers of *Marrubium vulgare*, whilst Lowe observed the imagines flying in a high wind over stunted bushes of elm, probably *Ulmus suberosa*, on June 28th, 1905, at Leuk, but, at Éclépens, on June 28th, 1906, it was found with *Nordmannia acaciae* on the flowers of *Sambucus ebulus*, or sunning itself on the leaves of common hazel. Norris also observes (*Ent.*, xxv., p. 240) that the insect was not uncommon on and around wych-elms in Piedmont—in the Val Pari, Val Sestrera, and Val Cavallo—and they also showed a great partiality for the flowers of the dwarf upright elder; the insect was observed to be much more attracted by flowers when the wind blew at all strongly than on a calm still day. Bird notes them at flowers of *Eupatorium cannabinum*, at Tintern, and Whittle that they were attracted to bramble blossom, towards the end of July, in the late season of 1904, at North Fambridge. Hearder observed the imagines busy, in June, 1865, feeding on the flowers of grass at Powick, near Worcester; Davis noticed the imagines freely in July, 1893, at flowers of *Rubus fruticosus*, near Sapperton; whilst Perkins says that, as late as August 10th, 1883, he found this species abundant on flowers of ragwort, at Wotton-under-Edge, and in 1897, found it common on the flowers of ragwort and bramble, at the same place; whilst Goulton also observed it at ragwort blossom on August 9th, 1903, on Box Hill; and Alderson on flowers of ragwort on Ranmore Common; Watkins has taken specimens at flowers of *Bryonia dioica* and *Betonia officinalis*, near Painswick; whilst Curtis notes that Walker captured it at Southgate, on flowers of *Spiraea frutex*. Busack records having taken specimens in 1904, at Schwerin, on flowers of *Eupatorium cannabinum* and *Valeriana officinalis*, the species being attracted to the blossoms of both. Keynes states that he found examples at the blossom of privet, in June, 1906, near Lahr, in company with imagines of *S. pruni*. Rössler and Voelschow both remark on the retired habits of the imago, and the latter remarks that he bred two pairs of imagines, which, in confinement, never flew until disturbed, and that, when this happened, they dropped to the ground with a sudden jerk, becoming at once still again. He collected in the neighbourhood of Schwerin five years before he saw imagines, and then found them on the flowers of the garden valerian, *Valeriana officinalis*, one hot afternoon, between

4 p.m. and 5 p.m., the butterflies at the time sitting quite motionless thereon, and the whole of the specimens observed being ♀s. Voelschow considered that they must have been attracted from some distance, as there were no elms in the near vicinity. Bromilow notes that, at Nice, he captured a ♀ on June 10th, 1892, on a plant of marguerite daisy in flower, but the species, he adds, is rare here, owing to the scarcity of elms. Rondou notes that, in the French Pyrenees, it occurs on the flowers of bramble, *Lathyrus pratensis*, etc. Although our observations go to show that it usually ascends into the tall trees in its vicinity to roost, we once saw a single example on the grass beneath an elm-tree, one of a long avenue, in the early morning, possibly it had been disturbed and dropped when freshly-emerged, and Griffith notes that at Morbihan, he has found it on bramble-flowers, and also very often, both morning and evening, on the ground under the elm-trees, so torpid, that it has been easy to take it with the fingers. In Geneva, Blachier says it sometimes settles on the mire of the roads and on the trunks of the elms.

Habitat.—This appears to be an exceedingly local species, its habitats largely confined to wooded areas, yet it exists from the Atlantic Ocean (Wales) in the west, to the Pacific Ocean (Japan) in the east, and from the Mediterranean (Sicily and Corfu) to Scandinavia—Westmannland 60°N. lat. (Dalman). In Britain, its distribution would appear to be limited, even in the districts it frequents, to the growth of the wych-elm, by far its favourite food. It appears, for example, to occur through Kent, Essex, Herts, Suffolk, Bucks, Surrey, Hereford, Gloucester, Glamorgan, Monmouth, Northampton, Nottingham, Leicestershire, etc., wherever the wych-elm appears, and possibly it occurs similarly in many other English counties. Although usually stated to be confined to a woodland habitat—forests, woods, and parks—it is often found in gardens where elm-trees border them, and even in the midst of towns where there are avenues of their favourite tree, whilst, in other places, it occurs in woods chiefly of other trees, where, however, wych-elm is occasionally found. On the continent, it is not generally considered to be a mountain species, and rarely occurs at a greater elevation than 3000ft., although there are some exceptions, *e.g.*, we found it ourselves on a few isolated wych-elms, between Allos and the Lac d'Allos in the Basses-Alpes, at fully 5500ft; whilst Keynes records it on the slopes of Pilatus, between Hergiswyl and the summit; it is also recorded by Miss Fountaine from the mountains above Buda. In the east, it appears to be confined to the lowlands, rarely going above 2000ft. in Austria, whilst in Bosnia and Hercegovina it never exceeds 3000ft., and is there rare and local; in Bulgaria, it occurs on the Vitos mountains (Rebel). Mrs. Nicholl notes its occurrence at Jablanica, in the Narenta Valley, by the railway-banks, which here present a delightful tangle of fragrant weeds and bushes, especially easily worked from the high road, which runs close to the line; it was also found on the Igmán, a wooded mountain, 4000ft. high, near Illidze. In Belgium, it chiefly frequents retired ridings in woods, parks where there are old elm-trees, and is sometimes to be seen flying along hedges by the sides of the roads lined with avenues of elm-trees, or settling on flowers by the hedgesides, etc. (Lambillion); it occurs in most of the large forests, *e.g.*, the Forêt de Soignes, etc. (Donckier). In France, it has occurred to us in two widely different localities. In the heart of Fontainebleau Forest, in the open spaces to be found by the side of one of the main roads leading through the Forest, where huge giant elm-trees and oaks form the mass of the tall trees, and low plants of rose, bramble, privet, etc., abound in the clearings, this species swarms with its ally, *S. ilicis*, flying in numbers quite out of reach, and absolutely safely, around the tall trees, but descending as the sun becomes more powerful, until, at about 11 a.m., the bramble and privet blossom form a living, active, insect home, with imagines of *Limenitis sibylla*, *Dryas paphia*, *Melitaea athalia*, *Epinephele ianira*, etc., disturbing the busy "hairstreaks" that want to settle down quietly to the luscious feast. Here they continue to assemble until the sun leaves the glades and openings, when they soon mount to safety in the arms of the leafy monarchs above. The other locality was an entirely different one. A steep mountain-path, leading from the little village of Allos to the lovely Lac d'Allos, levels out for some distance about a mile above the village. Here the path is bounded with a rough hedge on either side, chiefly formed of gooseberry, barberry, and blackthorn bushes. Among these a few fairly-grown elm-trees are found, edging the road for a short distance; on one side the steep rocky slopes here and there give place to cultivated patches, whilst, on the other, a field slopes down to the chasm through which rushes a boiling mountain stream. Here, a few worn specimens of *Edwardsia w-album* still lingered on August 11th, 1906, flitting about the elm-trees, gambolling with the more abundant *N. acaciae*, which frequented the neighbouring blackthorns. Two more unlike habitats of *E. w-album* could scarcely be imagined than this and that in Fontainebleau Forest, and it is just possible that the point reached on this mountain pathway represents the greatest altitude that the species attains in Europe. Throughout France, however, its localities are, as in England, woodlands, or places where elms are abundant. In the French Pyrenees, it occurs in avenues of elm-trees, along the main roads, on bramble-blossom in the bye-paths, and on flowers of *Lathyrus sylvestris* (Rondou); in the woods of the Dept. Indre, etc. (Sand); throughout the Haute-Garonne wherever elms grow (Caradja), in promenades planted with elms in the Gironde (Trimoulet), in woods at Brenne (Martin), in woods and along avenues of elm-trees, near Paris (Villiers and Guenée), in the forest of Raismes, in the Dept. Nord (Paux); in the forests of Baerenthal and Voipy, in Alsace (Cantener), etc. In the Baltic Provinces, it occurs in woodland meadows (Nolcken). In Switzerland, its localities are somewhat similar, but it is much more frequently found by roadsides, and in gardens, near which elms grow. One of the best known localities is the road between Aigle and Sépey, whilst, in Geneva, it often occurs in the gardens on the outskirts on the town (Blachier). In Italy, it is also, sometimes, a town insect, occurring in the Piazza Beccaria, in the city of Florence (Tolomei). In Germany, Speiser notes it as being largely confined to woods of deciduous trees in East and West Prussia, whilst in Pomerania, Hering observes it as being not rare, near the forester's house on the Schrey, near Garz-on-the-Oder, where it affects *Ulmus alba*, whilst it is very rare at Stettin, where only *Ulmus campestris* is found. Voelschow notes that the species is very retired, and difficult to find in nature, in the imaginal state, in Mecklenburg, but that the larvæ are fairly abundant where elms are abundant. Tessmann captured the species in a wood near the town of Stavenhagen, on *Populus tremula*, somewhat commonly. Rössler, like Voelschow, thinks that the species is much overlooked in Nassau, because of its retired habits, although it is found in the plantations, near the "baths," at Wiesbaden; whilst, at Cassel, Borgmann says that it occurs on the elms of the "Rasenallee," where this avenue crosses the "Lindenburg." In the Province of Saxony, it occurs on the northern slope of the "Steigerwald," in the woods of deciduous trees in the Saale Valley (Stange), whilst at Dessau, it also occurs in the woodlands (Richter), and in parks (Amelang). In Silesia, it is found in the foothills and lowlands, in bushy places, but is usually rare, although widely distributed (Wocke). In Bavaria, it occurs in the "Wolfschlucht," at Regensburg (Gillmer), and in the "English Garden" and the "Dachauer Moss," near Munich (Kranz). In Baden, it is distributed over the west side of the Schwarzwald, and among the foothills and on the plain, in woods of elms, lime, oak, etc. (Meess and Spuler), whilst Keynes notes that, near Lahr, the species occurs on a tract of low-lying land near the Rhine, the imagines frequenting the blossoms of some low privet bushes in June. In Alsace, it occurs in the woods of the plains only (Speyer). In Austria, the species is largely confined to the plains and lower valleys, *e.g.*, in Moravia, it is pretty common in the wooded pastures of the south (Schneider); whilst, near Vienna, it occurs among elms in the "Prater," the "Augarten" (Rossi), in the district above the "Wienerwald" (Schleicher), etc., whilst, in Salzburg, it appears to be very rare, occurring in few places, *e.g.*, the foot of the "Kuhberg" (Richter); it is also very rare in the Tyrol, and again, only at low elevations, *e.g.*, the "Gugler Garden" at Botzen (Hinterwaldner), in the Val Popena, in the Dolomite district (Mann), and at quite low elevations in the Innsbruck district (Weiler). It appears to be equally rare in Carinthia, where it has been taken in the Lavantthal and the Mollthal (Höfner). In Hungary, Aigner-Abafi says it is distributed throughout, but rather rare, although, in some years, occurring more commonly, being particularly attracted by the blossoms of *Sambucus ebulus* when growing near elm-trees. In Britain, it is generally assumed to be a woodland species, and the assumption is, in the main, accurate, although parks, avenues, hedgesides, gardens, etc., often give home to the species. Thus we find recorded—the ridings, clearings, and outskirts of Chattenden Woods (Tutt); generally distributed in the woods on the hillsides in the neighbourhood of Stroud (Davis); the outskirts of woods, and the borders of the rides of woods at Wellington, Somerset (Milton); occurs freely in a wood near Lincoln (Pearson); in the clearings of Monk's Wood (Westwood); in Cowleigh Park, and in the Trench and Warndon Woods in Worcestershire (Edmonds); in woods, chiefly composed of beech, but among which wych-elms grow, at Marlow (A. H. Clarke); in the woods of the Doncaster district (Brooks); occurs freely in a wood, quite close to Taunton, in which a number of wych-elms grow (Doidge); on the edge of a wood at Cwrt-yr-alla (Shelley); in Savernake Forest (Alderson); throughout the woods of North Lincolnshire (Simmons); in the woods at West Wickham (Sheldon); in a clearing in a wood near Box Hill (Turner); plentiful on the wych-elms on the south side of Box Hill (Oldaker); in woods, near the coast at Cowbridge, on blue lias, the country it frequents having a generally damp climate (W. E. R. Allen); in a wood, bordering the garden, at Ashgrove, Overton, in Flintshire (Perkins); in a garden at Larkfield, Maidstone (Saxby); frequent in the garden at Whitchurch (Bloom); occurs along the splendid avenue of wych-elms at Gifford's Hall, Stoke-by-Nayland (Mathew); in gardens, surrounded by elm-trees, around Buckingham (Slade); on the elm-trees along the banks of the Wye (Patten); common in the lanes, between Esher and Ripley, on wych-elms (Richards); in a lane, near the British Camp, at Malvern (Sich); on the railway-bank, between Arley and Highley, in the Birmingham district (Rossiter); in the roads, where wych-elms grow, in the Painswick district (Watkins). At Ashton Wold, it does not seem to be so strictly a wood-loving species as *Strymon pruni* and *Ruralis betulae*, as I have occasionally caught specimens in the lanes away from the woods, while, in Essex, I have taken the species abundantly, from high wych-elms, that grow in a grass field, and it also occurred in a similar locality, near Cambridge, some years ago. On one occasion, I captured *S. pruni* and *E. w-album*, the former worn, on the same privet-bush, at Ashton Wold (N. C. Rothschild). It occurs not only in Edlington Wood, but also in the adjoining lanes and field-sides (Porritt). The species is taken sparingly in Sherwood Forest and elsewhere in the north, but is locally abundant only in the south, of the county of Notts (Carr). In the Wye Valley district, in Monmouthshire, I have rarely seen this species at 200ft., or 300ft., higher than the river, but, among the wych-elms near the bottom of the valley, it is to be found commonly (Bird). Arkle notes that *w-album* occurs freely, locally, upon the wooded slopes near the village of Arthog, was more abundant in 1905 than in 1904, and states that, in a favoured open spot here, not a dozen yards across, a regular butterfly corner, and full of flowering bramble, scabious, meadow-sweet, knapweed, and St. John's wort, in the blaze of a hot sun, he netted specimens at his leisure, observing that they had a remarkable way of dodging the net, especially when on bramble.

British localities.—The distribution of this species in Britain deserves careful study. It appears to be quite absent from Ireland, and only Dumfries is recorded for Scotland, whilst its range in England and Wales excludes the south-western, the western (except the warm ocean-washed counties of Carnarvon, Flint, and Merioneth), and extreme northern counties; a line from the mouth of the Dovey to Exeter, and another from the mouth of the Dee to the mouth of the Tees, would include, on the eastern side, all the recorded habitats for this species, except Dumfries (*Ent. Wk. Int.*, vi., p. 202). Bedford: Bedford, Woburn (C. G. Barrett), Clapham (Gifford-Nash). Berks: local and uncertain—Maidenhead, Reading (A. H. Clarke), Sonning, Burghfield, near Reading (Bird), Ufton (Barnes), Bradfield (Young), Streatley, Lambourne (Blair), Tubney, near Abingdon, Reading (Hamm), Windsor (Stephens). Bucks: Chalfont Road (Rayward), Buckingham (Slade), Chesham (Browne), Marlow (A. H. Clarke), Stony Stratford rare (Foddy). Cambridge: generally distributed (Brown)—Madingley Wood (Stephens), Dry Drayton (Walker), Cambridge (Rickard), Boxworth (Thornhill), Conington (Peed). Carnarvon: Llandudno district (Harding). Cheshire: rare—the Wyches, near Malpas (Wolley-Dod), Delamere (Nixon). Derbyshire: Darley, Calke Abbey (Crewe), Cubley (Greene), Burton-on-Trent district, Brizlingcote (Brown), Seal Wood (Nowers), Repton (Sheldon), Repton Shrubs (Baker), Repton Wood (Hill), Hoofies Wood (Gibbs). Dorset: Buckland Newton, one only (J. C. Dale), Sherborne (Douglas). Dumfries: Dumfries (Lennon, *Ent. Wk. Int.*, vi., p. 202). Essex: appears to be wherever there is wych-elm, and generally distributed (Harwood)—Epping (Doubleday), Bergholt Woods, near Colchester (Harwood), Maldon (Fitch), North Fambridge (Whittle), Stanstead (Spiller), Witham (Burnell), Beeleigh, Coggeshall, Danbury, Hazeleigh, Purleigh (Raynor). FLINT: Ashgrove, Overton (Perkins). GLAMORGAN: near Cardiff (Ansaldo), Swansea district (Robertson), Porthkerry, Cowbridge (W. E. R. Allen), Cardiff district, most abundant (Drane, *Zool.*, 1858, recorded as *S. pruni*), Cwrt-yr-alla (Shelley). GLOUCESTER: near Gloucester rare (Merrin), Clifton (Hudd), Wotton-under-Edge (Perkins), near Sapperton (Davis), near Cooper's Hill and Birdlip (Newstead), Durdham Down (Barton), Westbury, one (Pease), Hill near Berkeley (Jenner-Fust), Coombe Dingle (F. D. Wheeler), Bristol (Stainton), Cheltenham (Robertson), Lydney (Stanger-Higgs), Forest of Dean (Searancke), Upton St. Leonard's (Higgs), King's Mill, Painswick (Watkins), Cirencester (Harman). HANTS: New Forest, one only (Corbin), Southsea, one only (Moncreaff), Basingstoke—Hackwood Park and Herriard Park, sometimes common (Hamm), Cove, near Aldershot (Heap, *Ent. Wk. Int.*, iv., p. 184). HEREFORD: distributed and often common in the woods of Herefordshire (Bowell)—Leominster, the Bache (Hutchinson), Symonds Yat (Peed), Oakley Park rare (Harman), Tarrington (Wood), Hereford (Blathwayt), Wofferton (Lucas). HERTS: Theobald's Park, Waltham Cross (Edelsten), Tring (N. C. Rothschild), Batch Wood (Dickinson), Bushey Heath (Barraud), Hemel Hempstead, between Felden and Bovingdon (Piffard), Sandridge (Griffith), Knebworth (Durrant), Watford (Spencer), Haileybury (Stockley), Bishops Stortford (Taylor), Cheshunt (Bond), St. Albans (Dickinson), Stanner (Wood). HUNTS: near Stilton (J. C. Dale), Monk's Wood (Westwood), St. Ives (Norris). KENT: widely distributed in the county—Chattenden Woods, Upnor, etc. (Tutt), Bridge, near Canterbury (Hammond), Dartford (W. West), Darenth Wood (Newman), Chatham district (J. J. Walker), Larkfield, Maidstone (Saxby), Herne Bay (Butler). LEICESTER: Mountsorrel, Buddon, Rothley, Swithland (Rowley), Owston (Scott), Loughborough (Wieldt). LINCOLN: near Lincoln (Pearson), Kirton-in-Lindsey (Fyles), Newball (Lewington), Caistor district (Mason), Market Rasen district (Lees), Skellingthorpe, Hartsholme and Doddington (Musham), near Lincoln (Carr), Haverholme Priory (Coward), Bowen Wood (Miller), Allington (Peter Wynne), woods near Lincoln (Simmons). MERIONETH: Arthog (Arkle). MIDDLESEX: Harrow Weald (Peers *teste* Rowland-Brown), Wembley (Hind, *Ent. Wk. Int.*, ii., p. 132), Southgate (Walker). MONMOUTH: Llandogo, Tintern (Bird), banks of the Wye (Patten), Monmouth (Palmer), Wye Valley above Tintern (Fountain), Gamaren (Langley). NORFOLK: very local, Newton St. Faiths, Lynn, Denton, Stoke Holycross (Barrett), King's Lynn (Atmore). NORTHAMPTON: local but generally distributed (V.C.H.)—near Northampton (Hensman), Barnwell Wold, near Brington (Bree), Ashton Wold (Stephens), Peterborough (Stainton), West Wood, near Peterborough (Whitwell), near Oundle (Bree), Sywell Wood, Yardley Chase, Salcey Forest (Goss), Daventry (G. C. Green). NOTTS: locally abundant—Sherwood Forest (Goss), south Notts abundant (Simmons), Newark (Gascoyne), Willin Wood, near Ollerton, rare (Brameld), also other woods in the north, but is locally abundant only in the south of the county (Carr). OXFORD: south Oxfordshire (Clarke), near Banbury (Perry), Deddington (Mitchell). RADNOR: Erwood district (Vaughan). RUTLAND: Stoke Dry (Raynor), Burley Wood, Oakham (W. B. Gordon). SHROPSHIRE: Benthall Edge (Barrett), Church Stretton (Newnham), Calverhall, near Whitchurch (Thornewill). SOMERSET: not very common, except near Bristol, Brockley Coombe and Weston-super-Mare (Crotch), Brockley (Hudd), Wellington (Milton), Taunton (Doidge), Orchard woods, near Taunton (Tetley), Clevedon (Mason). STAFFS: Burton-on-Trent district (Brown), Moddershall (Daltry), near Barton, in Needwood Forest (Jordan). SUFFOLK: generally distributed (Crewe), principally in the southeast of the county, rare elsewhere (Bloomfield)—Brandeston, Playford (Greene), Wolsingham Park (Crowfoot), Dodnash Wood (Harwood), Haverhill (Gaze), Sudbury (King), Old Hall Wood (*teste* Mosley), near Ipswich (Stephens), Bury St. Edmunds, Needham, Bures, Bentley, Great Glemham, etc. (Bloomfield), Easton (Harker), Bungay (Curtis), Flixton (Crutwell), Beccles (Crowfoot), Gifford's Hall, Stoke-by-Nayland (Mathew), Eye (Tyrer). SURREY: Guildford, Godalming, Witley, Cobham (Newman), Ripley, near Windsor (Stephens), Esher (Fleet), Claygate (Barrett), Shere (Tremayne), West Wickham Wood (Fletcher), Chertsey (A. H. Clarke), Box Hill (Oldaker), Reigate district (Tonge). SUSSEX: generally distributed (Draper), local and rare in the county—formerly common in Frenchlands Woods (J. H. White), Abbott's Wood (Levett). WARWICK: Brandon Woods (Sidgwick), Wolford Wood (Austen), Whitchurch (Bloom), Atherstone (Baker), Knowle Haselor, near Alcester (Blatch), Allesley (Morris), between Arley and Highley in the Birmingham district (Rossiter). WILTS: Savernake Forest (Alderson), Salisbury Plain district—

Netheravon, etc. (Manders). WORCESTER: Great Malvern, Cowleigh Park (W. H. Edwards), Malvern Link (Towndrow), Trench and Warndon Woods (Edmonds), Worcester, St. John's Bransford (Edwards), Cotheridge (Fletcher), Melton Woods (Stephens), Powick, near Worcester (Hearder). YORKS: Maltby Woods (Batty), Sheffield district (Thomas), Doncaster district—Wheatley Wood (Porritt), near York, Wharncliffe Wood (Birchall), Edlington Wood, near Barnsley (Harrison), Roche Abbey (W. H. Smith), Helmsley (S. Walker), Friarage Woods, Yarm, Kilton Wood, Cleveland (Lofthouse), Wadworth Woods (Brooks).

DISTRIBUTION.—Europe (except the polar region and Siberia), Asia Minor, Changai, Ussuri, and Japan (Staudinger and Rebel). ASIA: [North China (Fixsen), Shanghai, Peking (*teste* Rühl), Isle of Askold (Oberthür), Corea (Fixsen),] Japan—Hokkaido, Shiribetsu (Butler), Amurland—Sutschan (Dorries), Wladiwostok (Christoph). on the Bikin (Dorries), Ussuri—Mündung (*teste* Rühl), Eastern Siberia—Witim, Wilui (Herz). ASIA MINOR: Macri (Zeller). AUSTRO-HUNGARY: sparingly throughout (Höfner); Bohemia—Prague (Nickerl), Carlsbad (Hüttner); Moravia—Brünn (*teste* Rühl), pretty common (Schneider); Upper Austria—Steyer, Aschach (Brittinger), Schoberstein, Kremswiesen, near Herndl, Steyr, in the Dammberg, Spitzenbach, Schwanenstadt (Himsl); Lower Austria—near Vienna, Baden, Mödling, the Prater, the Augarten (Rossi), the district above the Wienerwald (Schleicher), Hernstein district, local (Rogenhofer); Salzburg—Salzburg, at the foot of the Kechberg (Richter); Tyrol—only in the southern Tyrol, lower region, very rare, Botzen, the Gugler Garden (Hinterwaldner); the Dolomite district—Val Popena (Mann and Rogenhofer), Innsbruck, Tratzberg (Weiler); Carinthia — the Lavant Valley, Wolfsberg (Höfner), Möll Valley (Nickerl); Hungary—Budapest, Parád, Eger, Nagyvárad, Pészer, Pécs, Sopron, Törökbälint, Verebély, Rókusx, Pozsony, Tavarnok, Gács, Rozsnyó, Igló, Eperjes, Nagyág, Mehádia, Vinkovcze, Fiume (Aigner and Pavel); Budafok (Nicholson), Herculesbad (Lang), Croatia — Slavonia (Koca), Mehadia, Transsylvania, Moldau (*teste* Rebel), the Bucovina — Galicia, near Lemberg (Garbowski). BELGIUM: rare, in the woods of the Ourthe and the Meuse; neighbourhood of Brussels and Louvain (Dubois), Forêt de Soignes (Donckier), Namur, Dinant (Lambillion), Vecquée (Dufrane), Gembloux (Lambillion), Liège (*teste* Rühl). BOSNIA AND HERCEGOVINA: rare and local, up to 1000m.—Dervent (Hilf), Sarajèvo district, the Igmán, Narental, near Jablanica (Nicholl). BULGARIA: West Bulgaria—Vitos mountains (Buresch coll.). CHANNEL ISLANDS: Jersey, once (Piquet *teste* Luff). DENMARK: Udbredt (Bang-Haas), Fridericia (*teste* Rühl). FRANCE: almost throughout (Berce)—Ain—Gex (Blachier); Allier—la Levé, on the road to Avernes, near Moulins (Rocquigny-Adanson); Aisne—wood of Holnon, St. Quentin (Dubus); Alpes-Maritimes, not common—Nice, St. Barthelemy, Cannes (Bromilow), La Verrerie (Millière); Aube—environs of Troyes, getting rarer (Jourdheuille); Aude—generally (Mabille); Auvergne—Limagne, etc. (Sand); Brittany—throughout (Griffith); Basses-Alpes—between Allos and the Lac d'Allos (Tutt); Basses-Pyrénées—St. Sauveur, Gèdre (Rondou); Calvados, common—Caperelli and Montlivet; Caen—Arromanches, Asnelles, Manvieux, Cérisy, Balleray (Fauvel); Charente-Inférieure—Royan (Salis); Cher—Sologne, St. Florent, rare; Creuse—Guéret, common (Sand); Dordogne—a single example at Le Baume (Tarel); Eure-et-Loir—local (Rocquigny-Adanson); Gironde—environs of Bordeaux (Brown); Haute-Garonne, throughout (Caradja); Hautes-Pyrénées (Rondou); Indre—Nohant, common (Sand); common in woods at Brenne (Martin); Ille-et-Vilaine—Rennes (Oberthür); Loire-Inférieure—Nantes (Deherman-Roy); Meurthe-et-Moselle (Rocquigny-Adanson)—Nancy (Dutreux); Meuse—Verdun (Dutreux); Morbihan—Vannes (Griffith); Maine-et-Loire, abundant on rushes (Delahaye); Marne—Rheims, Epernay, rather common (Demaison); Nord—rare and occasional, near Bailleul, Montnori, Lilleforts, forest of Raismes (Paux), near Cambrai (Brabant); Oise—Forest of Compiegne (Sheldon); Pas-de-Calais—forests of Lech, Guînes, and Boulougne (*teste* Gurney), Boulogne-sur-Mer (Timins, *Ent. Wk. Int.*, v., p. 115); Puy-de-Dome—common, Limagne (Sand); Sâone-et-Loire—a single example (Constant); Savoie, mountain parts (*teste* Speyer); Seine—near Paris (Villiers and Guenée), Forest St. Germain, Parc Maison Lafitte (Walker); Seine-et-Marne — Fontainebleau (Tutt): Seine-et-Oise — Versailles, Senart, Montmorency, Maisons Lafitte (H. Brown); Seine-Inférieure (Rocquigny-Adanson); Somme—Amiens (Rühl). GERMANY: widely spread, and possibly much overlooked (Gillmer), sparingly throughout, rare in most districts, very local in northwest Germany, scarce in the hill region (Speyer)—East and West Prussia—near Danzig, Elbing, rare, Königsberg, Rastenburg (Schmidt), Rauschen, Dammhof, Gross-Raum, Tapiau, Gerdauen, Mohrungen, Wotzlaff (Speiser); Pomerania—near Stettin, the Schrey, near Garz-on-the-Oder (Hering), Grubenhagen (Paul and Plötz); Mecklenburg-Schwerin (Voelschow), Stavenhagen (Tessmann); Lower Elbe district—Hamburg (*teste* Rühl), Bergedorf (Zimmermann); Hanover—Hanover (Glitz), Bremen (Rehberg), Lüneburg. Aurich (*teste* Speyer); Westphalia—Siegen (*teste* Speyer); Rhine Provinces—Bonn, Boppard (Stollwerck), between Aachen and Eupen (Mengelbir); Nassau—Mainz (Brahm), Wiesbaden (Rössler), the Taunus mountains (*teste* Rühl); Bingen (*teste* Speyer), Hanau (Limpert and Rottelberg), Frankfurt-on-Main, Hochstadt, between Frankfurt and Hanau (Koch), Marburg, Dillenburg (*teste* Koch), Cassel (Borgmann); Thuringia, rare and local—Sondershausen, in the Osterthal and Brückenthal, Rudolstadt, in the Mörlagraben (Krieghoff); Province of Saxony—northern slope of the Steigerwald, Erfurt (*Ent. Verein*), Saale Valley (Stange), Dessau (Richter), Gernrode, in the Harz (Reinecke), Göttingen (Jordan); Brandenburg—Rüdersdorf (Dadd), Finkenkrug (Pfützner), Jungfernhaide, Potsdam, Gross Lichterfelde, Hermsdorf (Bartel and Herz), near Frankfurt-on-Oder (Kretschmer); Posen—Moschin, Wonsowo (Schultz); Silesia—local in the lowlands and foothills (Döring), Brieg (*teste* Rühl), Görlitz (Möschler), Sagan (Pfützner), Muskau (Wolf *teste* Sommer); Kingdom of Saxony—Leipzig, Dresden (*teste* Rühl), Leutzsh, Rosenthal, Zwenkau, Hainichen. Rosswein, the Triebisch-, Saubach-, and Serre Valleys, Tharandt, Pillnitz, Berggieshübel, Müglitzthal, Wilsdruff, Bautzen, Lobau, Chemnitz. Zschopau, Börnichen (Winckler); Bavaria—Regensburg (Hofmann and Herrich-Schäffer), the Wolfschlucht (Gillmer), near Münich (Kranz); Baden—distributed on the western side of the Schwarzwald, Freiburg, Kaiserstuhl, Dinglingen, Karlsruhe, Heidelberg (Reutti), Lahr (Keynes); Rhine Palatinate—throughout (Bertram); Alsace, in the plains, rare (Speyer)—Colmar, Semmwald, Niederbronn, Forêt de Baerenthal, Metz, Forest of Voipy (Cantener). Greece: the Parnassus (Staudinger), Corfu (de la Garde). Italy: the lower altitudes of Piedmont, the hilly districts of Liguria, the plains and hills near Mantua, rather rare, and Calabria, rare (*teste* Speyer); Tuscany—Livorno, Limone (Stefanelli), Florence (Tolomei); Lombardy—Brianza, rather rare (Turati), Modena (Fiori); Piedmont—Iselle (Moss), Certosa di Pesio, Val Pari, Val Sestrera. Val Cavallo (Norris); Mantua. rare (Kane), the Tiber Valley (*teste* Rühl). Sicily—Palermo (Marott), Taormina (Struve), Madonie—Castelbuono (Kalchberg), Mondello (Ragusa), Corleone (Calberla). Roumania: near Comanesti (Caradja). Russia: Caucasus (Bramson) — Daghestan, Kasumkent (Romanoff); Transcaucasia — Borjom, Lagodekhi, Kedabeg, Migri, Adjekent, Lischk (Romanoff); Volga district—the Lower Volga, the foothills of the Urals (Eversmann); Casan district, Govt. Wiatka—near Sarapoul, Malmisch, Ourjoum (Kroulikowsky), Novorossiisk (*teste* Rühl), St. Petersburg (*teste* Nolcken); Baltic Provinces, rare—Segewold (Beinert), Wolmar v. Kingmandshof (Teich), Bathen, near Libau (Gerhard), near Dorpat (*teste* Rühl). Scandinavia: common in Lund, rare near Stockholm, Upsala, and Westmannland to 60°N. lat. (*teste* Speyer); Sweden—Skania (Lampa), Fairlof, near Christianstad (Siebke), Upland (Aurivillius), Stockholm (Wallengren); Lapland—Upsala (Dalman *teste* Zetterstedt); Norway—south, rarer in north—near Christiania. on the S. Hanshangen, in Töien, Soon, Skien, one only (Siebke), Akershus, Bratsberg (Schöyen). Servia (Hilf). Switzerland: local, and only at low elevations—Berne, Burgdorf (Meyer-Dür), Canton Waadt (La Harpe), Bechburg, Basle (Riggeubach-Stehlin), Liestal (Christ), Marly, near Fribourg, Neuveville, on the Schlossberg, at 1654ft. (Couleru), Uetliberg, Weissenburg (Huguenin); Zürich—Balgrist (Zeller-Dolder), east slope of Pilatus, between Hergiswyl and summit (Keynes), Interlaken district (Renshaw), Vallée des Ormonts (Jones), the Simplon—Gamsen (Anderegg *teste* Courvoisier); Rhone Valley—Noës, Corin, etc. (Favre), Aigle to Sépey (Wheeler), Sépey (Lemann), Rossinières (Tasker), Bex (Murray), Leysin (Blachier), Sion (Favre), Sierre (Postans), Leuk (Lowe), Charpigny (Wheeler); Geneva district—Bois de Veyrier, etc. (Blachier), Neuchatel (de Rougemont); Jura—St. Cergues (Blachier), Eclépens (Lowe), Charmez, Fribourgeois Alps, Geneva—wood at foot of Salève, etc. (Muschamp).

ADDENDUM.

Edwardsia w-album.—Two most important details have come to hand since the earlier part of our notes relating to this species was printed. One relates to the number of larval moults and the structure (particularly of the lenticles) of the larva in its second and third [noted as "third" and "fourth" by error (*anteà*, p. 160)] instars; the other relates to the spinning done by the larva previous to pupation, and, in spite of the fact that the observations on the latter point were made 177 years ago, it must be confessed that they are far in advance of the more or less superficial notes that we had ourselves collected concerning the silk-spinning habit of this larva (*anteà*, p. 169).

LARVA (*anteà*, p. 158).—*Number of moults:* This species appears to have only three larval moults and four instars. I have not reared one specimen through to be able to assert this from my own actual observation, but I have specimens given me as second and third instars, and these fall in between the first and last, with no room for another. Thus the heads of the four instars measured across, from mounted specimens, possibly somewhat distorted, so that the measures are roughly, but not absolutely, accurate, give—

FIRST INSTAR.	SECOND INSTAR.	THIRD INSTAR.	FOURTH INSTAR.
0·3mm.	0·54mm.	0·99mm.	1·64mm.

Taking the first two to be accurate, and the rates of increase of size to be, therefore, as 10 : 18, then the third and fourth instars should be 0·97mm. and 1·75mm. respectively. These are sufficiently near to the actual measurements, tabulated above, to show that no further instars could be interpolated (Chapman). *Second instar* (from mounted specimen) (*anteà*, p. 160, line 15): 5mm. long; head black and shining, diameter of head 0·54mm. The hairs are much more numerous than in the first instar; the setæ of tubercles i and ii are still distinguishable as the longest dorsal hairs, but are part of a group of 8 or 9 on each side, not definitely marked off from others, about 10 in number, between them and the spiracle. The flange group of hairs is now about 10 in number, and the lower group (of 2 in first stage) vary from 5 or 6 to 9 on different segments. The prothorax has a narrow transverse plate, about 0·5mm. transversely, about 0·12mm. from back to front, it has 2 or 3 short hairs on each side; there are about 16 hairs on each side, above the spiracle, in front of the plate; on each side of the middle line, close to the front margin of the plate, is a lenticle. On the mesothorax is, on each side, a great dorsal group of about 16 hairs, of which 5 or 6 are of the largest size; this group is continued by 4 or 5 hairs down the posterior margin of segment; then there is a group of 4 hairs about spiracular level, and a marginal set of 8 or 9, followed by the lower set of small hairs; no lenticles are clearly observed on this segment, but there is probably a mediodorsal one obscured by some of the hairs. The metathorax is very similar to the mesothorax as regards hairs, but has numerous lenticles—two dorsal, close to middle line, one rather in front of the other, one (on each side) below ii, and a second one on one side, and, on the other side, a lower one about spiracular level. On the 1st abdominal segment the dorsal group of hairs numbers about 12 on each side, of which 3 are large enough to be i or ii; 7 or 8 between this and spiracle; 8 or 9 marginal, of which one or two are about as long as i and ii, and the lower set of short hairs; the lenticles are—one mediodorsal (in middle line), one in front of, but lower than, ii, one above and one behind spiracle, and one between marginal and lower group. The 2nd and 3rd abdominals are much the same. On the 4th abdominal are two mediodorsal lenticles, none above spiracle, and one behind it only on one side; the inframarginal one as in anterior segments. The 5th abdominal has one mediodorsal lenticle, no supraspiracular, and one behind only one spiracle, but the opposite one to that possessing it on the 4th. The 6th, like the 5th, except that, of the dorsal group of hairs, the 2 posterior ones are very large and long. (On the 4th and 5th one dorsal hair was long.) All these long ones about 0·5mm., the mass of hairs about 0·2mm., but with all sizes, from 0·4mm. to 0·1mm., or even shorter. On the 7th abdominal segment are two mediodorsal lenticles, and two long hairs on each side, placed trapezoidally, but much too near spiracles (which certainly are more dorsal here, and more so on 8th, as in Lycænids as a rule) to be i and ii; below these, and behind spiracle, are two lenticles. Two very long hairs in marginal set. The 8th abdominal has only three or four short dorsal hairs, and four mediodorsal lenticles; the 9th has five or six short dorsal hairs, a lenticle below these. There are two very long marginal hairs, probably belonging one each to the 8th and 9th abdominals, with others nearly as long, and as many shorter, that belong to the 8th, 9th, and 10th abdominal segments, which may be distinguished dorsally, but not along the margin. The skin-surface is beautifully tessellated in minute hexagons. Each pad of prolegs carries five or six hooks of slightly varied length, but not distinctly in a longer and shorter series. The bases of the hairs spread out basally, and are divided into five or six rounded lobes, giving them a very petaloid (and flower-like) character. The hairs are all dark and finely spiculated. It is to be noticed that some lenticles are mediodorsal (azygos), and that they already are markedly inclined to differ on the two sides, apparently, from a certain theoretical number; some are wanting, and not symmetrically, a beginning of their very irregular distribution in the older larvæ. *Third instar* (*anteà*, p. 163, line 2): Head black, 1mm. across. The prothoracic plate a broad transverse oval, about 0·6mm. across, with a central forward tongue acutely pointed, and a broad, square, posterior wing, divided into two by a suture-like mark, that does not proceed forward into the central portion, with three hairs on each side, and three or four lenticles not quite symmetrically placed; the rest of the segment carries many hairs of the same pattern as elsewhere, 0·1mm. to 0·3mm. long, spiculated, and with petaloid bases—a sparser group round the end of the plate, a large group along the front, another in front of the spiracle, and another towards leg, not well separated from each other, except that the intervals have rather shorter and sparser hairs; there are a few scattered lenticles; the spiracle large, somewhat raised: the skin-surface in fine tessellated network. The mesothorax is much the same but without the plate, several of the dorsal hairs are 0·4mm. long. The metathorax and 1st abdominal are narrow segments, and none of the following, though wide, are quite as wide as the first two (pro- and mesothorax). These two segments, and the 2nd abdominal, are notable as having on each side one dorsal hair about 0·5mm. long; on the 2nd abdominal is a second moderate hair, but on the metathorax and 1st abdominal the next longest are about half the length, and grouped more densely round the long ones; otherwise the hairs are equally distributed, about 85 on either side, above spiracular level; there are also four or five long hairs in the lateral flange region, the longest nearly 0·6mm., ranging down to hairs of about 0·15mm; there are lenticles, three or four dorsally, six or seven about the spiracles. The 3rd, 4th, 5th, and 6th abdominal segments are much the same, all have a second dorsal hair, nearly, or quite, 0·4mm. long. The 7th abdominal is a somewhat reduced segment, with dorsal long hair, as in the preceding, but with numerous dorsal lenticles, and a central transverse patch, without hairs or lenticles, which is either an actual or obsolete gland. On the 8th abdominal segment the large spiracles are high, and diminish the dorsal area, which does not appear to possess any, or only one, very long hair; behind the spiracle is a base point, with the skin tessellæ radiating from it, again an actual or vestigial gland. The hairs are longer on the terminal segments, a dorsal hair on the 7th abdominal being about 0·8mm., and some of these on marginal flange of 8th, 9th, and 10th abdominals being about 1·0mm. long. Each pad of prolegs and claspers has from eleven to fourteen hooks, all in a row, but alternately longer and shorter. The whole dorsal skin surface has the tesselated pattern, but ventrally, especially in the incisions, it passes into an arrangement of spiculæ (Chapman).

Ovum (*anteà*, p. 154).—This egg is very flattened, and at first glance, to the naked eye, might easily pass for one of the Coccid scales, of which several species occur at precisely the position it occupies, *viz.*, amongst the wrinkles near a bud, where a leaf has fallen off a small twig. Under a hand lens, on top view, it looks very like a mince-pie baked in a saucer with the margin crinkled; seen sideways, it suggests an acorn, but one more flattened down than the flattest I have seen. It is just, or barely, 1mm. across, with a dark domed centre and a pale flat, or even raised, margin of about 0·08mm. wide. On a lateral view, it is 0·35mm. high (little more than one-third of the width). It is cup-shaped up to a height of 0·2mm.; at this height the pale margin goes right across, but there rises up from within the cup the dark dome, which is 0·65mm. wide, when it first shows above the margin, rises to 0·15mm. above it, and shows a rather flattened top for about 0·35mm. across the centre. The pale tufted base looks very like a flat acorn-cup, the dark interior like the acorn projecting above it. The sculpturing is somewhat difficult to describe; it consists of the added surface material as in (all ?) other Ruralid eggs. This is very trifling over the summit where the egg itself may be said to be visible, but is abundant as a zone of white columnar material round the margin of the egg. The egg, which appears to be about 1mm. across, is probably only about 0·8mm., if this addition could be removed. On removing the egg, and turning it over, the underside is found to be covered with a network, the walls of which are very narrow, but comparatively high, making the cell rather deep. The cells are about 0·04mm. in diameter. In the centre they are very regular hexagons, so that, with the high white walls of the cells, it looks like a piece of newly-made honeycomb. Towards the margin the cells are of less regular form (to accommodate the curvature), and get deeper and deeper till they form part of the deep marginal layer. This layer is about 0·08mm. thick, the half of this nearest the eggshell is apparently a hexagonal (approximately) structure, just like that over the base. The upper, or outer portion, consists of thick columns of white material, wider at their apices, and about as thick as the spaces they leave between them, and arising from the angular points of intersection of the honeycomb network. This structure ceases very suddenly, and, at a definite line, changes to the structure covering the top of the egg. This is, though so different, essentially the same as the rest of the coating. It is a network of very fine, hardly visible, lines, the cells are again about 0·04mm. in diameter, but are quadrangular, nearly square, where, half-way up, they are best developed and seen, the bounding lines being lines crossing each other and winding spirally out from the centre (engine-turning). At each angle of the crossing of the lines rises a slender hair-like spine, about 0·04mm. long, and apparently faintly knobbed. These fail in the centre, where, in the middle of the rather flat top, is a depression about 0·09mm. in diameter. On putting an egg in water on a slide, and viewing it by transmitted light, the central solid egg is seen very dark and contrasting with the light coming through the marginal coating (containing air). Refraction makes measurement untrustworthy, but the actual diameter of the real egg (as apart from coating) seems even smaller than stated above, about 0·73mm. or 0·75mm. In the dark part of the egg is seen a transparent slip, which is easily seen to be a vacancy, extending along one margin of the contained larva, due to its curled-up position; and across this two or three larval (dorsal ?) hairs lie at an acute angle. If any doubt existed about this it is removed by warming the egg by breathing on it, when the larva makes several obvious movements. [To make assurance doubly sure an egg is opened and the larva extracted.] It is possibly in connection with the mature embryo being inside that the upper dark central portion of the egg presents a different tint on the upper flat portion, instead of the dark chocolate tint of the circumferential portion; this has a slaty-grey tone, suggesting, as may be the case, that a layer of air here intervened between the eggshell and the larva, the extracted larva being of a deep, almost black, brown, and the eggshell colourless when the larva is removed. The uppersurface of the egg then presents four zones of different colours and different slopes. Centrally, the micropylar circle, 0·09mm. in diameter, hollow. The leaden zone, about 0·4mm. in diameter, nearly flat, but curving into the chocolate side slopes, 0·78mm. in diameter, and the frill of white spines or tufts, about 0·08mm. across, this is really white, but sufficient, if the dark colour of the larva (or background, back or other ?) is refracted through it, to give it a yellowish tinge. The micropylar area magnified shows an area of 0·15mm. in diameter, in which the reticulations of the eggshell proper are visible; outside this, whether they exist or not cannot be seen, owing to the additional surface coat. Centrally is a rosette of five cells meeting at a central point, each 0·03mm. in length, surrounded by others of about the same size, but not being drawn out to a point are variously polygonal, and about 0·025mm. in diameter, one or two look as if trying to press in to form members of the central rosette. They are visible, two or almost three deep, outwards from the five central cells (Chapman, March 26th, 1907).

Silk-spinning of larva in preparation for pupation (*anteà*, p. 169).—Vers la fin de Juin, 1730, plusieurs de ces chenilles s'attacherent chez moi, soit contre des feuilles, soit contre les parois des bouteilles où je les avois renfermées, avec le lien de fils de soye que j'avois tant envie de leur voir travailler, et ce fut devant moi que plusieurs s'attacherent. Pour entendre comment elles en viennent à bout, on se rappellera que les chenilles peuvent allonger et raccourcir leur corps, qu'elles peuvent gonfler certaines parties aux dépens des autres, c'est de là que dépend toute la mécanique que nous avons à faire entendre ; elle n'offre rien que de simple, lorsqu'on voit l'insecte dans le travail, mais nous craignons que nôtre explication ne la fasse parôitre plus composée et plus embarrassée qu'elle ne l'est. Supposons qu'une de nos chenilles a déja fait une partie de son lien, qu'il ne s'agit que d'ajoûter des fils à ceux qui embrassent déja son dos, et qui y sont si près les uns des autres qu'ils se touchent. Pour y en ajoûter un nouveau, elle raccourcit la partie de son corps, qui est depuis la tête jusqu'au lien commencé (pl. xxviii., fig. 5) ; mais elle la raccourcit plus d'un côté que de l'autre ; que ce soit en *l* qu'elle veuille coller le bout du nouveau fil, c'est du côté d'*l* qu'elle raccourcit le plus son corps ; elle l'incline vers ce côté, jusqu'à ce qu'elle ait porté la filiere, qui est au-dessous de sa bouche, sur l'endroit où sont attachez les bouts des autres fils. La filiere, l'ouverture par où le fil sort, colle le bout d'un fil sur l'endroit sur lequel elle s'applique. Voilà le commencement de l'operation ; pour la continuer, la chenille retire sa tête, elle la ramene insensiblement à être sur une même ligne droite avec le reste du corps. Si on l'observe avec une loupe pendant qu'elle est en route, on découvre un fil délié, qui devient de plus long en plus long, à mesure que la tête de l'insecte s'éloigne de l'endroit où son bout a été collé ; de nouvelle liqueur est tirée continuellement hors de la filiere, par la partie du fil déja formée ; elle en sort, elle se desseche à mesure, et devient en état de tirer d'autre liqueur. Ceci est commun à la formation de tous les fils ; ce qui est de particulier à ceux-ci, c'est que leur usage demande qu'ils ayent une longueur déterminée ; s'ils étoient longs jusqu'à un certain point, ils seroient un lien trop lâche qui soûtiendroit mal le corps de la chenille, et aussi mal ensuite celui de la crisalide ; il y seroit flottant. Lors donc que la chenille éloigne sa tête de l'origine du lien, elle tient la partie anterieure de son corps raccourcie ; si elle l'allongeoit autant qu'elle la peut allonger, le fil deviendroit la corde d'un arc plus considerable. La partie anterieure est donc toûjours raccourcie, et même se raccourcit de plus en plus, à mesure que la tête est plus proche du milieu de sa route, l'arc qu'elle décrit en devient plus petit. Quand elle y est arrivée, c'est vers l'autre bout du lien qu'elle s'incline, et cela de plus en plus, jusqu'à ce qu'ayant posé la filiere en *b* (fig. 5), où les bouts des fils sont attachés, elle y colle le dernier bout du fil qu'elle a fini, qui est en même temps le bout du nouveau fil qu'elle va commencer. Un fil doublé plusieurs fois, et qui a été attaché chaque fois qu'il a esté doublé, est ce que nous avons appellé jusqu'ici differents fils, parce qu'il est plus commode de considerer ses differentes portions, comme des fils differents. Ce que la manœuvre de la chenille a ici de plus délicat, semble être de conduire ce fil en place, de la faire passer sur son dos jusqu'où il doit aller. Pour y réussir elle prend ses mesures avant qu'il soit filé en entier à beaucoup près, et lors même que la moitié de la longueur est à peine filée, it sort d'au-dessous de sa tête, là est l'ouverture de la filiere. Lorsque la tête est proche du milieu de sa route, la chenille l'incline en enbas, et la courbe de façon qu'elle la fait passer sous ce fil ; desorte que le nouveau fil que se devide va toûjours se trouver sur le bout écailleux de la tête. Pour nous faire une image de sa route, prenons un peloton de fil entre le pouce et le doigt index, et que l'index soit en dessus ; qu'un bout du fil du peloton ait été devidé et attaché fixement quelque part, mais que le fil, qui du point fixe vient se rendre au peloton, passe sur l'ongle de l'index ; si on devide de nouveau fil en tenant toûjours tendu celui que est devidé, ou, ce que revient au même, en éloignant le peloton du point fixe ; celui qui se devidera de nouveau viendra successivement se rendre sur l'ongle de l'index. La filiere de la chenille est ici le peloton du fil qui se devide et qui se recourbe pour monter sur la partie superieure de la pointe de la tête, pour s'y appliquer et glisser dessus, comme le fil du peloton monte et glisse sur l'ongle. Ce fil ne doit pas rester là, mais le voilà à portée d'être poussé plus loin ; la chenille n'y songe pourtant que lorsqu'il est entierement fini, que lorsqu'il est attaché par les deux bouts. Pendant qu'elle retourne par su route precedente pour former un second fil, elle se donne les mouvemens propres à faire passer le premier jusqu'au lien commencé ; ils se réduisent tous à faire glisser le fil sur un plan incliné. Elle éleve d'abord le bout de sa tête, et comprime l' anneau qui la suit ; voilà donc une pente le long de laquelle le fil peut descendre sur le premier anneau. La tête s'abbaisse ensuite un peu, elle se releve ensuite, elle se meut un peu à droite, et après un peu à gauche. Toutes ces agitations tendent à déterminer le fil à glisser ; aussi glisse-t-il, il arrive sur le premier anneau, et jusques vers le milieu du premier anneau. Y est-il arrivé, c'est cet anneau que la chenille éleve, et qu'elle gonfle en même temps, pendant qu'elle abbaisse et applatit l'anneau qui le suit. Des mouvemens pareils à ceux que nous venons de décrire forcent ce fil à couler sur le second anneau. Ainsi d'anneau en anneau il est conduit à la place pour laquelle il est destiné; il est conduit à s'appliquer contre les autres. Le vrai est que pour l'y faire arriver, il faut que l'insecte se donne bien des contorsions ; malgré la flexibilité de son corps, il est étonnant qu'il puisse pousser le fil si loin, il est prodigieusement fin, à peine les yeux seuls le peuvent-ils appercevoir. Nous avons dit ci-dessus que le corps de la chenille est tout herissé de poils roides, ils sont courts à la verité, mais ils sont cependant des colomnes d'une hauteur prodigieuse par rapport à un fil si fin, c'est sur une forest de pareilles colomnes qu'il faut qu'il passe, sans rester accroché et sans se casser. J'ignore le nombre des fils dont chaque lien est composé, mais je lui en crois plus de cinquante ou soixante ; malgré les difficultes qu'il y a à les conduire en place, tout l'ouvrage est pourtant fini en moins d'une heure. L'insecte alors reste tranquille, il ne se donne de mouvements que ceux qui lui aident à prendre la forme de crisalide, sous laquelle il paroît ordinairement au bout de vingt-quatre heures (pl. xxviii., figs. c-d). La crisalide est soûtenuë par le même lien qui la soûtenoit lorsqu'elle étoit sous l' enveloppe de chenille (Réaumur, *Mémoires pour servir à l' Histoire des Insectes*, i., pp. 450-454).

Genus: Strymon, Hübner.

Synonymy.—Genus: **Strymon**, Hb., "Verz.," p. 74 (1816-8); Stphs., "Ill. Brit. Ent.," iv., app. p. 404 (1835); "List Brit. Lep.," 1st ed., p. 16 (1850); 2nd ed., p. 15 (1856); Kirby, "List Brit. Rhopal.," p. 3 (1858); Butl., "Cat. Diurn. Lep.," i., p. 192 (1869); Tutt, "Ent. Rec.," xviii., p. 131 (1906). **[Papilio-] Plebeius**, Linné, "Sys. Nat.," xth ed., p. 482 (1758). **Papilio**, Linné, "Faun. Suec.," 2nd ed., p. 283 (1761); Scop., "Ent. Carn.," p. 175, *in part* (1763); Hufn., "Berl. Mag.," ii., p. 68 (1766); Fuess., "Verz.," p. 31 (1775); Rott., "Naturf.," vi., p. 6 (1775); Schiff., "Schmett. Wien.," 1st ed., p. 186 (1775); Geoff., "Fourc. Ent. Paris.," p. 243 (1785); Schneid., "Sys. Besch. Ent.," p. 220 (1785); Lang, "Verz.," ii., p. 46 (1789); Bork., "Sys. Besch.," i., p. 135 (1789); "Rhein. Mag.," i., p. 297 (1793); Hb., "Eur., Schmett.," pl. lxxvi., figs. 386-7 (1799); p. 58 (*circ.* 1805); "Raupen," etc., Pap. II., Gens. A. *e*, figs. 1*a*-*b* (*circ.* 1800); Ill., "Schmett. Wien.," 2nd ed., p. 279 (1801); Latr., "Hist. Nat.," iii., p. 398 (1802); Herbst, "Nat. Syst.," xi., p. 88, pl. 307, figs. 4-5 (1804); Ochs., "Die Schmett.," i., pt. 2, p. 111 (1808); Freyer, "Neu. Beitr.," vi., p. 89, pl. 535, figs. 1-3 (1836). **[Papilio-] Ruralis,** Poda, "Mus. Graec.," p. 76 (1761); de Vill., "Car. Linn. Ent. Fn. Suec.," p. 62 (1789). **[Papilio-Plebeius-] Ruralis,** Linné, "Syst. Nat.," xiith ed., p. 788 (1767); Fab., "Sys. Ent.," p. 521 (1775); Esp., "Schmett. Eur.," p. 353 (1779), pl. xxxix. (supp. xv.), fig. 1*a* (1777); Goeze, "Ent. Beit.," p. 7 (1780); Bergs., "Nomen.," p. 57, pl. xxxvi., figs. 5-9 (1780); Fab., "Spec. Ins.," pt. 2, p. 118 (1781); "Mant. Ins.," p. 68 (1787); Brahm, "Ins. Kal.," p. 234 (1791); Schwarz, "Raup.-Kal.," p. 177 (1791); Haw., "Lep. Brit.," p. 38 (1803). **[Plebeius-] Ruralis,** Esp., "Schmett. Eur.," p. 259, pl. xix., fig. 3 *cum* larv. et pup. (1777). **[Hesperia-] Ruralis,** Fab., "Ent. Sys." iii., pt. i., p. 277 (1793). **Cupido,** Schrk., "Faun. Boica," pt. 2, p. 219 (1801); [Latr., "Hist. Nat.," iii., p. 398 (1802)]. **Polyommatus,** Latr., "Hist. Nat. Crust. et Ins.," xiv., p. 117 (1805); "Enc. Méth.," ix., p. 647 (1819); Godt., "Hist. Nat.," i., p. 184, pl. ix., fig. 2 (1821); Bdv., "Eur. Lep. Cat.," p. 10 (1829); Dup., "Cat. Meth.," p. 29 (1845). **Thecla,** Leach, "Edinb. Encycl.," ix., pt. 1, p. 129 (1815); Oken, "Lehrb.," etc., ii., p. 722 (1815); Sam., "Ent. Comp.," p. 241 (1819); Curt., "Brit. Ent.," v., fo. and pl. 264 (1829); Wood, "Ind. Ent.," p. 7, pl. ii., 51*a*; pl. iii., fig. 10 (1839); Bdv., "Gen. et Ind. Meth.," i., p. 8 (1840); Humph. and Westd., "Brit. Butts.," i., p. 87 (1841); H.-Sch., "Sys. Bearb.," i., p. 136 (1843); Westd. and Hewits., "Diurn. Lep.," ii., p. 487 (1852); Led., "Verh. zool.-bot. Gesell.," p. 19 (1852); Wallgrn., "Skand. Dagfalter," i., p. 188 (1853); Sta., "Man.," i., p. 52 (1857); Speyer, "Geog. Verb. Schmett.," i., p. 262 (1858); Hein., "Schmett. Deutsch.," p. 93 (1859); Dbldy., "Syn. List," 2nd ed., p. 2 (1859); Curtis, "Gen. Brit. Lep.," pl. iii., fig. 11 (1858); Staud., "Cat.," 1st ed., p. 3 (1861); Kirby, "Eur. Butts.," i., p. 86 (1862); Snell., "De Vlind.," p. 66 (1867); Nolck., "Lep. Fn. Estl.," ii., p. 51 (1868); Newm., "Brit. Butts.," p. 110 (1869); Kirby, "Syn. Cat.," i., p. 397 (1871); Staud., "Cat.," 2nd ed., p. 7 (1871); Curò, "Bull. Soc. Ent. Ital.," vi., p. 107 (1874); Kirby, "Eur. Butts.," i., p. 59, pl. xv., fig. 3 (1879); Frey, "Lep. Schw.," i., p. 10 (1880); Lang, "Butts. Eur.," p. 80, pl. xviii., fig. 1 (1884); Buckl., "Larvæ," etc., pl. xii., fig. 5 (1885); Kane, "Eur. Butts.," p. 23, pl. ii., fig. 7 (1885); Auriv., "Nord. Fjär.," i., p. 8, pl. vii., fig. 4 (1888-91); Barr., "Lep. Brit. Isles," i., p. 48, pl. viii., figs. 2-2*b* (1893); Leech, "Butts. China," ii., p. 361 (1894); Rühl, "Pal. Gross-Schmett.," p. 183 (1895); Meyr., "Handbook," etc., p. 543 (1895); Tutt, "Brit. Butts.," p. 208, pl. i., figs. 13-14 (1896); Kirby, "Handbook," p. 53, pl. xli., figs. 1-2 (1896); Tutt, "Ent. Rec.," ix., pp. 73-76 (1897); Reuter, "Ent. Rec.," x., p. 97 (1898); Staud., "Cat.," 3rd ed., p. 69 (1901); Lamb., "Pap. Belg.," p. 192 (1902); Wheeler, "Butts. Switz.," p. 50 (1903); South, "Butts. Brit. Isles," p. 143, pl. xciv., figs. 4-7 (1906). **[Zephyrus-] Aurotis,** Dalm., "Sv. Vet. Acad. Handl.," i., p. 91 (1816). **Lycaena,** Ochs., "Die Schmett.," iv., p. 28 (1816); Evers., "Faun. Volg.-Ural.," p. 67 (1844). **[Thecla-] Strymon,** Dale, "Hist. Brit. Butts.," p. 41 (1890).

The heterotypical genus *Strymon*, of Hübner, was first created (*Verz.*, p. 74) for rather more than the whole Strymonid group. He diagnosed the coitus as—

> The wings brown; beneath, at least, the hindwings spotted with rust-colour, and marked with interrupted white lines—*Strymon mopsus*, Hübn., *Zutr.*, 135, 136. *S. pruni*, Linn., *Syst. Pap.*, 22; Hübn., *Pap.*, 386, 387. *S. betulae*, Linn., *Syst. Pap.*, 220; Hb., *Pap.*, 383-4. *S. w-album*, Knoch, *Beytr.*, ii., *Pap.* no. 1; Hb., *Pap.*, 380-1. *S. esculi*, Hb., *Pap.*, 559-560, 690-1. *S. ilicis*, Esp., *Pap.*, 39, 1*b*; Hb., *Pap.*, 378-9. *S. acaciae*, Fab., *Mant. Pap.*, 655; Hb., *Pap.*, 743-6. *S. melinus*, Hb., *Zütr.*, 121-2. *S. lynceus*, Fab., *Ent. Hesp.*, 73; Hb., *Pap.*, 692-3. *S. spini*, Schiff., *Verz.*, Pap. O, 5; Hb., *Pap.*, 376-7. *S. beon*, Cram., 319 B, C (Hb., *Rust. Arm. Poeas.*). *S. pan*, Drur., ii., 23, 4 (*pann*, Fab., *Ent. Hesp.*, 67). *S. mars*, Fab., *Spec. Pap.*, 501 (*acis*. Cram., 175, C, D).

It will be seen that this group is hopelessly heterotypical, and a restriction was first made, in 1835, by Stephens (*Illus. Brit. Ent. Haust.*, iv., app. p. 404), when he placed in *Strymon* the British species—*pruni*, *betulae*, *w-album*, and *? spini*. In 1850 (*List*, pp. 16-17), he eliminated *spini*, by that time known not to be a British species, and, in 1856, retained

(*List*, 2nd ed., p. 15) the same three species—*betulae*, *pruni*, and *w-album*. In 1858, Kirby used *Strymon* for *pruni*, *w-album*, ? *spini*, ? *ilicis*, in his little *List of the Brit. Rhopalocera*, p. 3, whilst, in 1869, Butler, *Cat. Diurn. Lep.*, i., p. 192, used *Strymon* for *ixion*, Fab., *mars*, Fab., *titus*, Fab. (=*mopsus*, Hb.), *anacreon*, Fab., *spini*, Den., *ilicis*, Fab., *pruni*, Linn., and *w-album*, Fab., thus overlooking Stephens' restriction. In 1872, Scudder fixed (*Syst. Rev.*, p. 32) *titus*, Fab. (=*mopsus*, Hb.), as the type, his action being evidently *ultra vires*, in face of the previous usage of the name for groups, from which *titus*, Fab., had been omitted. In 1906, we fixed (*Ent. Rec.*, xviii., p. 131) *pruni* as the type.

The *pruni* group, therefore, forms the typical genus of the tribe *Strymonidi*, and it is to this, as we have shown, the name *Strymon* properly belongs (see also preceding volume, p. 314). Like the allied genera, *Edwardsia* (type *w-album*), *Felderia* (type *eximia*), this genus has the characteristic ♂ androconial cell towards the apex of the discal cell of the forewings; it has, however, only one caudal appendage to the hindwing, the upper one, very abbreviated in *Edwardsia*, being in *Strymon* practically absent. The species in this genus are easily recognised by the characteristic markings of the underside, the orange submarginal band being continued on all the wings, and markedly spotted on its inner margin in the interneural spaces. This spotting suggests an alliance with the remarkable genera *Fixsenia* (type *herzi*) and *Leechia* (type *thalia*), which, superficially approximating to *Bakeria* (type *ledereri*) in the definitely spotted underside of the wings, have the androconial brand characteristic of our first section of the Strymonids present, whilst the latter has it absent, this marked point of difference leading up to suggest the two species as possible bases for our sections A and B respectively (*anteà*, p. 142).

We are indebted to Bethune-Baker for the following diagnosis of our genus *Strymon* (based on *pruni* as the type):

Face broad, hairy, with a fringe of long hairs on each side; vertex hairy, with long curved hairs extending between the antennæ, which are fixed on the extreme edge of the vertex, as far apart as possible, the antenna terminating in a short club. Eyes hairy, not large. Palpi porrect, of moderate length; end segment longish, scaled; 2nd segment fringed below with long hairs. Legs stout, rather short, scaled throughout, with hairy femora. Forelegs with tarsi of male not aborted into a single hook, but fairly developed, though not perfect. Wings fairly broad. Primaries with costa slightly arched, depressed slightly at apex, termen slightly arched below the apex, then nearly straight. Secondaries with costa slightly truncate above apex, termen scalloped between the nervures, increasing in depth to vein 2, which is lengthened, forming a short, stout, curved tail. Neuration: Primaries, vein 2 at a third from the lower angle, 3 from just in front of the lower angle, 1 and 4 from the lower angle, 5 from above the middle of the discocellulars, 6 from the upper angle, 7 from near to 10, slightly depressed at the base, caused probably by the patch of androconia, 8 and 9 absent, 10 from a fifth before the upper angle, 11 from just beyond the centre of the cell; the bases of veins 6, 7, and 10 have a patch of androconia, producing the appearance of a small, oval, bare spot at the upper angle of the cell; cell broad, nearly half the length of the wing, and highly arched on its upper margin. Secondaries with vein 2 from a third in front of the lower angle, 3 and 4 from the angle, 5 from about the middle of the discocellulars, 7 from a third in front of the upper angle, well arched upwards, 8 highly arched upwards from close to the base; cell broad, half as long as the wing. The cells and base of both wings are covered with fine superimposed hairs, and the scaling beneath is different from that which obtains in the other species of black hairstreaks.

Our genus *Strymon*, thus limited, is a very natural little group, containing, so far as we at present know, the following species—

PLATE IX.

Photo. A. E. Tonge and H. Main.

STRYMON PRUNI.

The Natural History of British Butterflies, etc., 1907.

PLATE IX.

(To be bound facing Plate IX.)

STRYMON PRUNI.

FIG. 1.—Ovum ×10.
FIG. 2.—Larva fullfed on foodplant ×1.
FIG. 3.—Larva spun up for pupation (dorsal view) ×2.
FIG. 4.— „ „ „ „ „ (lateral view) ×2.
FIG. 5.—Pupa shortly after shedding larval skin ×1.
FIG. 6.—Pupa mature ×1.
FIG. 7.—Pupa (dorsal view) ×2.
FIG. 8.—Pupa (ventral view) ×2.
FIGS. 9-10.—Pupæ (lateral view) ×2.
FIG. 11.—Imago ×1.

(Figs. 1, 3, 4, 7 by A. E. Tonge, all others by H. Main.)

stygianus, Butl., ♀ (=*mera*, Jans., ♂), *rubicundula*, Leech, and *pruni*, Linn. (type). Its proper relationship with some of the species in the allied genus *Felderia*, still remains to be worked out.

The egg of *Strymon pruni* is more characteristically "hairstreak" in its general build and character than is that of the allied *Edwardsia w-album* (compare pl. ii., figs. 3-4). The remarkable development of the prothorax of the larva in width, compared with the long and more slender prothorax of *E. w-album*, is very noticeable, but still more marked is the angulated pupa, in which its spines, etc., resemble rather a Vanessid, than Ruralid, pupa, and in the development of which it differs entirely from the smooth rounded pupa of *E. w-album*. Chapman says: "The pupa of *S. pruni* is also remarkable, among our British "hairstreaks," for its exposed habit. Instead of securing protection by hiding away, it does so by becoming conspicuous, but, in a cryptic fashion, resembling a bird-dropping, or some of the lichens, or perchance some of the collections in old spider-webs, all of which are usually plentiful on old blackthorn bushes. *E. w-album* comes nearest to it, as that species pupates on the twigs or leaves of its foodplant, but under a leaf, in a curled dead leaf, or otherwise hidden. The pupæ of *Ruralis betulae* and *Bithys quercûs* have no cremaster, and the larvæ pupate in or beneath dead leaves and other material on the ground, whilst the larva of *Callophrys rubi* actually goes beneath the earth, if this be at all loose enough to allow it to do so. Consequently all these other species are rounded, and of obscure and tolerably uniform coloration, that of *B. quercûs* having a dead leaf colonr, and that of *C. rubi* a dark earthy one."

It will be observed that *Strymon* is an essentially eastern Palæarctic genus, only one species, *pruni*, Linn., coming into the European area. The remainder are, like the species of *Felderia*, chiefly confined to eastern Asia.

Strymon pruni, Linné.

Synonymy.—Species: **Pruni,** Linn., "Sys. Nat.," xth ed., p. 482 (1758); "Fauna Suec.," 2nd ed., p. 283 (1761); Poda, "Mus. Graec.," p. 76 (1761); Scop., "Ent. Carn.," p. 175, *in part* (1763); Linn., "Sys. Nat.," 12th ed., p. 788 (1767), etc. **Ptorsas** ♀, Hüfn., "Berl. Mag.," ii.. p. 68 (1766) [referred to as **Prorsas,** Ochs., "Die Schmett.," i., pt. 2, p. 111 (1808)]. **Prorsa,** Rott., "Naturf.," vi., p. 6 (1775). [N.B.—All other references mentioned in the generic synonymy (*anteà*, pp. 192-193) are referable to *pruni*.]

Original description.—*Papilio* (*Plebeius*) alis subcaudatis supra fuscis, subtus fascia marginali fulva utrinque nigro-punctata. Roes., *Ins.*, Pap., 2, t. 7; Raj, *Ins.*, 130, n. 9 (?); Pet., *Gaz.*, ii., fig. 10 (?). Habitat in *Pruno domestica*. Descr.—Alæ omnes supra fuscæ; postice caudatæ et ante caudam maculis 2 s. 3, ferrugineis lunatis. Subtus omnes obscure cinereæ, linea transversa. Secundaria intra marginem posticum fascia fulva, utroque margine nigro punctata (Linné, *Syst. Nat.*, 10th ed., p. 482).

Imago.—25mm.-31mm. All the wings brown, rather than blackish-brown, the androconial patch oval and dark grey; an antemarginal series of orange lunules on the hindwings (sometimes also on forewings); the caudal appendage well-developed (no trace of an upper one), turned very obtusely outwards; a tiny blue spot at anal angle. Underside of all wings brown or yellowish-brown, with white transverse line across the forewings, edged internally with darker, and broken up by nervures; a similar one on hindwings curves round to the middle of the inner margin; a faint row of submarginal orange lunules on forewings, each, usually, with a black point edged towards wing-base with white; a continuous well-developed submarginal orange band on hindwings, with a series of seven small black spots internally, the latter edged internally (towards base of wing) with white; an external series of black, filled-in, arches, edged externally with white, runs along the grey-brown marginal wing-border; a blue spot in the second marginal black arch from anal angle; fringes grey.

Sexual dimorphism.—On the whole, the ♀s average larger than the ♂s, and the caudal appendage is rather longer. Superficially, one can generally distinguish the ♀s from the ♂s by the larger quantity of fulvous marking on the margins of the wings, the ♂s rarely having any on the forewings, the ♀s having at least two, often three, blotches on the outer margin; whilst the presence of an oval androconial patch at the apex of the discoidal cell, as in the allied species, characterises the ♂, apart from placing any dependence on the variable element of colour. Pierce writes (*in litt.*): "The ordinary scales of the forewing of the ♂ are generally 3-pointed parallel-sided scales, ·006in. long, ·001in. wide, those of the ♀ are similar, though often 4-pointed, and also rather wider and stumpier, *viz.*, ·005in. long, and ·002in. wide. The androconial scales are rounded at the tip, nearly parallel-sided, but narrowing gently to the stalk, and appear to contain a thick pigment; they are ·004in. long, and ·002in. wide. The underside scales in both sexes are 3- and 4-pointed, with the half-scales, as in the allied species." Aurivillius notes (*Bidrag Sv. Vet.-Akad. Handl.*, v., p. 22): "The ♀ is marked differently from the ♂ by the presence of reddish-yellow spots on the outer edge of the forewings in cells 1-5. On the other hand, the ♂ has a spot, similar to that described in *w-album*, which has the same position, size, and influence upon the course of the 7th nervure, as in the latter species, whilst the androconial scales contained therein are similar to those of *w-album*, except that they are probably somewhat longer and narrower." Rühl notes a sexual difference in the fringes, for he says that those of the forewings of the ♂ are violet-grey, whilst those of the ♀ are somewhat lighter; the fringes of the hindwings of both sexes being grey, shot with black.

Variation.—We have already noted that the ♀s of this species are more marked with fulvous on the upperside of the wings than the ♂s. The latter usually have three fulvous submarginal patches (the 3rd sometimes small) on the hindwings; further patches are occasionally developed up to the costa, whilst, on the forewings, total absence of the fulvous patches is usual, although one, two, three, or even four, may be more or less developed on the forewings, the examples with them well-developed being exceedingly rare in this sex. The ♀s rarely have so little as the normal quantity of the ♂s, *viz.*, three on hind-, and none on the forewings; usually some patches are present on the latter, commencing from the anal angle, and there may be none, one, two, three, four, or five fulvous spots, getting fainter as they reach the costa; whilst, similarly, on the hindwings, there may be three, four, or five patches, getting fainter also as they go up to the costa; these spots also show considerable variation in their width, especially on the forewings, where the best-developed ones form a band of almost uniform, and considerable, width. The form with entirely fuscous forewings, and two or three fulvous patches only on the hindwings, is the Linnean type. The various stages may be grouped as:

(1) Forewings unicolorous, hindwings with two or three fulvous patches = *pruni*, L.
(2) Forewings with two or three fulvous patches, as in the hindwings = ab. *progressa*, n. ab.
(3) Forewings with four or five fulvous patches, as in the hindwings = ab. *excessa*, n. ab.
(4) Forewings with wide fulvous patches, crossing through as a complete band (broken only by nervures); the hindwings with a similar band = ab. *ptorsas*, Hufn.
(5) The wings faintly suffused all over with fulvous, spreading from the usual fulvous patches = ab. *fulvior*, n. ab.

The patches also show considerable difference in depth of colour, some inclining more distinctly to orange, others to yellow = ab. *lutea*. With regard to this spotting there are several notes, *e.g.*, Knatz records one in which the orange lunules, towards the anal angle of the hindwings, are altogether wanting (*Ent. Zeits. Guben*, i., p. 5) = ab. *obsoleta*, n. ab. Wheeler observes (*Butts. of Switz.*, p. 50) that, in Switzerland, the ♂ has generally two or three spots on the upperside of the hindwings, and none on the forewings, the ♀ three to five on the hindwings, and two or three on the forewings. Raynor observes (*in litt.*) that "he has two ♀s (bred from larvæ taken at Monk's Wood, 1901) in which the three orange blotches along the lower half of the outer margin are very strongly developed." Rühl observes (*Pal. Gross-Schmett.*, p. 183) that "the ♂ generally has, on the outer edge of the forewings, between nervures 1-3, a row of two to three very faint rusty-red spots, which sometimes, however, are missing; in the ♀, however, these spots always show as a reddish-yellow marginal border, which is divided into spots by the very pronounced black nervures. The hindwings of the ♂ often show only the outline of an antemarginal stripe, formed of small, rusty-red crescents, which generally extends only from one-half to two-thirds along the outer border, and never reaches the costa; one to three delicate blue dots can be seen in the black margin, near the finely blue-bordered tail; the antemarginal rusty-red band is much larger and more pronounced in the ♀, but it also, in this sex, never extends to the costa." Aigner-Abafi says that, in the Hungarian specimens, the rust-coloured marginal spots usually hardly noticeable in the ♂, are also sometimes quite absent in the ♀. He further notes that the ground colour of the underside of the examples taken in Hungary is often nearly as yellow-brown as is that of *Ruralis betulae*, the red hind-marginal band in most specimens being brightly coloured (*in litt.*). There is also considerable variation in size. Ash observes that some examples that he bred from larvæ in 1901 were exceedingly small, and there is a marked tendency for specimens reared in confinement to be of small size, unless provided with an abundant supply of fresh food. We would call examples less than 25mm. in expanse ab. *minor*, n. ab., and those above 32mm. ab. *major*, n. ab. Keynes observes that the specimens that he captured near Lahr, in June, 1906, were not only larger than English ones, but had a great deal more orange on the forewings. Nolcken states that the examples from the Baltic Provinces are larger than a pair from north France, although, otherwise, they do not vary from them, except that the French ♀ has the ground colour of the underside of a lighter and more vivid browinsh-yellow. Graeser observes (*Berl. Ent. Zeits.*, 1888, p. 72) that the two ♀s which he captured at Pokrofka, in Amurland, have a wing expanse of 26mm. and 28mm. only, and are, therefore, a little less than the average mid-European examples; the fulvous spots on the outer margin of the hindwings are, in both specimens, of a duller tint, and edged less distinctly than ♀s from Thuringia; the spots also do not extend to the inner angle of the forewing. Similarly, the specimens in the British Museum collection, from the Altai, are no larger than ordinary European examples, and are little marked with fulvous, the ♀s, even, having scarcely any on the forewings. On the other hand, there are, in this collection, large specimens, two ♂s and two ♀s, of the *major* form, from Bagovitza, Podolia, the ♂s, however, with little fulvous, and one ♀ also with none on the forewings, the other with more (four fulvous spots). From Sutschan, also, come large, well-developed examples, with three yellowish spots on the hindwings, and three only on the forewings; the tails well-developed; the blue spot fairly large. Fixsen records a ♀ from Corea, and, comparing it with European examples, says (*Rom. Mém.*, i., p. 279) that it has a sharper design, the submarginal row of fulvous spots on the forewings more distinct, and edged internally with white, whilst the series of black spots bounding the broader reddish-brown band of the hindwings is also more strongly marked with white; length of forewing 18mm. Esper figures, somewhat roughly, a specimen of our ab. *excessa*, in his *Eur. Schmett.*, i., pl. xxxix. (supp. xv.), fig. 1*a*, as an ab. of *pruni* (and also under the same name, fig. 1*b*, a quite distinct species, which he later, *op. cit.*, p. 353, named *ilicis*). The fig. 1*a* shows four wide yellow patches on the forewings, and three lunules on the hindwings; on the underside are three yellow patches, with the usual inner black spots, on the forewings, the rest almost normal, except that all white parts are made yellow. He writes (*op. cit.*, p. 353): "*P. pruni*, variet., pl. xxxix., fig. 1*a*.—Underside precisely like that of the type, only the upperside of the forewings has a broad yellow patch, as in the ♀ of *P. betulae*. Very often this consists rather of spots placed near together, which are here broader, and form somewhat of a band. The colour is red- or orange-yellow. They are wanting in the ♂." Leech observes (*Butts. China and Japan*, p. 362) that there was a ♀ from Yesso, in Pryer's collection, which is much suffused with pale fulvous on the upper surface, and is figured in *Rhopalocera Nihonica*. We believe this example is now in the British Museum collection, and if so, one suspects it to be an example of *S. mera*. We have a bleached ♀, the ground colour almost entirely of a pale fawn tint = ab. *pallida*, n. ab. Of the banded ♀ form, there appears to be a description by Hufnagel, dating back to 1766. This reads as follows:

Papilio ptorsas.—Dark brown, with an orange stripe on all four wings, and two points on the hindwings. Underside light olive-brown, with a white transverse stripe and blue spot. Larva pale green, with some white stripes, the head shiny yellow, without spines. Lives singly (or "solitarily") on sloe and plum. Larva in June, imago July, of the "third size," rare (Hufnagel, *Berl. Mag.*, ii., p. 68, 1766).

It was referred to this species by von Rottemburg as *prorsa* (*Naturf.*, vi., p. 6), and by Ochsenheimer (*Die Schmett.*, i., pt. 2, p. 111) as *prorsas*. Gillmer has just recently sent us a description of two ♀s of this form, under the M.S. name of ab. *fulvo-fasciata*, taken at Mecklenburg, July 5th, 1904. His description reads:

> The upperside of the forewings possesses, generally, some orange spots, near the tornus, in typical females; but, in the two above-named specimens, a complete broad orange fascia runs from the dorsum to the cell 7, and gradually extends towards the median and basal areas. Also, in the hindwings, the generally orange marginal spots of typical females, form, in these specimens, a continuous orange marginal fascia, 3mm. broad, which also runs from the tornus nearly to the apex. The ochreous-brown underside is of an exceptionally bright colour, but otherwise quite normal.

In a later note, Gillmer refers one of these specimens to *ptorsas*, the other to *fulvior*. To the British lepidopterist the first look at the underside of this species is interesting, and, if comparison be made with the allied species, so that the origin of the black spotting is thoroughly appreciated, the interest becomes still greater. The underside has a ground colour of a brown tint, but, in some, there is more than a distinct suspicion of yellow therein. The chief characters of the underside of the wings, however, are—(1) The orange fulvous transverse border. (2) The presence of the black spots on either side of the marginal band. The development in excess or the reverse of these two characters give the most marked variational features of the underside. The former, which has in it usually a strong tint of orange, in some specimens, however, distinctly inclines to yellow, and one notes, in the examples in the British Museum collection, the following special characters:

1. Forewings with no trace of orange in marginal border—one ♂.
2. Forewings with ill-defined suffusion of orange on marginal border—two ♂s.
3. Forewings with suffused orange marginal border, and one black spot ringed with white—three ♂s, one ♀.
4. As in 3, but with two, or three, or four black spots ringed with white—many of both sexes.
5. As in 3, but with five black spots ringed with white—three ♂s, three ♀s.

Many of these most highly-developed specimens have the orange-fulvous developed into a complete band. In the hindwings, there is usually a complete row of seven black spots on the inner edge of the orange-fulvous band, varying, however, in size. In one ♂ example (no. 1 above), none of these are present. This specimen is a most obsoletely marked example, devoid of all the usual markings on the underside of the forewings, except the white transverse line, without the inner row of black dots on the hindwings, and with only two of the black marginal dots = ab. *paupera*, n. ab. The number of black marginal lunules varies in different examples from seven to two, those nearest the anal angle being the largest and best developed; the second from the anal angle contains the blue scales. Rühl says that "the brown underside of *pruni* is especially notable because of the black spots edged with 'blue' on the inside, situated on the margin of the yellowish-red outer border, and by the 'bluish-white' stripe (not 'white' as in *ilicis*) which is edged with a very fine black line on the inside, and which extends transversely across all the four wings. The black outer marginal line of the forewings, similar in both sexes; on the hindwings broad, pronounced, and extending from the inner to the costal margin." To us, the line and edging to the spots look almost pure white, not blue. As a rule, the white transverse line does not show any noticeable variation. There is, however, a marvellous underside aberration in the British Museum collection, labelled "Germany—Leech collection," which may be described as:

α. ab. *albofasciata*, n. ab.—The whole area, between the white transverse line of the fore- and hindwings and the white edging to the inner row of black spots, filled in with white scales, forming a broad white transverse band, made up, on the forewings of six, and on the hindwings of eight, large blue-white, almost oblong patches, owing to the brown nervures subdividing what would otherwise be a continuous band on each wing. The specimen is a ♀, and well banded with orange-fulvous on the upperside of all the wings.

One wonders whether this is the same form as that of which, in 1789, Borkhausen noted (*Besch. Eur. Schmett.*, i., p. 136): "There exists an aberration of this species, which, instead of the usual band of white and black dashes, has a blue band running across the four wings; the orange-coloured band on the hindwings being edged with blue on both sides." It may be so, and the white band may have had a blue tinge when freshly-emerged. Only one equally interesting underside aberration appears to have been described or figured. This is Hübner's remarkable figure, which has the underside of the forewings unicolorous brown, without even the usual median white transverse line, but the hindwings with a white band as just described in ab. *albofasciata*. This we would call:

β. ab. *semi-albofasciata*, n. ab. *Pruni* var., Hb., "Beit.," ii., pt. 3, p. 72, pl. iii., fig. T (*circ.* 1790).—*Papilio pruni*, ♂. This butterfly is in the collection of Herr Gerning, of Frankfort-on-the-Main. It is evidently an aberration of *P. pruni*, Linn. It was taken at Frankfort. The ordinary form has repeatedly been figured. The figure which I here give I have made from a drawing by Miss Hochecker; hence its accuracy is not to be doubted (Hübner, *Beit.*, ii., pt. 3, p. 72).

The individual is certainly *pruni*, although the underside of the forewings are entirely brown and there are no other markings thereon; the bases of the hindwings also are brown; but the space between the median transverse white line and the edging to a continued black line (which replaces the normal row of black spots on the inner margin of the orange band), is filled in with white, so as to form a complete and continuous median white band. Two of the outside black arches contain a blue spot, one on either side of the base of the tail.

γ. ab. *obsoleta*, n. ab.—Underside of wings without any white markings whatever.

In the "Mason collection," sold March 14th, 1905, was a specimen of *S. pruni* without white lines on the underside of the wings (*Ent.*, xxxviii., p. 113).

Teratological examples.—A ♀ emerged, in 1890, without antennæ (see Nussey, *Ent.*, xxiv., p. 80).

Egglaying.—The eggs are laid, generally singly or in twos (not touching, but near together), on the main stems of blackthorn, or at the point of junction between a small twig and the main stem. They are generally laid sparingly along the stem, but, in one instance, I found no fewer than 25 eggs laid along a space measuring $\frac{3}{4}$ in., many of the eggs in this case touching one another; the eggstage lasts over the winter (Raynor). The eggs, according to specimens received, are laid on the small stems, very frequently amongst the irregularities, the rough surface of wrinkles, and dormant buds, where the shoots of the year, or, preferably, the shoots of the previous year, arose. Their colour varies, but often, sometimes perhaps from weathering, agrees very closely with the bark around, and, like those of *Bithys quercûs* and

Edwardsia w-album, they might easily be mistaken for one of the dormant, or half-dormant, buds, common in this situation; there were no specimens on the smooth bark of a twig between the nodes. On the more slender wood of the sloe, they select an older portion of wood than is done by, say, *Bithys quercûs*, which, on the more robust oak-shoots, often places its eggs amongst the buds for the coming spring (Chapman). The egg is laid on the twigs of *Prunus spinosa*, and remains attached thereto all the winter (Newman). In confinement, living ♀ s sleeved on a plum or sloe bush, if the gauze be sprinkled with water, will lay freely (N. C. Rothschild). Lambillion notes that the eggs are laid in July on the twigs of plum and of sloe in Belgium.

Ovum.—The egg is round and flat; 0·75mm. in diameter, 0·36mm. in height. Seen from the side, the ends are rounded, not quite in a semicircle, as the lower margin is less rounded than the top, or perhaps more clearly, taking the top and bottom to be parallel, the bottom is longer (*i.e.*, wider) than the top. The top and bottom are so nearly parallel that, at 0·15mm. from either end, the height is 0·35mm., and it is not ·40mm. at the middle. Seen from above, however, it is observed that the top is by no means flat; the egg rises dome-like to 0·25mm. from the margin, and at once curves down again to a deep central hollow, 0·25mm. across. The egg is interlaced all over by a mesh of raised ribs in triangular patterns (six triangles being often regular enough to form a good hexagon), a little irregular in places, but so that a direct line of ribs can often be traced diagonally from the top to the bottom of the egg. Each triangle is about 0·03mm. along each side, where they are largest round the margin of the egg. They become smaller upwards and towards the centre, and, in the hollow on top, are very small and fine, and hardly discernible centrally, where there appears to be a slight elevation. At each intersection of ribs (or meeting-place of usually six, sometimes fewer, ribs) there rises a short column. These are evanescent in the hollow on top, very short round it, and are only fully developed round the sides, where they are nearly as high as the sides of the triangles are long; their summits expand and are notched into six beads with a central hollow. The less well-developed columns have the summit structure less fully displayed. The real arrangement of the surface would perhaps be more correctly described if we began with these columns each in its place, and then described the connecting ribs as hanging from one to another in catenary curves, and the egg-surface between the ribs as similarly hanging inwards from the ribs. Pictured in this way, the elegance of the whole arrangement may be more fully realised. The materials of the eggshell appear to be bright brown, as is evident when columns or ribs are got as transparent objects in profile, but the interior contents (larva ?) seem of a leaden colour, so that the colour of the egg, as a whole, is somewhat darker and greyer than a nut-brown (Chapman, December 23rd, 1905).

Habits of larva.—Very little is known of the young larva. Of one that hatched out of an egg on March 4th, 1906, Chapman writes—"*March 4th:* Larva hatched on this date, began to eat petals of a plum-flower (*Prunus myrobalus*). *March 5th:* Small larva seems restless and dissatisfied, and will not look at flowers, leaves, or unopened buds of sloe; makes, however, a little frass. *March 6th:* Has eaten a small hole into a slightly expanded bud, and made some "frass." It is a curious lumbering awkward creature with very large prothorax, and meso- and metathorax also large. Hairs long, a double dorsal series (i?) form two long high crests down the back, and the lower series also are in line as flanges or crests when the larva is looked at end on. It is very deep brown; head black. I have not ventured on a more profound examination yet, having only the one example. It leaves the egg by eating an exactly circular hole on top, involving apparently just the whole of the inner smooth flat surface. *March 8th:* Appeared to eat a little yesterday, but to-day looks as if dead, or nearly so. *March 9th:* Is certainly dead; it has all along had a very peculiar outline, owing to the largeness of the thoracic segments, equal to nearly the rest of the larva, and especially the bulk of the prothorax, more expanded even than one would expect were a moult imminent." When the larva is in its last two stadia, its slow gliding motion is very remarkable; the anal prolegs are pushed forward as far as possible, and this forward movement is followed by each pair of prolegs in turn, and then by the true legs, so that a wave seems to run from segment to segment along the body. When not moving, the legs are retracted, and the larva rests almost flat upon the surface of a leaf; when in motion, the anal segment is slightly raised. The movements of the larva give some variation to its tint, for, whilst the larva at rest is very uniformly green, in motion there is a distinctly darker green, mediodorsal, line, traceable from the head to the anus, making the central furrow appear darker than the ground colour; this darkening is, of course, largely due to the food in the alimentary canal. The larvæ can be beaten from blackthorn during the day, being very hard to find by searching at this time, for they appear to hide very successfully, assimilating to the colour of the leaf, whilst they feed and move freely during the night (Tutt). Russell notes (*Ent. Rec.*, viii., p. 104) that, towards the end of May, 1896, he made a long search in the haunts of *S. pruni* for larvæ, but, although he could beat them without difficulty, he only succeeded in finding one by searching, so that he concluded that they must hide very successfully; yet, the one he did take was not at all difficult to see. It was quite fullfed, reclining on the topmost sprig of a blackthorn bush in a curved position, stretched at full length, and not humped—apparently feeding. In confinement, larvæ kept in the dark in small tin boxes, fed freely. Russell believes the larvæ rest quietly by day on the upperside of a leaf, that their colour assimilates well with that of the leaf, and that they move and feed during the night. Raynor notes (*in litt.*): "The larvæ are fullfed about May 20th. They seem chiefly to frequent the taller blackthorns in the denser parts of the wood, and are, therefore, difficult to beat, unless one can bend the upper branches down right over the umbrella. In Monk's Wood, on May 19th, 1904, nearly all the larvæ of *S. pruni* beaten were fullfed, whereas a single larva of *Ruralis betulae* obtained was only just hatched." Dixon insists (*Ent. Rec.*, x., pp. 110-111) that the proper way to obtain the larvæ (and pupæ) of *S. pruni* is by searching, and not by beating. He states that, in 1897, he visited a well-known haunt for this species, where the bushes had been beaten so unmercifully that, not only were the terminal and lateral shoots broken, but the bark, and the stout stems themselves, had been cut off or injured by the strokes, and he very pertinently asks, what must have been the result on any larva or pupa in the line of the stroke, this having been the effect on the wood. He insists that a careful study of the position of rest of the larva, and position selected for pupation, will give any reasonable collector as many larvæ or pupæ as he may require in a normal season. Rothschild says that, at Ashton Wold, the larvæ feed on the higher sloe bushes, and are generally fullfed about the third week of May. The larvæ are best obtained in Whittlebury Forest by beating sloe bushes, but even here it is very local, and never abundant (Foddy). We can find very few actual records of the dates on which larvæ have been taken, but note: Larvæ, June 1st, 1877, in Monk's Wood (A. H. Jones); larvæ, June 5th, 1877, in Monk's Wood; fullfed larvæ, May 3rd, 1893, near Oundle (Bower); larvæ abundant, May 19th, 1897, at Ashton Wold (Sheldon); larvæ, May 23rd, 1897, near Peterborough; pupæ, found May 30th, 1897, near Peterborough (Pearson); larvæ, nearly fullfed, May 15th, 1901, in Monk's Wood (Ash); larvæ, May 20th, 1906, in Monk's Wood (Kaye); larvæ fullfed June, 2nd 1907, at Ashton Wold (Rothschild).

Larva.—*First instar* (newly-hatched): Short, thick, under 2mm. long unless stretched. It has the usual Theclid rows of hairs down the back, *i.e.*, i and ii on each side. The hairs are all finely spiculated, that arising from tubercle i is much the same from the 2nd thoracic to the 8th abdominal segments, rather shorter on first and last of these; it is, at longest, about 0·4mm. long, stands fairly erect, but with a sweeping curve that makes the tip directed somewhat backward; the seta of ii is a little further out, but close to that of i (both being a good space from the corresponding hairs of the opposite side); it is two-thirds the length of i in front, but shorter behind, about half the length of i; it lies more flatly to the larval surface, so that the tip points directly backwards, it is curved similarly to i. The next marked feature is a row of lenticles, a little nearer to i and ii than to the spiracles, they occur on the metathorax and the 1st to 7th abdominal segments. There are, on each segment, a pair at this situation, a large one and a smaller below and behind it; on the metathorax the lower is the larger, but on the 7th abdominal segment both are small, and the lower is lower down, near the spiracle. The spiracles are large and obvious, nearly as large as the lenticles. Below the spiracles (abdominal), is a group of four hairs on each segment; these are probably iv and v, and occupy the flange; there is no iii, unless the lenticles represent it. These four hairs are placed two above at a level, and two below; of these the posterior is the lower. Then there are two small hairs, a little above foot level, on all the thoracic and the first 7 abdominal segments. On the 3rd abdominal are three (probably an aberration), and one only on the 8th and 9th abdominals; each of the 8th and 9th abdominals carries, however, a large lenticle above these and below the four of the marginal group of hairs. The prothorax has a rather large dark plate with two small lenticles on each side, and apparently three hairs; it is diamond-shaped, the outer (long) and front angles being acuminate; the posterior edge full, but rounded; there are three short hairs along the outer portion of its front margin, about 0·12mm. long; and two fine ones in front of the spiracle. On the metathorax there is a hair on each side of the front margin; nearer the middle line than i, behind these, is a little irregularity, as if an obsolete plate; just in front of i and ii is a lenticle; it possibly belongs to the "slope" series of the following segments, but if so it is much out of alignment with them. The meso- and metathorax each have two hairs, apparently ranging with the flange set (of four) of the abdomen. Quite above and in front of these is another pair that can hardly belong to the flange set, and a little way above these is another. The 9th and 10th abdominal segments are quite fused together and have, on either side, seven or eight hairs, apparently of the flange series, but much longer and stronger (about 0·22mm.). There appears to be an anal plate, whose hairs, if any, are not made out, the posterior margin of the anal flap carries a fringe of large, sharp, skin-points. The prolegs (as in other Theclid larvæ) have an anterior and a posterior pad, each with two hooklets and a process between them, capable of being protruded as a transparent extension, widened to the end and terminating in a square extremity. The prothorax seems very large, and, when the "neck" is extended, is nearly a third of the length of the larva. The small setæ in front of, and external to, i, that exist in other Theclid larvæ (as *E. w-album*) are not detected, and seem to be absent. The true legs are black. The head black, polished, and apparently without any hairs, the jaws brown, the other mouthparts white (colourless). The general surface deep purple-brown, pale beneath (Chapman). *First instar* (later): 2mm. long, about 0·45mm. thick. On side view the head is black, about 0·2mm. wide. Prothorax nearly as long as meso- and metathorax together, and these are longer (wider) than any other segments. Colour a deep reddish-brown. The meso- and metathoracic, and the first seven abdominal segments, carry i and ii almost identically; i and ii are close together, but there is a great width dorsally between those of either side; on the mesothorax the two tubercles are a little further from the middle line, and on the 7th abdominal segment i seems to be absent. Neither are discoverable on the prothorax or 8th abdominal segment. Each tubercle has a chitinous, basal, tapered barrel (like a tailor's thimble), i about middle of segment, ii touching i, but separate, and obliquely outwards and backwards from it. These "thimbles" are, in diameter, quite the fourth part of the width of a segment. From i proceeds a thick, white (or colourless), spiculated hair, curved, so that, starting rather forwards, it is soon upright, and, at its tip, points about 30° behind the vertical; they are of equal length (0·3mm.), and (seen from the front) are all in one plane; tubercles ii afford hairs as thick as those on i, similarly colourless and spiculated, rather more than half the length of i; they start at an angle of about 45°, and, being curved, their ends point almost directly backwards; that on the 7th abdominal is rather larger than the others, and, at first view, was taken for i, and not for ii. These hairs, like i, lie in a plane, as seen from the front. Very conspicuous on the sides of the segments are the spiracles, as brilliant white spots; magnified, they are slender black circles, with silvery-white discs; the prothoracic one is rather low. Those on the 7th and 8th abdominals are higher up than the others, the 7th very large, $\frac{3}{2}$ diameter of those in front; the 8th intermediate. As viewed from the side, there is, on the 1st-6th abdominal segments, half-way between i and ii and the spiracles, a pair of black circles (not thimbles) of about the size of i and ii, and similarly placed obliquely. These would appear to be lenticles. They are repeated on the 7th abdominal segment, but are smaller and some distance apart; they are represented on the 3rd thoracic by a very large one, and a very minute one in front and above it. The latter would appear to correspond with a similar minute one on the 1st and 2nd abdominal segments, above and in front of the pair. Below the spiracles (1st-7th abdominals) is a group of four hairs, with "thimble"-bases, the hairs similar to i and ii but much shorter, pointing downwards and backwards. The largest of these is rather behind the spiracle, and as much below it as the lenticles are above; just below this (forming with it an equilateral triangle) are two rather smaller, and a still smaller one is level with it, well to the front. Marginally, on the 3rd, 4th, 5th, and 6th, abdominal segments, are two very small black tubercles with short hairs. The same pair, apparently, at least at the same level, occurs on all the thoracic segments. On the 1st abdominal segment there is only one rather larger hair centrally; on the 2nd abdominal is a large lenticle (this lenticle is wanting on the other side), and a small hair below and behind it; on the 7th abdominal, a lenticle with the hair below and in front, and, on the 8th abdominal, a large lenticle with the two hairs well below it, looking much like, and in a line with, the others. The group of four subspiracular hairs is represented on the 2nd and 3rd thoracic segments, by a pair of rather smaller hairs, nearly level, and above (in line with abdominal spiracle) is a group of three hairs; these correspond in size with the subspiracular ones, the two lower are a trifle smaller. On the 2nd thoracic is a dark transverse shade between i and ii of either side; in front of this, on either side, is a single ("thimble"-based) hair directed forwards, with a lenticle just outside it. The 8th, 9th, and 10th abdominal segments present no sutural lines above; below the 8th spiracle is a group of six hairs, of which the two posterior probably belong to the 9th abdominal segment, leaving four to correspond with the four here placed on the other segments. Dorsally, the 9th abdominal segment has no armature, *i.e.*, between the tubercle on the 8th and the anal plate is a vacant space, without hairs, lenticles, or anything, which seems a very narrow one. Laterally, below the anal plate, are five hairs continuing the subspiracular range. The anal plate has three longitudinal dark lines, but does not appear to carry any hairs, no long ones like the others at any rate. The prothoracic plate is large, diamond-shaped, stretched out to a point at either side. It has about six very small transparent spots on either side, three apparently with hairs. In front of each angle are three hairs in a row, the inner most forward, two similarly *en echelon* in front of spiracle, with the two marginal ones (already referred to) below. The prolegs have large swollen bases (pedicels), with two fine hairs on their outer sides. There are a pair of hooks to the front, and three to the back, of the inner margin, and between them, and more central, an extensile process, with transparent lappet at end; the claspers seem to be identical. The head, thoracic plate, anal plate, tubercular bases, rings of lenticles and spiracles, and the abundant skin-points, are black; the true legs are dark, but not black; what seems to be the darker brown of the dorsum is really the effect of the numerous black skin-points (Chapman). *Final instar* (May 30th, 1896): Colour of a lovely delicate green, with a tinge of yellow in it, especially laterally, the sides ending below in a pale tumid subspiracular ridge. It is well supplied with short brown hairs. The ventral surface is much paler—whitish-green rather than yellowish-green; it is also very glassy, and the skin is more sparingly sprinkled with pale glassy-looking hairs. *Head:* Very small, exceedingly pale whitish-brown, the mouthparts darker brown; the ocelli transparent, placed on two black lunules, one on each cheek, five ocelli being arranged in an arc on the side nearest the mouth, a sixth being separate, and placed by itself on the side of the cheek remote from the mouth. The head is sprinkled with a number of glassy-looking hairs; it is quite retractile within the prothoracic segment, but is extended to some distance beyond the prothorax when the larva is attempting to find a crossing from one leaf to another. *Thorax:* The front edge of the prothorax is also studded with glassy-looking hairs, similar to those on the head, but further back (dorsally) the prothorax is covered with short, black, curved bristles. The segment itself is very extensible, and stretches considerably when the larva is actively moving. The true legs are very pale and glassy, well sprinkled with long glassy hairs, and terminated by a dark brown inflexed hook. The meso- and metathorax are flattened dorsally, although the segmental incisions are very deep, and there is a gradual rise from the head to the 2nd abdominal segment. *Abdomen:* The 2nd to 6th abdominal segments bear a double ridge of raised dorsal serrations, the raised points decreasing in size on the 5th and 6th abdominal segments. These are distinctly separated by the deep segmental incisions, and by the fact that they do not extend so far forward as the first subsegment of each segment. The apices of these raised projections are edged with purplish-red internally, and yellowish externally, and are well-supplied with purplish-red hairs. The spiracles on the 1st to 8th abdominal segments are very minute, scarcely to be detected by the naked eye, but, under a moderate power, each shows as a dull, orange-coloured, cup-shaped hollow, with a brownish rim. Just above the spiracles, a subspiracular line is to be traced, slightly paler than the ground colour. This line, under good magnification, is found to be studded with minute glandular-looking warts, the "lenticles," probably the traces of supraspiracular tubercles, a few similar warts, "lenticles," occupying the position of the prespiracular tubercles, but they are all quite smooth, and bear no hairs, although the skin is plentifully supplied, both laterally and dorsally, with short brown hairs. These are particularly abundant on the hinder abdominal segments, and, on the posterior edge of the anal segment, the black hairs are much longer than elsewhere, and form a dense fringe, which is even visible to the naked eye. The prolegs are retractile, exceedingly pale, and terminated by a broad flange, covered with short, and apparently weak, pale brownish, hooks, while the joints of the prolegs are supplied with long, pale, glassy-looking hairs, like those on the true legs (Tutt). In the last instar the larva has next to no brown left, but has combinations of green, yellow, and pink, varying much in different specimens, that give the larva many most pleasing colour schemes. One handsome specimen noted is green, with yellow dorsal ridges, in which the yellow is hardly seen, owing to the outer margin being white on the 2nd, 3rd, 4th, and partly 5th, abdominal segments, and the inner margin bright rose-pink. The oblique lines in this specimen are less pronounced. The red (or pink) is mediodorsal on the mesothorax, and suffused along the sides and along the tops of the 7th-10th abdominal segments. In others, the whole dorsal area is suffused pink, and some might almost be called red rather than green. The head is pale green, with very black eye-spots and pink labrum. The dorsal ridges are well apart (over 1·0mm.). The slopes rather flat. The prothorax much overhung by mesothorax, which is very prominent in the dorsal ridge lines. The ridges themselves, however, in this and the two following segments (metathorax and 1st abdominal), are flat and rounded, and the outline of the segments, seen laterally, is gently waved. The 2nd, 3rd, 4th, and less so the 5th and 6th, abdominals, on the other hand (seen laterally), stand up as angular humps. The oblique lines are well-developed, they begin with the white line on outer side of the dorsal ridge. The posterior portion, owing to the angular prominences of this ridge, runs downwards and backwards, continues through the oblique line proper of the following segment, and then, passing to the next one, goes on as the second oblique line above the spiracle. The "slope" is hardly cushioned at all, but, in a specimen with some feeding still to do, the lateral flange stands out as a round rib, and the prominences below are marked and rounded. The fine hairs are black; they are very short over the dorsal flange, as elsewhere, those of the lateral flange, and especially those below, are longer and pale. Another example (mounted), examined for structural detail, has: Head pale castaneous, transparent, dark round the five ocelli, that lie in a curve round the larger central one (in pale area); two longish hairs towards front of clypeus and near antennæ, and a good many very small ones, scattered, but obviously symmetrical at fixed positions; otherwise, the head is smooth and polished. The transparent labrum shows, on each side, three curious marks or processes, looking just like the catches to hold a ratchet-wheel, the jaws with four large teeth, two others, small, one at each end, a further small one halfway down posterior margin, and four or five minute ones on a ridge running in from posterior end; no doubt, when correctly viewed, this ridge forms a continuous curved line with the four large teeth. The prothoracic plate is ill-defined, chiefly by a line in front of it without hairs; it is wide across (1mm.), and very narrow (0·2mm.), from back to front; it is of the same tint as the skin generally (extremely pale castaneous in mounted specimen); each side has about seventy hairs and five or six lenticles; the hairs are about 0·1mm. long; the portion of segment in front has several times as many, and longer, hairs, with no distinct demarcation between dorsal, lateral, and marginal. The mesothorax has a (subsegmental?) line marking off, dorsally, a front portion (overhanging prothorax) and a posterior one; the front is rather the wider, and has more, and longer, hairs; the hairs are, perhaps, 200 or 300 on each side; they are dark chitinous on, and above, lateral flange, longer, but colourless, below. On the metathorax and 1st abdominal segment, the hairs are longer, darker, and more numerous on the dorsal flanges, the segments being here wider, and admitting of these being humps; on all these segments, lenticles are numerous, but scattered, and seem very few in comparison with the abundant hairs. On the three following segments the humps are more distinct, with a mediodorsal area free from hairs, but containing six to ten lenticles. This area is in front of the humps and is intersegmental; it is less free from hairs in other specimens, but equally abounds in lenticles and the skin network to some degree radiates on it from a central point. On the 5th abdominal the two humps are not distinguishable, but conjoin in the middle line, but with the full width of two humps. The width diminishes on the following segments until, on the 8th, there is practically only a median hump. On the 5th to 8th abdominal segments, there is a tendency to a transverse (subsegmental) division across dorsum, so that that on the 7th abdominal, that looks very like the trace of the glandular opening, is probably not so; there is no indication of glands on the 8th abdominal. The spiracles are very large, with radiating grating (?) closing them to the centres, the margins have rounded lappets all round reminding one of the petaloid hair-bases, or, perhaps, of the lenticled spiracles in *B. quercûs*; above each is a group of twelve to twenty lenticles, which are continued less plentifully up the whole "slope" to base of dorsal hump. On the hump itself they are wanting, probably completely, as none are detected, and elsewhere they are fairly conspicuous. The prolegs each carry two curves, just joined (the two pads), of hooks, in two sizes alternating, about 16 in the forward sweep, and 24 in the hinder, but varying in different feet. Their bases are clothed with abundant, fine, colourless hairs. The skin-surface has a fine network of colourless, pavement-epithelial pattern. The hair-bases have the usual petaloid arrangement, but are comparatively (with those of *Bithys quercûs*, etc.) narrow and small, and are not so conspicuously floral. The spiracles and lenticles have quite a smooth marginal outline. The hairs are rather short and thick, and the spiculation is so short that, without some magnification and some close observation, they might pass as smooth (Chapman).

Variation of larva.—Russell notes (*Ent. Rec.*, viii., p. 104) that, amongst the larvæ he found in May, 1896, one was younger than any of the others, and was much more deeply tinged and marked with red. As they get nearer to being fullfed, he says, this marking seems to become more of a yellow colour, and then the larvæ are not unlike those of *Callophrys rubi*.

Quiescent stage of larva preceding pupation.—On May 26th, 1896, a larva of *Strymon pruni* had already attached itself to a leaf of blackthorn by a white silken anal pad and slender white girth, that passed round the centre of the metathoracic segment. The head was quite retracted, and the dorsum had assumed an arched appearance, although the venter was closely appressed to the leaf to which it was fastened. The larva, in this position, gradually increases in height and width from the prothoracic to the 3rd abdominal segment, and then narrows again to the anal segment. The 2nd, 3rd, 4th, 5th, and 6th abdominal segments bear a double longitudinal serrated ridge, in the form of a series of raised points on either side of the mediodorsal area, which forms a furrow between the two ridges. This furrow narrows posteriorly, and ends in a point on the anal segment. The absence of the ridge on the thoracic and 1st abdominal segment, makes the dorsum slope rapidly from the 1st abdominal to the head. The colour of the larva at this stage is yellowish-green, the apices of the ridge-points purplish-red, externally edged with yellowish, the central furrow rather darker green than the ground colour. The skin is thickly sprinkled with short black bristles; these are mixed with longer brownish hairs on the thoracic segments, with longer white hairs along the sides, and purplish hairs on the dorsal ridges. The segmental incisions are deeply cut, causing the segmental sections of the ridges to appear to be pointed backwards. *Thorax:* The prothorax is narrow, but protuberant, and covers the retracted

Plate XVI.

(To be bound facing Plate XVI.)

Prolegs of larva of Strymon pruni.

A. Prolegs of 5th abdominal segment. B. Prolegs of 6th abdominal segment. Segment of larva in third instar from right side $\times 60$.

The figure shows well the presence of two separate pads of hooks on each proleg, also the alternating larger and smaller hooks in each pad. The hairs (partly cut off) at top of picture belong to the group representing tubercle vi, the large central patch belongs to vii; there are also hairs on the stem or pedicel of the proleg itself.

B

A

PROLEGS OF LARVA OF STRYMON PRUNI. *Photo. F. N. Clark.*

PROLEGS OF (A) 5TH AND (B) 6TH ABDOMINAL SEGMENTS ×60.

The Natural History of British Butterflies, etc., 1907.

head. It is thickly covered with long pale brown hairs. The prothoracic spiracles are placed low down, one on each side, just in front of the segmental incision that separates the prothorax from the mesothorax. The mesothorax is wider than the prothorax, extends back considerably, and is somewhat protuberant, the two transverse subsegmental divisions apparent on the dorsum, and suggesting the mesothorax of the pupa. The metathorax is wider transversely, but very narrow from front to back. It is round the centre of this segment that the silken girth is placed at this stage, although it slips back to the 1st abdominal when pupation takes place. *Abdomen:* Dorsally, the 1st abdominal segment is narrow from front to back, and without any special armature. (It may be readily distinguished, however, by its conspicuous spiracle.) The 2nd, 3rd, 4th, 5th, and 6th abdominal segments have a raised ridge on each side of the mediodorsal area. These are broken up by the segmental incisions, and, owing to the stretched condition of the larva in this stage, it is seen that the portions of the ridge do not extend to the anterior subsegment of the segments on which they are placed. This suggests, also, that the backward direction which each portion of the ridge takes, has been brought about to make it appear as complete as possible when the larva is crawling, whilst the absence of the ridge on each anterior subsegment gives freedom of movement to the larva. The upper edges of the ridges are of a purplish-red colour, outlined with pale yellowish externally, the purplish portions being well-supplied with purplish-coloured hairs, the yellowish portion with pale hairs. Although the ridges practically end with the 6th abdominal segment, the median furrow is theoretically extended to the anal segment, where the ridge crops up again as a raised, median, purplish-red, dorsal, terminal point. The furrow is but very little darker than the ground colour. The anal segment bears some general resemblance to the prothoracic segment, in its flat, lip-shaped appearance. *Laterally:* The sides of the caterpillar are separated from the venter by a slightly tumid, longitudinal, marginal ridge, well supplied with long whitish hairs, whilst above this, and parallel with it, is a pale, sharply defined, longitudinal, subspiracular line, which extends the whole length of the body. The segmental incisions are well defined and pale, and the points, where the segmental incisions cut the subspiracular lines, are very prominent. The dull orange spiracles are very conspicuous, and placed very high on the sides, about half-way between the lateral (subspiracular) line and the dorsal ridge. The larva changed to a pupa during the night of May 27th (Tutt). On June 1st, 1907, I received three larvæ of *S. pruni*, already fixed for pupation. They are notable for the great increase in height of the larva. One is fixed on the tin, the other two on leaves (of sloe). They measure 11mm. long, 4·7mm. and 4.3mm. wide, and 5·8mm. high, at 3rd abdominal segment. The girth passes over between the thorax and abdomen. Seen laterally the larva has the 3rd, 4th, and 5th abdominal segments forming angular serrations dorsally, the 2nd and 6th very slightly so. From the 6th abdominal segment to the end is nearly a straight line down the dorsum. The four serrations are on a curve. From the 2nd abdominal segment to the mesothorax is a fairly straight line; from front of mesothorax down prothorax is a line 2·3mm. long, about vertical to surface of leaf. The colour is vivid green, with yellow and brown along the dorsal edges, rather bright on the serrations, elsewhere hardly visible; spiracles golden-brown. The greater part of the development of this shortened angular form takes about seven hours, for a larva that completed fixing itself about 10 a.m., June 3rd, 1907, had, at 5 p.m., assumed this form noted as characteristic of the suspended larva (Chapman).

Foodplants.—*Prunus domestica* (Linné), *P. spinosa* (Ochsenheimer), *P. padus* (Peyerimhoff), *Rhamnus frangula* (Stange), *Amygdalus nana* cum flore pleno (Richter), feed well on apricot (Brunn), plum preferred to sloe in Bavaria (Schmid). [Kaltenbach notes (*Insektenfeinde*, p. 156) that Wilde mentions *Rhamnus catharticus* as a foodplant, but Gillmer says this is not so, for Wilde notes only, in his *Besch. d. Pflanz.*, pp. 17-18, that *pruni* lives on *Prunus spinosa* and *P. domestica*. Kaltenbach also notes that Koch says that it lives on "sloe" and "almond." Gillmer points out that what Koch says (*Schmett. Südwestl. Deutschl.*, 1856, p. 34) is, that it lives on "sloe" and "plum."] Sloe, birch (Sand).

[Parasite.—*Perilitus scutellator*, Nees, is noted by Mosley. This is given by Bignell, in *Buckler's Larvae*, etc., i., p. 200, for *Edwardsia w-album*, and is probably an error of copying.]

Puparium.—The fullfed larva spins a white silken pad on a leaf of blackthorn, and to this it attaches its anal claspers; it also spins a slender white girth that passes round the centre of the metathorax. In this position it pupates, the girth at this period slipping back to the 1st abdominal segment. Our note says that, in the specimen observed, the pupa did not get rid of the cast larval skin (Tutt). Russell says (*Ent. Rec.*, viii., p. 104): "The pupæ I found were (except in two instances) attached to the front of a blackthorn leaf, and plainly visible, forming, however, an excellent imitation of a bird's dropping. In the two exceptions mentioned, the pupæ were attached to twigs." Pearson writes (*in litt.*): "The larva itself, in full plumage, is a capital imitation of the sloe leaf on which it feeds, the segments giving the serrations of the leaf; when ready to pupate, however, the larva generally climbs to the upper part of the twig, the young growth of which is purple, and, before pupating, the larva changes from green to a dull purple, which closely matches the leaf; the pupa, however, is usually fixed on the upper surface of a leaf, and, being brown and white, closely resembles a bird's-dropping, for which it might easily be passed over." A favourite place for pupation is on a twig of last year, it may be lower, or again even upon a leaf. Larvæ, pupating in captivity, from specimens received from Mr. Kaye, selected a woody stem of the previous year, sometimes, however, a larva selected a leaf, and, one supposes, would sometimes have chosen a thicker stem had it been available. The slender twig of the previous year has silk spun all round it, for a length of quite the full-grown larva (more than that of the pupa), though its amount varies; it is a little increased where the girth arises some 5·7mm. in front of the anal pad; the girth is single dorsally, but may divide into strands near its origin. It passes a little forwards, usually impresses the wings, making a groove, and crosses between the 1st and 2nd abdominal segments (Chapman). Schmid observes that it is to be noticed that pupation takes place on branches, whilst that of its allies takes place on the ground, under leaves. We suspect this is a very dubious generalisation. Rühl notes that the pupa is suspended perpendicularly from a branch by its cremaster; the pupal stage lasting sixteen days. This also appears to be far too general a statement; one suspects that, in nature, pupation rarely takes place on a branch at all. Lambillion compares the pupa in form and colour with a large fruiting-bud of sloe (prunellier), and says that it is difficult to discover. Borkhausen notes the pupal stage as lasting fourteen days. Paul and Plötz observe that, in Pomerania, the pupal stage lasts twenty days. Dixon fixes (*in litt.*) its pupal period at fifteen days, and says that, on one occasion, he found a pupa, the larva of which had evidently strayed, on whitethorn; all other pupæ found, were on the sunny side of a drive, on blackthorn.

Process of pupation and development of pupal form.—On June 3rd, 1907, at 7.30 p.m., a particular larva was observed laid up for pupation, and presenting all the characters of shortening, thickening, and especially heightening, since June 1st, at 9 p.m. The larva shows slight, white, wrinkles down the incisions of the first three abdominal segments. At 8 p.m.: Wrinkles now show in all the abdominal incisions, and across between the first two pairs of dorsal humps; the pupal metathorax is very distinctly outlined in back part of mesothorax, showing mesothoracic skin has been pushed back so far, but the larval suture between the meso- and metathorax is not obvious, and it may not be quite so far forward; there is yet no slit in skin, and even no drawing of the tracheal threads at the spiracles; this specimen shows, just now very plainly, though in faint tints, two oblique lines on the 3rd to 6th abdominal segments (downwards and backwards), one above spiracle pale, edged below with darker; the other, halfway between this and humps, pale only; the white area of pupal dorsum—prothorax, metathorax, etc.—is clearly outlined through the larval skin as of an opaque white area. 8.30 p.m.: Little change, white wrinkles across dorsa of all abdominal segments. 8.37 p.m.: Skin split down back to end of mesothorax, and tracheæ drawing out. 8.43 p.m.: Skin halfway down back, girth has fallen into place, and the front edge of mesothorax laps over it very markedly. 8.47 p.m.: Moult completed a minute or so ago. The skin is finally pushed off the last segment by quite a different process from that by which the *Papilionidae* get rid of it. They leave the skin adhering by claspers, and pull the tail out of it, afterwards pushing it off. In this case, the skin has no hold by claspers, and is got rid of by the extreme mobility of end segment, retracted and extended, and pushed, first to one side, then to the other, until the skin, which, by the stickiness of its inner surface, retains any folds and wrinkles given it, and so continually contracts and does not expand, is pushed quite off, and the tail is at liberty to seek the anal pad of silk. In this specimen, the dorsal colouring is extremely brilliant, and the dorsum of the 10th abdominal segment seems to be a solid plate, dark, but with a red margin; beneath it, immediately the skin was removed, there appeared, when the segment was raised, a smooth surface, with two raised red processes, exactly like claspers, and probably really them, as regards the part of larval skin from which they come; a few minutes later, this 10th abdominal plate faced backwards, *i.e.*, posteriorly, instead of dorsally, and then this ventral soft green area must have become much contracted. In the earlier stage of the moult, the prothorax had a very marked central notch on its front edge, as occurs in the larva. [This is very marked in the larva of *Somabrachys aegrota*, so like, in many respects, to a Lycænid, that one cannot help speculating as to possible relationship.] 9 p.m.: Colouring as in specimen described *infrà*, but red of humps brighter; already the abdomen is darkening; no black on front of mesothorax. 9.8 p.m.: Waist formed, but mesothorax still rounded; a dark shade in lateral hollow of this segment; other humps and hollows, spiracles, etc., mature. The median, narrow, sutural red line on thorax ending abruptly, and succeeded on abdomen by the two (dorsal ridges) red lines, nearly 1·0mm. apart, is striking. The 2nd abdominal rolled over girth during moult, else the present appearances would compel one to imagine that there was some growth from behind which the girth hindered from passing forward, hence the great rise of the abdominal segments, the rolling over of the front of the 2nd abdominal segment, the comparative meagreness of the 1st abdominal segment and metathorax, and, indeed, of thorax compared with abdomen, is noticeable. 9.40 p.m.: Thorax and wings green; white patches, well marked, but still look as if overlying green; abdomen dark olive; red marks still distinct, white ones obscure; the narrow black mark over lost girth distinct on 2nd abdominal segment; the mesothorax still rounded, as noted at 9.8 p.m. This specimen probably means to have it less pointed than usual. 9.50 p.m.: Abdomen decidedly darker, but still olive; thorax and wings quite green. 10.15 p.m.: Dark areas are now very dark, and, at a casual glance, the pupa appears of mature tint, but really, the dark areas look soft, instead of hard and solid, as in the mature pupa, and have still a decided green underlying them. 10.30 p m.: There is still a greenish tone, especially over thorax. 12.0 p.m.: Looks quite mature (Chapman).

Maturation of pupa.—A pupa of *S. pruni*, that had just completed the actual moult, was observed at 4.30 p.m., on June 3rd, 1907. Immediately after moult, it still has the larval outline and also the larval colouring. It moves the last segment about freely till it has got it well away from the larval skin and pushed this somewhat off. The chief object of the movement seems, however, to be to get the anal extremity well tucked underneath, so that, at the end of ten minutes, the pupa has assumed very much its mature outline, with the central line of the dorsum of the last segments, which at first sloped backwards, now vertical to the surface of attachment; the front of the metathorax already sunk into a waist, and the 1st and 2nd abdominal segments behind it rising precipitately. Until this time the pupa has been making movement at some seconds intervals, of a writhing or twisting nature, such as one often sees done by pupæ, and supposes to assist the change of form by making the fluids circulate freely and find the places where the capacity for extension (into the new form) most easily accommodates it. When first moulted the pupa is bright green, like the larva, with the dorsal flange as in the larva, and humps on the 2nd, 3rd, 4th, 5th, and less on 6th abdominal segments. These humps are very brilliantly coloured, more so than in the larva, a fine rose-red on their inner sides, part of a continuous coloured line, running all the way down the abdomen, dull, pale, and as if buried on the other segments, and on the front half of these, but brilliant on the humps, even one brilliant speck on the hump of the 7th abdominal segment; the outer side of the hump is clear bright (white); this colour is confined to the humps, and is not part of a wider scheme of coloration like the red line. There is also a red line (median suture) on the front half of the mesothorax. Within a minute the white areas of the mature pupa (prothorax, portions of mesothorax, metathorax, and 1st abdominal segment) show a slight opacity, which gradually increases till, at the end of twenty minutes, it is really white, the rest of the pupa being still green; the thorax and appendages pale and bright, but the abdomen already distinctly darkening. The hollow of the slopes are, by this time, mature; they were indicated within five minutes of the moult; the spiracles also are now prominent, and the pupa may be called mature as to form; the mesothoracic dorsal hump is hardly fully formed, but the mesothorax rises from the waist. The raised spiracles are on pale transparent bases, and form white dots along the sides, the spiracular line or slit proper being very white, and, by refraction, making the humps (bases) the same. 5 p.m.: At the end of half-an-hour the abdominal venter, so far as visible, is white, the dorsum darker, but still green, and the colour of dorsal spines only a little less bright than at first. On dorsal view the thorax is still white and pale green, not very different, the abdomen decidedly darker; the broad abdomen and narrow thorax are those of the mature pupa. 5.30 p.m.: White is very white; the thorax still green; the dark of abdomen deep olive, the colouring of humps still distinct. A point that has escaped observation is now noticed, in consequence of two marks, already quite black (nothing else being more than olive); they are on the front margin of the 2nd abdominal segment, each beginning as a fine point opposite the hump and ending at the hollow, half-way to the spiracle, being here nearly half the width of the segment. About the middle of these the girth disappears to the same point on the opposite side, and it is obvious that the front margin of the 2nd abdominal segment has rolled over the 1st abdominal segment far enough to cover it. [Examining a mature pupa that moulted last night, these black marks are quite distinct, the other black areas being polished and shining, this is dull.] The girth disappears in the same way. By looking at the pupa from various angles it appears impossible in any way to see the girth across the pupal dorsum. 6 p.m.: The whole pupa is now mature as to colour, and happens to be a very black one, except just above the spiracles; there is nothing but black over the whole abdominal dorsum, except, of course, the first segment. The most curious part of the pupating process was the mobility of the last segments immediately after the moult; these were, at that time, apparently actively investigating the cast skin, so as to know best how to deal with it (Chapman).

Pupa.—In its dorsal aspect a very excellent imitation of a bird's-dropping. The general colour black, with a whitish patch on each side of the anteriorly protuberant prothorax, another on the lower central area of the swollen mesothorax, and a third, somewhat)—(-shaped, crossing the constricted metathorax transversely, and terminated by the wings. Two other narrow lateral whitish patches run along, one on each side of the abdomen, below the spiracles. These white patches produce a marked effect on the black ground colour, and there can be no doubt that the pattern of coloration is protective. The skin is somewhat wrinkled and thickly covered with short golden bristles, except on the wing-, leg-, antenna-, and maxilla-cases. These are smoother, of a greenish-black hue, and somewhat translucent. *Dorsal view:* The head is placed ventrally; the prothorax rounded, bulging somewhat anteriorly; the mesothorax is large and swollen, the central area bulging and rounded, and not medially ridged. The metathorax is narrow, and, with the 1st abdominal segment, constricted to form a very marked waist. The abdominal segments gradually increase in size from the 1st to 3rd, and then decrease to the anal segment. The 1st abdominal is more constricted than the metathorax, and the girth passes under the incision of this segment with the 2nd abdominal; the 2nd and 3rd abdominal segments, however, bulge out rapidly, whilst the 2nd, 3rd, 4th, 5th, and 6th, abdominal segments bear a double row of dorsal prominences, corresponding with the segmental sections of the dorsal ridges of the larva. Of these, the prominences on the 3rd, 4th, and 5th, abdominals are most conspicuous, those on the 6th the least so. *Lateral view:* The prothoracic spiracle is very inconspicuous, black in colour, and placed in the dark ground colour, which forms the segmental incision between the pro- and mesothorax. The wings are dull blackish-green, somewhat translucent, the outer and inner margins sunk in the abdominal segments, which form raised ridges around the wing-edges. The spiracles on the 1st, 2nd, 3rd, 4th, 5th, 6th, and 7th abdominal segments are small, prominently situated, though not conspicuous, placed high up on the sides of the pupa, upon little elevations, below which is a row of small, sharp, subspiracular points, forming a sort of lateral ridge on either side on the abdominal segments 2-7. Each spiracle has a dead black rim, surrounded by a shiny black cincture. Along the lateral edge of abdominal segments 2-8, small whitish patches form a broken lateral line along the ridge. *Ventral view:* The mouthparts and glazed eye are ventral, greenish-black in tint, the glazed eye edged with shiny black, and extending from the base of the first pair of legs to the antennæ, which edge the prothorax laterally, and are then rapidly brought round into the medioventral line of the body, ending with the apices of the wings on the 5th abdominal segment. About halfway down the wings the antennæ hide the maxillæ, which pass beneath them, and are not seen again. The joints of the two pairs of legs (which lie between the antennæ and the base of the maxillæ), and the segmentation of the antennæ are not very distinctly marked. The colour of the wings ventrally is somewhat lighter, but still greenish-black. The ventral area of the 6th, and following abdominal segments is much restricted, and the skin is folded into deep corrugations. The genital organs, however, are traceable (Tutt, May 29th, 1897). The pupa of *S. pruni* is angular, almost Vanessid in the appearance of its sharp mediodorsal mesothoracic spine, and in the abdominal spines. It is also black and white in a conspicuously contrasted manner, the considerable amount of ochreous-brown, a true ground colour for a Theclid pupa, amongst the black, largely escaping notice. It, nevertheless, largely preserves the Theclid character of a globular abdomen, with a smaller rounded thoracic portion in front. The globular form of the abdomen comes out in the great height of the 2nd, 3rd, and 4th abdominal segments, but is interfered with by the latter segments being produced to a cremastral point (or angle) in a somewhat ordinary pupal fashion, instead of being rounded as in the pupæ of *Callophrys rubi* and *Bithys quercûs*. The ventral line is nearly straight. There is an anal cremastral attachment, and also a girth, which may be all in one strand or of more or less separated threads, crossing over the back between the 1st and 2nd abdominal segments. The girth sometimes impresses a line across the wing. The following are the chief measurements of a pupa under observation :—

From front.		Width.	Height.
1mm.	Incision of prothorax with mesothorax	3mm.	2·4mm.
3mm.	Spine on dorsum of mesothorax	3·7mm.	3·9mm.
4·5mm.	Thoracic-abdominal hollow	3·5mm.	3·3mm.
6mm.	Summit of 3rd abdominal segment	4·8mm.	4·9mm.
7mm.	End of wings	3·4mm.	3·5mm.
10mm.	End of pupa	—	—

The front of the pupa is the line between the head and antennæ below, and the prothorax above; they unite at almost a sharp angle, so that the nearly straight line thence to the thoracic spine ends very close to the surface of attachment. There is a little fulness of the prothorax on each side that might, with a little imagination, be claimed as nose-spines, but that (in the Vanessids) nose-spines belong to the head, not the prothorax. There are several roughnesses in the region of the wing-spines, but nothing quite to be called a spine. There is a dorsal spine on either side of the dorsum of the first six abdominal segments. These are probably at the sites of ii. They are weak on the 1st and 6th, and can hardly be said to exist on the 7th or 8th abdominals, on the 2nd-4th they are as conspicuous as those on the 3rd or 5th of many Vanessids: their summits are, however, rounded. The roughness of surface is maintained by two hollows on each segment, between the spines and the spiracles, the depth of the hollow being apparently increased by the dark coloration. The spiracles are on a short projection. The coloration varies in the amount of black, which is, really, in spots and marblings, overlying the brownish-ochreous ground colour. Some are possibly white and black only (the wings and appendages no doubt paler, as in other specimens). There is a patch of paler colour on abdominal segments 4 and 5, against the hind margin of the wings. The white colour claims the whole prothorax, the posterior slope of the mesothoracic spine, and the whole of the metathorax, except a spot or two, and the wing portion, these two portions together forming a large white saddle. The appearance of roughness is much increased by the mingling of ochreous and black over the whole dorsum. The white portions have, perhaps, a trace of creamy tint, but white is fairly correct. The wings and appendages are of a fairly uniform tint, brown rather than ochreous; they are practically not seen in the ordinary positions of the pupa. The wings are very finely wrinkled (not netted), and show, in the arrangement of the wrinkling, the venation and Poulton's line, the latter some 0·3mm. from the hind margin. The face, which is entirely ventral, has a central raised point on each side, that might very properly be regarded as representing nose-spines. There are also some slight median wrinkles; also a rough point (obsolete hair ?) in the centre of the eye. The labrum is a very small triangular piece, about 1·8mm. long, the mandibles meet in the middle line for a similar distance. The 1st legs, are broad, but short, reach 2·3mm. down maxillæ, followed by the 2nd for about 0·8mm. The antennæ run to the end of the wings, side by side, for about 2·2mm., after meeting over the proboscis. On both sides of one specimen (others not examined) the tibio-tarsal articulation is marked both in the 1st and 2nd legs by an unusual structure, *viz.*, a group of circles, that are possibly entitled to be called lenticles. On one side, the 1st leg has seven of them, and the 2nd five; on the other the 1st has five and the 2nd three. Another specimen is slightly different in numbers. A faint trace of these exists in *Rumicia phlaeas* (not in *Chrysophanus dispar*), but it is distinctly present in all the Theclids I have examined. That it is absent elsewhere is a statement for which I cannot claim ready acceptance, as they are very large and well marked in the pupa of *Callophrys rubi*, yet up till now have escaped my notice. In *C. rubi* the network of sculpture, which is elsewhere on the legs rather vague and irregular, is distinct and very like that on the body where most marked, as above the spiracle of the 3rd abdominal segment; notably it has the stellate points from which the ribs radiate, and, amongst these, but dissociated from them, are one or more large lenticles. In one specimen the forelegs have nine points and one lenticle on one side, six points and one lenticle on the other; the 2nd legs have respectively five and seven points, but each has three large lenticles. In another specimen the number of points and lenticles are different. [I have been accustomed to regard the appendages as free from the special coverings, hairs, etc., of the body surface; a hair or two on a wing margin being exceptions I have regarded as teratological. Here, however, is, at the tibio-tarsal articulation, a genuine bit of body sculpture and armature. Does it occur largely throughout Lycænids? and elsewhere? It seems to be absent in *Hamearis lucina*.] The prothorax (returning to *S. pruni*) is variously wrinkled, with stellate points at the intersections, in a few places anteriorly and posteriorly, whilst, at the dorsum, lenticles are numerous, as are also minute hairs (about 0·08mm. long), pale, tapering, and spiculated. The mesothorax is wrinkled; there are a good many stellate points, showing the wrinkling to be essentially the same as the netting on other Theclid pupæ; lenticles are much less numerous than on the prothorax; there are also very many, but fewer, hairs of just the same character; they are here more obviously curved. The same description would apply to the metathorax, but items of sculpture are fewer and less marked. The short, sharp, pointed wing portion is dark and wrinkled, but (being wing) without hairs, points, or lenticles. The 1st abdominal is much the same. The following abdominal segments have abundant lenticles round the spiracles. The wrinkling tends to the netted form with stellate points, most distinctly a little way below and behind the spiracles. Lenticles are sparse dorsally, *e.g.*, on one side of the 5th abdominal are eleven lenticles above the spiracular group, which has something like 70 of them. Hairs are tolerably regularly distributed, of almost the same character and length as elsewhere; on one side of the 5th abdominal above the spiracle there are

Photo. F. N. Clark.

Strymon pruni—portion of Cremaster of pupa ×100.

The Natural History of British Butterflies, etc., 1907.

PLATE XIII.

(To be bound facing Plate XIII.)

STRYMON PRUNI.

Portion of cremastral area of pupa $\times 100$.

A fractured piece showing very well :—

1. Some of the cremastral hooks projecting beyond the broken edge. [The central part of photograph fails to show much, owing to the colour due to density of chitin.]

2. The skin-sculpture of the more dorsal portion of the 10th abdominal segment exhibiting the fact that it is rather an irregular wrinkling than the neat network exhibited in some other Theclid pupæ.

3. Some of the ordinary hairs at the fractured margin of this portion.—*T. A. Chapman.*

about 100 hairs, amongst them a good many stellate points, the ribs or wrinklings attached to which are nearly evanescent. On each of these segments the two hollows, referred to already, present darker surfaces, with wrinkles radiating from the centre and free from any hairs, points, or lenticles; they are, therefore, very definite structures. Their positions are, if one divides the space from the dorsum to the spiracle into four spaces, the dorsal spine *in* the dorsal division rather behind middle of segment—the upper hollow will be half way from dorsum to spiracle, and in middle or slightly to front of segment; the lower hollow will be on the line between the 3rd and 4th divisional spaces, and decidedly towards posterior margin of segment. On carefully exmining the pupa of *Callophrys rubi*, the representatives of these marks may be recognised, a little lower on the segment, and consisting of a minute area, darker, and with more marked ribbing, and without hairs, lenticles, or points. The 5th, 6th, and 7th abdominal segments are very weak in the ventral line, in one specimen discontinuous, but for a delicate membrane, and behind them is no very definite structure except finely granulated membrane right back to the dorsum of the 10th abdominal segment, though some lines can be detected between the dorsum of the 10th abdominal and what are probably the eminences of the venter of the 9th abdominal segment. There is, on the extreme dorsum, a trace of the suture between the 9th and 10th abdominal segments. The cremastral hooks cover, as on a great continuous horseshoe, the whole area surrounding the thin membrane referred to. The hooks are less than 0·1mm. long, with a hook on each side of the tip (anchor-shaped), and may number 500 or 600. Like the other Theclids, the spiracles of the 7th and of 8th abdominal segments are both obsolete (Chapman). Freyer notes the pupa as being very different from that of the other "hairstreaks," since it has edges and points, whilst the pupæ of all the other species are smooth and more rounded. Wilde gives a figure of the pupa in his *Syst. Besch.*, pl. viii., fig. 1.

Dehiscence of pupa.—The dehiscence is along the usual Theclid lines; a slit down the thoracic dorsum, and one separating the head and antennæ from the prothorax and a portion of the wings; the metathorax may separate from the 1st abdominal segment, and other incisions break down easily in the empty pupa-case. Towards their middle and onwards, however, the antennæ may adhere to the wings, and, holding the face-parts in position, the valves, so formed as to allow the butterfly to escape, usually spring back into place, so that an empty pupa-case is very similar to a living one. As regards free segments, all the abdominal incisions from the 1st to the 8th abdominal segments (not 8th to 9th) open easily in the empty pupa-case, showing an intersegmental membrane, the 1st-4th abdominal, however, only dorsally, and the wings seem to have some adherence to the 5th abdominal segment in some pupæ. Probably all, or some of these, open a little in dehiscence, but it is not clear that movement takes place in any of them in the living pupa.

Time of appearance.—As this species extends neither to very high nor low latitudes, nor to high altitudes, we find comparatively little range in the time of its appearance, such variation as is found being largely due to the difference of the seasons in its special locality. In England, its average time may be said to be between June 20th and

July 10th, earlier and later dates being exceptional and dependent respectively upon favourable and unfavourable meteorological conditions, *e.g.*, in the early season of 1893, the species was practically over by early June, whilst, in 1881, and again in 1888, it was still to be found in early August. That this difference is really meteorological is well shown by the fact that, in most of its haunts, it affects the privet bloom, and the blossoming of the privet in any given year is usually a good sign as to the date at which the newly-emerged imagines are to be obtained. In Ashton Wold, Rothschild says that "the butterflies emerge about the third week in June, and are on the wing in some seasons into July." A fortnight or three weeks appears to be about the average time of emergence, and a fortnight perhaps the length of an individual life. The rearing of seventeen larvæ from Monk's Wood in 1904 is noted by Raynor as follows: "I did not lose a single larva, every one producing an imago. These emerged as follows: June 15th, 2; 16th, 4; 17th, 2; 18th, 1; 19th, 3; 20th, 3; 21st, 1; 22nd, 1." He adds: "Most of the early emergences were ♂s, no ♀ appearing during the first four days. The ♂s outnumbered the ♀s in the ratio of about 2 to 1." In the warmer parts of the continent, early June is a more usual time of appearance, but the records of Central Europe are very similar to our own; thus—in Belgium, June and July (Lambillion); in June and July, in Holland (Snellen); in Roumania, June 7th-July 23rd (Caradja); in Switzerland, mid-June to commencement of August (Frey); in June, in the Valais (Favre); June 17th-27th near Geneva (Blachier), and June 22nd-July 2nd, at Éclépens, in the Canton Vaud (Lowe); in France, chiefly June, *e.g.*, in June, in dept. Doubs (Bruand), in the forest of Bondy and Wolckam (Villiers and Guenée), in Saône-et-Loire (Constant), in Morbihan (Griffith); in June and July in the Basses-Pyrénées (Rondou), etc. In Germany we note—end of May and June for Hanover (Rehberg and Glitz. This record, Gillmer thinks, must have been based on quite exceptional appearances); July 1st-7th, in the Elbing district (Schmidt); in June and July, in Pomerania (Paul and Plötz); early June, 1889, at Krefeld (Rothke); mid-June to beginning of July for Elberfeld and the Rhine Provinces generally (Weymer); early June in 1868 (when *ilicis* also was on the wing) (Fuchs); June 12th-20th, at Wiesbaden (Vigelius), and June, for Cassel (Borgmann), but mid-June till end of July, at Frankfurt-on-Main (Koch), and end of June and beginning of July for Rhoden and Waldeck (Speyer); June is noted generally for Thuringia, June for Zeitz-on-Elster, July for the northern slopes of the Steigerwald, June for Dessau (Richter), but end of June to the middle of July for the Province of Saxony, generally (Jordan); the end of June is given for Brandenburg (Kretschmer), and June and July for the plain districts of Silesia (Döring), but Wocke gives end of May and June for the same districts, whilst, in the Trebnitz mountains, June and early July are mentioned for Obernigk (Nohr), and the end of June at Seufzen (Pfitzner); in the Kingdom of Saxony, June and July are given (Winckler), and June for Bavaria (Schmid, Kranz); June and July, for Baden, both in the plains and foothills (Meess and Spuler), although Gauckler only mentions June for the Durlach Wood, and Lowe says that it was much worn at Freiburg on June 16th, 1901, though only just emerging in the same spot on June 8th, 1906, whilst Keynes observed it as just emerging on June 6th, 1906, but much worn by June 21st, on the banks of the Rhine, near Lahr. Cantener gives the first fortnight of June as the usual time for its appearance in Alsace. In Austria, it is also reported to occur from June to August (Höfner), *e.g.*, June and July, in Bohemia and Moravia (Nickerl); June, at Brünn (Schneider); and June 20th, at Nikolsburg (Fritsch); throughout Lower Austria, in June and July (Brittinger and Himsl); June 12th-26th, at Linz (Fritsch); July is noted for Lower Austria (Rossi), and end of June till August, in the lowlands and hill region of Salzburg (Richter)—the earliest recorded dates at Salzburg in several years extending from May 31st to June 23rd, and the latest, from July 16th to August 13th (Fritsch)—in the Tyrol, it occurs mostly in the hill region, and is late in its appearance, being recorded from Mendel, between July 23rd and August 4th, 1895 (Lemann); and August 4th, at Bregenz (Fritsch); for Carinthia, June and July are given (Höfner), and for Carniola, a single capture only, the end of June (Mann); for Dalmatia, June to August (Mann *teste* Rühl); in Hungary, its appearance is earlier, May for Budapest (Rühl), although this must be an early date, for it was abundant at Budapest and Blocksberg from June 8th-21st, 1893 (Nicholson), and Aigner-Abafi says that it may be taken at Budapest from the end of May until mid-July. In Russia, in the Baltic Provinces, it is recorded as occurring from June 10th until the end of July (the record for May, by Sodoffsky, being an error) (Nolcken). In Italy, Rühl notes May for the Roman Campagna. In Scandinavia, July is given by Wallengren. CONTINENTAL RECORDS: June 23rd, 1849, abundant at the Kulkerteich, in Waldeck (Speyer); June 10th, 1867, and on into July, at Pichtendahl (Nolcken); early June, 1868, in great numbers, in the Wisper district (Fuchs); June 24th, 1879, on the Altenberg, near Kissingen (Maassen); June 11th, 1882, in great numbers, at Hirtenhau, in the Mosigkauer Haide (Amelang); June 29th, 1883, on bramble, growing by the roadside, near Carlsbad (Becher); June 12th, 1886, in Corea (Fixsen); June 27th, 1884, near Pokrofka (Graeser); June, 1892, at Budapest (Lemann); June 8th-21st, 1893, at Budapest and Blocksberg (Nicholson); between July 23rd and August 4th, 1895, at Mendelpass (Lemann); June 25th, 1897, between Sépey and Aigle (Wheeler); June 10th, 1905, at Digne; (Muschamp); June 16th, 1901, at Neu Breisach (Lowe); June 29th-July 16th, 1904, at Mestlin (Busack); June 20th, 1905, and June 10th, 1906, at the Bois des Frères, Geneva (Muschamp); June 6th-21st, 1906, on the banks of the Rhine, near Lahr (Keynes); June 8th, 1906, at Freiburg-in-Baden (Lowe); June 17th-27th, 1906, near Geneva (Blachier); June 22nd to July 2nd, 1906, common, at Éclépens (Lowe); June 26th, 1906, at the foot of the Salève, near Geneva (Rehfous); June 9th, 1907, at Hermance (Muschamp). BRITISH RECORDS: June 24th, 1829, in Monk's Wood (Babington); July 2nd, 1833, and July 17th, 1837, in Monk's Wood (J. C. Dale); June 18th, 1841, in Monk's Wood (Doubleday); June 19th, 1858, rare in 1859, at Kettering (Sturgess); June 22nd, 1859, very common, near Oundle (Whall); July 4th, 1874, in Linford Wood (Thompson); June 29th, 1875, abundant, but worn, in Monk's Wood (Raynor); [August 4th, 1881, at Owston (Scott), almost certainly an error for *E. w-album*]; July 7th, 1895, near Peterborough (Pearson); July 10th, 1895, eight specimens seen, only one captured, at Kinver Edge (Wells); June 19th, 1896, near Peterborough; bred June 12th-14th, 1897, from larvæ taken near Peterborough (Pearson);

bred June 22nd, 1897, and following days, from larvæ and pupæ collected in Northamptonshire, June 20th and 21st; bred also June 28th to July 4th, 1898, from larvæ and pupæ taken June 18th-19th, in a wood about one mile away from those taken last year (Dixon); June 29th to July 8th, 1898, in Monk's Wood (Peed); July 15th, 1899, in Monk's Wood (Rowland-Brown); bred June 14th-22nd, 1901, from Monk's Wood larvæ (Ash); abundant July, 1901, in Monk's Wood (Keynes); July 12th, 1903, in Monk's Wood (Crisp); June 15th-22nd, 1904, bred from larvæ obtained in Monk's Wood (Raynor); July 1st, 1904, and following days, in Monk's Wood (Dewar); bred from June 15th, 1905, onwards, for a period extending over three weeks, the larvæ obtained in Monk's Wood (Kaye); last days of June, and first few days of July, 1906, in Hunts (Fryer).

Habits.—This species appears to resemble somewhat in its habits those of *E. w-album*, being very infrequently seen, except by close observers, until seduced by the flowers of some favourite plant in the neighbourhood of its habitats, both sexes being then equally attracted; privet blossom is one of its favourite weaknesses, and Rowland-Brown observes that, when the insect is at rest, showing only the markings of the underside of the hindwings, it mimics the fading flowers of the privet to perfection. It was first recognised as a species apart from *E. w-album* on its discovery in Monk's Wood, in 1828, and was later taken somewhat abundantly in this locality, Stephens observing (*Illus. Brit. Ent.*, iv., p. 382) that "the species occurs in profusion in Monk's Wood towards the end of June, when it was taken by Babington, and also at the beginning of July, when I took it myself." It is also, like *E. w-album*, irregular in its appearance in abundance, and Bree writes (*Zool.*, 1852, p. 3349): "*T. pruni* is very uncertain in its appearance, for, in 1837, it literally swarmed in Barnwell and Ashton Wolds, in Northamptonshire; I do not scruple to say that it would have been possible to have captured some hundreds of them, had one been so disposed; for the last few years it has appeared very sparingly indeed." Sturgess notes (*Ent. Wk. Int.*, iv., p. 111) that, in June, 1858, he "captured three dozen *pruni* flying around the flowers of *Viburnum lantana*, at Kettering." Dewar states (*in litt.*) that, "during the first few days of July, 1904, he was able to observe the habits of the insect in Monk's Wood, where it occurred in a ride, bordered on one side for 50 yards or more by a blackthorn hedge, 8ft. or 9ft. in height. At the time they were on the wing, one would not, perhaps, for a few minutes, see a butterfly, and then, providing the sun was shining, one would come flitting, or rather dancing, along, generally well out of reach, at the top of the hedge; after a few minutes it would generally settle, and was then difficult to see; when one settled it often remained motionless for a considerable time, and, owing to this habit of prolonged basking, the insect appeared to be in fewer numbers than it really was. The least cloud checked their flight. Rarely were more than one or two to be seen at the same time, yet there was a constant succession of individuals, and as many as twenty were sometimes captured in an hour. The butterfly was seldom seen far from its foodplant, but was occasionally observed in little open sunny spaces throughout the wood, where it was generally found to be visiting flowers of *Viburnum lantana* and *Ligustrum vulgare*, or settling on flowers of hazel." N. C. Rothschild writes (*in litt.*) that, "in Ashton Wold, the butterflies love to settle on privet blossoms, crawling about the bushes, but, if disturbed, flying rapidly away; on one occasion I captured both *E. w-album* and *S. pruni* on the same privet bush, the latter worn, whilst the former was in good condition." He adds; "I have also noticed the ♀s crawling about the blackthorn bushes, possibly ovipositing, but I did not find the ova." Mosley states that, "in Barnwell Wold, the imagines principally affect the privet and bramble bloom, and the best way to capture them is to stand near a good patch of bloom and wait until they arrive." Thompson records that, "on July 4th, 1874, he captured several specimens, mostly ♀s, on the flowers of privet, in Linford Wood." It is also recorded as being taken at "bramble flowers," at Kinver Edge (Wells); on flowers of valerian, at Barnwell Wold (Kaye), etc. Its recorded habits abroad are almost identical with those noticed in England, *e.g.*, Keynes notes (*Ent. Rec.*, xix., pp. 88-89) that, on June 18th and 21st, 1906, on the banks of the Rhine, near Lahr, he discovered a tract of low privet bushes in bloom, on the flowers of which *S. pruni* was sitting in scores; the ♂s were, however, then over, but a good series of ♀s was taken; feeding on the same blossoms with these were a few *E. w-album*, the latter in fine condition. Reutti also records that, in Baden, the imagines are to be found sitting on plants of different species of *Prunus*, and on *Symphoricarpus racemosus*. Lowe observes (*in litt.*) that, at Freiburg-in-Baden, on June 16th, 1901, the species was abundant on flowers of bramble, but much worn, whilst, on June 8th, 1906, in the same place, only one freshly-emerged imago was observed at the flowers. He found it abundantly, however, between June 22nd and July 2nd, 1906, at Éclépens; here, the insect was observed basking in the sunshine on a thick hedge of mixed growth, rising for short spiral flights, and generally returning to the same spot again. It appeared to show a slight preference for the flowers of *Clematis vitalba*. Busack observes (*in litt.*) that, between June 29th and July 16th, 1904, he noticed the species at Mestlin, in Mecklenburg. He states that "he caught the butterfly flying in the full sunshine, on the outskirts of a wood, where sloe, hazel, and bramble, grow abundantly. The imago often returns to its old resting-place, sucking the nectar from the bramble-flowers, or sitting upon the leaves of hazel, so that one has only to disturb it to capture it; yet, it is a very active insect, and particularly so in the hot sunshine, between 11 a.m. and noon." Löffler reports (*in litt.*) that the species occurs in several places near Heidenheim, in Württemberg, where he usually finds it most abundant on flowers of marjoram, during the morning only, for, at noon, it flies actively about, and is then most difficult to capture. Glaser notes it on flowers of bramble at Giessen, whilst Gillmer observes that, in the forests of Klein-Zerbst and Diebzig, the species occurs somewhat rarely, and is not often observed flying, but is sometimes seen walking about on the sloe leaves, from which it is easily disturbed, the butterfly, however, usually settling down very quickly again. The walking and the basking is only done in the hot sunshine, and at such times they may be seen moving the hindwings to and fro over one another; during the cloudy periods the butterfly sits quite still. He adds that he has only seen the butterfly sucking nectar from the flowers of *Thymus serpyllum*, in Thuringia. Wocke also notes it as abundant in some lowland localities in Silesia, flying around sloe bushes. Nolcken notes that it was very abundant in 1867, at Pichtendahl, resting on shrubs, but much preferring to sit on plants of *Rhamnus frangula*. Constant notes the irregularity of its appearance, observing that, in Saône-et-Loire, the species is more common than *Nordmannia acaciae*, being particularly abundant in some years. Fuchs notes its great abundance in the Wisper district in 1868, when it flew abundantly about the hedges near the villages, and appeared at the commencement of June, the ♂s appearing before the ♀s, the later specimens of the latter sex being on the wing with *N. ilicis*. Glaser also notes it as occurring at Giessen, with *N. ilicis*, both frequenting the bramble flowers at the same time, or walking over the leaves of the blackthorn bushes. At Frankfort-on-Oder its comparative abundance, flying about plum-trees in gardens gregariously, is noted by Kretschmer, and Stange says that it is practically a gregarious species at Halle. Near Carlsbad, it was taken on bramble growing by the roadside (Becher). In Carinthia, Höfner says that its habit is to fly singly about the plum-trees in orchards. Lambillion says that, in Belgium, the imagines love to rest on the leaves of bushes, and on flowers in the bush-covered ground that borders woods, and one also finds it sometimes flying in fruit-gardens. He considers the species much easier to capture than *E. w-album*, as it does not fly so high. Blachier states that, in Geneva, he has noticed its flight to be short, and not long sustained, whilst Reverdin observes that it flies rapidly and whirlingly around *Prunus spinosa*, appearing to prefer rather high bushes, and to rest on the highest twigs. He adds that it appears to fly in an analogous manner to *Bithys quercûs*, around the higher branches of oaks.

Habitats.—This insect is essentially a woodland species, loving the sides of the open ridings, clearings, or the outskirts of woods, but not despising thick sloe-hedges not far removed from woods, and even gardens. From these haunts it flies to the most attractive flowers in the near neighbourhood, flowering bushes of bramble, privet, *Viburnum lantana*, *Symphoricarpus racemosus*, valerian, thyme, marjoram, etc. Dewar says that, in Monk's Wood, it most affects ridings by the sides of which tall blackthorn hedges run, going hence to visit sunny open spaces in the woods, where *Viburnum lantana* and privet are in flower. N. C. Rothschild says that, at Ashton Wold, it is now very local, occurring only in a few open places in the wood, the species affecting the higher sloe-bushes, and straying off to privet bushes that are in blossom. He thinks that improvement in forestry, *i.e.*, increasing the number of forest-trees to the acre at the expense of the undergrowth, the cutting down of bushes, abolishing open spaces in woods, etc., are fatal to this species, and explain its disappearance from many localities in Northants. It is certainly an exceedingly local species in Britain, confined to a few English counties, almost all in the Midlands, and only occurring at all freely in limited localities in Bucks, Hunts, and Northampton. On the continent its localities are also limited, and even more so in Asia, the species also failing almost entirely both in the extreme north and south throughout the Palæarctic area. Kane notes it as "very local throughout Europe, occurring in clearings of woods, often resting on bushes, especially on those of *Cornus sanguinea*." In Belgium, Lambillion notes that it is confined to the limestone district where sloe abounds. In Germany, it is recorded as occurring in Mecklenburg, in the wood near Kleinen, in places where blackthorn bushes are abundant, whilst Tessmann notes it as occurring on the blackthorns by the road to "Fuchsberg"; in the Rhine Provinces, Stollwerck records it as occurring chiefly in the clearings of woods, although, at Trier, it is found occasionally in gardens. Rössler observes that, in Nassau, the species continually gets rarer because of the continual uprooting of the blackthorn, the species also being apparently confined to very warm slopes, outside, and not in, the woods; Gillmer, however, says that he took the butterfly here, on the sloe bushes growing by the side of the wood-ridings, as in Anhalt and Mecklenburg, *i.e.*, quite in the woods, whilst at Heidenheim, in Württemburg, it also chooses sunny wood-ridings, (Löffler). In the Wisper district, where the species is sometimes very common, Fuchs says it prefers hedges to trees, and the neighbourhood of villages to more secluded places; whilst Glaser observes that, at Giessen, etc., it chooses hedges and gardens, and visits the bramble bushes when in flower. Siegel says that, near Giessen, he has only noticed it on the outskirts of woods, or in woods in places exposed to the sun; Vigelius, too, notes it as occurring in the gardens of Wiesbaden. At Zeitz-on-the-Elster it chooses wood-clearings (Wilde), and, at Halle, is found in gardens, and woods of deciduous trees, where blackthorn grows (Stange), whilst in the Mosigkauer Haide it haunts the blackthorns in great numbers (Amelang), and is found in the forests of Klein-Zerbst and Diebzig (Gillmer); in the Harz district it only occurs in the low foot-hills (Speyer). At Potsdam it is recorded from gardens, and also in gardens on the outskirts of Frankfort-on-Oder. In Silesia it rarely goes into the mountains, its haunts in the plain being pretty generally distributed wherever blackthorn is found; similarly in Baden, it is recorded as occurring only in the plains and lower hills, not ascending into the mountains (Meess and Spuler), and being especially abundant in the Durlach Wood (Gauckler); near Lahr, Keynes found the species abundantly close to the Rhine, haunting a tract of privet-bushes in bloom, on the flowers of which they sat in scores, whilst at Freiburg-in-Baden Lowe says it prefers hedges of mixed growth, showing a marked liking for flowers of bramble and *Clematis vitalba*. In Alsace, clearings of woods, where it loves to rest on the bushes, are most frequent, whilst it is also found by the sides of the canal at Mulhausen; the roads near the Semmwald, the road leading to the forest of Bouxwiller, and the outskirts of the woods of Voipy, near Metz, are also noted as habitats of this species. In Mecklenburg, Busack notes the wood of Mestlin as a good locality, whilst Löffler, as already noted, says that, in Württemburg, sunny paths in woods provide the best localities. In Bavaria, Maassen took it on the Altenberg, near Kissingen. In Austria, it is reported in the gardens of Bohemia and Moravia (Nickerl); in fruit-orchards, gardens, and along blackthorn hedges, throughout Lower Austria (Rossi); in orchards, and by the edges of fields, among blackthorn bushes, but only in the plains, or on quite low hills in Salzburg (Richter), and in fruit-orchards, flying around plum-trees in the Lavantthal and Möllthal (Höfner), etc. In Hungary, Aigner-Abafi says that it is generally rare, and is found flying around trees of *Prunus domestica* and *P. spinosa*, and is specially attracted by bramble-blossom. In Roumania, it is reported by Caradja as occurring in gardens and in woods, locally, in several places. In Switzerland, Blachier says that it is found on hedges of sloe, by the sides of roads, and in the clearings of woods; it is found at the foot of the Grand Salève, a fine, overgrown, bushy piece of waste land, on the outskirts of the wood, that covers the lower slopes of the mountain. It is also recorded as occurring in the Valais, in the clearings of the woods, both of the plain and the lower mountain district, resting on bushes, like the rest of its congeners; at Martigny, it occurs in gardens (Favre); between Aigle and Sépey, it is found on the hedges by the roadside (Wheeler). In France, it is reported as occurring in woods and forests in the districts of Berry and Auvergne (Sand); on the borders of woods, in the Doubs (Bruand); in clearings of woods, in Morbihan (Griffith), the woods of the Aube (Jourdheuille), abundant in the forests of Bondy and Wolckam (Villiers and Guenée), but preferring gardens in Saône-et-Loire (Constant), hedges in the Basses-Pyrénées (Rondou), etc. In the Baltic Provinces, it occurs in woods of fir and deciduous trees mixed, with much undergrowth in the clearings, and the lowlying parts pretty swampy (Nolcken). Speyer himself records it as occurring in a garden within the city of Florence, whilst Carrucio says "not infrequent on the low hills round Modena," but Fiori mentions *w-album* only, and omits *pruni*, as a native of Modena. Of its Asiatic habitats practically nothing is known. Graeser says that those he caught near Pokrofka, were found on the banks of a brook, on bushes of *Prunus padus*.

British localities.—Exceedingly local and almost entirely confined to a few midland counties of England. Bedford: Putnoc Lane, near Bedford (Gifford-Nash). [Berks: Beaumont (Gardner, *Ent.*, xviii., p. 268). Not caught, therefore requires confirmation.] Bucks: north Bucks (Goss), Whittlebury Forest (Foddy), Linford Wood, near Stoney Stratford (Thompson). [Derby: near Chesterfield (Hind, *Ent. Wk. Int.*, ix. p. 26.] Gloucester: Forest of Dean (F. D. Wheeler), Morton-in-the-Marsh (Hopkins). [Hants: Isle of Wight—Freshwater (Grant, *Ent.*, xxi., p. 115), Petersfield (Robinson. The latter in error. Corrected to *R. betulae*, *Ent.*, x. p. 303).] Hunts: Warboys Wood (*teste* Barrett), Monk's Wood (Bower), St. Ives (Jagger), Overton Wood (Allis). [Leicester: Owston (Scott), Gumley (Matthews). Both records almost certainly *E. w-album.*] [Monmouth: St. Julian's Wood (Lock), certainly *E. w-album.*] Northampton: near Brington, very common (Bell), Northampton (Hensman), near Peterborough (Pearson), the Hanglands, near Peterborough (Whitwell), Ashton Wold (Rothschild), Rockingham, Kettering (Sturgess), near Oundle, Barnwell Wold (Bree), Oundle (Bower) Towcester (Clark). Rutland: Uppingham, abundant (Bell, *Ent. Wk. Int.*, vi., p. 172). Suffolk: Brandeston, one worn (Greene), [Playford (Greene *teste* Newman).] [Warwick (recorded in Blatch's *Handbook* in error).] Worcester: rare (Fletcher), Malvern district (*Trans. Malv. Nat. Field Club*, p. 176; *Illus. Nat. Hist. Worcester*, p. 138), Kinver Edge (Wells). [Yorks: (recorded by Curtis, *Brit. Ent.*, v., fo. 265, in error, see Newman's *Brit. Butts.*).] Milton Wood, near Doncaster (Henderson), no doubt this refers to *E. w-album.*]

Distribution.—Central and northern Europe (except Polar region), north and central Italy, Dalmatia, Altai, Ussuri, Corea (Staudinger and Rebel). Asia: [Japan—Yezo, a single specimen (Pryer),] Corea (Fixsen), Amur district—Pokrofka (Graeser), Sutschan district (Dorries), southwestern Altai (Kindermann), Semipalatinsk (Grum-Grshimailo), Lower Ussuri (Fixsen), Vladivostock (Elwes), Asia Minor—Beyrout (Mathew). Austro-Hungary: throughout, sometimes rare (Höfner); Bohemia and Moravia—Prague (Nickerl), Carlsbad, abundant (Becher), Hans Heiling, Ewiges Leben, Schupfenwiese (Hüttner), Brünn, Obran, Kleiduwka, Ochos (Schneider), Nikolsburg (Fritsch); Upper Austria, generally distributed (Brittinger)—Linz (Fritsch); Lower Austria, generally distributed (Rossi)—above the Wienerwald (Schleicher), Hernstein (Rogenhofer); Salzburg, confined to the lowlands and hill region, not rare (Richter)—Salzburg (Fritsch); Tyrol, the lower region, not abundant (Hinterwaldner)—

Mendelpass (Lemann), Innsbruck valleys (Weiler), near Botzen (Stentz), Bregenz (Fritsch); Galicia—Lemberg (*teste* Rühl); Carinthia—in the Lavantthal and Möllthal, singly (Höfner), Carniola—Heiligenkreutz (once), Dalmatia (Mann); Hungary, throughout (Aigner) — Budafok, Budapest. Peszér, Arad, Beél, Nagyvárad, Eger, Pécs, Pápa, Györ, Sopron, Pozsony, Tavarnok, Verebély, Rozsnyó, Kocsócz, Gölniczbánya, Igló, Eperjes, Kassa, Ungvár, Nagykároly, Gyeke, Nagyszeben, Nagyág, Mehádia, Lipik, Vinkovcze, Josifsdal (Aigner-Abafi); Blocksberg, near Budapest (Nicholson), the Bucovina (*teste* Rühl). BELGIUM: local and rare, Province of Luxembourg—near Brussels, Louvain (Dubois), Namur, Jambes, Dinant (Donckier), Philippeville, Florennes, Chaumont (Wautier), Warnant, Anhée, Vallée de la Molignée, rare, Dave, Beez (Lambillion). BOSNIA AND HERCEGOVINA: Dervent (Hilf), Sarajevo (Rebel). BULGARIA AND EAST ROUMELIA: near Samakov, Tirnova, Kalofer, Slivno (Pigulew). DENMARK: Lolland (Dohlmann). FINLAND: Ryska Karelia (Lampa). FRANCE: eastern and central (Villiers and Guenée)—Allier—Forêt de Montpensier, Vichy, etc. (Sand); Aube—Ervy (Jourdheuille); Basses-Alpes—Digne (Muschamp); Basses-Pyrénées (Larralde); Cher, rather rare—St. Florent (Sand); Doubs (Bruand); Haute-Marne, generally distributed, but rare (Frionnet); Indre—Brenne, rare (Martin); Maine-et-Loire—La Maignanne, very rare (Delahaye); Marne—Rheims district, rare (Demaison); [Morbihan, doubtful (Griffith);] Oise—Chantilly (H. Brown), Bondy, Forêt de Wolckam, abundant (Villiers and Guenée), Compiègne (Berce); Puy-de-Dôme—Enval, Randan, rare (Sand); Saône-et-Loire (Constant); Sarthe (Desportes); Seine-et-Oise—Mesnil-le-Roi, Rangean (H. Brown), Versailles (Giard); Somme—Amiens (Rühl). GERMANY: generally distributed in the lower region, but scarce or local (Speyer), East and West Prussia—Elbing district (Schmidt), Gross-Raum, Königsberg, Braunsberg, Saalfeld, Liebstadt, Willenberg (Speiser); Pomerania, rare (Hering)—Grubenhagen (Paul and Plötz); Mecklenburg—Kleinen, Schimm (Schmidt), Schwerin (rare), Mestlin, near Parchim, Neustrelitz, Rülow, Sülze (Gillmer), Lübeck, near Fuchsberg (Tessmann); Hamburg—the Sachsenwald, rare (Tessien), Harburg (Zimmermann); Hanover — Lüneburg (Machleidt and Steinvorth), Bremen, Schönebeck, Vegesack, Stoteler Wood (Rehberg), Hanover, near Misburg (Glitz), Osnabrück (Jammerath); Rhine Provinces—Crefeld, Cologne, Bonn, Boppard, Bingen, Trier (Stollwerck), Elberfeld (Gillmer), the "Ellerforst," between Erkrath and Eller, the "Reisholz," near Eller, Carnap, on the "Hülsen," at Hilden (Weymer), the Egelsberg (Rothke); Hesse-Nassau—near Oberursel, the Wisper district (Fuchs), Hanau, not abundant (Limpert and Röttelberg), Wied-Selters district, western slopes of the "Westerwald" (Schenck), Vogelsberg, Giessen, Hinterland, etc. (Glaser), Frankfurt-on-Main, the "Kirschenwäldchen," the "Rebstecker Wäldchen," and Niederwäldchen (Koch), Upper Hesse, not rare (Borkhausen), Wiesbaden (Vigelius), Rhoden, Korbach, rare, Kulkerteich (Speyer), Lindenberg, near Cassel (Borgmann); Thuringia, distributed and common in some places (Krieghoff)—Gotha, Siebleber Holz, Rudolstadt (Knapp), Mühlhausen, rare, Sondershausen, Kyffhäuser, Nordhausen (Jordan), Gera (*Ent. Verein. Gera*); Province of Saxony, Anhalt and Hartz—Erfurt (Keferstein and Werneburg), in the "Schwedenschanze," northern slope of the Steigerwald (*Entom. Verein. Erfurt*), Zeitz-on-the-Elster, Thiergarten, Kuhndorfer-Mühle, Schneidemühle (Wilde), Naumburg, Göttingen, rare (Jordan), Halle, in the Abtei, Ammendorf (Stange), Dessau (Richter), Mosigkauer Haide, *e.g.*, Hirtenhau, Raumer's meadows (Amelang), Forests of Klein-Zerbst and Diebzig (Gillmer), the foot-hills of the Harz (Speyer), Ballenstedt (Brunn), Braunschweig, Quedlinburg, Osterode (Jordan), Wernigerode (Fischer), northeastern Hartz, rare, the Sternhaus, near the Roseburg (Reinecke); Brandenburg — Potsdam, Rahnsdorf (Bartel and Herz), Frankfurt-on-Oder, the Tzschetzschnow district (Kretschmer); Silesia, chiefly in the plain, not common (Döring) — Trebnitz mountains, Obernigk, not abundant (Nohr), Zittau, rare, Kunnersdorf, near Bernstadt, once (Möschler), Brieg (*teste* Rühl), Breslau (Blachier), Upper Lusatia, the Königshainer mountain, near Niesky (Christoph), Seufzen, not rare, Oberleschen, Altkirch, Carlswald, abundant (Pfitzner); Kingdom of Saxony, distributed—Borsdorf, Geithain, Burgstadt, rare, Hainichen, rare, Leina, not abundant, Jahna, Triebisch and Saubach Valleys, Niederwartha, Loschwitz, Pillnitz, Hainsberg, Dippoldiswalde, Zittau, Bernstadt, rare, Guttau, near Bautzen, Kamenz, abundant, Elstra, Crimmitschau. Plauen (Winckler); Bavaria—the Altenburg, near Kissingen (Massen), Regensburg (Hofmann and Herrich-Schäffer), Munich, most abundant, Grosshesselohe, etc. (Kranz), Augsburg, singly (Freyer), near Kempten, abundant (von Kolb); Württemberg, throughout (Seyffer) — Heidenheim, etc. (Löffler);

Baden, generally distributed—the Lake of Constance to the "Bergstrasse," in the lowlands and the foothills (Meess and Spuler), Durlach Wood (Gauckler), Freiburg (Keynes), Neu Breisach (Lowe); Rhine Palatinate (Bertram); Darmstadt—Darmstadt (Schenk *teste* Glaser); Alsace—Colmar, very common, near the Semmwald, Mulhausen, Bouxwiller, Voipy (Cantener), Neuland, Fronholtz (Peyerimhoff). ITALY: Piedmont (de Prunner); Florence (Speyer), Roman Campagna (*teste* Rühl); [? Modena (Carrucio). Fiori notes *w-album* only from Modena, but not *pruni*]; Tuscany, common—near Salviano, Siena, Livorno, ? Pisa (Stefanelli); Sicily—Madonie, singly (Minà-Palumbo); Osimo (Spada); Ficuzza, Marraccia (Marott). NETHERLANDS: Friesland, Limburg (Snellen)—Breda (*teste* Rühl). ROUMANIA: near Grumazesti, Bistritza Valley, near Slanic (Caradja), near Dulcesti, Valesaca (Hormuzaki). RUSSIA: Baltic Provinces—Riga, Sessau, Frauenburg, Kokenhusen, Pichtendahl (Nolcken), Bathen, near Libau (Gerhard), Schloch, Zemmern, Livonia (Teich), near St. Petersburg (Rühl), the Baschkiria district, rare (Eversmann), Podolia — Bagovitza (Grum-Grshimailo). SCANDINAVIA: Sweden—Skania, near Lund (Zetterstedt), Småland—Oland; Kalmarlän—Halltop, Ålem (Forf). [SPAIN: Granada (*teste* Rühl).] SWITZERLAND: scarce and local—Basle and Liestal (Knecht), the Aargau Jura (Wullschlegel), St. Blaise, Neuveville (Couleru), Aarberg, Schüpfen (Rothenbach), Vaud—Éclépens (Lowe), near Lausanne, Orbe, at 1376ft. (Laharpe), Schaffhausen, not rare (Trapp), Zürich (Lemann)—Katzensee, Weissenburg, New Baths, scarce (Huguenin), Charpigny (Fison), Bex (*teste* Kane), Choully, Meyrin (Blachier), Valais, not very rare but local—Aigle (Wheeler), St. Triphon (Fison), Martigny, Sierre, Noës, Corin, etc. (Favre); Geneva district (Blachier), foot of the Salève (Rehfous); Bois des Frères, Hermance (Muschamp); Grisons—Igis (Amstein), Chur (Killias), Simplon—Gamsen (Anderegg), Waadt Canton (Meissner).

Tribe: RURALIDI.

This tribe differs considerably from the Strymonids in all stages—eggs, larvæ, pupæ, and imagines—although retaining all the characteristic "hairstreak" characters. The imagines are generally of brilliant colours, the males of some species being beautifully iridescent, and the sexes usually very different in their colour and markings. There are only two British (and European) species—*Bithys quercûs* and *Ruralis betulae*—and the latter, being the typical genus and species of Linné's *Rurales*, gives us our tribal name. This group is essentially an Old World one, and, one may say, essentially Asiatic, the Bithynid section being particularly abundant in eastern Asia, and much more numerous than the Ruralid section. De Nicéville thinks (*Butts. of India*, iii., p. 300) that the headquarters of the group are in the hills of northern India, where thirteen species occur, but there is a considerable number of species in China, Amurland, and Japan. Staudinger records seventeen species for the Palæarctic region, ten belonging to the Bithynid group and seven to the Ruralid, the whole being massed together under the generic name *Zephyrus*. Similarly, De Nicéville (*Butts. of India*, iii., pp. 298 *et seq.*) includes the whole of the Indian species in the genus *Zephyrus*, but all these appear to belong to the Bithynid section of the tribe.

That this lumping of the whole of the species of one tribe into one genus is not altogether satisfactory is evident on a mere superficial examination, and the Bithynid and Ruralid sections are separated readily on purely imaginal characters, the more extreme forms of the Ruralid group being very striking. We propose, therefore, to separate at least the Bithynid and Ruralid species as represented by *quercûs* and *betulae* respectively, and, later, to make a tentative grouping of the species that have come under our notice in our account of *Bithys* and *Ruralis* respectively.

The general superficial characters of the Ruralids (*sens. rest.*) are clearly indicated. The imagines are, on the whole, considerably larger than those of the Strymonids; the hindwings are usually furnished with one short caudal appendage, and a slight extension of the anal angle; there are no defined androconia observable, but the sexual dimorphism in colour, marking, and to a less extent in shape, is very distinctly marked. The neuration of the forewings is characterised by the upper discoidal nervule of the forewing being given off from the subcostal nervure some distance beyond, instead of a little before, or at the apex of the discoidal cell, and similar in the two sexes. The underside markings of the Bithynid species are somewhat nearer those of the Strymonids than are those of the Ruralids, of which the group represented by *R. betulae* has its most divergent form in *saepestriata*.

Both groups have representatives without a caudal appendage to the hindwings; in the Bithynids, *khasia*, de Nicév., in the Ruralids, *raphaelis*, Obth., with its var. *flamen*, Leech. Of the difference in the sexual coloration, readily recognised in the two groups by that of *B. quercûs* and *R. betulae* respectively, much might be noted, and of it de Nicéville writes (*Butts. of India*, iii., p. 300): "The species are very variable in colouring, the male of *R. betulae* brown above, with some pale ochreous markings on the disc of the forewing on the upperside, the female with a prominent orange band, the underside also orange, much brighter in the female than in the male; *B. quercûs* is purple on the upperside of both sexes, but the colour is much restricted (though more intense) in the forewing, and replaced by blackish in the hindwing, of the female. The Indian species (which all belong to the Bithynid section) are all more or less green, blue, or violet (in one species) on the upper surface of the male, this colour being most magnificently metallic in several of the species, less so in others. The females differ widely, as a rule, from their respective males, and, in Japan, according to Leech (*Proc. Zool. Soc. Lond.*, 1887, p. 412), one species, *japonica*, Murr., has four distinct female forms, besides which all intermediates occur." This statement must be accepted with caution. Noting some of the Indian species, he remarks that "the female of *duma*, Hew., is black above, with an orange band on the disc of the forewing; that of *syla*, Koll., is more or less blue; of *birupa*, Moore, blackish, with two pale patches on the forewing; of *icana*, Moore, and *dohertyi*, de Nicév., the females are very like that sex of *duma*, but have a little purplish towards the base of the forewing. . . . . The opposite sexes of *ziha*, Hew., are marked and coloured exactly alike, the upperside of all the wings blue, the obliquely-placed spots on the forewings white."

The Ruralid (*sens. strict.*) egg is more Lycænid in its general appearance than the Strymonid, being somewhat less flattened, *i.e.*, fuller, but like the latter passes the winter, the young larva being fully-formed within the eggshell for a considerable time before hatching takes place. The eggs of our European species are laid on the twigs of their foodplants, those of *Bithys quercûs* on twigs of oak, and those of *Ruralis betulae* on twigs of blackthorn. Chapman, speaking of the Ruraline egg (as exemplified by *R. betulae*), says: In form, it comes very near *Thecla titus*, as figured by Scudder, but is not quite so flat; the sculpturing is more elaborate. The structure seems more allied to the pits of the Chrysophanid eggs, as also is the form, with ridges, and points left by their intersections, than with the Lycænid form of egg, of a network, with knobs at the intersections; there are, indeed, no indications of knobs. Apart from the surface sculpture, the eggs proper of *Bithys quercûs*, *Ruralis betulae*, *Strymon pruni*, and *Edwardsia w-album*, are probably all much the same, but the sculpture makes them differ much in external appearance, due to the different form and development of the adventitious coat, which is *the* feature of nearly all Lycænid eggs. The egg of *Ruralis betulae* is (of these four) at one end of the series, having a very thick coating, in which the cells, especially in the upper part of the egg, are reduced to mere slender tubes by the great thickness and coalescence of the columns and connecting ribs. At the other extremity is *Edwardsia w-album*, in which the coating is fairly developed marginally, but over the dome of the egg is reduced to a few hairs, the representatives of the columns, the eggshell proper being very fully exposed. The apparent shape of these two eggs is, therefore, very different, that of *R. betulae* being high and rounded, that of *E. w-album* flat, and with a flange-like margin. The egg of *R. betulae* is also snowy white, the coating only being visible, *E. w-album* takes a dark colour from the true egg, and its contents being evident. The eggs of *Strymon pruni* and *Bithys quercûs* are very much alike in having a moderate and fairly developed coating of very similar pattern. I have never seen these just laid, but fancy they are even then dark, as compared with that of *R. betulae*.

The Ruraline larva shows considerable difference from the Strymonid; the latter is characterised by the depression of the prothoracic plate, the great hood formed by the mesothorax, the wide depression formed between the double dorsal ridge and waved slopes, whilst, in the former, the mesothorax is comparatively flat, the sloping sides very straight, the two dorsal ridges approximating, and quite flattened at the apex, and not presenting at all the humped outline, as observed in *Strymon* (*pruni*), *Edwardsia* (*w-album*), etc. Chapman says: The newly-hatched larvæ of *Ruralis betulae* and *Bithys quercûs* agree in having abundant hairs and lenticles on the prothoracic plate, that of *Edwardsia w-album* has comparatively few, and on that of *Strymon pruni* there are six hairs, but no large lenticles. In *R. betulae* and *B. quercûs*, the great lenticle on the slope has two small associated hairs. In *S. pruni*, it is accompanied by a small lenticle, which, in *E. w-album*, only occurs on the 1st abdominal segment, on the following segments it is solitary. In *R. betulae* and *B. quercûs*, there is also, on the 1st and 2nd abdominal segments, a large lenticle, near spiracle in the same group, just above spiracle, however, in *B. quercûs*, below and in front of it in *R. betulae*, a very material difference, therefore, between these two species. All four species have two pads with hooks, in common with so many Lycænids, on each proleg; each pad carries two, rather large, hooks, and there is the central fleshy process. In *B. quercûs*, however, there is, on the outer margin of the base of the pads, a little row of four or five very small hooks, of which no trace exists in *S. pruni* or *E. w-album*. In *R. betulae*, this row is even more developed than in *B. quercûs*, and some nine or ten hooks exist in it. There are some other minor differences in the distribution of the lenticles, but in more important features, the only notable difference is the absence in *S. pruni* of the small hair in front of tubercles i and ii. The larvæ of the species of this tribe appear to be confined to trees and woody shrubs, are particularly smooth, and gliding in their motions, the eggs not hatching till rather late in the spring; the larval life is comparatively short, rarely extending to more than ten weeks, mid-April to late June or early July being, perhaps, the average length in this stage. These species are also absolutely single-brooded, and, as in the Strymonids, the larvæ change colour considerably just before pupation takes place.

The Ruralid pupæ are remarkably smooth and rounded in outline, and are characterised by the entire absence of a cremaster; the larvæ, when fullfed, descending, and pupating under, or in, a dead leaf on the ground; their colour is dark, and assimilates wonderfully well with that of dead leaves or other similar material lying on the surface of the ground. Comparing the Strymonid pupæ (as illustrated by those of *Strymon pruni* and *Edwardsia w-album*) with the Ruralid (as illustrated by those of *Bithys quercûs* and *Ruralis betulae*), Chapman says: As regards the Strymonid pupæ, that of *Strymon pruni* is very specialised for protection in an exposed position. It has a copious and well-developed cremaster, and abundant hairs. In both these characters it is followed, at a little distance, by *E. w-album*, which also pupates above ground, on the leaves of its foodplant, etc., but hidden, and, therefore, with the ordinary Lycænid rounded outline. The Ruralid species, *Bithys quercûs* and *Ruralis betulae*, pupate on, or below, the ground (including rubbish as ground), or in a closed cocoon; *B. quercûs* has no trace of cremaster, *R. betulae* has a few obsolete hookless batons. *R. betulae* has, also, a very few short hairs in the spiracular region, *B. quercûs* has rather a larger number, and they are a little specialised towards fungus-formed hairs (*see* pl. iii., fig. 2). Both *R. betulae* and *B. quercûs* are very rounded and of reddish earthy colour, not differing much in this respect, however, from *E. w-album*.

De Nicéville gives (*Butts. of India*, iii., p. 300) the following diagnosis of the group, under the name *Zephyrus*:

Forewing large, subtriangular; costa regularly arched, apex subacute, outer margin slightly convex or straight, inner margin straight; costal nervure reaching to about half the length of the wing, terminating just opposite to the apex of the discoidal cell; first subcostal nervule given off from the subcostal nervure at about two-thirds the length of the discoidal cell, second subcostal nearer to the apex of the cell than to the base of the first subcostal, third subcostal originating rather nearer to the apex of the wing than of the cell; upper discoidal nervule given off from the subcostal some distance beyond the apex of the cell; middle discocellular nervule nearly straight (slightly concave), upright, lower discocellular longer than the middle discocellular, concave, slightly outwardly oblique; second median nervule given off before the end of the cell; submedian nervure straight. Hindwing large, broadly ovate, the extremity of the first median nervule elongated into a fine tail, variable in length (very short in the European *quercûs*, Linn., and entirely absent in *khasia*, de Nicév.), and the anal angle produced into a larger or smaller anal lobe; first subcostal nervule arising from the subcostal nervure rather near to, but before, the apex of the cell; discocellular nervules nearly in one straight line, outwardly oblique, the upper rather shorter than the lower; second median nervule arising just before the lower end of the discoidal cell. Eyes hairy. Antennæ clavate, the club very gradually formed. Palpi somewhat long, obliquely porrected, the third joint horizontal, the second joint very bristly beneath, third joint naked.

Larva short, thick, onisciform, tapering towards each end, clothed with fine short hairs.

Pupa short, thick, rounded.

One of the most interesting features of the imagines of this tribe is the marked sexual colour dimorphism that occurs in the group. The general appearance presented by the sexes of *Bithys quercûs* may be taken as characteristic of the Bithynid section, but one can hardly say that the parallel characteristics of the Ruralid section are equally well shown by the sexual difference exhibited by *Ruralis betulae*, for few, if any, of the species have so much dark brown as has this in the ♂, although the tendency to develop more orange, at the expense of the brown, is throughout more marked in the female than in the male. One of the most striking features of the females of the Bithynid group, is the development of two (or three) pale (orange or whitish) spots just beyond the discal cell, forming what one may call the "*bellus*" type. This feature is characteristic of the Bithynid female throughout, and the study of its modifications leads one to suspect it to be a very ancestral marking of the species of this group.

Gynandromorphism appears to be a very rare phenomenon among the "hairstreaks." Among the Ruralines we are able to record the following:

1. *Bithys taxila*, Rühl, "Pal. Gross-Schmett.," i., p. 321 (1893).—Left ♀, right ♂. Found near Nikolajewsk.
2. *Bithys quercûs*, Junkel, "Iris," xviii., p. 26, pl. i., fig. 6 (1905).—Ground colour of ♂, with dark hindmarginal band of ♂, in addition ♀ purple patch on right forewing. Bred from larva taken near Lauterbach.
3. *Bithys quercûs*, "Ent.," xxxiii., p. 157.—Right ♂, left ♀.
4. *Ruralis betulae*, Wiskott, "Iris," pl. x., fig. 4, pp. 379-80 (1897).—Right ♂, left ♀. Bred at Hamburg.
5. *Ruralis betulae*.—Left side ♂, right side ♀. Bred at Eperjes (Aigner-Abafi, *in litt.*, 21, iii, 1907).

Among the Strymonids, two gynandromorphs of *Nordmannia ilicis* have been recorded, *viz.*:

1. Incomplete gynandromorph; ♂ and ♀ markings irregularly mixed; abdomen ♀. Bred at Parchwitz, Silesia [Wiskott, *Lep.-Zwitt.*, p. 10 (1897)].
2. Incomplete gynandromorph; preponderantly ♂ in coloration, with a large orange ♀ spot on the left forewing; shape of body ♂. Locality unknown; from the Karstanjen Collection, in Leipzig [Wiskott, *op. cit.*].

Genus: Bithys, Hübner.

Synonymy.—Genus: **Bithys**, Hb., "Verz.," p. 75 (1816-1818); Stphs., "Illus. Brit. Ent. Haust.," iv., app. p. 404 (1835); "List," 1st ed., p. 16 (1850); 2nd ed., p. 15 (1856); Tutt, "Ent. Rec.," xviii., pp. 131-2 (1906). [**Papilio-**] **Plebeius**, Linn., "Sys. Nat.," 10th ed., p. 482 (1758). **Papilio**, Linn., "Faun. Suec.," 2nd ed., p. 283 (1761); Müll., "Faun. Frid.," p. 36 (1764); Hufn., "Berl. Mag.," ii., p. 62 (1766); Schiff., "Schmett. Wien.," 1st ed., p. 186 (1775); Fuess., "Verz.," p. 31 (1775); Müll., "Zool. Dan. Prod.," p. 36 (1776); Fuess., "Mag.," i., pt. 2, p. 262 (1778); Geoff., "Ent. Paris.," p. 243 (1785); Schneid., "Sys. Besch.," p. 221 (1785); Lang, "Verz.," ii., p. 47 (1789); Bork., "Sys. Besch.," i., pp. 136, 265 (1788); "Rhein. Mag.," i., p. 295 (1793); Hb., "Eur. Schmett.," pl. lxxiii., figs. 369-370 (1799); text p. 56 (*circ.* 1805); "Raupen," etc., Pap. I., Gens A, *c. d.*, figs. 2*a-c* (*circ.* 1800); Ill., "Schmett. Wien.," 2nd ed., p. 279 (1801); "Ill. Mag.," iii., p. 203 (1803); Herbst, "Nat. Syst. Ins.," xi., p. 67, pl. 306, figs. 1-4 (1804); Ochs., "Die Schmett.," i., pt. 2, p. 96 (1808). [**Papilio-Plebeius-**] **Ruralis**, Linn., "Syst. Nat.," 12th ed., p. 788 (1767); Fab., "Sys. Ent.," p. 521 (1775); Bergs., "Nomen.," p. 58, pl. xxxvii., figs. 4-5 (1778); Goeze, "Ent. Beit.," p. 10 (1780); Fab., "Spec. Ins.," p. 118 (1781); "Mant. Ins.," p. 69 (1787); Brahm, "Ins.-Kal.," p. 375 (1791); Schwarz, "Raup.-Kal.," i., p. 47 (1791); Haw., "Lep. Brit.," p. 38 (1803). [**Plebeius-**] **Ruralis**, Esp., "Schmett. Eur.," p. 262, pl. xix., figs. 2*a*, *b*, *c* (cum *larv.* et *pup.*) (1777). [**Papilio-**] **Ruralis**, de Vill., "Car. Linn. Ent. Faun. Suec.," p. 63 (1789). [**Hesperia-**] **Ruralis**, Fab., "Ent. Syst.," iii., pt. 1, p. 278 (1793); Panz., "Schaeffer's Icones," etc., 2nd ed., p. 147, pl. clviii., figs. 4-5 (1804). **Cupido**, Schrk., "Faun. Boica," ii., p. 218 (1801). **Polyommatus**, Latr., "Hist. Nat. Crust. Ins.," xiv., p. 117 (1805); "Gen. Crust. Ins.," iv., p. 207 (1809); "Consid.," etc., p. 206 (1810); "Enc. Méth.," ix., p. 651 (1819); Godt., "Hist. Nat.," p. 190, pl. ix *tert.*, fig. 3, pl. ix *sec.*, fig. 1 (1821); Bdv., "Eur. Lep. Ind.," p. 10 (1829). **Thecla**, Fab., "Ill. Mag.," vi., p. 286 (1807); Oken, "Lehrb. Zool.," ii., p. 722 (1815); Leach, "Edin. Encycl.," ix., pt. 1, p. 129 (1815); Ochs., "Die Schmett.," iv., pt. 1, p. 27 (1816); Sam., "Ent. Comp.," p. 241 (1819); Stphs., "Ill. Haust.," i., p. 76 (1828); "Ins. Cat.," 1st ed., p. 20 (1829); Meig., "Eur. Schmett.," pt. 2, p. 47 (1830); Dup., "Hist. Nat.," supp. i., p. 387 (1832); Ramb., "Faun. And.," p. 260 (1839); Wood, "Ind. Ent.," p. 7, pl. ii., fig. 54*a* (1839); Bdv., "Gen. et Ind. Meth.," p. 8 (1840); Humph. and Westd., "Brit. Butts.," p. 86 (1841); Dup., "Cat. Méth.," p. 29 (1845); H.-Sch., "Sys. Bearb.," i., p. 137 (1843); Westd. and Hewits., "Gen. Diurn. Lep.," ii., p. 487 (1852); Led., "Verh. zool.-bot. Gesell.," p. 9 (1852); Gerh., "Schmett.," etc., p. 4, pl. iii, figs. 3 *a-c*, pl. iv., fig. 2 (1853); Sta., "Man.," i., p. 54 (1857); Speyer, "Geog. Verb. Schmett.," p. 260 (1858); Ramb., "Cat. Lep. And.," p. 33 (1858); Hein., "Schmett. Deutsch.," p. 94 (1859); Dbldy., "Syn. List," 2nd ed., p. 2 (1859); Staud., "Cat.," p. 3 (1861); Kirby, "Eur. Butts.," i., p. 87 (1862); Snell., "De Vlind.," p. 67 (1867); Nolck., "Lep. Fn. Estl.," pt. 2, p. 51 (1868); Newm., "Brit. Butts.," p. 106 (1869); Butl., "Cat. Diurn. Lep.," p. 182 (1869); Staud., "Cat.," 2nd ed., p. 7 (1871); Curò, "Bull. Soc. Ent. Ital.," vi., p. 107 (1874); Frey, "Lep. Schweiz," p. 11 (1880); Lang, "Butts. Eur.," p. 81, pl. xviii., fig. 2 (1884); Kane, "Eur. Butts.," p. 24 (1885); Buckl., "Larv.," etc., i., p. 185, pl. xiii., fig. 2 (1885); Dale, "Hist. Brit. Butts.," p. 40 (1890); Barr., "Lep. Brit. Isles," i., p. 51, pl. viii., figs. 3-3*c* (1893); Rühl, "Pal. Gross-Schmett.," i., p. 190 (1895); Meyr., "Handbook," etc., p. 344 (1895). **[Zephyrus-]Aurotis**, Dalm., "Vet. Ak. Handl.," i., p. 90 (1816). **Lycaena**, Evers., "Faun. Volg.-Ural.," p. 65 (1844). **[Thecla-]Bithys**, Stphs., "List," 1st ed., p. 16 (1850); 2nd ed., p. 15 (1856). **Zephyrus**, Wallgrn., "Skand. Dagf.," p. 181 (1853); Kirby, "Syn. Cat.," p. 403 (1871); "Eur. Butts.," p. 58, pl. xv., fig. 6 (1879); Auriv., "Nord. Fjär.," p. 7, pl. vii., fig. 6 (1888); Tutt, "Ent. Rec.," vii., pp. 220, 300 (1895); "Brit. Butts.," p. 199, pl. i., fig. 12 (1896); Kirby, "Handbook," etc., p. 67, pl. xliv., figs. 4-6 (1896); Reut., "Ent. Rec.," x., p. 97 (1898); Staud., "Cat.," 3rd ed., p. 71 (1901); Lamb., "Pap. Belg.," p. 197 (1902); Wheeler, "Butts. Switz.," p. 47 (1903). **Aurotis**, Scudd., "Hist. Sketch Gen.," p. 127 (1875); Grote, "Schmett. Hildesheim," p. 41 (1897).

The above synonymy shows that, until 1816, *quercûs* was generally lumped with the other "hairstreaks," under the name *Ruralis*, *Polyommatus*, or *Thecla*. In this year, Dalman created (*Vet. Ak. Handl.*, pp. 48 *et seq.*) the comprehensive group name, *Zephyrus*, for the whole of the Ruralids, dividing it into three sections—*Aurotis*, *Heodes*, and *Cyaniris*, for the "hairstreaks," "coppers," and "blues" respectively, and fixed "*betulae*," one of the species in the *Aurotis* section, as the type of the whole group. The species *betulae*, therefore, as the common type of *Aurotis* and *Zephyrus* reduced *Aurotis* at once to the position of being a synonym of *Zephyrus*, and as, in 1781, *betulae* had been fixed as the type of *Ruralis*, by Barbut, *Zephyrus* itself fell as a synonym of *Ruralis*. It is also to be noted that, in 1821, Swainson fixed *betulae* as the type of *Thecla*, Fab., thus reducing this also as a synonym of *Ruralis*. *Aurotis*, *Zephyrus*, *Thecla*, and *Ruralis*, all, therefore, stand for the same genus, of which *betulae* is the type. This makes all these names impossible for the genus of which *quercûs* is the type, and leaves the later name *Bithys*, Hb., in undisputed possession.

The genus *Bithys* was created (*Verzeichniss*, p. 75) by Hübner, for a most mixed lot of species, chiefly exotic, and gathered from Cramer's figures, but containing at least two, *leucophaeus* and *quercûs*, of which he appears to have had personal knowledge. His diagnosis of the group reads:

The wings beneath pale and shaded with grey, ornamented with a white line and reddish-yellow spots—*Bithys tyrrhenus* (*erix*, Cram., 82, B). *B. cubentus*, Cram., 337, F-G. *B. cethegus*, Stoll., 38, 5, 5, E. *B. vesulus*, Cram., 340, J-K. *B. sicheus*, Cram., 144, C-D. *B. lydus* (*eryx*, Cram., 143, D). *B. tephraeus*. *B. leucophaeus*, Hübn., *Zutr.*, 87-88. *B. sphinx*, Fab., *Syst. Pap.*, 329 (*dindymus*, Cram., 46, F-G). *B. strephon*, Fab., *Syst. Pap.*, 344 (*cyllarus*, Cram., 27, C-D). *B. quercûs*, Linn., *Syst. Pap.*, 222; Hübn., *Pap.*, 369, 370, 368.

In 1835, Stephens used (*Illus.*, iv., app. p. 404) the generic name only for *quercûs*, thus making this the type. In 1850, he uses (*List*, p. 16) it in the same manner, whilst, in 1858, Kirby, in his little *List Brit. Rhop.*, also uses it for *quercûs*. In 1869, Butler goes back on this, and uses the name for *strephon*, Fab., *cyllarus*, Cram., *agrippa*, Fab., and *dindymus*, Cram. In 1875, Scudder notes (*Hist. Sketch of Genera*, p. 127) that "the usage of Stephens and Kirby is indefensible, as *quercûs* must belong to *Aurotis*," but we have already shown that Leach himself made *betulae* the type of *Aurotis* and *Zephyrus*, and that both fall before *Thecla* and *Ruralis* (with the same type). In suggesting, therefore, "*strephon*" as the type of *Bithys*, he is much too late, and his action altogether *ultra vires*. Scudder's note (*op. cit.*) on *Aurotis* is equally illogical. He rightly points out that, in 1816, Dalman founded this as a subgenus of *Zephyrus* for *quercus*, *betulae* (type), *pruni*, *w-album*, and *ilicis*, and that Dalman names *betulae* as type. He then says that "the last three of Dalman's species (*suprà*) belonging to *Thecla*, after the foundation of *Zephyrus*, *quercûs* must be taken as the type of *Aurotis*, if it is generically distinct from *betulae*, if not, *Aurotis* falls," *i.e.*, Dalman having made *betulae* the type of the subgenus *Aurotis* and the genus *Zephyrus*, Scudder, 60 years after, says that *quercûs* and not *betulae* is the type of *Aurotis*, because *pruni*, *w-album*, and *ilicis* belong to *Thecla*, which to us is; to say the least, a remarkable conclusion.

The Bithynid species are very characteristic and somewhat easily recognised as such, and one supposes that they are capable of subdivision into various natural groups. We find ourselves unable to deal with, or to follow, the material as at present arranged in the British Museum collection, and feel satisfied that some confusion occurs in the "*orientalis*" section, especially among the females. A revision of the entire group is altogether outside the scope of this work, although undoubtedly needed, and a few general remarks on some of the more characteristic species is all that is possible. The general characters of the sexes are well exhibited in *Bithys quercûs*, the males being almost uniformly metallic in tint on the upper surface, chiefly purple or green, the females with a brighter metallic blotch towards the base, in the discoidal cell and the interneural space below, with usually two (or three) pale spots outside the cell. This sexual colour dimorphism in the Bithynids is most interesting, and, certainly, one of the most striking features is the appearance of the two pale spots (orange or white) just noticed. These produce a peculiar appearance, which we may well call the "*bellus*" type, as European collectors know the marks as a rare form of aberration =ab. *bellus*, Gerh., in female *B. quercûs*. It also occurs as a rare aberration in *taxila*, Brem., but becomes normal in *icana*, Moore, *dohertyi*, de Nicév., *paro*, de Nicév., *ataxus* ♂, Hew. (+*katura* ♀, Hew.). In *tsangkie*, Obth., they are united. In other species the metallic patch at the base of the wing disappears, and the spots, separate (*hecale*, Leech) or united (*duma*, Hew., *coruscans*, Leech), remain as the only ornament. In all these species the spots are orange. In other species they become pale, and in some are lost almost altogether. The following grouping of some of the species may prove interesting:

A. Hindwing not furnished with a tail; apex of the median nervule only toothed —*khasia*, de Nicév.
B. Hindwing with the apex of the first median nervule of hindwing developed into tail—
  a. Violet-based ♀s.
    a. ♀s of the "*quercûs*" type (metallic basal patch only)—*quercûs*, Linn., *taxila*, Brem.
    b. ♀s of the "*bellus*" type (orange spots in addition)—*icana*, Moore, *dohertyi*, de Nicév., *pavo*, de Nicév., *ataxus*, Hew. (+*katura*, Hew.), *brillantina*, Staud., *japonica*, Murr., etc.
    c. ♀s of "increased *bellus*" type (orange spots united) —*tsangkie*, Obth, etc.
  b. Black ♀s.
    a. ♀s of the "*bellus*" type (with orange spots)—*hecale*, Leech.
    b. ♀s of "increased *bellus*" type (with united spots)—*duma*, Hew., *coruscans*, Leech.
  c. Blue ♀s.
    a. ♀s of the "*bellus*" type (with pale or whitish spots)—*syla*, Koll., *birupa*, Moore, *ziha*, Hew.
  d. Grey ♀s.
    a. ♀s of the "*bellus*" type (with pale spots)—*orientalis*, Murr.
    b. ♀s almost unicolorous—*saphirina*, Staud.

Many species we have here not attempted to group, being doubtful, in some instances, whether the females in the British Museum collection belong to the males with which they are placed. Nicéville gives an excellent grouping, as far as his material goes, of the males of the Indian species, and notes also the characteristic markings of the underside (*Butts. of India*, iii., p. 301). Of these the species are:

Brilliant metallic green on upperside of all wings—*khasia*, de Nicév., *zoa*, de Nicév., *ataxus*, Hew., *absolon*, Hew., *duma*, Hew., *syla*, Koll., *birupa*, Moore.

Metallic green in some lights, purple in others—*icana*, Moore, *dohertyi*, de Nicév.

Obscure violet at base of forewing only, otherwise entirely black—*mandara*, Doh.

Blue or purple on disc and base, with two spots on disc placed obliquely—*ziha*, Hew., *pavo*, de Nicév.

It is possible that the last-named section, in which the pale discal spots occur in both sexes, forms one of the older groups, the ♀s only, in most of the other species, retaining these characteristic markings, the ♂s having specialised in an entirely different direction, whilst, in other species, *e.g.*, *taxila*, *quercûs*, etc., the marking only rarely occurs as a memory of the former markings of the ♀. Gebhard (*Soc. Ent.*, xii., p. 132) mentions a ♂ *B. quercûs* with these "*bellus*" spots (see *posteà* p. 239).

The undersides of some of these Bithynid species are as beautiful in their pearly-grey markings of different shades, *e.g.*, *ataxus* ♂ (*katura* ♀), etc., as the uppersides are sparklingly brilliant.

As affecting purely European lepidopterists, the distribution of the species is most interesting, for our single species, *B. quercûs*, common over the greater part of Europe, Mauretania, and Asia Minor, does not enter at all into Asia proper, the metropolis of the genus. De Nicéville states that thirteen species occur in the hills of northern India, and Staudinger and Rebel (*Cat.*, 3rd ed., p. 71) note ten from northeastern Asia (including north China), but this means little, for, at present, the species appear to be not properly distinguished, many of the ♀s are joined to ♂s by a system that may be termed mere guesswork, and the life-histories of the species are an absolute blank. One wonders why it works out that these beautiful butterflies live at one end of the Palæarctic region, whilst the students of them live at the other.

How many natural genera these beautiful butterflies will fall into, when one is able to pair off certainly the sexes of all of them, and know the details of their life-histories, etc., one cannot even guess. At present, we can only add a diagnosis of the genus *Bithys* (based on *quercûs* as type), for which we are again indebted to Mr. Bethune-Baker, and leave it to future entomologists to eliminate those species which cannot be united in the same little section as *quercûs*, and place them then in different genera. This diagnosis is as follows:

Head moderate in size, clothed with longish rough hairs, interspersed with shorter finer ones. Face slightly curved, almost level with the eyes, hairy. Eyes largish, prominent, hairy. Antennæ of moderate length, inserted in a scaled socket at the apex, almost over the eyes, ending in a very gradually tapered club (club decidedly longer than in *Callophrys*). Palpi slight, porrect, not as long as the face, fringed with hairs below, end segment short. Patagia short, narrow, tapering rapidly, hairs fine, erect. Primaries broad, less than a third longer than broad, costa evenly arched, more sharply arched at the extreme base, termen nearly straight. Secondaries large, truncate at apex, slightly scalloped to the tail. Neuration.—Primaries, vein 2 from a quarter before the lower angle, 3 from below the lower angle, 4 from the angle, 5 from above the middle of the discocellulars, 6, 7, and 8 stalked, 6 from just beyond the upper angle, 7 and 8 close to the apex, 9 absent, 10 from close to the end of the cell, 11 from beyond the middle of the cell. Cell broad, fairly even in width, fully half the length of the wing. Secondaries, two internal veins, vein 2 from well before the angle, 3 and 4 from the angle, 5 from about the middle of the discocellulars, 7 from the cell, 8 highly curved upwards to the costa, then suddenly following a parallel course just below the costa. Legs, ♂, with tarsi and tibiæ of equal length, the front tarsi not fully developed, terminating almost as the other legs, but without the claws; in the ♀ the tarsi terminate as the other legs. Mid pair tibiæ with a short pair of spurs, hind legs tibiæ with no spurs. Genitalia.—Clasps fairly ample, evenly curved from the base on the inner side up to the lobe at the extremity, where the curve is sharper; basal side short, slightly curved, outer side waved, terminating at each apex in a sharp tooth, the upper apex suddenly angled and then curved and extended into the narrow lobe. Girdle erect, slight, nearly as long as the very ample tegumen, of which it forms the lower part. Tegumen broad, hood-shaped, of equal width, terminating at its lower outer extremities into strong falces, which are coupled on in a broad spatulate shape, which suddenly tapers off into strong, curved, rather short hooks. Penis-sheath large, broad, very slightly expanding. Orifice suddenly expanding, serrated above and below.

Bithys quercûs, Linné.

Synonymy.—Species: **Quercûs**, Linn., "Syst. Nat.," 10th ed., p. 482 (1758); "Faun. Suec.," 2nd ed., p. 283 (1761); Müll., "Faun. Frid.," p. 36 (1764); Linn., "Syst. Nat.," 12th ed., p. 788 (1767); Fab., "Sys. Ent.," p. 521 (1775); Schiff., "Schmett. Wien.," 1st ed., p. 186 (1775); Fuess., "Verz.," p. 31 (1775); Harris, "Eng. Lep.," p. 6 (1775); Müll., "Zool. Dan. Prod.," p. 36 (1776); Esp., "Schmett. Eur.," p. 262, pl. xix., figs. 2*a-c* (cum *larv.* et *pup.*) (1777); Bergs., "Nomen.," p. 58, pl. xxxvii., figs. 1-5 (1778); Goeze, "Ent. Beit.," p. 10 (1780); Fab., "Spec. Ins.," p. 118 (1781); Geoff., "Ent. Paris.," p. 243 (1785); Schneid., "Sys. Besch.," p. 221 (1785); Fab., "Mant. Ins.," p. 69 (1787); Bork., "Sys. Besch.," i., pp. 136, 265 (1788); de Vill., "Car. Linn. Ent. Fn. Suec.," p. 63 (1789); Lang, "Verz.," i., p. 47 (1789); Brahm, "Ins.-Kal.," p. 375 (1791); Schwarz, "Raup.-Kal.," p. 47 (1791); Fab., "Ent. Syst.," iii., pt. 1, p. 278 (1793); Bork., "Rhein. Mag.," i., p. 295 (1793); Lewin, "Ins. Gt. Brit.," p. 90, pl. xliii., figs. 1-5 (1795); Hb., "Eur. Schmett.," pl. lxxiii., figs. 369-370 (1799); text, p. 56 (*circ.* 1805); "Raupen," Pap. I., Gens A, *c*, *d*, figs. 2*a-c* (*circ.* 1800); Ill., "Schmett. Wien.," 2nd ed., p. 279 (1801); Schrank, "Faun. Boica," ii., p. 219 (1801); Haw., "Lep. Brit.," p. 38 (1803), etc.

BITHYS QUERCÛS.

Photo. H. Main and A. E. Tonge.

PLATE X.

(To be bound facing Plate X.)

BITHYS QUERCÛS.

FIG. 1.—Ovum *in sitû* on oak-twig ×5.

FIG. 2.—Ova ×10.

FIG. 3.—Larva on foodplant ×1.

FIG. 4.—Pupa (ventral and dorsal views) ×2.

FIG 5.—Imago ×1.

(Figs. 1 and 4 by H. Main, the others by A. E. Tonge.)

[N.B.—All other references mentioned under the generic synonymy (*anteà*, pp. 230-231) are referable to *quercûs*.]

ORIGINAL DESCRIPTION.—*Papilio Plebeius quercûs*, alis subcaudatis, supra cæruleis, subtus cinereis linea alba, puncto ani gemino fulvo. Pet., "Gaz.," t. 11, f. 9. Ray, "Ins.," 129, no. 8. Alb., "Ins.," t. 54, f. a. b. Roes., "Ins.," i., Pap. 2, t. 9. Wilk., "Pap.," 61, t. 1, a. 1. Habitat in Quercu. DESCR.: Alæ omnes supra fuscæ disco cærulescente. Subtus omnes canescentes; linea transversa repanda alba; posterius caudatæ et ante caudam ocello gemino fulvo: pupilla nigra (Linné, *Sys. Nat.*, 10th ed., p. 482).

IMAGO.—31mm.-37mm. ♂. All the wings of a deep purple, extending to the somewhat narrow, marginal, black border; the costa of the hindwings also black; the outer margin of hindwings slightly crenulate; the caudal appendages white-tipped; fringes of all wings greyish-white. ♀. Brownish-black, the forewings with a double violet patch, the upper portion filling up discoidal cell, the lower portion in the space beneath extending towards the anal angle; the hindwings wholly black-brown, rather paler than forewings; fringes rather whiter than in ♂. Underside of both sexes grey, with a well-developed white line, edged internally with dark grey, crossing all the wings; a rather dark grey antemarginal band, edged on either side with paler, darker towards the anal angle of forewings, and containing an orange-coloured, ocellated (black-centred) spot in hindwing, and orange anal patch, edged inferiorly with black, at anal angle of hindwings; discoidal lunule well marked in all wings.

SEXUAL DIMORPHISM.—There appears to be some little difference in the outline of the forewings in the sexes, those of the female rather shorter and squarer than those of the male. The colour-difference in the sexes is most marked, that of the male being purple, and extended all over the wings, except the outer-marginal band, which is black; in the female the colour is brighter, violet rather than purple, and limited to the discoidal cell and the area between the nervures, although it sometimes spreads into the cell above. The examples in the British Museum collection suggest that the ♂s are rather larger than the ♀s—the smallest ♂ being 35mm., the largest 40mm.; the smallest ♀ 28mm., the largest 37mm.

GYNANDROMORPHS.—The following are the only records we have of gynandromorphic examples:

1. Right side ♂, left side ♀. Sold with the "Stevens" collection, March 27th, 1900. £3 15s. (*Entom.*, xxxiii., p. 157). This example was figured by Mosley, *Illus. Vars. Brit. Lep.*, *Thecla* pl. i., fig. 4 (1880).

2. Left side ♂, right side ♀. Ground colour of all the wings that of the ♂ sex; all the wings also have the dark ♂ hindmarginal band; the right forewing shows in addition the purple ♀ patch, but the lower lobe of the patch does not run even half across the wing. The abdomen appears rather stout. Bred by Junkel, June 26th, 1902, from a larva taken near Lauterbach, near Crimmitschau (*Iris*, xviii., p. 26, pl. i., fig. 6).

COLOUR OF BITHYS QUERCÛS.—The very slight prominence of the teeth, and the general flatness of the scales in the iridescent glossy areas, would suggest that this flatness, by scattering less the superficially reflected light and reflecting it more in mass, gives this species its glossy appearance. All the dark brown of this insect seems to be certainly due to pigment-granules in the scales, but I also notice that the more superficial scales which give the purple colour (undoubtedly by dispersion of light) are also coloured pale yellow or yellowish-brown. Is it not probable that this yellow pigment explains the purple colour? When white light is dispersed by the striæ of the scales, may not the yellow light combine with the dispersed blue—its complementary colour—and form white light, whilst the remaining waves of red and violet mix to form the purple we see? How else can we explain the purple? If this be the case, does not pigment, even in *B. quercûs*, play by far the largest part in the production of colour? I may add that the brown scales and yellow scales are different, the brown have teeth, and are more finely striated (in the proportion of 3 to 2) than the yellow; the latter have *no* teeth, and, therefore, would not scatter the light, but reflect it more in mass; the striæ are also more raised, and the white scale has the appearance of being distended with air. The test as to whether interference is the cause of colour is the variability of the colour at varying angles of the incident light, but, as I have endeavoured to show, in the case of *B. quercûs*, interference alone does not explain the purple gloss, but, plus pigment, it helps to do so (Riding). [*See* "Discussion on the nature of certain insect colours," *Ent. Rec.*, vi., pp. 204 *et seq.*; pp. 255 *et seq.*]

Pathological example.—The following is the only specimen that we have noted:—

Male with a patch of flesh-coloured scales at angle between the outer margin and inner margin of right hindwing (Studd, *in litt.*, 23, iii, 1907).

Variation.—The males only vary in the amount and intensity of the purple gloss on the wings, some examples being much brighter than others, *i.e.*, of a slightly more violet tint, and in only two specimens have we seen what may be really termed colour aberrations. These are in the British Museum collection. One is labelled "Veluchi, Greece, 1863," and has the tint, instead of the usual purple, of a pale blue-grey, in some lights almost green-grey =ab. *pallescens*, n. ab., not unlike that sometimes seen in males of *Agriades corydon*, the other specimen is from "Jena, 1852"; in this, the tint, although quite pale compared with the type, is yet distinctly of a rather bluer-grey hue than the example from Veluchi. Both these males are beyond average size. The females also differ but little in tint; occasionally a specimen is of rather brighter violet than usual, and, rarely, one is a shade redder, *i.e.*, the variation is merely slightly in the direction of a bluer- or redder-violet respectively; the area is sometimes slightly increased towards the centre of the wing. Morton records (*Ent. Mo. Mag.*, xxxiv., p. 1) a female in which the violet of the upperside of the forewings is replaced by a beautiful metallic blue, that was taken in July, 1897, in the New Forest. In one specimen in the British Museum collection, labelled "Germany, Leech coll.," the upper portion of the patch, normally found in the discoidal cell, is entirely absent, the lower half, however, normal in tint and extent =ab. *semi-obsoleta*, n. ab. Raynor states that he has a female, bred at Hazeleigh, July 5th, 1904, in which the purple colour of the forewing is so much reduced as to be hardly noticeable =ab. *obsoleta*, n. ab. Among the females one finds various stages in the development of what is known as the *bellus* form. This latter has three small separate orange-coloured patches towards the upper outer margin of the violet-coloured area. In the British Museum collection is a large female from Greece, "Veluchi, 1863," with the faintest possible trace of an orange or brown patch just outside the discoidal cell =ab. *bellus-obsoletus*, n. ab. A rather small example, labelled "Buda-Pest, Leech coll.," has the same spot wedge-shaped, and very brightly marked =ab. *bellus-unipunctus*, n. ab. Norgate also records (*Ent.*, vii., p. 69) a female, captured August 1st, 1874, at Drayton Drury, in Norfolk, that has a wedge-shaped orange spot above the centre of each forewing (on the upperside); the small end of the orange wedge is directed towards the tip of the wing and the large end towards the base. He says (*in litt.*) that he captured five *B. quercûs* from the top of one oak, that one ♀ had a distinct (=ab. *bellus-unipunctus*), and the other an indistinct, orange spot in the middle of the upperside of each forewing=ab. *bellus-obsoletus*. Another ♀ in the British Mus. coll., somewhat smaller, labelled "Silesia, Elwes coll.," has two orange spots, the wedge-shaped one as just described, and another just below and a little outside (on the right forewing there is a vague suspicion of a third spot below the second)=ab. *bellus-bipunctatus*, n. ab. Raynor notes (*in litt.*) that he has an example, bred at Colchester, July, 1901, by Harwood, with a conspicuous orange spot at the end of the discal cell, on upperside of forewings, also a fainter cloud between the orange spot and the outer margin, evidently, therefore, of the *bipunctatus* form. Another specimen labelled "Buda Pest. Leech coll." has the three orange-coloured spots that characterise the true *bellus*, Gerh., so also has a second, and somewhat larger example, labelled "Austria. Leech coll." The most remarkable specimen, however, of this series is one labelled "Ber. Leech coll.," in which not only are the three usual spots of *bellus* well developed, but, in addition, a well-marked brown streak runs along the inner margin from the anal angle, rather more than half-way towards the base=ab. *bellus-excessus*, n. ab. The most marvellous specimen of the *bellus* type that has been recorded is, however, a male (the character throughout the group being almost entirely a female one) bred by Gebhard, who notes (*Soc. Ent.*, xii., p. 132) that he bred a male, from a larva taken at Klopfen, in which the iridescent violet of the upperwings had beautiful yellowish-brown spots, leading one to believe it identical with var. *bellus*. The size variation of the species is considerable, and there is a tendency for specimens bred in confinement to be rather small. Wheeler says that the average size of Swiss examples is 34mm., but they are sometimes captured as small as 29mm. The largest examples in the British Museum collection are males labelled respectively "Lenkoran, 30. vi. '74 (Christoph)," "Veluchi. 1863 (Merlin coll.)," and "Jena. 1852 (Schläger) (Zell. coll.)." The last two have been noted as ab. *pallescens* (*suprà*). Staudinger also describes the specimens from the Parnassus as larger than, but, otherwise, very similar to, German specimens. Rebel states that the examples he took on the Calvarienberg, near Botzen, were very large. Graves observes (*Ent. Rec.*, xix., p. 67) that Marsden's collection contains large specimens up to 42mm. in expanse, taken on Mount Troodos in late July. We would call all specimens below 30mm. ab. *minor*, n. ab., and above 38mm. ab. *major*, n. ab. There is also considerable difference in the depth of the ground-colour and markings of the underside, some of the ♀s being particularly pale, almost whitish-grey, others have a faint brownish tinge; the intensity, width, and completeness of the white transverse line, as well as the dark border, vary considerably, so also does the depth of the colour of the antemarginal band, particularly in the forewings. Courvoisier speaks (*Mitt. Schw. Ent. Ges.*, xi., p. 24) of a "forma latefasciata," in the ♂, in which the "Thecla-stripe" on the underside is strikingly broad. The unusual development of orange in the antemarginal band of the underside of the forewings, especially towards the anal angle, is sometimes sufficient to merit distinction = ab. *aurantia-excessa*, n. ab. Strangely, the best marked examples of this form in the British Museum collection are all labelled "England." In the hindwings, the size of the orange ocellated spot, and patch at the anal angle, as well as the intensity of the orange tint, shows considerable variation. The southern race, var. *iberica*, is comparatively faintly marked on the underside, the characteristic markings being more or less obsolete. Barrett notes that there is, in the "Webb coll.," a ♂ having dashes of blue on the costal margin from the middle nearly to the apex. We have a male, taken at Digne, August, 1906, with a small spot of the bright violet colour of the female, about $\frac{1}{16}$ of an inch square, on the right forewing, towards the base, and not far from the inner margin. The only hitherto described forms appear to be as follows :—

a. ab. *bellus*, Gerh., "Schmett.," etc., p. 4, pl. iv., fig. 2 (1853); Staud., "Cat.," 2nd ed., p. 7 (1871); Kane, "Handbook," etc., p. 21 (1885); Rühl, "Pal. Gross-Schmett.," pp. 191, 739 (1893); Carad., "Iris," viii., p. 33 (1895); Tutt, "Brit. Butts.," p. 200 (1896); Gebh., "Soc. Ent.," xii., p. 132 (1897); Staud., "Cat.," 3rd ed., p. 71 (1901); Lamb., "Pap. Belg.," p. 198 (1902). *Quercûs* var., Hb., "Beitr.," ii., p. 83, pl. iv., fig. 1 (1786-9); "Eur. Schmett.," pl. cxxi., fig. 621 (1805). *Bella*, Wheeler, "Butts. Switz.," p. 47 (1903); South, "Butts. Brit. Isles," p. 141 (1906).—Hübner has already figured this beautiful aberration; but it is scarce. Lederer kindly sent me this form, and from his example my figure was made. Hübner's figure is too highly coloured (Gerhard).

Gerhard's original figure (*Schmett.*, pl. iv., fig. 2) is a female, the normal violet basal area of a bright blue; a double orange spot at the end of the discoidal cell, *i.e.*, touching the external edge of the upper portion of the brightly coloured basal area, with a third orange spot rather lower and further out towards the margin. [In the copies of Gerhard's work consulted (those of the Natural History Museum and the Zoological Society of London), the orange-coloured spots have unfortunately faded, the pigment having entirely changed, but, in Bethune-Baker's copy, the spotting is still bright.] Hübner's figure (*Eur. Schmett.*, fig. 621), too, has the three spots very distinctly marked, one at the end of the discal cell, and two rather outside the lower. This is a most interesting form of the female, showing as it does an atavic connection between this species and those of several allied Asiatic Bithynids, in which similar orange spots occur either, as in this species, as an aberrational form, *e.g.*, *taxila*, etc., or, as a permanent feature of the female, *e.g.*, *icana*, *dohertyi*, *pavo*, *ataxus*, *brillantina*, *japonica*, etc. The specimens of *bellus* in the British Museum collection, although few in number, present characters that suggest the various evolutionary stages between the least and most highly marked specimens exhibiting the development of these orange spots—a series extending through one, two, and three spots, and a further stage with three spots and a marked stripe running parallel with the outer half of the inner margin (see *anteà*, p. 237). The form appears to occur as an occasional aberration throughout the greater part of the range of the species. It is certainly developed in Greece, Hungary, Dalmatia, Germany, Switzerland, France, and England, and possibly elsewhere. It is diagnosed by Staudinger (*Cat.*, 3rd ed., p. 71) as "ab. ♀, alis anterioribus maculis fulvis." Rühl simply notes it as "female, with reddish-yellow spots ('Wische') at end of the discoidal cell." Ochsenheimer notes (*Die Schmett.*, i., pt. 2, p. 98) that "the female aberration with two or three reddish-yellow spots on the upperside of the forewings is very rare," and that he has only obtained it by rearing it from larvæ. Hübner observes (*Beiträge*, etc., ii., p. 83) that the aberration he figured came from Radda of Vienna. Gebhard states (*Soc. Ent.*, xii., p. 132) that he bred a male of *quercûs*, from Klopfen, that had beautiful yellow-brown spots on the iridescent violet forewings, which was identical with var. *bellus*, a most remarkable fact, that wants further elucidation. Our notes on its distribution read as follows: Austria: Slavonia—Pakrac (*teste* Rühl), Hungary, rare—Budapest, Nagyvárad, Pécs, Tavarnok, Pozsony, Lipik (Aigner-Abafi), also in the mountains above Buda (Fountaine). England: Colchester district (Harwood), Drayton Drury (Norgate). France: Maine-et-Loire (Delahaye). Germany: Saxony—Leipzig, the Leina, near Altenburg (*Ent. Ver. Dresden*); Rhine Provinces, near Elberfeld (Gillmer); Brandenburg, very rare with the type—Finkenkrug, Brieselang, Königs-Wusterhausen (Bartel and Herz); Posen—the Eichwald at Posen (Schultz); Silesia, rare with the type in the hills of Wichelsdorf (Pfitzner). Roumania: Grumazesti (Caradja). [Russia: Baltic Provinces—Klopfen (Gebhard).] Switzerland: near Winterthur (Rordorf).

β. ab. *iberica*, Staud., "Cat.," 3rd ed., p. 71 (1901); Lamb., "Pap. Belg.," p. 198 (1902). *Quercûs*, Obth., "Études," etc., i., p. 19 (1876).—Subtus pallidior signaturis evanescentibus. Iberia cent. et merid.; Mauretania (Staudinger).

Oberthur's description, to which reference is made by Staudinger, is as follows: "Diffère un peu du type français par la teinte du dessous, qui est plus pâle, plus grise, et plus effacée. Boghari (Ach. Raffray)" (*Études d'Entom.*, i., p. 19). Miss Fountaine observes that this form swarmed in the oakwoods to the west of Sebdou, early in August, 1904; the examples captured resemble the type on the upperside, but have the white line on the underside very faint and indistinct.

Egglaying.—On December 8th, 1906, I made search, with Mr. Tonge, for eggs of *Bithys quercûs*. We soon met with them, and found altogether two or three dozen or so. We, of course, could only examine the lower branches, on which, therefore, we found that eggs were laid, whether or no they are laid on the higher ones also, we could not determine; we found them up to about 12 feet from the ground, and as low as 3 feet or 4 feet. As regards their place on the twigs, we found them in three situations, most commonly amongst the little group of terminal buds, once or twice at the base of a bud lower down, and several times on the rough ring at the base of the year's growth, where minute buds, very like eggs, were common. When placed on one of the terminal buds, the position was lateral, *i.e.*, rather in the angle between the bud and the central stem, necessarily no doubt, thus to avoid the leaf, which, though now fallen, must have been present when the egg was laid. Sometimes it was on the bud, more often, perhaps, on the bark against a bud. The favourite situation was the south side of the tree, but, with some exceptions, on the north side of the group of buds. One set of branches we found richer than any other we came across; these were some branches spread out on the south aspect of a dense mass of holly, that must not only shelter the oak branches from northerly exposure, but even reflect the sunshine on to them. At this spot, one little double twig, 6 inches long, was found with six eggs, of which two were close together on a small twig on the side of it, next the main branch. On several other occasions two eggs were found on one twig, but always far enough apart to make it probable, if not certain, they were not laid at the same time. These two were also probably laid at different times, the immediate positions being obviously very attractive ones. One or two eggs were found with minute holes in them, too small for a larva to have emerged from, and concluded to be caused by a hymenopterous egg-parasite; another egg, apparently whole, was found, when broken, to be empty except for some mites. A sound egg opened, presented a quite mature young larva (Chapman). The eggs are usually laid upon an oak twig, upon which, in spite of their colour, they are not conspicuous, each looking like a small, inconspicuous, fungoid growth (Tutt). Bignell notes (*Ent.*, x., p. 285) that, on August 29th, 1877, he saw a ♀ at rest on a sallow-bush; pulling down the branch very carefully he observed that she had deposited an egg on the leaf on which she rested. Having boxed the ♀ she obliged him with another egg, which, being compared with the first, was found to be identical.

Ovum.—The eggs are of a bluish-grey colour, varying a good deal in tint, some rather white. They suggest that, when fresh, they were probably white, but gradually acquire a dark tint from rain washing on to them the carbon of honeydew and other colouring matters. Sometimes their colour matched their surroundings so as to make them difficult to see, other specimens were more conspicuous, as pale grey against brown; it is very probable that those whose colour assimilated best to their position very often escaped our observation. There is one other reason for their being at present darker than one suspects they were at first; this is the development of the contained larva, which is dark in tint, and the eggshell proper is a good deal exposed between the walls of the outer raised network, which itself probably takes a tone also from its background. Seen under a hand-lens, the egg looks as if covered with a felting of fine wool or hairs, but a higher magnification shows that the rough coating is a raised netting, usual on Ruralid eggs, with knobbed projections at the angles of intersection. The egg is 0·8mm. wide and 0·42mm. high. These dimensions are to the outside of the ornamental coating, the true egg is decidedly smaller, perhaps 0·75mm. and 0·37mm., probably a little less. Looked at from above, the egg shows a central depression 0·12mm. in diameter. The bottom of this shows a fine network of small cells (the reticulation of the eggshell proper?). There is a central cell, with about seven surrounding it, as a rosette, in the usual way, and round this about four circles of cells fill up the space to the margin. The walls of the cells are comparatively wide (or thick), so that the cells, though arranged approximately hexagonally, are each circular, or nearly so. The four circles are regular in places, but in others so broken that there is, in fact, no complete circle, and one doubts whether they tend to be three, four, or five circles, or are, perhaps, an approach to a spiral. All the cells—the central one, those of the rosette, and the others—are of fairly uniform size, *viz.*, about 0·01mm. The eggshell, as seen in the interspaces of the superficial layer, is somewhat obscured, but seems to present cells of very similar size and arrangement; beneath are similar cells, but of larger size and higher walls, so that one doubts whether they are sculptures of the shell proper or belong to the superficial system, but the continuity of their walls with the superficial layers at the margin, and with similar material that lies thicker in places to attach the egg as a cement to the surface from which the egg has been detached, seems to show that they are of the superficial layer; they are of fairly hexagonal form, their diameter is about 0·02mm. There remains to be described what passes for the most part as *the* egg, *i.e.*, the beautiful sculpturing of the superficial corky layer. Of the eggs collected, the darkest have this considerably damaged, tending to show this was white when fresh, several, however, seem quite perfect. Where best developed, round the shoulder of the egg, this is arranged as high narrow walls enclosing triangular cells; at the angles of intersection are raised pillars with thickened summits; the walls sag a little between these points. As compared with other Ruralid eggs, the chief feature is that the walls seem to be of uniform thickness from top to bottom, and that the bottom of the cells is the eggshell proper, or, if covered by the adventitious, then thinly and uniformly, with no thickening or spreading out of the walls of the cells. Round the micropylar hollow the arrangement is the same, and looks as if this layer were cut off abruptly at its margin, the ends against it having very little rounding, and each wall a little thickened ending separately. Though the arrangement is the same, it is curiously modified, the cells being lengthened radially and narrowed across, just as the meshes of a net are altered, if drawn together at the top of a bag. In these lengthened meshes the transverse walls are wanting centrally, and out to where the wall of the egg begins to slope (if the diameter of the egg be divided into four, the egg is nearly flat, over the two middle ones). It results from the central gathering-in process that about 35 ribs end suddenly against the micropylar hollow, and hardly more cells are found in a circle a little above the margin of the egg. The pillars on the intersection of the ribs or walls form a diamond pattern (two triangles) above, more strictly triangular round the margin. Radially, they are about 0·09mm. apart, circumferentially less, about 0·06mm. at the margin of the flat top, about 0·08mm., both ways, marginally. They are ranged in line, radially, at these distances, alternating in neighbouring rows, but are closer in oblique rows (either way) (engine-turning pattern) (Chapman). Echinoid in appearance. In outline (when viewed laterally) a depressed cylinder with rounded edges. Length : breadth : height, as about 2 : 2 : 1, forming roughly a squat oval in vertical, and a circle, of ·8mm. diameter, in horizontal, section. Its colour is of a yellowish milk-white, somewhat waxen in appearance. The surface is covered with a rough, raised reticulation, formed by two oblique series of curved ribs running from the edge of the apical depression to the base, in opposite directions, thus cutting each other and covering the surface with irregularly-formed diamond-shaped cells, with the cross-points forming markedly prominent knobs; or the surface may be likened to a chain-harrow, in which the blunted teeth (or tines) extend centrifugally, with no regular arrangement of the processes. The apical depression is somewhat hexagonal in shape, its base pitted; the micropylar rosette, placed centrally in the hollow, also hexagonal; the diameter of the apical depression about one-fifth the equatorial diameter of the egg. The diamond-shaped or rhomboidal cells are smaller at the top, and form approximately about sixteen rows from the apex to the base (Tutt, January 18th, 1897). Of the shape common to the Lycænids, but larger than that of any of our British species of "blues," *e.g.*, its wide diameter compared with that of the egg of *Celastrina argiolus*, is as 4 : 3, and this, of course, indicates a considerable increase of bulk; it is round in outline, flattened, and, with the exception of a central depression on the upper surface, covered with irregular oblong reticulation, the lines of which, much more prominent on the top than in any of the "blues," on the sides become so exaggerated that, at the knobs, they stand out like spines, and the egg looks quite like a rough *Echinus* in miniature. The undersurface which rests on the leaf (or stem) is only granulated; the shell under the reticulation apparently has a very pale pinkish-brown tinge; the lines of the reticulation are whitish (Hellins).

Habits of larva.—A larva that hatched on April 1st, 1907, was placed on a hardly developed leaf of *Quercus pubescens* about ·75in. long. At this stage, the leaves of this oak are densely felted with hairs. On April 2nd the larva was half buried in the felting, and ejecting a few pellets of frass. On April 3rd, there is nothing visible of the larva but its anal claspers, the rest being buried in the felt as in a mine, and quite invisible; above the claspers is a little pile of pellets of frass. When nearly fullfed, in the first instar, the larvæ burrow under the tomentum, preferably from below; they also burrow in the thick young tissues, but do not bury themselves beyond a segment or two, eating, however, the whole leaf thickness except one surface. A larva in the second instar, placed on a fresh young leaf ·75in. long, began at once to dig into the centre of the broken midrib. When about half-grown and on young oak-shoots the larvæ of both *Bithys quercûs* and *Nordmannia ilicis* have a habit of hiding by burying themselves on the upperside of a leaf, along the midrib, the petiole being too short to count, with the head pushed as far as may be into the axil. In this position they are remarkably invisible, the oak at this stage having both greens and red-browns, to which these larvæ closely assimilate (the larva of *N. ilicis* green, that of *B. quercûs* brown) (Chapman). When in the third instar, it is almost impossible, without the closest search, to see the little *B. quercûs* larvæ on an oak-twig with the young leaves and blossoms of the oak just bursting, the stipules and bracts, with their dull brownish tint, being almost exactly of the colour of the young larvæ. They appear not to dislike getting on the blossoms, but on the leaves they seem to prefer the edge or underside, and eat tiny holes through the surface of the leaf. They are slow in their movements, and maintain a fixed position for a considerable time. The small larvæ here noted were received from Raynor, May 11th, 1906 (Tutt). The larvæ certainly eat their cast skins at each moult, as only the heads can be found. When preparing for its moult from the third to the fourth stadium, a larva under observation spun a little pad, but also fastened down a few surrounding bracts, etc., so as to form a little nest. The fastening down is, as it were, accidental, not due to pulling the bracts, etc., into place, but to the larva having crept in amongst them, and so the spinning of the pad has retained them where they are (Chapman). The larvæ feed up pretty rapidly, varying somewhat according to season, and are usually fullfed in early June, at which time they may readily be beaten from the lower branches of tall oak-trees. Buckler objects to the term "onisciform," which is frequently applied to this larva, retaining it particularly for that of *Rumicia phlaeas*, considering that the flattened lateral ridge in *B. quercûs* renders the similitude inexact. Mathew observes (*in litt.*) that, in some years, the larvæ of this species are very abundant, in Essex, and that he has beaten them in hundreds from the lower branches of oaks in Stour Wood, and that then for several years following hardly a larva could be obtained. Atmore records their exceptional abundance in June, 1901, at King's Lynn, and Edelsten, in June, 1900, in Abbott's Wood; whilst Gibbs also remarks on their great abundance in some years in Bricket Wood, Herts. Newman observes that, when the larva is fullgrown, it closely resembles the familiar shell known as the *Chiton*, and rests appressed to the surface of the leaf, just as the *Chiton* does to the surface of rock; the head small and retractile, the incisions between the segments of the body very distinctly marked, the posterior edge of one segment slightly overlapping the anterior margin of the next following segment, etc. Dollman observes that the low branches of oak, with thin growth of foliage on isolated trees, often prove the best for larvæ of *B. quercûs*, the halfgrown examples of which exactly resemble the bud-sheaths in colour. Lewin says (*Ins. Gt. Britain*, p. 90) that the larvæ may be taken in plenty by beating the boughs of oak-trees, towards the latter end of May, when they are fullfed. In Chattenden Woods, the larvæ are fullfed, according to the particular season, from the end of May until the middle of June, and are not confined to any special age or position of tree, although, perhaps, the large ones with spreading branches prove most productive. They vary, too, greatly in abundance in different years, in some years being comparatively scarce, in others in great numbers. Steinert says that, in the Kingdom of Saxony, it occurs in May and early June, and may be beaten from low bushes exposed to the sun, as well as from young trees placed more in the shade. Kranz observes that, at Munich, the larvæ are, in some years, very abundant on the lateral branches of *Quercus pedunculata*, at the end of May and beginning of June. Stange says that, at Halle, the larvæ prefer the lowest branches of old oaks; Glaser found the larvæ very abundantly, in 1853, on young oaks, 15ft.-20ft. high, in the "Hinterland" of Hesse; Kretschmer also notes their preference for the lower branches of old oaks at Frankfort-on-Oder, whilst Pabst makes an exactly similar remark for Chemnitz. Larvæ are usually to be taken in the Geneva district, from May 24th to July 14th, on *Quercus pedunculata* and *Q. sessiliflora* (Rehfous). In Germany, Austria, and France, the larvæ appear to be fullfed, as with us, from the end of May to mid-June, according to the earliness or lateness of the season, and also to vary greatly in abundance in different years, whilst such records as we have, suggest that, throughout France, and even in Spain, the larvæ are rarely fullfed before the end of May. Constant says that, in Saône-et-Loire, larvæ can be obtained throughout May and up to mid-June, whilst Nicholson obtained larvæ near Huejar, in Granada, on June 4th, 1895. Bingham-Newland records (*Ent. Rec.*, 1901, p. 108) that he found, at Wishanger, a larva on a nesting-box for tits, nailed against a shed, which had evidently been carried by the old birds (*Parus caeruleus*) to their young, and had either escaped or been rejected by them, as it was uninjured, and fed up on oak, pupating in a few days, and producing an imago on July 16th, 1900. The larvæ are easy to rear, but are fearful cannibals (Lambillion). The cannibalistic habit of fullfed larvæ devouring those just a little advanced, and, in the quiescent stage preceding pupation, has been frequently noted. Jenkyns observes that, in June, 1881, a larva spun up ready for pupation, was devoured by three others that were being fed up with it, in spite of the fact that they had plenty of fresh oak-leaves. Courtice also notes (*Ent. Mo. Mag.*, ii., p. 45) that the larvæ of this species eat the newly-formed pupæ. On May 27th, 1865, he observed a larva busily eating a pupa; it had bitten off the anal end, and had cleared out the contents, and, after being disturbed and liberated, it returned and finished up the greater part of the pupal skin. The following are the only dates of capture that we have noticed, almost all of which refer to larvæ having been beaten—June 4th, 1858, in Maltby Wood, near Sheffield (Batty); May 25th-30th, 1865, at Worcester, the larvæ being rarely found on the lower branches of the oaks (Edmunds); June 11th, 1871, near Battle (Jenner); June 12th-16th, 1871, in Sherwood Forest (Daltry); June 28th, 1872, at Bickleigh (Bignell); June 2nd, 1873, in Darenth Wood (Bower); May 31st, 1881, in Hampshire (Jenkyns); June 17th, 1887, in Chattenden Woods (Bower); larvæ fullfed April 29th, 1893, at Instow (Hinchliff); May 6th, 1893, at Oxton (Studd); May 19th, 1893, in the New Forest (Quail); May 11th-15th, 1894, in the New Forest (Tremayne); May 26th-June 2nd, 1894, at Brockenhurst (James); June 3rd, 1894, in Bagley Wood (Christy); May 31st-June 3rd, 1895, in the New Forest (Tremayne); June 4th, 1895, at Legsby (Raynor); May 23rd, 1896, in Beechen Lane, in the New Forest (Tremayne); May 24th-26th, 1896, at Brockenhurst (Edwards); June 2nd, 1896, at Langworth (Raynor); May 23rd, 1897, at Oxton (Studd); May 27th, 1897, at Hazeleigh (Raynor); June 5th-8th, 1897, fullfed, at Lyndhurst (Tremayne); June 11th-16th, 1898, in Selby Wood (Walker); June 3rd, 1899, at Ringwood (Fowler); June 8th, 1899, at Hazeleigh (Raynor); June 9th-13th, 1899, at Lyndhurst (Edelsten); May 20th, 1900, at Bexley (Carr); June 9th, 1900, most abundant, at Abbott's Wood (Edelsten); May 23rd, 1901, at Danbury (Raynor); May 27th, 1901, at Brentwood (Mera); May 28th, 1901, at Oxton (Studd); May 31st-June 3rd, 1901, at Hazeleigh (Raynor); June 1st-8th, 1901, in the New Forest (Robertson); May 27th, 1902, very small, on June 9th, somewhat larger, at Hazeleigh (Raynor); May 2nd-9th, 1902, very small, in the New Forest (Robertson); end of May and early June, 1902, abundant in the Harwich district (Mathew); June 15th-24th, 1902, common, in the New Forest (Lawrence); June 18th-July 1st, 1902, in the New Forest (Lofthouse); June 1st, 1903, at Ranmore (Oldaker); June 3rd, 1904, June 1st-3rd, 1905, at Hazeleigh (Raynor); June 18th, 1905, nearly fullfed, at Ashford (Wood); May 17th, 1906, at Hazeleigh (Raynor); May 17th, 1907, at Hazeleigh (Raynor); June 7th, 1907, at Netley Heath (Tonge).

LARVA.—*First instar* (nearly fullfed): The larva is very pale, almost whitish, with a black head, deep brown thoracic plate, and small brown anal plate. The prothorax is otherwise almost white, paler than the following segments. There is a darker dorsal line, a pale (white ?) band down each dorsal ridge, and a pale lateral flange, with oblique pale lines between (downwards and backwards) the 2nd and 3rd thoracic and the 1st-7th abdominal segments. This is from a dorsal view. On a lateral view, what seemed from above to be a pale lateral flange is, in reality, a broad pale band along the lower part of the slope, separated by a fine dark line from the narrower white line of the flange proper. Beneath the flange the colour is again darker, paling gradually to the ventral line. As already noted, the head is black, smooth, and shining, with six eyespots, five outside and a central one ; several hairs on clypeus, about eyes and on vertex, symmetrical ; mouthparts pale fuscous ; jaws and labrum brown. The prothoracic plate, legs, hairs, and hair-bases, black, but so delicate that, when magnified, they are light fuscous ; the hair-bases are large, trumpet-shaped, but with a mere trace of the divisions, etc., that make these hairs, in some species, like flowers (*Convolvulus*, etc.). The hair-spiculæ (present on all hairs) are so short and appressed that finely serrate would better express their size, but not their arrangement ; they are uniformly spread over the hairs. The prothorax has a plate 0·25mm. across, the front margin rounded, forming an arc of about 100° of a circle, the posterior margins might be the corresponding radii, with the central angle cut off and with some irregularities. On either side, on its front margin, are two hairs (about 0·2mm. long) with a very large lenticle between them ; there is also, on each side, a large central hair, one at the outer angle, and one at the middle of the posterior margin ; there are, on the disc, also, two or three minute lenticles ; on the segment, along the margin of the plate and towards its outer angle (and therefore placed obliquely), are three hairs (about 0·21mm.), and parallel with these, and in front of spiracle, two others, not quite as long ; there are also two small hairs (about 0·06mm.) at base of legs ; these are represented on all the following segments ; the spiracle is large with a rather tall conical base. The mesothorax and following segments have a similar hair distribution, and it may be better to take each set of hairs and follow them along. On the mesothorax is a short hair, not far from the middle line, close to anterior margin (about 0·15mm. long) ; this hair is the same on the metathorax, is wanting on the 1st abdominal segment, but occurs on the 2nd to 7th abdominals, if, as seems difficult to doubt, it is the same one, rather outside than inside the line of hairs assumed to be the setæ of tubercles i and ii ; that on i is a long hair, upstanding with a sweeping curve, making its extremity directed backwards ; it is the chief element of the crest (ii assisting) seen on a side view of the larva, and standing up as a plane when it is seen in front ; it is shorter in front, 0·2mm., and longer behind, 0·3mm. on the 7th and 8th abdominal segments. There is a short (0·15mm.) dorsal hair on the 9th abdominal segment, that is more probably the seta of ii. The hair on tubercle ii is a shorter hair than that of i (0·1mm.-0·12mm., on the 3rd abdominal 0·16mm.), rather larger on the central than on the end segments, excepting that, on the thorax, it is nearly equal to i ; it arises outside and behind that of i. On the 7th and 8th abdominal segments its place is taken by a large lenticle with a high conical base, very like a spiracle. Between these and the margin, is (on the abdominal segments 1-8) the spiracle, and between the seta of ii and the spiracle a group of lenticles and hairs. On the 2nd and 3rd thoracic segments these are all represented by one short hair (0·08mm.) On the 1st abdominal is the spiracle; close above and in front of it is a large lenticle, and halfway between ii and the spiracle another long lenticle; the two large lenticles are the feature of the "slope"; between them are two short hairs (0·08mm.), nearly level, the front one higher and a little longer. The hairs and upper lenticle continue to the 6th abdominal segment, the lower only on the 1st and 2nd abdominals, wanting on the 3rd and following abdominal segments. On the 7th abdominal segment the spiracle is larger, higher up, and the space available smaller; what appears to be the upper lenticle is close to the posterior margin of segment, very large, larger than spiracle, and with room for the posterior hair between it and the spiracle; the anterior hair is just above spiracle; in front of this hair is another very large lenticle (not quite so large as the other) and not in line with, but perhaps the same as, the second lenticle of abdominal segments 1 and 2. On the 8th abdominal segment the spiracle is very large and high up; it has a small lenticle in front of it; this is probably in series with the smaller lenticle of previous segment; there is no other hair or lenticle between ii and the spiracle. The marginal* (subspiracular) flange-hairs are four, three on a level, the first short, the second long (0·2mm.-0·25mm.), and a lower one, between the first and second, usually long (0·25mm.-0·3mm.). They have this distribution on the 1st-8th abdominal segments, but, on the thorax, they are all on different levels, the 1st, 2nd, and 3rd in an oblique line from before backwards and above downwards, the 4th lower than and below the second, or between the 1st and 2nd. On the 9th abdominal segment are two hairs, probably of this series, and six long hairs on the 10th abdominal, below the anal plate. The anal plate appears to be without hairs (unless one or other of these six long hairs belong to it and is not so recognised owing to optical difficulties). The two lower short hairs (true marginal ?) are present on all three thoracic segments, and are represented on the abdominal segments by a single hair. On the prothorax they have a small lenticle behind them; on the 2nd-6th, and on the 9th, abdominal segments, there is a fairly large lenticle above the single hairs. On the 1st, 2nd, 7th, and 8th abdominal segments is a minute hair (0·05mm.) at the site of prolegs (on abdominal segments 3-6). The prolegs have the usual double pad, each with two large hooks, and the central retractile transparent process; above these pads, outside, is a short row of four or five very small hooks, and above these two short hairs (armature of prolegs and not marginal). The general surface is covered with abundant black skin-points; they look angular when looked at vertically, but, in profile, are rounded, the hard black chitinous points seeming to be covered with a layer of transparent cuticle. As definite microscopic hairs, of a scale comparable with skin-points rather than with hairs, are certain points at definite situations, not always easy to see and determine, and always (?) at margins of segments (? representing primary hairs of an area now absorbed in the intersegmental mem-

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* I fear I use the word "marginal" ambiguously, it comes easy to apply it, as here, to the lateral flange, which is so distinct a "margin" in Ruralid larvæ, but I believe usage more properly applies it to the two small hairs (vii) at the base of legs.

brane [?] or present partially [?] in Hepialids). Of these may be noted—on the front margin of segment, one outside ii, one above the two (true) marginal hairs on thorax, below on abdomen; in front of the prolegs, just short of the front margin, possibly representing ventral hairs of other abdominal segments. There are certain ventral and anal areas where the skin-points are quite spicular. *Second instar:* The larva in this stage has almost identical colour and markings with those of the large first stage larva, the anal plate is nearly as dark, but the prothoracic plate, though well marked, is marbled dark and light, much like the general surface. Head black. Length nearly 4mm. Hairs more numerous, but still a dorsal and lateral crest, with a few short hairs on slope; the crest hairs are pale and seem to be not actually larger than those of larva in the first stage. *Same instar* (laid up for moult April 17th): Length 6mm. Oblique lines very marked, with darker shades on each side of them. Widening of dorsal groove (or plain) on thorax also marked. The prothoracic plate brown, with some short hairs, and surrounded behind by a white, smooth area, which is probably *not* part of the plate. In the second instar, the hairs are much more numerous, a dorsal and lateral set still predominant, but they exist over the whole larva, irregularly disposed. Lenticles are comparatively scarce; one is tempted at first to say wanting. Perhaps the most notable difference is the absence of the black skin-points, so conspicuous in the first instar; the skin is now transparent, and set out on a pavement-epithelium pattern; on the ventral aspect there are spicular skin-points, hardly tinted however. The prothoracic plate is 0·6mm. across, more angular on its front margin, but otherwise of similar shape; there are fifteen or sixteen hairs on each side, the longest about 0·3mm. long, and one not very conspicuous lenticle. In front of, and above, the spiracles, on each side, are about 30 hairs; on the spiculate surface in front of prolegs? (below "chin") are some curious, little, broad, pointed, javelin-like hairs (0·025mm. long); amongst these is one lenticle, and another in front of spiracle. On the dorsal area of the 2nd thoracic are two lenticles, one in the lateral, and one in the marginal, region; they are nearly lost amongst the numerous hairs present in all these regions. Down the dorsum, lenticles are given to be present, two on one side, and only one on the other. The longest hairs are 0·4mm. to 0·6mm. long. The two pads of the prolegs have five or six hooks, and the outer upper set have 5 to 7 also, and much like the others in size; they are, however, of equal length: the other sets (pad) tend to have alternate lengths; the longest are about 0·03mm. long. On the abdomen are two lenticles (sometimes three) near the spiracle; there are about 70-100 hairs to a segment, still a little grouped by size, and slightly by distribution to the dorsal, lateral, and marginal areas; the longest about 0·5mm., except on the 8th and 9th abdominal segments, where are several 0·6mm. long; the margins of their bases are more crenate, and tend to divide in the petaloid manner. *Third instar* (April 21st): (1) The larva is 8mm. long, and is not yet much grown in this instar; pale nut-brown, with pale dorsal (subdorsal ridge), lateral and oblique lines; the latter start at front of segment almost with subdorsal lines, and run down and back, meeting the posterior margin of the segment, or rather not quite reaching it; halfway between the subdorsal and lateral lines it is margined below with a much darker shade, giving the triangle above it a ruddier tone by comparison, and the lower half of the slopes a pale one, though these two areas are of much the same tint. There is a dark dorsal line. On the abdomen this occupies the whole of the dorsal plain, which is very narrow. On the meso- and metathorax there is a pale space on each side of it, where the dorsal plain becomes the anterior slope. The lateral slopes are very flat. The oblique lines are on the 2nd and 3rd thoracic and 1st to 7th abdominal segments; the prothoracic plate is nearly square, with diagonals across the segment and longitudinal; it has a double dark dorsal line, and a dark shade towards the lateral angles. Head and legs black. There is still a double dorsal crest of hairs, and a lateral one; the slopes are well covered with very short hairs, all pale ochreous, nearly white. (2) *Two other larvae assumed to be in the third instar* (one just moulted, 6mm. long; the other somewhat grown, 10·5mm. long): The larger one (10·5mm. long) is reddish-brown, with black, smooth, and shining head. Head nearly 1mm. across; body about 3·0mm. from metathorax to the 6th abdominal segment; the chief tapering at the ends, *i.e.*, at the prothorax, and in the 9th and 10th abdominal segmental areas, so that the ends look rounded. On the abdominal segments the two dorsal flanges or ridges are very close together, and give a long slope, which is fairly flat from dorsal to lateral flange. The larva is much flatter and thinner than that of *Ruralis betulae*, *i.e.*, the slopes are not nearly so steep. The dorsal flanges separate on meta- and mesothorax, but, on each segment, it is in a separate curve, and it is hardly present on the prothorax, so that, though there is a front slope between the flanges, it is not so trim and exact a triangle as in *Ruralis betulae*. The dorsal and lateral flanges try, not quite successfully, to be white, and present, therefore, pale lines; on the prothorax they do not continue, but there is, on either side, a short line in front of the prothoracic plate, and a larger one (obliquely outwards and backwards) outside it. The pale dorsal triangles (so marked in the larvæ of *Callophrys rubi*) are present on the metathorax and 1st-6th abdominal segments, but modified on the 7th and 8th abdominals to lines; they are outlined by the pale dorsal line, and an oblique pale line from a little outside the flange in the front of the segment, outward and backward at an angle of about 45° to posterior margin of segment; the included area is paler than the lower portion of the slope. The oblique line is shown up by another dark oblique line forming a lower border to it. The segments are divided into two subsegments, and this is well seen where the division crosses the oblique lines. The dorsal lines, it should have been noted, are interrupted, and only occur on the posterior half, or two-thirds, of the segments. The prothoracic plate is shining, slightly fuscous; the anal plate is small, round, dark, and has a pale bordering line. There are still crests of hairs along the dorsal and lateral flanges, those on the slope being much shorter. (3) *Seven other larvae assumed to be in the same instar* (May 11th, 1907): Length 9mm. Colour and markings much as in last skin, a deep rich brown, with dark dorsal plain, widened on thorax, bordered by a pale (yellowish-white) line down the dorsal ridges. The latter are about 0·12mm. apart on the abdomen, about 1·5mm. on the mesothorax. The oblique lines are pale, edged with darker beneath; on the 7th and 8th abdominal segments they are straighter, almost parallel with dorsal lines; on the 10th abdominal segment the same marks are white, obliquely outwards, with dark space between. The paler tint above the oblique line is very marked on the 6th abdominal segment, sometimes amounting to a great white dorsal patch, whilst, on the 7th abdominal, the pale area is marginal. The broad result, not looking to details, is a crust-brown larva, with a dark central spot forwards, bordered with white (dorsal plain of thorax, with flange white line), a length of serrated surface (the oblique lines giving this effect), then a pale dorsal mark at the other end running obliquely backwards to the margin, with the small portion beyond paler. There are still two dorsal and lateral crests of hairs (about 0·25mm. long), too numerous to recognise as those of tubercles i, ii, or any other primary hair. Head shining, black. On May 16th, this larva moulted to last skin. It is to be noted that, in the third instar, hairs, etc., are more numerous than in the second, *e.g.*, on each side of the prothoracic plate are about thirty hairs and eight or nine lenticles. The plate itself is about 0·9mm. across, and is rather more diamond-shaped; about 100 hairs between the dorsal line and spiracles; on the abdominal segments six or seven dorsal ones of these are very large, and one might select two of these as being the setæ of i and ii; the longest hairs are about 0·6mm., *i.e.*, the same length as the longest hairs in the second instar; the lateral flange, and marginal groups are still distinct, the lateral has a number of larger hairs, the marginal separated from it by a narrow clear space; there is again a little group of 20-25 hairs (about 0·1mm. long) at the base of the prolegs. There are two or three small lenticles below and behind each spiracle, and appearing to be attached to it, and five or six larger ones above it; there are two or three small ones in the dorsal mass of hairs, one or two in the lateral and in the marginal groups. The small (0·24mm. across) round anal plate has eight or nine hairs and a lenticle on each side. The prolegs have about thirteen hooks to each pad, alternately long and short, and about ten on the outer row, which are the smaller, and vary a very little, but irregularly, in size. The anal prolegs are much the same, but want the outer row of hooks. There is no trace of gland arrangement on the 7th or 8th abdominal segments. The hair-bases have the complicated structure giving the petaloid aspect, but the margins have not the segments crenately rounded; from the central circle, to which the hair is attached, there run to the margin black lines, usually four or five in the bases to the smaller, but eight or nine or more in the bases to the largest, hairs. A good many hairs, chiefly on the "slope," and especially posteriorly, have a curious structure, very curved (like a scimitar), or even angulated, apparently rather flat, the middle of the hair very broad, and projecting in very marked angles, by the development in excess of the irregularities that are, elsewhere, mere spicular serrations. *Third instar* (*laid up for last moult*, May 25th, 1906): Length, 10mm.; width, 3mm.; height, 2·8mm. Hairs tolerably uniformly distributed, but longer ones along the sides and along the dorsal ridges, about 0·6mm. long, general hairs about 0·04mm.; all very pale brownish, those on slopes arising from dark bases. Dorsal lozenges bounded by yellowish dorsal (ridge) line and oblique line, pale brown within the oblique line, margined with darker below. Viewed from the front, the dorsal ridges appear close together (0·3mm. apart); the slope long (nearly 2·0mm.), not flat, but full and rounded; the dorsal ridges, or, rather, the yellow lines indicating them, for they are very flat, separate on meso- and metathorax. A large quadrangular prothoracic plate, but with the angles situated as anterior, posterior, and lateral, ochreous, with fine hairs; a yellow transverse line behind it, and yellow lines between it and lateral yellow line. Mesothorax but slightly above prothorax. Seen laterally, each segment rises high above the deep incisions; some small lenticles round the inconspicuous spiracles; general surface covered with very small pits, leaving intermediate ridges that, in places, run, in some degree, into line. *Fourth* (*and last*) *instar:* As in so many Ruralids, there seem to be only three larval moults and four larval instars. In the last, the hairs are exceedingly numerous, very short and very thick, so thick and short as to be almost another sort of hair from those in the earlier instars. They are of various lengths, but the longest on the abdominal dorsum (representatives of tubercles i and ii) are much shorter, not much more than half the length of the setæ of i in the first instar, but they are two or three times as thick; short, straight, rather thickened in the middle (or perhaps narrower at their bases); the spiculæ are acute and recurrent, running down the shaft a long way. The hair-bases have the radiating lines, and the sections are more rounded (and petaloid) than in previous instars. The margins of the spiracles are spread out in a flange, and in this are embedded four to eight small lenticles; there are lenticles generally distributed, but a group of six to seven occurs near the spiracles (most of them above). The edges of the lenticles present irregularities of margin, variously developed in different specimens, in some looking like five or six spicules radiating from the margin, in others like a widening of the margin and its divisions by lines like those in the hair-bases; the latter is more likely correct, as the lenticles are certainly more allied to hair-bases than to hairs. The skin-surface is finely reticulated in a pavement-epithelium pattern in very transparent colourless lines. The ventral line throughout is, as before, spiculated. The prothoracic plate has a definite median suture (wanting in previous instars); it has about 60 very short hairs on each side, and about fifteen lenticles. The hairs on the true legs look smooth and of ordinary pattern when slightly magnified, but a stronger lens shows them to be spiculated like the others. The anal plate is nearly round, with about 60 very short hairs and lenticles. The prolegs have the two pads of hooks practically united into a continuous set, but with an angle where they meet; the hooks are about 24 in the front group and 35 in the posterior, in one row of alternating larger and smaller hooks, the large ones being largest in the front portion; the inner row is of about 24 rather smaller hooks, also of two alternating sizes (Chapman). *Final instar:* Just before its last moult it is 8mm. long, but, in the last instar, it grows considerably, and, when fullgrown, is 16mm. long and not quite 5mm. wide. The head is small, rounded, and entirely retractile into and under the prothorax; viewed from above, the prothorax is longest, and tapers to the head; the width is almost even from the mesothorax to the 8th abdominal, the latter a little narrower than the rest, whilst the 9th abdominal is much narrower, and tapers roundly in almost a circular curve. Viewed sideways, the back arches in a curve, highest at the 1st and 2nd abdominal segments. The segments are strongly divided, each sloping forward so that the back edge of the next rises like a notch, except between the pro- and mesothorax, for

Plate XVII.

(To be bound facing Plate XVII.)

Larval hairs and spiracle of Bithys quercûs.

Fig. 1.—Hairs of fullgrown larva × 100.

The hairs show the characteristic floral form of base seen in the larval hairs of many Theclids. The margin of the apparent petals are attached to skin; the hair represents the stalk, so that the apparent flower is inverted, the resemblance being none the less striking. The dark rays that divide the base are probably manifestations of the same developmental tendencies that form the rays of the stellate bases of the larval hairs of Lycænines. The spiculation of the hairs and fine reticulation of the skin are shown very distinctly (though greatly lost in reproduction).

Fig. 2.—Spiracle of 4th abdominal segment of larva in last instar × 200.

This shows the curious way in which, in some Theclid larvæ (very pronounced in that of *B. quercûs*), the lenticles are, in the later larval stages, embedded in the actual chitinous margins of the spiracles; in this species they have rounded margins, but the same dotted membrane filling up the lumen as in ordinary lenticles. Separate lenticles are also well-shown with the lateral processes that these nearly all have; occasionally a lenticle has a margin like the bases of the hairs, but narrowed and small, one such is seen opposite the middle of spiracle on right margin of figure; these show the close relationship of hairs and lenticles, and suggest that the processes of lenticles are traces of the radiating lines of hair-bases. The fine skin-netting is well shown; also some hairs (better, however, seen in fig. 1).

1. Larval hairs and spiracle of Bithys quercûs. 2. *Photo. F. N. Clark.*

Fig. 1.—Hairs of fullgrown larva ×100. Fig. 2.—Spiracle of 4th abdominal segment of larva ×200.

the latter rises higher than the former at its front edge; the 7th and 8th abdominal segments are also less distinctly divided. Below the spiracles each segment is produced into a flattened ridge, thus causing the great proportional width; the belly is flat; a transverse section of the larva would be almost triangular; all the legs are short and well under the body, the motion is even, almost gliding, the general colouring is brown; the centre of the back is fawn-colour, with a dark brown dorsal line bordered with yellowish, which looks like a groove; the prothorax is edged with yellowish, and has a central brown spot in front with a greyish patch, the mesothorax has a semicircular brown patch with its curve behind, the metathorax has a similar patch, but smaller: on each of the segments, from the mesothorax to the 6th abdominal, there is, in the subdorsal region, a pale streak slanting downwards and backwards, edged below with very dark brown, growing wider and more intense backwards; these streaks map off the centre of the back; below them the side is darker than the back; the edge of the ridge is yellowish; some way above the ridge are the round, small, dark-brown spiracles, placed in a hollow. On the 7th and 8th abdominal segments the centre of the back is brown, the sides yellowish, the hinder part of the 8th abdominal segment chestnut, the 9th abdominal has a small, squarish, chestnut patch at the tip, bordered with yellowish-white; the colour under the ridge is reddish-brown, just above the legs is a pale line; the centre of the belly blackish; the true legs black and shining, with a fringe of bristles along them on the outside, the prolegs soft pale brownish-ochreous (Hellins).

Comparison of larvæ of Bithys quercûs and Ruralis betulæ.—The fullgrown larva of *B. quercûs* differs from that of *R. betulae* in being comparatively flat, *i.e.*, the dorsal ridges are flat, the slopes flatter, especially above, so that they are convex instead of plane. It agrees with that of *R. betulae*, however, in the narrowness of the dorsal plane, *i.e.*, in the ridges being very close, 0·3mm. or less, the slopes being 3·7mm. on the abdomen, and widening out on the thorax, forming an anterior "slope," though the larva is more rounded at the ridges, etc., and therefore not so pronounced, in these respects, as that of *R. betulae*: especially the ridges do not run down to the marginal flange as in *R. betulae*. It differs from the larva of *Strymon pruni* in the dorsal ridge being comparatively flat, rather, if anything, hollowed in the middle of each segment, than acuminate, and is much the same from the mesothorax to the 6th abdominal segment. The larva is fairly constant in colour, and shows well the dorsal triangles, bounded by a dorsal (yellow) line (*i.e.*, ridge), the oblique line (yellow), and posterior border of segment; they are more or less marked from the mesothorax to the 6th abdominal segment. For the rest, the colour is a rich oak-brown, darker below triangles, with faint indication of a second oblique line and yellow lateral line; there is a yellow line just above the legs (Chapman).

Larva in the quiescent stage preceding pupation.—The larva awaiting its moult is very different from the feeding larva. It is now short, thick, and rounded, more the form of the pupa. It is red on the back, green elsewhere, but very translucent, as if there were a solid, central, whitish body surrounded by green fluid, and covered by colourless skin, studded closely with black hair-points; the pink back is due to the white central material showing more distinctly on a back view; on a side view, the back has the same green transparency as elsewhere. The first spiracle is an obvious ochreous spot; the others are less conspicuous. The prothoracic plate shows a white central line, shaded dark on either side, and the margins also are dark; there are black hair-points, closely set, as on the general skin-surface. No trace of a girth can be seen (Chapman).

Foodplants.—*Quercus robur* (Newman), *Q. cerris* (Rogenhofer), *Q. lusitanica* (Walker), a species of oak with downy undersides to leaves, allied to *Q. pubescens* (Nicholson), *Q. pedunculata* (Richter), *Q. sessiliflora* (Pabst). Barrett notes a larva found on oak-apple, at Haslemere; the diet was continued to maturity, but the resulting imago was very small. [Egg laid on "sallow" (Bignell, *Ent. Mo. Mag.*, xiv., p. 112); "sallow" is not known as a foodplant.] [Lienig found the larvæ on *Prunus padus* (Nolcken, *Lep. Faun. Estl.*, p. 52). Lüders found a larva on *Myrica gale* and reared it up on this plant (Sorhagen, *Illus. Zeits. für Ent.*, iv., pp. 259-261.) These want confirmation.]

Parasites.—*Pimpla mixta* (Rondani), *Exorista vulgaris* (*teste* Watkins). The caterpillars of *Bithys quercus* are often parasitised, and contain the larvæ of a fly with stiff bristles; the parasitic larva allows the host to pupate, when its own pupation takes place within the pupa it has already killed (Steinert).

Puparium.—Lewin gave, to an early race of British lepidopterists, the statement that the larvæ of this species prepared for pupation by fastening themselves round by the middle and by the tail with a slender web against the small branches or twigs of the tree on which they have fed. Sepp, however, noted (*Beschouwing der Wonderen Gods*, iii., pt. 3, pl. xlv) the larva as spinning up for pupation between two leaves. In 1833, Bromfield recorded (*Ann. Mag. Nat. Hist.*, ser. 1, vol. vi., p. 189) that several larvæ in his possession, taken in the neighbourhood of Plymouth, all retreated below the surface of the earth placed in the bottom of the breeding-cage, pupated there, and produced imagines in due course. Harpur-Crewe observes that the larva of this species, when fullfed, descends the trunk of the tree, spins a slight web among the roots of grass, and therein pupates. Davis writes (*in litt.*) that, in the early evening of June 30th, 1902, in the Stroud district, he took a larva as it was crawling down the bole of an oak, which produced an imago on July 19th, 1902. Stainton says (*Man.*, i., p. 54) that the statement that the larva of this species undergoes its transformation below the surface of the ground is perfectly substantiated. Newman says that, "in captivity, the larva spins no cocoon, nor does it fasten itself by any belt, or anal hooks, as is the manner of its tribe, but retires just below the surface of the earth, and there turns to an obese, unangled, brown pupa." Hellins says: "For pupation the larva spins a few threads, making a frail sort of cocoon just on the surface of the earth, or availing itself of the shelter of a fallen leaf," whilst Bowles notes that the larva spins a loose silken web to enclose itself, and the pupa is, he says, as often as not, fixed to the silken strands by the anal hooks. The error here is doubtless due to the pupa sometimes adhering to the larval skin, and this to some surface. This is occasional with all Ruralid pupæ without cremasters, and is probably the rule with some. As there are no anal hooks, it is obvious this observer inferred them only, but he probably *did* observe some fixation. Chapman writes: "On May 11th, 1907, a larva, having no other resource than the leaves on which it had been feeding, quite small ones, less than one inch in length, went to the bottom of the jar and drew three or four of these together, with some rather feeble threads of pale silk, forming, however, a cocoon or cavity so as to completely hide the larva, except through a crack or two between the leaves. In this it rested, dorsum upwards, and the larva pupated by the afternoon of May 13th. On May 25th, 1906, five larvæ cocooned together amongst some oak-leaves on which they were supposed to be feeding. They are, in two instances, two placed close together, the other separate. They have drawn the leaves round them as a definite cocoon, closed either by the leaves themselves, or by a thin network of silk closing the open end. It is to be noted that these larvæ had no opportunity of 'going down.'" Rothke observes that, at Krefeld, the larva of *B. quercûs* pupates on the ground. Rössler says that, at Wiesbaden, it pupates on the surface of the ground under leaves. Glaser says that he obtained larvæ abundantly in the "Hinterland," in Hesse, and from 20 to 30 of these changed into pupæ, without spinning a girth, and under moss. Cole notes (*Ent.*, v., p. 355) rearing a specimen, July 9th, 1871, that he believed came from a pupa of the previous year. Borkhausen noted the pupal stage as lasting fourteen days, sometimes less; Ochsenheimer gives fourteen days, Roesel sixteen days, Glaser twelve days, and Nolcken 20 days.

Maturation of pupa.—A larva pupated during the afternoon of May 13th, 1907. The pupa, after some three or four hours, is mature as to form, but is still very definitely coloured, if it may be so expressed, in larval colour and markings. Ventrally, the wings and appendages form the greater part of the surface, but not only these, but the head and the ventral surface of the 5th and following abdominal segments are colourless, transparent, and pellucid. Laterally, the spiracles are white on a pale area, and below them, on the exposed abdominal segments, is a reddish line (the marginal flange), then a pale line (the incision or suture between the marginal flange and the one below it), then a reddish line (the second flange bordering the pale under-surface). These flanges are, therefore, well marked in colour, but are not marked by any trace of ridge (or hump) or incision, the white surface being very smoothly rounded. Dorsally, the thorax is already assuming something of the permanent pupal colouring; it is greyish-ochreous, pellucid-looking, and has a dark dorsal line and dark reddish lines at a lower level, most marked on the mesothorax, making a long oval, with the dorsal line as its long axis. This is really the oblique (larval) line, stretched out by the expansion which the mesothorax undergoes in the pupa, the posterior line of the oval, being the same line of the metathorax shortened and crowded dorsally. Some fuscous marblings are superficial and are proper pupal colour. The abdomen is very reminiscent of the larva, it is almost bright red, with a dark (reddish-brown), dorsal line, and a dark (oblique) mark halfway between this and the margin (as seen from above) of a similar colour, on the 2nd to 7th abdominal segments, and in each of the marks a small round black spot that looks depressed. Under a low power (hand-lens) it looks a definite, small, circular hollow, but, more magnified, it is equally a depression, but with regular sloping sides, it is without spiculate- (umbrella-) hairs, these are elsewhere (not on appendages) evenly distributed and rather abundant. In this fresh pupa they are very brilliant, on tall stems, with rather flat and not very thick disc-like tips; these tips have ten to fifteen spicules on their margins, and as the discs (and spicules) shine like diamonds in the light, each tip is very like a bright star, of the conventional pattern, but with ten or more rays instead of the allotted five (pl. iii., fig. 2). *May* 14*th*, 1907 (sixteen hours later): The pupa beneath is now a pale ruddy-brown, still a little transparent medially, but the wings, antennæ, and head have a more solid look and are sprinkled with dark, nearly black, dots, forming almost a line along the inner margin of the wing. Dorsally the pupa is very dark, so that the black markings cover more area than the paler dark red-brown ground colour. There is a pale (not invaded by black) area round each spiracle and along each incision; between the dorsal line and the spiracular area the black dots are fused together into an irregular worm-eaten patch, that occupies four-fifths of the area. The thorax is not quite so covered by black, the individual dots are not symmetrical, but the crowding is such as to form a patch on each side in front of the mesothorax, a double patch on the summit, and an extension from this to either wing-base. *May* 21*st*, 1907: The mature pupa is very little darker than last noted. It is of a red-brown colour, paler beneath, with very few black spots ventrally; dorsally, the black is in ragged irregular bands (of essentially coalesced spots) across each segment, covering about two-fifths of the area of each segment, and nearly complete on the 7th abdominal. They are symmetrical, or nearly so, and have their largest portion a little above spiracle (Chapman).

Pupa.—The pupa is well rounded; the only trace of angularity is at the wing-spine. Seen dorsally, the wings form the sides of the middle of the pupa; from opposite the 1st abdominal suture the sides separate a little in accordance with the wider abdomen; in front they run forwards quite parallel to the wing-spine, and here the margin turns inwards at quite a sharp angle. On closer examination, with a lens, there is really no angle, the surface being rounded. With very little disturbance the pupæ fall out of their cocoons quite free, one only retaining some adherence to the leaf by the cast larval skin, which sticks both to the pupa and the leaf. It is, however, clearly the natural process for the pupa to be quite free of the larval skin. There is less disparity between the size of the thorax and abdomen than in some other Theclid pupæ; the dimensions being—from front to thoracic-abdominal incision, 5mm.; the abdomen, 6mm.; total, 11mm.; the width at wing-spine and waist, 5mm.; at the 3rd abdominal segment, 6mm.; the height 5·7mm., being about the same at the mesothoracic dorsal eminence and the 3rd abdominal segment, rather less at thorax in three specimens, greater in one other. The pupa has a fairly straight ventral line, a little prominent at the end of the wings (3rd-4th abdominal segments). As usual in Theclid pupæ, the face is quite ventral; the bases of antennæ being the front of the pupa; the bases of maxillæ, 1·5mm. from front; to the end of the wings, 8·2mm.; the rest of the pupa being 2·8mm. The posterior end of the pupa is formed by the dorsum of the 8th abdominal segment, the 9th and 10th abdominals being quite ventral. The pupa is of a mahogany colour, paler ventrally, speckled with abundant black spots; these are rarer ventrally, and may be absent there, denser dorsally, massing into spots and bands. There is enough variation in the few pupæ under observation, to make it probable that there might be pupæ pure brown (without black dots), or quite black (dots everywhere coalescing). In the palest pupa the dots form a pair of black spots on each side of the mesothoracic dorsal spine, and some dark shades at the wing-bases; on the abdominal segments a dorsal spot, and one a little behind and outside it on either side, then, between this and the spiracle, three in an oblique line, from above, downwards, and backwards. The spiracles always show as pale spots in paler areas. The darkest pupæ still preserve the mahogany ground colour, on centre and a little on each side of the mesothorax, and along the posterior border of the abdominal segments, with a good many scattered and minute dots and patches, showing the black to be an aggregation of dots and not definite marks. The hairs (pl. iii., fig. 2) show a very interesting form between ordinary spiculate hairs as shown in *Edwardsia w-album* (*see* pl. iii, fig. 1) and fully formed trumpet-hairs (*see* preceding vol., pls. x, xi, xii, xiv). They have a genuine trumpet extremity, although it is small and more pronouncedly spiculate than in the Chrysophanids. They are also, like the trumpet-hairs, smaller than ordinary spiculate hairs are; for instance, they are about a third of the length of the spiculate hairs on the pupa of *Edwardsia w-album*, *viz.*, 0·1mm. in *Bithys quercûs*, 0·34mm. in *E. w-album*. In plate iii., fig. 2, the region shown is near the spiracle, of which a portion is seen, of the 2nd abdominal segment. Five trumpet-hairs and a portion of a sixth appear on the plate. There also appear a number of lenticles, chitinous circles that look as if they ought to carry hairs, but have their lumina merely closed by a faintly dotted membrane. There are also two circles that are almost certainly bases of trumpet-hairs that have been broken away. In the pupa of *Bithys quercûs* these lenticles are very numerous near the spiracles, but very sparse elsewhere, the greater part of, for instance, this 2nd abdominal segment being occupied by the dark stellate points, with connecting ridges, that we saw so well-developed in the pupa of *Thestor ballus* (*Ent. Rec.*, vol. xvii., p. 145, and *Nat. Hist. Brit. Butts.*, i., pl. xv). In the plate (pl. iii., fig. 2), the area shown is so small that it does not extend outside the lenticular region of this spiracle, and may leave the impression that the lenticles are a more marked feature of the pupal skin than is really the case. Suggestive as these stellate points are of hairs, they do not here, any more than in the other pupæ examined, appear to belong to the same phylum as the hairs and lenticles, that always occur in the spaces between the ridges, which are attached to the stellate points, but invariably avoid hairs and lenticles. The magnification of the figure is 200 diameters. [As to further observations on hairs, see notes on immature pupa (*anteà*, pp. 253-254).] The appendages are reticulated with a network of very fine, raised, darker lines; the lines are elegantly waved, and the meshes vary much in size, shape, and outline. At the tibio-tarsal articulation a few very minute lenticles occur (see notes on *Strymon pruni* pupa, *anteà* p. 216). The prothoracic spiracle-cover is narrow, spindle-shaped, small (0·3mm. long), of the same colour as the pupa, and covered by minute, straight, spicules, with dilated summits; it falls within the area of wing-reticulations, not that of the dorsum; just behind it are two spots (wing-spines), on which the reticulations are blurred, and arranged a little concentrically. The prothorax has a margin against spiracle that has several rows of minute papillæ (spiculæ ?); it has a large number of lenticles, a good many of the characteristic hairs, and a ground-work of angular reticulated raised lines with points at the angles; these points are more or less angular, according with the lines connected with them. They are smooth, raised and rounded, but, centrally have an inner spot, sometimes with a stellate aspect. On the mesothorax, the sculpturing is less dense and paler, but otherwise like that of the prothorax; perhaps there are proportionally fewer lenticles. The same remarks apply to the metathorax; its short, sharp wing-extension has only the lines of network, like other appendage covers. On the abdomen, the lenticles are massed abundantly round the spiracles, but, otherwise, the hairs, lenticles, and network are as on the thorax. The 7th and 8th abdominal spiracles are obsolete (each represented by a closed cicatrix); ventrally, there are considerable areas of finely spiculated surface, and between the 8th and 9th abdominal segments is a curious sloping piece (in mounted specimen), apparently dipping in between the segments, of darker chitin, and closely spiculated. So far as the vague indications go, of a suture between the 9th and 10th abdominal segments, the latter seems here, at the ventral line, to coalesce with that of the 8th and 9th abdominals, so this piece may be really the ventral portion of the 9th abdominal segment (the 8th is undisturbed, so the specimen is probably a male); the area behind this is wrinkled, but fairly smooth; it has no skin-sculpture other than several (apparently) lenticles, nearly symmetrically placed; its posterior border is a transverse thickening, with longitudinal branch medially in front (anal scar). In this region, the points of the network are larger and more stellate than elsewhere, and the ribs have something of a beaded structure, but there is no trace of even obsolete cremastral hooks (Chapman). Stout and rounded in outline, about 9mm. long, and rather more than 4mm. at its widest, the back rounded, the belly more flattened, the abdomen not extending more than 3mm. beyond the wing-cases, which are rounded off short, the tail rounded off without any knob or spike; the skin a little roughened, but glossy, on both sides of the abdomen the skin is set with tiny short bristles with flat heads, like old-fashioned, flat-headed pins; the colour mahogany-red on the back, freckled with darker, and the dark slanting marks on the side of the larva seem retained, the wing-cases paler, and not much freckled; the underside of the abdomen reddish, without freckling (Hellins).

Dehiscence of pupa.—The thorax splits down dorsally and the opening continues to either side, leaving the 1st abdominal segment in one piece, but separating the thorax from it and continuing down and separating the wings from the 1st, 2nd, and 3rd abdominal segments. The face and antennæ also separate from the wings, but the antennæ and included legs and appendages remain in one piece. The ends of the antennæ, apices of wings, and front of 4th abdominal segment continue attached to each other, but so slightly that they easily separate, so as to be loose, but maintain an attachment by interior membrane (intersegmental, &c.). Of course, when the pupa is dry, this breaks at once, almost as if it did not exist. There may be a slight separation of 5th and 6th abdominal segments dorsally. The prothorax also hinges back from the mesothorax, but maintains a membranous attachment; at its anterior border is a narrow, separate, minute portion, the dorsal head-piece, not easily distinguishable in the living pupa (Chapman).

Stridulation of pupa.—Constant writes (*Cat. Lep. Saône-et-Loire*, p. 25): The chrysalis can be heard, when it is taken between one's fingers, to make very distinctly a sort of stridulation, analogous with that made by certain longicorn beetles. He adds that he failed to discover the means by which the sound was made. Parish observes (*Ent.*, xiii., p. 186): Pupæ were noticed in July, 1880, whilst being held in the hand, to make a sound something like a squeak; the sound produced being like that obtained when two stones, or marbles, are knocked together in rapid succession, with an occasional louder sound. As soon as the sound ceased a gentle shaking set them all squeaking again. Fowler says (*Ent.*, xxxiv., p. 17): About forty pupæ of this species (obtained from larvæ) were placed in a tin tobacco box, and the latter by chance, was placed in a cardboard box. During the evening I constantly heard a sound like the ticking of many watches, but with a kind of slight rasping as well. Upon opening the tin all was quiet, but, on gently tapping the tin, the sounds commenced again. I then placed the tin upon the table and tapped, when the same ticking was resumed, but it was not quite so audible. The position they first occupied acted as a kind of sounding-board, and I could repeat the experiment any number of times. All the pupæ produced imagines, so the sounds could not have been produced by parasites. Fowler also refers (*op. cit.*) to the tapping made in a cardboard box by fallen pupæ of *Eugonia polychloros*, but this is a very different thing, for, in the pupa of the latter species, the movable segments of the abdomen bring round the anal end of the pupa with some force, but the pupa of *Bithys quercûs* is practically solid and incapable of any movement of this kind. [For stridulation in the pupæ of *Callophrys rubi*, see *anteà*, p. 114.]

Time of appearance.—The species appears to be absolutely single-brooded, the greater number of specimens emerging between the first week of July and the second week of August, but early examples appear in some seasons by mid-June, and late examples in other seasons in September, the period for almost any year extending over some five weeks. There is little difference in the various localities in the northern, southern, and south-eastern parts of its range, *e.g.*, July and August are given for Scandinavia, June to August for Perthshire, July for Tokat, and early August for Algeria, and the dates for central Europe are practically identical with those of Britain, *e.g.*, in Germany—June and July in Pomerania (Paul and Plötz), in Hanover (Glitz); July in Mecklenburg (Schmidt), at Wiesbaden (Rössler); from the middle of June to the end of July in the lowlands of Baden, but lasting in the mountains until August (Meess and Spuler), usually from the end of June till early July (Schmid), and on into August at Munich (Kranz); in July and beginning of August in Thuringia (Krieghoff), mid-July and early August in East and West Prussia (Speiser), and at Elberfeld (Weymer); in early seasons at the end of June in Hesse (Fuchs), but generally from July until the end of August (Glaser); from June to August at Eutin (Dahl); in July and August in Posen (Schultz); from June till the beginning of August in Silesia (Döring); the end of June and beginning of July at Obernigk (Nohr), as well as in Upper Lusatia (Möschler), distributed throughout the Kingdom of Saxony from June until August; in 1875, a specimen was taken at

Rachlau at the end of May (Schütze); from July until the end of August at Waldeck, a worn ♂ on one occasion as late as October 21st (Speyer); end of July to September in Holsatia (Boie); abundant in June on the summit of the Neuenahr (Maassen). In the Netherlands it occurs in July (Snellen); in Belgium in July (Lambillion). In Austria it occurs in July and August in Bohemia generally, but June and July at Carlsbad (Hüttner); July and August everywhere throughout Moravia (Schneider), the earliest date at Brünn being June 12th, and extending up to July 4th (Fritsch); June and July are noted for Upper Austria (Brittinger), but Himsl says that July and August are more usual; in Lower Austria, June and July (Rossi); from the end of June to mid-August in Hungary (Aigner-Abafi); the end of July on the Calvarienberg, near Bozen, in the Tyrol (Rebel), in June, at Wolfsberg (Höfner), and also on the Nanos, in Carniola (Mann). In Switzerland, July until mid-August (Wheeler), but chiefly in July in the Valais (Favre), and from June 21st-August 7th, in the Geneva district (Blachier). In Denmark from the beginning of July until the beginning of September, sometimes extremely abundant (Bang-Haas); Gillmer notes that this lengthy period agrees with his observations in the forests of Anhalt. It is also perfectly true of Britain taken over a period of years. In France it occurs in June in the dept. Gard (Lemann), in July in Eure (Dupont), from June to August in Saône-et-Loire (Constant), in July at Uriage (Reverdin), and in the Pyrenees (Rondou), late July in the Hautes-Pyrénées (Distant), and at Luchon (Fountaine); July, in the Gironde (Trimoulet), June and July in the Haute-Garonne (Caradja), June 17th-July 25th, in Berry and Auvergne (Sand); in June in the Doubs (Bruand), in June and July in the former French depts. of the Haut- and Bas-Rhin, Meurthe-et-Moselle, and Vosges (Cantener), and Aube (Jourdheuille); in July and August in the Alpes-Maritimes (Bromilow), but Millière gives June for this dept.; July and August in Morbihan (Griffith); in late July and early August in Savoie and Haute-Savoie (Tutt). In Italy, in Piedmont, in late July and early August (Tutt); July and August at Lucca (Verity); in the summer and early autumn in Tuscany (Stefanelli); in June in Milan (Turati); and July to October in Sicily up to 1700m. (Minà-Palumbo). In Greece, on the Parnassus, it occurs in July (Staudinger). In Roumania, from the middle of June (Caradja). In Bulgaria it was taken in the Balkans on the Pass of Ginec, etc., at the end of July, 1899 (Nicholl). In Russia it is found in July and August in Transcaucasia, its most eastern recorded habitat (Romanoff), in July in the Wiatka Govt. (Kroulikowsky); middle of July to early August at Rathen, near Libau (Gebhard); from June 20th-August 25th, but flying most abundantly at the end of July and the first half of August in the Baltic Provinces (Nolcken). July and August are noted for Scandinavia (Wallengren). In Spain, in July, in the Gibraltar dist. (Walker), also in Catalonia, on Monserrat (Cuni y Martorell). In Portugal, in June and July (C. Mendes d'Azevedo). In Algeria, swarming in early August, 1904, at Sebdou (Fountaine). In Asia Minor it was taken at Tokat, in July (Fountaine). The following dates of capture will perhaps give some little idea of the variation between the times of appearance at different places in different seasons, but, as showing the difference in the dates of different seasons in the same district, we may first note—August 31st, 1877, near Callander (Evans), and June 22nd, 1859, at the Bridge of Allan, when three males and nineteen females were taken (Wingate). The dates we have collected are—CONTINENTAL RECORDS: July 8th, 1872, in the Valley des Vaux, in Jersey (Piquet); July 24th-31st, 1875, at Argèles, in the Hautes-Pyrénées (Distant); first seen July 7th, 1887, in the Gibraltar district (Walker); July, 1888, at Wiesbaden (Prideaux); July 2nd-3rd, 1890, at Digne (Lemann); July 30th, 1891, at St. Martin Vésubie (Bromilow); July 25th, 1892, and onwards, in the neighbourhood of the Certosa di Pesio (Norris); June 16th, 1893, at Pont du Gard; July 7th-17th, 1894, at Vernet-les-Bains (Nicholson); July 10th to August 1st, 1895, at Divonne (Reverdin); July 1896, in the Jungfernheide (Schultz); July 15th, 1897, near Aigle (Wheeler); July 19th, 1897, at Wolfsberg (Lemann); August 11th-18th, 1897, at Susa; July 26th-28th, 1898, at Grésy-sur-Aix (Tutt); August 3rd, 1898, in the Sépey Road (A. H. Jones); July 20th, 1899, in the Val Flora, between Val André and Dahouet (Turner); July 20th-21st, 1899, in the Balkans, on the pass of Ginec (Nicholl); at end of July, 1899, in the Balkans (Elwes); August 16th, 1900, at Charpigny (Wheeler); July 18th-26th, 1901, at Tragacete (Chapman); August 5th, 1901, at Crissolo (Tutt); July 28th-31st, 1902, at Chavoire (Tutt); July, 22nd, 1903, at Sierre (Lemann); July 12th, 1903, at Aigle (Sheldon); July 23rd, 1903, at Chippis, in the Val d'Anniviers (A. H. Jones); July 27th, 1903, between Roche and Yvonne (A. M. Cochrane); August 4th, 1903, at Digne (Rowland-Brown); June 20th to August 29th, 1904, in the Schwerin district (Gillmer); July, 1904, at Neuhausen (Lemann); July 1st, 1904, at Gryon (Wheeler); July 9th, 1904, near Geneva, the earliest date observed in the district; July 29th to August 1st, 1904, on the Salève (Muschamp); July 14th-19th, 1904, at Mendel (Rowland-Brown); July 31st, 1904, at La Granja (Chapman); early in August, 1904, west of Sebdou (Fountaine); July 14th to August 2nd, 1905, between Aigle and Sépey (Moss); July 28th, 1905, at Grésy-sur-Aix (Tutt); August 23rd, 1905, near Geneva, the latest date recorded for the district (Muschamp); August 2nd, 1906, at the foot of Mont Aiguille, near Clelles; August 6th, 1906, at Digne (Tutt). BRITISH RECORDS: July 8th, 1692, a pair, sitting on nettles, at Croydon (Ray); August 1st-8th, 1856, at Shanklin (Trimen); July, 1857, at Balcombe (Tugwell); July 16th to August 1st, 1857, in the Forest of Dean (Langley); July 16th, 1857, at Box Hill; July 18th, 1857, on Ranmore Common (Trimen); July 17th-21st, 1857, in Poynings Wood (Andrews); July 17th-21st, 1857, near Ramsbury, Wiltshire (Rye); August 1st-8th, 1857, at Ilfracombe (Mathew); August 2nd, 1857, in Sherwood Forest (Rodgers); July 5th-11th, 1858, at Herne Bay (McLachlan); July 11th, 1858, abundant, in Darenth Wood (Fisher); July 19th, 1858, near Worcester (Edmunds); July 21st, 1858, at West Wickham (Perkins); July 24th, 1858, first one of the year seen at Barnstaple (Mathew); July 24th, 1858, at Ashford (Russell); abundant, at the Bridge of Allan, June 22nd, 1859 (Wingate); July 18th, 1859, near Abbey Wood (Cox); July 18th, 1859, common, near Worcester (Edmunds); August 9th, 1859, at Perth (White); August 13th-16th, 1859, at Lulworth (Morison); scarce, in August, 1860, at Stoke (Harvie); August 6th, 1860, at Doune; August 21st, 1860, near Loch Earn (Lovell-Keays); August 28th, 1860, in Perthshire (White); July 23rd, 1870, at Oxton (Studd); one emerged July 9th, 1871, at Croxton (Cole); August 13th, 1871, at Walton-on-the-Naze; August 28th, 1871, at Loughton

(Burrows); August 9th, 1872, in Hazeleigh Wood (Raynor); August 20th, worn, in Sherwood Forest (Madden); July 4th, 1873, at Quorn (Rowley); very common, in July, 1874, in the New Forest (Cooper); August 1st, 1874, at Drayton Drury (Norgate); August 3rd, 1874, at Ulverscroft (Rowley); July 16th, 1875, at Great Malvern (Edwards); August 1st-21st, 1875, at Drayton Drury (Norgate); July 18th, 1876, in Abbott's Wood (Dale); July 21st to August 25th, 1876, in Foxley Wood (Norgate); July 27th, 1877, at Swithland (Rowley); July 27th, 1877, in Foxley Wood (Norgate); August 29th, 1877, at Stonehouse (Bignell); August 31st, 1877, at Bracklyn Falls, near Callander (Evans); July 22nd, 1878, at Brandon, July 30th, 1878, in Monk's Wood (Bower); August 17th, 1878, at Stagsden, near Bedford (Greenwell-Lax); July 17th, 1879, at Ansty Lane (Rowley); August 31st, 1879, at Mottingham (Bower); July 16th, 1881, in Foxley Wood (Norgate); August 1st, 1881, in the New Forest (Bankes); July 18th, 1882, in Chattenden Wood (Bower); July 22nd, 1882, in Abbott's Wood (Sotheby); July 24th, 1882, in the New Forest (Bankes); August 2nd, 1882, in Hockering Wood (Norgate); about August 15th, 1883, but worn, at Braunton (Riding); abundant July, 1885, in the Eastbourne district (Mitchell); July 18th to August 8th, 1885, in the New Forest (Hawes); August 2nd-7th, 1886, worn, at Swanscombe (Bower); July 1st-13th, 1887, at Brentwood (Burrows); July 18th-28th, 1887, at Brockenhurst (Mitchell); bred July 16th, 1888, from larva collected June 13th, 1888, in the Isle of Purbeck (Bankes); July 20th-31st, 1888, in the New Forest (Mitchell); August 3rd, 1888, at Groombridge (Blaber); July 10th, 1889, at Lyndhurst (Nicholson); August 1st, 1889, and following days, on the banks of the Wye (Patten); abundant August 7th, 1889, at Tan y Bwlch; August 8th, 1889, also abundant near Harlech (Arkle); July 6th-26th, 1890, very rare, at Lyndhurst (Simes); August 2nd, 1890, at Oxton (Studd); July 15th-29th, 1891, at Lyndhurst (Simes); July 23rd, 1891, at Lyndhurst; August 20th-21st, 1891, in Beechen Lane, common (Alderson); August 7th to September 5th, 1891, at Sidmouth (Wells); August, 1891, at Ashtead (T. Bainbrigge-Fletcher); July 18th to August 2nd, 1892, in the New Forest (Bloomfield); July 22nd-29th, 1892, in the New Forest (Alderson); July 29th, 1892, in Oxhey Wood (Rowland-Brown); July 29th and August 5th, 1892, at Oxton (Studd); August 4th-11th, 1892, in the New Forest (Blathwayt); August 7th, 1892, at Dulverton (de la Garde); August 17th, 1892, in Chambercombe Woods, near Ilfracombe (Battley); bred indoors June 4th-5th, 1893 (Studd); imagines wild June 8th, 1893, at Instow (Hinchliff); June 21st, 1893, in Dalyston Wood, at Kilglaunah (Dillon); June 24th to July 10th, 1893, near Clovelly and Lynton (Sheldon); June 29th, 1893, at Bridestowe (Still); July 21st, 1893, at Bentley (Burrows); July 20th, 1894, at Darenth (Jones); August, 1894, at Ashtead (T. B. Fletcher); July 16th-21st, 1895, at Brockenhurst (Jones); July 12th, 1896, at Oxton (Studd); mid-July, 1896, in the New Forest (Bayne); August 4th, 1896, at Bentley (Burrows); bred indoors June 22nd to July 5th, 1897; August 26th, 1897, at Oxton (Studd); July 9th to August 21st, 1897, at Bentley (Burrows); July 15th, 1897, at Hazeleigh Wood (Raynor); August 1897, at Bridgwater (Barraud); August 26th, 1897, at Oxton (Studd); July 2nd, 1898, at Appledore (Heitland); July 8th to August 24th, 1890, still in fair condition at latter date in Monk's Wood (Peed); July 12th, 1898, in Hazeleigh Wood (Raynor); July 16th, 1898, first appearance for the year in the Leicester district (Dixon); July 16th-27th, 1898, in the New Forest (Carr); July 20th-30th, 1898, at Sidmouth (Wells); August 18th, 1898, between Woodhall Spa and Lumby (Musham); August 25th, 1898, at Aber, in North Wales (Barraud); early June, 1899, on Dartmoor (Gummer); July 11th, 1899, in Chattenden Wood (Jones); July 27th-28th, 1899, at Shipley (J. F. Bird); August 6th, 1899, common, in the Hailsham district (Carr); August 6th, 1899, in Nottinghamshire (Leivers); July 20th-30th, 1900, in myriads, in the New Forest (Alderson); bred July 21st, 1900, from larvæ found in a wood, near Lincoln (Pearson); July 24th, 1900, at Wareham; August 13th, 1900, at Dartmouth (Bankes); July 26th, 1900, and following days, at Burgess Hill (Dollman); July 28th, 1900, at Stoke Wood (Pickett); July 28th to August 11th, 1900, in the New Forest (J. E. Gardner); imagines, common in Abbott's Wood, in August, 1900 (Edelsten); August 8th-10th, 1900, at Oxton; August 30th, 1900, at Bexley (Bower): August 13th-20th, 1900, at Newbury (Hopson); bred indoors, June 28th to July 3rd, 1901 (Studd); July 12th, 1901, at Broxbourne (J. E. Gardner); July 13th to August 13th, 1901, near Brendon (Prout); July 16th-25th, 1901, at Cowfold (J. F. Bird); July 23rd, 1901, in Bentley Wood (Pyett); July 24th, 1901, at Oxshott; July 29th, 1901, at Bushey Heath (Barraud); August 7th, 1901, in the Isle of Purbeck (Bankes); August 9th-19th, 1901, in the Porlock district (Carr); August 18th, 1901, at Burgess Hill (Dollman); bred June 28th, 1902, from larvæ taken at Ranmore, and that pupated June 4th (Oldaker); July, 1902, in Carlisle (Malcolm); imago (male) bred July 19th, 1902, from larva taken June 13th, at Stroud (Davis); July 26th, 1902, at Lyndhurst (Rowland-Brown); July 27th, 1902, at Cowfold (J. F. Bird); August 1st-11th, 1902, at Bank, in the New Forest, abundant (Carr); August 1st-20th, 1902, at Burgess Hill (Dollman); August 4th, 1902, on Thundersley Common (Whittle); August 25th, 1902, in the Llyfnant Valley (Tetley); up to September 3rd, 1902, near Harlech (Graves); July 2nd, 1903, at Combe Martin (Peed); July 12th, 1903, in the New Forest (Hopson); July 18th to August 21st, 1903, near Brendon (Prout); August 6th-13th, 1903, at Bentley (Burrows); August 1904, common, in Blean Woods (Battley); August 2nd-24th, 1904, at Tintern and Llandogo (J. F. Bird); August 3rd-17th 1904, at Brockenhurst (Oldaker); bred July 14th-17th 1905, from larvæ pupated June 29th 1905, at Ashford (Wood); July 15th-20th, 1905, at the Fairy Steps, Arnside (Clutten); July 15th, 1905, at Mucking (Burrows); July 22nd-27th, 1905, at Tintern and Llandogo (J. F. Bird); imago emerged July 7th; imagines caught July 28th, 1906, at Hazeleigh; August 17th, 1906, at Stoke Dry (Raynor); first noticed July 20th, and still to be met with on September 2nd, 1906, at Tintern and Llandogo (J. F. Bird); July 25th, 1906, near Ashford (Wood); August 6th, 1906, at Market Rasen (Lewington).

Habits.—Glaser observes that, in 1853, he reared a considerable number of imagines, in Hesse, that the pupal stage lasted about twelve days, that at first only females emerged, and that the last of all the emergences were males. Raynor notes (*in litt.*) that an imago emerged on July 7th, 1906, at 8.30 a.m. The "purple hairstreak" loves to gambol about the tops of oak-trees, or around the outstanding branches, and is usually particularly active high up the trees between 10 a.m. and 3 p.m. Later in the afternoon they come lower down but fly just as freely, and hence are even more conspicuous, and when they settle they can be readily disturbed; even in the daytime the imagines frequently descend to the lower branches of an outspreading oak, especially when they reach nearly to the ground. We have seen dozens flying round such an oak, in a meadow on the outskirts of Chattenden Woods, although the imagines were equally abundant in the woods around the oaks on the top of the hill where *Apatura iris* specially loved to congregate, and on the much smaller trees by the side of the ridings in the lower parts of the wood, nor does it always confine itself to oaks, for we have seen examples, with those of *Edwardsia w-album*, circling, in the noonday sun, round the tops of ash saplings. Its habits abroad are identical; between Roche and Aigle, we saw many examples flying swiftly round the oak-bushes growing on rough, steep, rocky slopes, occasionally darting off to a nut-bush, resting with its tail to the sun, partly lowering its wings and rapidly moving its hindwings to and fro like revolving discs, and then darting off to a similar position to repeat the operation. Near Susa, a rocky slope, covered with oak and chestnut, was its haunt, and, strangely, the imagines appeared to prefer the chestnut on which to sun. On the hills above Grésy-sur-Aix, at the end of July, 1905, whilst hunting for *Satyrus hermione* on some isolated pear-trees growing just below the ridge of the hill, above the woods, we observed dozens of imagines flying round the tops of the trees about 2 p.m. Several were captured, all ♂s. Nor is this species proof against the attraction of flowers, for Gillmer observes that, on July 10th, 1904, when it was in unusual abundance in Klein-Zerbster Busch, 1904 being hot and distinctly a "*quercus*" year, it was especially attracted to the blossoms of the bushes of *Rhamnus frangula*, just coming into flower, and plentifully distributed throughout the clearings of the forest, at which there were several hundreds of specimens, mostly males, although usually not very abundant in the locality, where the bushes stood in the full sun. The butterflies only flew up if one pushed against the bushes, and one could select the finest specimens at leisure. No examples were to be seen in the shady part of the forest, and the large clearings where they occurred are almost entirely surrounded by oaks. This "swarming" habit, in certain years, is not unusual, *e.g.*, the species was exceedingly abundant in certain parts of Germany in 1854, 1886, 1904, etc. Trimen says very abundant, but flying very high round the oaks on Ranmore Common, July 18th, 1857; Rodgers records it as swarming about the large oaks in Sherwood Forest, August 2nd, 1857; Bayne observed it swarming in mid-July, 1896, round small oaks in one of the New Forest enclosures; Tetley observed it in countless numbers in August, 1902, in the Llyfnant Valley, Montgomeryshire; Gibbs says that it flew in clouds around some young aspens and oaks, from July 23rd-25th, in Bentley Wood; Dale observed it in swarms after 5 p.m., on July 18th, 1876, at Abbott's Wood; whilst Vaughan says that the insect swarmed, in 1887, round the tops of some oak-trees in the wood near Craig-y-pwl-ddhw, but the examples flew very high and were difficult to net. Simes saw it very abundant, flying over oak and ash, in 1891, at Lyndhurst; Sheldon says that, in June and early July, 1893, the imagines were in great numbers, flying over the oaks near Clovelly and Lynton.

Alderson observed them in "myriads" in the New Forest, in July, 1900. Russell records them as swarming around birch-trees in a copse at Fleet; and Rogers states that it swarms in the oak-woods of the Teignmouth district. Aigner-Abafi says that, in Hungary, the females mostly sit about on the leaves, and that they are males that fly so freely above the trees, in swarms, especially towards evening, but the species prefers young woods, and is found sometimes about mere oak-bushes. Jeffreys notes that, near Barmouth, the species was observed flitting over the oak-trees, and they were especially noticeable as the sun was declining in the afternoon. Norgate, too, saw the species in Foxley Wood, most abundant towards evening, and one was caught at the same place on a tree-trunk within an inch of a sugar patch. Of the habit of resting on ash, Davis notes (*Ent.*, ii., p. 312): "Whilst collecting in July, at West Wickham, I shook a small sapling ash, and observed several specimens fly from it, and almost immediately return and settle again on the leaves, in most instances upon the identical leaves from which they had been disturbed; further observations proved this to be the case with most of the young ash-trees in the wood, and I could have captured dozens had I been so disposed. On the same day, I observed about twenty specimens gambolling and settling upon an ash-tree, near Beckenham, no oak being near." Sturgess observes that it was so common, in 1856, at Kettering, that quite forty were counted sporting round one lime-tree. Cox observed it flying around the tops of elms as well as oaks at Abbey Wood, in July, 1859; and Bogue says that, although common around oak-trees in Burford Wood, near Shepton Mallet, it sometimes also shows a decided preference for ash. This preference for ash was noted by Stephens, in 1828, when he observed that it frequented the tops of lofty oak- and ash-trees. Bird observes (*Ent. Rec.*, xvii., p. 311) that, at Tintern and Llandogo, this species appears almost to ignore an oak-tree, with the exception of females when presumably ovipositing, principally for ash, but what the attraction is he does not know, unless it is the presence of honey-dew. He says: "In this neighbourhood, where we collect, at the end of July and beginning of August, each ash-tree has several of these butterflies settled on, or crawling about, its leaves and twigs, or else flying round the tops, pursuing and fighting each other, and when one is driven away it will generally fly off to another ash. Very occasionally they will settle on the leaves of an oak, hazel, or wild cherry, but the ash is by far the most frequented. We have even seen a small ash, little more than a bush, with three of these butterflies settled on it at one time. Only once have we noticed the species at flowers, when a female was observed this year (1906), late in the season busily extracting the sweets from *Eupatorium cannabinum*." He further notes (*in litt.*): "On July 25th, 1906, in the morning, I was surprised to see a specimen of *Bithys quercûs* flying quietly about bracken and settling on the fronds to sun itself. The bracken was on a very steep hillside, and about the same altitude as the tops of the oak and other trees growing below, which may, I think, explain its forsaking them, perhaps mistaking the bracken-covered hillside for the tops of a wood. I watched it for a little while and noticed that it liked to sit tail to the sun, and, unlike *Edwardsia w-album*, occasionally expanded its wings a little when at rest. It was also very fond of rubbing its hindwings up and down in opposite directions against the forewings, keeping the latter still, and even did so when the wings were opened. On the same date, in the evening, while walking through a wood, I came across another of this species asleep on a bent grass stem by the side of the path. Its antennæ were extended in front, and pressed quite close together so as to appear like one appendage, and held in an arched position with the clubs inclined downwards. It was very sluggish. I have been comparing the habits of this species with that of *Edwardsia w-album*, and have tried to puzzle out why they differ. *E. w-album* likes to stay in the neighbourhood of its foodplant and never strays far. *B. quercûs*, on the contrary, may often be seen flying swiftly over the bushes and across country. No doubt the stay-at-home habits of *E. w-album* are due to the comparative rarity of the wych-elm which is decidedly local, but *B. quercûs* can safely indulge in long flights and, wherever it goes, so long as it keeps to the woodlands, will always be able to find an oak-tree when it wants to do so." Rowland-Brown says that he observed males on holly at Lyndhurst, on July 26th, 1902, and Sotheby records it as flying round mountain-ash in Abbott's Wood in July, 1882. Alderson observes (*Ent.*, xxv., p. 314) that the imagines could be beaten out in dull weather in the New Forest in July, 1892, and Wilkinson that it may sometimes be beaten from pine-trees, in Barron Wood, after dusk. Raynor observes (*Ent. Rec.*, xviii., pp. 298-9) that the females often run about the twigs, apparently busy egg-laying, but evidently not doing so, and that he was unable to detect a female at the actual operation, although he often noticed what he thought were females laying their eggs. Although we have noted the species as being very abundant in 1904, at the blossoms of *Rhamnus frangula*, on the Klein-Zerbster-Busch, the habit of visiting flowers in numbers must be considered rather exceptional. We found a female, with several of *Klugia spini*, feeding on the flowers of a white saxifrage, growing on the tops of the walls near Chavoire, by the banks of the Lac d'Annecy, July 29th, 1902, whilst others were flying freely round the oak-bushes on the slopes above, and settling on the topmost boughs, a much more usual habit with this species (Tutt). In the historic little gorge at Digne, just beyond the "Baths," we captured a specimen in early August, 1906, on *Eupatorium cannabinum*, among swarms of *Coenonympha dorus*, *Erebia neoridas*, *Loweia dorilis*, *Hipparchia arethusa*, and other species. As stated above, Bird once observed a specimen of this species on flowers of *Eupatorium cannabinum*, at Tintern; this was a female, and Edelsten observes that, in August, 1900, the imagines were seen flying high round the tops of the oaks in Abbott's Wood, whilst the females often settled on large low boughs, where they appeared to be egglaying; the imagines also came to late flowers of bramble. Lewin also says that it may be taken frequently at bramble-blossoms whilst feeding, and on which it frequently settles. Armstrong notes it as abundant in the Carlisle district, on oaks in August, also flying around *Circium arvense* and other plants, the white varieties of the former being seldom visited. Hamm notes it at flowers of lime at Aldermaston Park. Gebhard records it as being attracted at Rathen, near Libau, by the odoriferous "queen of the meadow," thistle-flowers, etc. Constant says that in Saône-et-Loire it often flies around chestnut-trees in blossom, at a great height, which makes it difficult to capture. Griffith says that, in Morbihan, it almost always flies about the summit of oaks, sometimes, however, resting on the fruit of the chestnut.

Rondou observes that it flies during the warm part of the day, above young oaks, ash-trees, and limes in the Pyrenees. Near Clelles, it sported in the afternoon sun, above the summits of some oaks about 20 feet in height, growing on a rocky hillside (Tutt). Rowland-Brown observed imagines at Digne, in early August, 1903, much attracted by the pods of a shrub covered with honeydew. In the Rhine Provinces, it is to be seen on the summit of the Neuenahr, flying abundantly round the heads of the highest oak-trees (Maassen), whilst at Elberfeld, its habit, like that of *Nordmannia ilicis*, is to fly round oaks, often at a considerable elevation (Rothke); Fuchs also compares its flight at Oberursel with that of *N. ilicis*. In the Wetterau, at Giessen, around the tops of oak-trees and over oak-bushes, it flies, at a good height, often in considerable numbers. Glaser says that, in Hesse, the butterfly is most abundant in the Hinterland, and on the Winterstein, near Friedberg, flying high around the sun-lit heads of the oaks in numbers, and only to be caught with difficulty. Pabst observes that, at Chemnitz, the butterflies circle high round the oak-trees, especially towards evening, at sunset. In Belgium, the imagines fly in July in the ridings and clearings of woods, etc., and may sometimes be seen flying in hundreds round the heads of large oaks, but they also love to rest on the leaves of little oak-bushes, when they are not difficult to capture (Lambillion). In Spain, too, their habit is to fly round the tops of the tall oak-trees, *e.g.*, at Monserrat (Cuní y Martorell), in the Gibraltar district (Walker), etc. Engramelle (*Papillons*, etc., i., p. 155) says that, when both sexes are flying together about the tops of oaks, they appear always to be at war, chasing one another continually. Blachier observes (*in litt.*) that the butterfly is somewhat difficult to capture, for it loves to fly high around the trees; Rehfous adds that it appears to fly, as it were, by leaps from one branch to another, but once it settles on a leaf often remains there a long time. Nolcken states that, in the Baltic Provinces, its habit is to fly rather high up round oaks, to sun itself upon the leaves, but adds that, in dull weather, it rests on the underside of the leaves. Others have also noted this same peculiarity. Crotch says that, in North Wales, he found the species best taken by using two poles, about 20 feet long, one on which the net is mounted, and the other for tapping the trees. Studd records (*Ent.*, xxxi., p. 71) the capture of a male in his light-trap at Oxton, Devon, on the night of August 26th, 1897. We have already noted the pugnacious disposition of *B. quercûs*, but Healy records (*Ent. Wk. Int.*, iv., p. 20) how, whilst examining the "Bishop's Paling" one day, in July 1857, his attention was drawn to a battle between a *B. quercûs* and a wasp, in which he was surprised to see the undaunted pluck of the former. "The butterfly repeatedly charged the wasp in a most furious manner; he never attempted to fly away, but stuck to his opponent with bulldog courage. The scene presented the appearance of a minature cock-fight. At length the wasp altered his tactics, and, as *B. quercûs* made a charge, with wings erect, he dodged on one side, and whipped off a portion of his wings; this trick he repeated until the butterfly's wings were half-destroyed, and, seeing that he would shortly fall a victim to his cunning opponent, I captured him, and now have him in my cabinet."

Habitats.—Throughout the more wooded portions of the British Islands, where oaks are at all frequent, this species appears to occur, it also inhabits, as Borkhausen mentioned a century-and-a-quarter ago, the oak-woods throughout central Europe, eschewing gardens, and being very rarely observed in open ground. We have also seen it flying commonly about the little oaks, in the wood-scrub covering the extensive slopes above Grésy-sur-Aix, dashing out and attacking a passing *Limenitis camilla*, and then returning to its perch; also about the pear-trees growing on the little farm just below the ridge that lies above this wood; also in an open oak-wood on a steep rocky slope at the foot of the Mont Aiguille, near Clelles, in the Dauphiné Alps, and, yet again on a rough, rocky, bush-covered slope, between Roche and Yvonne, in the Rhone Valley, where *Leptidia sinapis*, *Hipparchia alcyone*, *Satyrus cordula*, *Melitaea didyma*, and a score of other species were abundant; also in a similar locality, to wit, the oak-scrub on the slopes near Chavoire, just above the Lac d'Annecy. Near Susa, in Piedmont, it haunted, in August, 1896, a rocky slope, covered with lovely chestnut-trees, among which it flew, settling on the chestnut-leaves in the brilliant sun, or flying high around the tops of the trees. Here, strangely, we noticed few oaks (there may have been more than memory suggests), and, on the outskirts of the tree-covered area, *Erebia neoridas* was abundant, whilst *E. aethiops* flew amongst the trees and settled on the leaves, exhibiting a distinctly different habit from its ally; again, in 1901, on the zigzags going up to Crissolo, where the magnificent chestnut-woods give way to oak here and there, we found this species, the locality really not very unlike that at Susa. A century-and-a-half ago it occurred commonly in what is now London, in woods that have long since been cleared, and the sites of which are now occupied by houses. Amongst others, Harris observes (*Aurelian*, p. 21) that it was "common in Honour Wood, near Peckham, on oak." Even during the last 30 years the species has disappeared from Westcombe Park, Shooter's Hill Wood, and other suburban London areas, where, however, oaks are still moderately abundant. Why it does not occur in our London parks has always been to us a mystery, unless the London sparrow is, as we suspect, largely responsible, for the insect spends its life high up, and cannot be particularly affected by the human element. It still, however, is not uncommon in many places a few miles outside the metropolis. In Wales, one finds that, in Merioneth, near the village of Arthog, it occurs upon the wooded slopes, and a corner full of flowering bramble, scabious, meadowsweet, knapweed, and St. John's wort, produced specimens of this species, as well as many others (Arkle); in Glamorgan, it occurs in the woods near the coast at Cowbridge, on blue lias, where the climate is rather exceptionally damp (W. E. R. Allen). White remarks that "it is a rarer species in Scotland than *Callophrys rubi*, occurring in several places in the lowland part of the county of Perth, as far north as Dunkeld; although found in Argyllshire, it does not seem to occur everywhere in the south of Scotland as might be expected." Lennon notes it as occurring in Camlorgan Wood, about ten miles south of Dumfries, and near the coast, and also on the slope of the wooded hills that bound to the west the valley in which Dalscairth is situated. In England, almost all records note the species as occurring in oak-woods, *e.g.*, the oak-woods near Newark (Carr), near Oxton (Studd), near Lincoln (Pearson), at Balcombe (Tugwell), at Taunton (Doidge), etc. It also occurs freely round the oaks on Exmoor (J. E. Gardner); frequents the oaks on the south side of the Hog's Back, near Guildford (Swinton); and occurs in young oak plantations at Braunton (Riding); in the Isle of Purbeck it is seldom met with, although oak is plentiful (Bankes). Rothschild says that, in his experience in various localities, solitary and low trees are generally the best. Barrett says that, in Norfolk, it occurs on the outskirts of woods, and occasionally in fens. In Ireland, it appears to be confined to the south and southwestern parts, which have a mild and equable temperature, where the coast is washed by the Gulf Stream (Kane). We have already noted it in some of its French haunts (*anteà*, p. 266); Rowland-Brown observed it at Digne, in early August, 1903, in the woods above the great fountain, still commoner on the rough ground at the top of the hill above the cemetery, and here much attracted by the pods of a shrub covered with honeydew; our only experience of the species at Digne was in that marvellous insect-haunt, the little glen with a stream for its path, just beyond the "Baths," where almost all the insects of the district sometimes appear to congregate. In Saône-et-Loire, it is reported as very common, in the clearings and in the avenues of the large woods (Constant); in woods and oak-scrub, also among ash and lime in the Pyrénées (Rondou); on the edges of the oak-woods in the Alpes-Maritimes (Millière); Rowland-Brown took it in a copse of oak-trees off the high road from Nice, about two miles from the village of St. Martin Vésubie. It occurs in mixed pine- and oak-woods in the Gironde (Trimoulet), the oak-woods of Berry and Auvergne (Sand), in the forests, woods, and thickets of the lowlands of the Doubs (Bruand), throughout the oak-woods of Aube (Jourdheuille), and of the Eure, flying swiftly around the oaks (Dupont), and among the young oaks in the Parc Maison Lafitte (Walker). In Italy, we have so far only seen it in Piedmont—at Crissolo and Susa—in mixed woods of oak and chestnut on mountain slopes, at about 3000ft. elevation, and Norris notes similar ground in the neighbourhood of the Certosa di Pesio. Marott says that it occurs in the oak-woods of Ficuzza, and Failla-Tedaldi, that it extends up to 1500 metres in the oak-woods of the Madonie mountains in Sicily. In Belgium, it is widely distributed in the oak-woods of the greater part of the country; it is also especially fond of oaks growing in avenues, and is found in the clearings of woods, and on the edges of forests (Lambillion). Walker notes it as being somewhat scarce in the Gibraltar district, where it is taken sparingly among *Quercus lusitanica* in the stone-pine plantation—commonly known as the "First Pine Wood"—about a mile north of San Roque; Lang says that it occurs in the cork-woods near Gibraltar, and Cunì y Martorell in the oak-woods of Monserrat. Miss Fountaine records it as swarming in the oak-woods west of Sebdou, early in August, 1904. The only note we have of its habitat in Asia Minor is to the effect that it occurs in the pine-forest above the old Sivas road, near Tokat (Fountaine). In Bulgaria, Mrs. Nicholl found it in the Balkans, on the pass of Ginec, and among the forests on the limestone slopes, between here and Lom-Palanka, on the Danube. In Roumania, Caradja says that it occurs locally throughout the oak districts, as it also does in the surrounding countries, but that, owing to the absence of oak, it does not occur in the steppes of southern Russia at all. In Germany, as in Britain, it is particularly attached to oak-woods, being found throughout the plains and hilly districts of this country and Switzerland, where its foodplant grows (Speyer). It is recorded as occurring throughout the oak-woods of Hesse, being particularly abundant in the " Stadtwald " at Frankfort-on-Main (Glaser), in most of the oak-woods of Pomerania (Hering), Mecklenburg (Schmidt), Hanover (Glitz), the plains of Silesia (Wocke), the kingdom of Saxony (Schütze), Bavaria (Kolb), Posen (Schultz), and the lowlands of Baden, extending into the foothills and lower mountains (Meess and Spuler). It haunts sunny hillsides timbered with oaks in East and West Prussia (Speiser), the hedges containing oak-trees by fields and meadows, as well as the oak-woods in Holsatia (Laplace), the oak-scrub, and woods of deciduous trees on the foothills and lower parts of the Trebnitzer mountains, rarer in the woods of the lowlands of the district (Döring), but also occurring not rarely in all the oak-woods of the plains of Silesia (Wocke). It also occurs on the tall oak-trees on the summit of the Neuenahr (Maassen), in parks, flying high around the tall oak-trees, in the Rhine Provinces, especially abundant on the right banks of the Rhine, near Cologne, and in the forests of Kuppersteg, as well as in almost all woods consisting of deciduous trees near Elberfeld and Barmen (Weymer), abundant in all the oak-woods of Hesse (Schenck), especially abundant in the "Hinterland," and on the Winterstein near Friedberg (Glaser), the oak-forests of Thuringia (Krieghoff), prefers the clearings in the oak-woods of the province of Saxony (Wilde), and distributed throughout the oak-forests of the kingdom of Saxony (*Ent. Ver. Dresden*); in Anhalt and the Hartz mountains it occurs in all the oak-forests, abundantly in the Mosigkauer Haide, the clearings in the forests of Anhalt, etc., swarming in some years in the forest of Klein-Zerbst (Gillmer), also occurring in all the oak-woods of the north-eastern border of the Hartz (Reinecke), and the foothills of the Wernigerode district (Fischer). In Switzerland, it haunts not only the oak-woods, but copses and oak-scrub growing on the lower slopes of the mountains; Blachier notes it as occurring in oak-woods in the neighbourhood of Geneva, and also in a wood of mixed growth at the foot of Mont Salève; Frey says that it occurs throughout the country on oak, and up the mountains to the elevation that the tree grows, being sometimes common, at other times rare. In Austria, it occurs in the oak-forests of Bohemia (Nickerl), and of Lower Austria (Rogenhofer), in the glades of the oak-woods of southern Moravia (Schneider); in Upper Austria it is somewhat rare, but rather more common in the lowlands (Himsl); in the Tyrol, too, it appears not to go up any distance into the mountains (Weiler). Eversmann says that it is not rare among hazel and oak in the Russian provinces of Casan, Orenburg, Saratov and Sarepta, where it is apparently getting towards the eastern limit of its range. It occurs throughout the Baltic Provinces wherever oak occurs, particularly in woods of deciduous trees, and on the outskirts thereof, flying rather high up around the oak-trees (Nolcken). Speyer says that it is fairly common in the south of Scandinavia and the centre, at least as far as Stockholm.

British localities.—Distributed throughout, in oak-woods, from Ross to Cornwall, and Norfolk to Galway, more particularly abundant in the southwestern counties of England and Wales. The distribution in Ireland is really little known. Argyll: local and rare—Kilmun (Watson), Tayvallich (Stewart). Ayr: Monument Plantation, Monkton (J. P. Duncan). Beds:

generally distributed—Bedford (Nash), Stagsden (Greenwell-Lax), Potton (Bond-Smith), Luton (Lucas). Berks: common in oak-woods—Aldermaston Park, etc. (Hamm), Bagley Wood, Boar's Hill (Geldart), Newbury (Hopson). Bucks: abundant in the woods—Buckingham district (Slade), Black Park (Stevens), Claydon (Harpur-Crewe), Wendover (Barrett). Cambridge: Cambridge (Crisp), Shelford (Lee). Carmarthen: generally distributed (Barker). Carnarvon: oak-woods near Deganwy (Gardner), Aber (Barraud), Llandudno (Harding), Vale of Conway, abundant (Gardner). Cheshire: very rare—Eastham Wood (Walker's List), Delamere (Chappell), Edge, near Malpas (Wolley-Dod), Wallasey, once (Prince). Clare: Cratloe (Neale). Cork: Skibbereen (Wolfe), Timoleague, Glandore, Ummera Woods, not common (Donovan). Cornwall: locally abundant in the east, scarce further west—Millook, Liskeard, Bodmin (Clark), Truro (Benson), St. Austell (Hodge), Burngullow (Rollason), Godolphin (Spiller), Polperro district (Perry-Coste). Cumberland: locally distributed in oak-woods—Barron Wood, common, etc. (Hodgkinson), Armathwaite (Wilkinson), Thurstonfield, Orton (Routledge), Newby Cross Dalston, Newbiggin Woods (Dawson). Denbigh: Gresford (Archer), Chirk (Gardner), Llandulas (Sharp), near Ruthin (Ward). Derby: Melbourne district, common (Corbett), Repton Shrubs (Brown), Seal Wood (Baker). Devon: generally distributed—Brendon (Prout), Lynmouth (Briggs), Instow district (Hinchliff), Braunton (Riding), Torrington (Doidge), Barnstaple (Mathew), Combe Martin (Peed), Silverton (Ward), Torquay district (Crocker), Teignmouth district (Rogers), Paignton district (Goodale), Totnes (Swinton), Dulverton-on-Exmoor (de la Garde), Dartmouth (Bankes), Sidmouth, abundant (Wells), Dartmoor (Arnold), Bickleigh (Bignell), Egg Buckland (Briggs), Bridestowe (Still), Chambercombe Woods, Ilfracombe (Battley), Clovelly, Lynton (Sheldon), East Devon—Honiton district, very abundant (Riding), Stoke (Harvie), Oxton, common (Studd), Exeter, very common, Plymouth district (Stainton), Starcross, Morthoe (Barrett). Dorset: Sherborne (Douglas), Yellowham Wood (Bogue), Isle of Purbeck, Rempstone, Wareham (Bankes), Lulworth (Morison), Poole (Green), Blandford, common (Stainton). Dublin: near Dundrum (Kane). Dumbarton: near Luss (Logan), Helensburgh (Scott). Dumfries: Camlorgan Wood, Dalscairth (Lennon). Durham: confined to the northeast—Gibside (Wailes), Derwent Bridge (Hancock), Dunston (Hedworth). Essex: common and generally distributed—Colchester (Harwood), Epping, very common (Stainton), Theydon Bois (Wright), Loughton, Walton-on-the-Naze, Mucking (Burrows), Great Totham (Image), Thundersley Common (Whittle), Harwich district, Stour and Maldon Woods, common (Mathew), Brentwood (Mera), Hazeleigh, Danbury, Woodham-Ferris (Raynor), Stanstead (Spiller). Fermanagh: Enniskillen, scarce (Partridge). Flint: Overton (Gardner), Ashgrove (Perkins). Galway: Galway district, Dalystown Wood, Kilglaunah, Loughrea (Dillon). Glamorgan: Cardiff district (Ansaldo), Swansea district (Robertson), Cowbridge (W. E. R. Allen), Llandaff (Helstrip). Gloucester: widely distributed — Stonehouse (Bignell), Bristol (Stainton), Aldsworth (Todd), Dowdeswell (Robertson), Kimberland, Painswick, Dursley, etc. (Merrin), Grange Court (Metcalfe), Newnham (Morse), Parkend, Forest of Dean, common (Hopkins), Great Witcombe (Newstead), Wotton-under-Edge, scarce (Perkins), Painswick, scarce (Lifton), Stroud district (Davis), Stanley, near Stroud (Isacke), near Cheltenham (Robertson), Forest of Dean (Langley). Hants: common in all oak-woods—Alton (Reid), Fleet (S. G. C. Russell), Warsash (Swinton), New Forest, common (Bankes), Lyndhurst (Edelsten), Beechen Lane (Alderson), Stubby Copse, Brockenhurst (James), Bank (Carr), Winchester (Tomlin), Ampfield (Hewitt), Portsmouth district—Great Salterns, Portsea Island (Pearce), Frensham district, Wishanger (Bingham-Newland), Ashford, near Petersfield, Forest of Bere (Hawker), Isle of Wight—Parkhurst (Prideaux), near Freshwater (N. C. Rothschild), Shanklin (Trimen), Bullen, near Ryde (Jordan), near Brading, very common, between Bonchurch and Shanklin (Rowland-Brown), Bembridge, common (Stainton). Hereford: common in oak-woods throughout (Bowell)—Dinmore Wood (Lucas), Leominster (Hutchinson), Tarrington (Wood). Herts: Bricket Wood, Radlett, Shenley (Gibbs), Sandridge (Griffith), Hitchin (Durrant), Haileybury (Bowyer), East Barnet (Gillum), Watford (Spencer), Tring (Rothschild), Norton Green Woods (Matthews), Broxbourne Woods (Boyd), Oxhey Wood (Rowland-Brown), Bushey Heath (Barraud), Hatfield (Mera). Hunts: Monk's Wood (Bower), St. Ives' district (Norris). Kent: throughout—Shooter's Hill Woods, Chislehurst (Fenn), Abbey Wood (Cox), Chatham district—Wigmore Woods (J. J. Walker), Chattenden, Higham, Cuxton, etc. (Tutt), Birch Wood (Stephens), Ashford district (Wood), Sevenoaks district (Holmes), Blean Woods

(Battley), near Lyminge (Freke), Mottingham, Cudham, Shoreham, Darenth, Bexley, Swanscombe (Bower), Appledore (Heitland), Lower Fant, Maidstone (Golding), Tenterden, very common (Stainton), Tunbridge, Pembury (Cox), Canterbury district (Parry), Ewell district (Hall), Ramsgate district (Willson), Herne Bay (McLachlan). KERRY: Killarney (Donovan). LANCS: Manchester district (Edleston), Preston district, singly (Hodgkinson), Arnside, common (West), Fairy Steps, Arnside (Clutten), Arnside Knott (Forsythe), Grange (Hodgkinson), near Carnforth (Murray), near Stonyhurst (Hodgkinson). LEICESTER: Leicester district (Dixon), Quorn, Ulverscroft, Buddon Wood, Swithland, Ansty Lane (Rowley), Loughborough (Wieldt), Gumley (Matthews). LIMERICK: near Limerick (Neale). LINCS: near Lincoln (Pearson), Louth district, not common, Maltby, Burwell, and Muckton Woods (Kew), Langworth, Newball, Legsby (Raynor), Market Rasen, sparingly (Lewington), Gainsborough district (Burton), Alford district (Woodthorpe), Castor district (Porter), between Woodhall Spa and Lumby, Skellingthorpe (Musham), near Sleaford (Stow). [LINLITHGOW (Evans).] MIDDLESEX: Pinner Drive (Melvill), Kingsbury (Bond), near Enfield (Sykes), Mill Hill (South). MERIONETH: Barmouth (Gibbs), Arthog, Tan y Bwlch, abundant (Arkle), Harlech (Graves). MONMOUTH: banks of the Wye (Patten), Tintern, Llandogo (Bird). MONTGOMERY: Llyfnant Valley, in countless numbers in some seasons (Tetley). NORFOLK: local (Barrett)—Brandon, (Bower), Drayton Drury, Foxley Wood (Norgate), Croxton (Cole), Reedham, near Yarmouth (Knights), King's Lynn (Atmore). NORTHAMPTON: common—near Northampton (Hensman), Whittlebury Forest, very common (Foddy), Castle Ashby (Horton), Helpston Heath (Morley), Ashton Wold (Rothschild), Kettering, abundant (Sturgess), Daventry, very common (Green), Peterborough (Stainton). NOTTS: Mansfield (Daws), Sherwood Forest (Madden), near Newark (Carr). OXFORD: Charlbury, near Enstone, common (Saunders). PEMBROKE: Castlemartin district (Puckridge). PERTH: Firth, Earn, Gowrie, Perth, and Athole districts (F. B. White), Bracklyn Falls, near Callander (Evans), Loch Earn, Doune (Lovell-Keays), Bridge of Allan (Wingate). RADNOR: Erwood district, near Craig-y-pwl-ddhw (Vaughan). ROSSSHIRE (Davidson, *Ent.*, v., p. 213). RUTLAND: Stoke Dry (Raynor), Burley Wood, Oakham (W. B. Gordon), Uppingham, very common (Bell). SHROPSHIRE: Shrewsbury (Harding). STAFFS: Swynnerton, plentiful (Freer), Charnwood Forest (Harris), Burton-on-Trent (Stainton). SOMERSET: generally distributed in oak-woods, Leigh, etc. (Hudd), Bridgwater (Barraud), Burford Wood, near Shepton Mallet (Bogue), Taunton, abundant Orchard Woods, etc. (Tetley), Porlock district (Carr), Portbury (Griffiths), Wellington (Milton), Ellescombe Wood, Creech Hill, Castle Cary (Macmillan). SUFFOLK: generally common—Bentley Woods (Gibbs), Old Hall Wood, near Ipswich, very abundant (Mera), near Lavenham (Gaze), Stowmarket, common (Stainton). SURREY: generally distributed—Stoke Wood (Pickett), Oxshott (Barraud), Reigate district (Tonge), Ranmore Common, abundant (Oldaker), near Dorking (Sheldon), the Princes' Covers, Claygate, common (Hewat), Guildford (Swinton), Coombe Wood (Mera), Ashtead (T. B. Fletcher), Box Hill (Trimen), near Bagshot (Floersheim), West Wickham (West), Croydon (Hall). SUSSEX: west of county—Shipley, Cowfold (Bird), east Sussex, not uncommon in oak woods—Brighton district, Hayward's Heath, Isfield, Ashburnham, Battle, etc. (Jenner), Balcombe (Tugwell), Poynings Wood (Andrews), Frant (Cox), Polegate, Hailsham (Hamlin), Holmbush, very abundant (Image), Abbott's Wood (Edelsten), Groombridge (Blaber), Burgess Hill (Dollman), Hastings, St. Leonard's (Bloomfield), Eastbourne district (Bromley), Worthing, Lewes, common (Stainton). WARWICK: fairly common—Oakley Wood (Baly), Atherstone (Baker), Brandon Woods, Rugby (Rugby Lists), Wolford Woods (Austen), Alveston, near Whitchurch (Keighley-Peach), Coombe Wood (Longstaff), Tile Hill Woods, Corley Woods (Bree), Knowle (Blatch), Sutton (Imms). WATERFORD: Portlaw (Flemyng). WESTMORLAND: Kendal district, locally common (Moss). WEXFORD: Killoughrim Wood, Enniscorthy (Moffat). WICKLOW: Powerscourt, in the Deer Park (Birchall), Bray Head, etc. (Kane). WILTS: Ramsbury (Rye). WORCESTER: Worcester (Edmunds), Monk Wood, Crown East, Middleyards, Trench (Towndrow), Cowleigh Park, Malvern Link, Wyre Forest (W. H. Edwards), Great Malvern (Edwards). YORKS: York (Helstrip), Askham Bog (Prest), Bishop's Wood (Grassham), Bramham (Smith), Doncaster (Warren), Leeds (Birchall), Pontefract (Hartley), Forge Valley (Head), Scarborough (Wilkinson), Sheffield (Doncaster), Wakefield (Talbot), Whitby (Clarke), Cleveland district—Sandsend (Lofthouse), Maltby Wood, near Sheffield (Batty), Overton Wood, near York, common (Backhouse).

Distribution.—Throughout Europe (except the extreme north), Armenia, the Taurus mountains, Mauretania (Staudinger and Rebel), and Asia Minor. Armenia (*i.e.*, Transcaucasia) and the Province of Orenburg, 55°E. long., are its most eastern recorded limits; its most northern limits are—Abo, in Finland, and Vestmanland, in Sweden, about 60°N. lat., its most western—Ireland, about 10°W. long., and its most southern—Algeria and Cyprus, 35° S. lat. Africa: Algeria—Boghari (Oberthür), west of Sebdou, abundant (Fountaine). [Canary Islands: Madeira, abundant (Macdonald, *Ent. Wk. Int.*, vi, p. 62), almost certainly *Lampides boeticus*.] Asia: Asia Minor—Beyrout (Mathew), Amasia (Staudinger); Sivas Road, near Tokat (Fountaine). Cyprus—Mount Troodos (Marsden *teste* Graves). Austro-Hungary: throughout, but not abundant—Bohemia—Prague (Nickerl), Carlsbad (Hüttner); Moravia—Brünn, abundant (Schneider), Neutitschein, Troppau (Fritsch); Upper Austria—Steyer, Wels, Rottelthal, near Grammastetten, rare (Brittinger); Linz, Pöstlingberg, Pfenningberg, Krohleiten, near Kirchdorf (Himsl); Lower Austria, local—Vienna, Park of Schönbrunn, Dornbach, Giesshübel (Rossi); Gresten, singly (Schleicher), eastern part of Hernstein district, Hölles (Rogenhofer); Salzburg—Salzburg, the Glan-meadows, southern end of the Eichet (Richter); Tyrol—Mendel (Rowland-Brown), Etsch Valley (Hinterwaldner), the Calvarienberg, near Bozen, singly (Rebel), Mödling (Fountaine), Croatia and Slavonia (Rebel); Dalmatia (Rebel); Carniola—the Nanos (Mann); Carinthia, singly—Wolfsberg (Lemann), Hermagor, Möllthal (Höfner); Hungary, common throughout—Budapest, Peszér, Nagyvárad, Pécs, Debreczen, Eger, Psér, Györ, Sopron, Szaár, Pozsony, Nagylévand, Tavarnok, Selmerrzbánya, Gáas, Kocsocz, Rozsnyó, Eperjes, Kolozováa, Nagyág, Réa, Mehadia, Orsova, Lipik, Vinkovcze, Fiume (Aigner-Abafi). Belgium: Marchovelette, very abundant (Wautier), Namur, Beez, Vecquée, Marlagne (Lambillion), Ardennes, Rochefort, Ortho, common (Slégers), Dinant, Yvoir, Hastières (Bodart). Bulgaria and East Roumelia: West Bulgaria, on the Antibalkan, Pass of Ginec (Nicholl); Slivno, common—Kirchenwald, Gök dagh (Haberhauer). Channel Islands: Jersey—Mont Musère, St. Lawrence, Vallée des Vaux, St. Saviour's (Piquet); Alderney, once, an unexpected capture, oaks being very scarce in the island (Luff). Corsica (Rambur). Denmark: Selskaberi, Egeskove (Bang-Haas). Bosnia and Hercegovina: Domanovic (Hensch), Stolac (Winneguth), near Sarajevo (Rebel). Finland: Abo district—Kakskerta, Korpo, Reso (Federley). France: throughout (Berce)—Ain—Divonne, at the foot of the Jura (Reverdin); Aisne—woods of Holnon and Savy, St. Quentin (Dubus); Alpes-Maritimes—on the Route de Venanson, St. Martin-Vésubie (Bromilow); Aube—common (Jourdheuille); Brittany—throughout (Griffith); Basses-Alpes—Digne, common (Rowland-Brown); Basses-Pyrénées (Rondou); Calvados, very common (Fauvel), very rare at La Soulève, forest of Cérisy (Moutiers); Charente-Inférieure—Royan (Salis); Cher—St. Florent, Sologne (Sand); Côtes-du-Nord—Val André (Turner); Dordogne—Corail, near Lembras, St. Sauveur, Mont Albany near Mouleydur (Tarel); Doubs (Bruand); Eure—Pont-de-l'Arche, rare (Dupont), Elbeuf (Coulon); Eure-et-Loire (Guenée); Gard—Pont du Gard (Lemann); Gironde—Bordeaux, common (Rt. Brown), Pessac, Boascat (Trimoulet); Haute-Garonne (Caradja)—Luchon (Fountaine); Haute-Marne—common (Frionnet); Hautes-Pyrénées—generally (Rondou); Haute-Savoie—Annecy (Tutt); Indre—Brenne, scattered (Martin), woods of Vavray and of Chanteleloup, Nohant (Sand); Isère—Uriage (Reverdin); Clelles, foot of Mont Aiguille (Tutt); Loire-Inférieure—Nantes, Savernay, la Chapelle-sur-Erdre, wood of Touchlaye (Deberman-Roy), Lozère (Bellier de la Chavignerie); Maine-et-Loire—common (Delahaye); Manche—Mont du Roule, les Trouquets, Cherbourg, rare (Nichollet); Marne—Rheims, common (Demaison); Nord—common in all the large woods (Paux); Pas-de-Calais—near Hesdin (Rowland-Brown), Boulogne-sur-Mer (Timins), forests of Leek, Guînes and Boulogne (Gurney); Puy-de-Dôme—Auvergne district (Sand); Pyrénées-Orientales—le Vernet (Struve), Saône-et-Loire, common (Constant); Sarthe (Desportes); Savoie—Grésy-sur-Aix (Tutt); Seine—Paris district, Parc Maison Lafitte (F. Walker), La Varenne, St. Maur (Ragonot); Seine-et-Oise—St. Germain, etc. (H. Brown); Seine-Inférieure—forest of Arques (Moore); Meurthe-et-Moselle; Vosges—Epinal, forest of St. Antoine (Cantener). Germany: East and West Prussia—Tilsit, Cranz, Rauschen, Warnicken, Germau, Neuhäuser, Wargen, Dammhof, Metgethen, Königsberg, Kleinheide, Tapiau, Insterburg, Gerdauen, Rastenburg, Ludwigsort, Mohrungen, Osterode, Gr. Buchwalde, Ramuck, Ortelsburg, Willenberg, Kulm, Elbing, Danzig, Zoppot, Konitz, Jastrow (Speiser); Pomerania, throughout—but scarce (Hering), Rügen, Göhren, Mönchgut, Kl. Barnekower Woods, Franzburg, Anclam (Homeyer); Mecklenburg, distributed—Sülze, Neustrelitz, Rülow, Waren, Parchim, Ludwigslust, Schwerin, Wismar (Schmidt); Lübeck, throughout (Tessmann), Eutin, not common (Dahl); Holsatia—abundant (Boie); Hamburg—Sachsenwald, Schnelsen, Harburg, etc. (Laplace), Schleswig-Idstedter Holz (Peters); Hanover—Lüneburg, abundant (Machleidt and Steinvorth), Bremen (Rehberg), Hanover (Glitz), Brunswick (Heinemann), Osnabrück (Jammerath); Rhine Provinces, rare—Bochum, between Uerdingen and Crefeld, Fischeln (Stollwerck), on the summit of the Neuenahr (Maassen), Bonn, Boppard, Bingen, Trier, Cologne, forests of Küppersteg, Aachen, near Karlshöhe (Stollwerck), Elberfeld, Barmen (Weymer); Hesse—Wiesbaden (Rössler), Oberursel (Fuchs), Hanau (Limpert and Röttelberg), the Wetterau, Giessen, on the Winterstein, near Friedberg, in the Vogelsberg, Darmstadt (Glaser), the Stadtwald of Frankfurt-on-Main (Koch), Cassel (Borgmann); Waldeck—throughout; Thuringia—Gotha, Siebleber Holz, Berlach, Boxberg, Hirzberg, etc. (Knapp), Gera (Verein Gera), Erfurt, the Steigerwald, and Willrodaerforst (Keferstein and Werneburg); Province of Saxony—Zeitz, Ossig, Knittelholz, Prössdorf Forest (Wilde), Mühlhausen, not rare, Rudolstadt, Naumburg, Sondershausen, Kyffhäuser, Nordhausen (Jordan), Dölauer Haide, Halle (Stange); Anhalt and Hartz—Dessau (Richter), Mosigkauer Haide (Amelang), Diesdorf, forest of Klein-Zerbst (Gillmer), Ballenstedt, in the Hartz (Ahrens), Gernrode, on the north-eastern edge of the Hartz, not rare (Reinecke), Wernigerode, abundant (Fischer), Quedlinburg, Osterode, Göttingen, rare (Jordan); Brandenburg, distributed, but not rare (Pfützner)—Berlin district, Finkenkrug, Brieselang, Königs-Wusterhausen (Bartel and Herz), Frankfurt-on-Oder, on the Kornbusch, Eichwald, Buschmühle (Kretschmer); Posen, nowhere abundant—Moschin, the Eichwald, Posen (Schultz); Silesia—the foot-hills of the Trebnitzer mountains, sometimes abundant, Bitke, rare, Obernigk, abundant, Upper Lusatia, singly, Zittau, Hirschfelde, Görlitz, Lauban, Bautzen (Möschler), Sprottau district, very rare, near Mallmitz, Oberleschen, Modlau, Altkirch, rare (Pfitzner); Kingdom of Saxony, distributed throughout, nowhere rare—Leipzig district, abundant—Leisnig, Lausigk, Frauendorf, Frohburg, Hainichen, Zwenkau, Leina, near Altenburg, Rosswein, not rare; Dresden district, somewhat abundant—Dresden, in the Triebisch, Jahna and Saubach Valleys, Spitzgrund, Lössnitz, Klotzsche, Priessnitzgrund, Plauenscher Grund, Tharandt, Kaitzergrund, Dohna, Loschwitz, Pillnitz, Meissen, in great abundance near the Götterfelsen and Hohe Eifer, Freiberg, abundant; Bautzen district—Saxon Lusatia, distributed, not rare; Chemnitz district—frequent in the Küch and Zeisig Forests, Crimmitschau, Werdau, not abundant (*Ent. Verein*), Rachlau (Schütze); Bavaria — Regensburg (Hofmann and Herrich-Schäffer), the Tegernheimer Berge (Gillmer), Munich (Kranz), Strassberg, Deuringen, Scherneck (Freyer), Börwang (Kolb); Württemberg, throughout—Stuttgart, Tübingen, Reutlingen (Seyffer); Baden, distributed—throughout the oak-forests of the plain and mountains (Meess and Spuler), Karlsruhe, not rare (Gauckler); the Palatinate (Bertram); Alsace—Colmar, woods of Hohlandsberg, Semmwald, Bouxweiler, forest between Bouxweiler and Obermothern, Metz, wood of Ste. Agathe, near Voipy, Sarrequemines, forest of Buchholz (Cantener). Greece: Parnassus (Staudinger), Veluchi (Merlin). Italy: Liguria (Speyer), Piedmont—Crissolo, Susa (Tutt), the Certosa di Pesio (Lowe); Tuscany, throughout — near Florence, Portoferrajo, Pisa, Livorno, Isle of Elba, Porta Romana, Poggio Imperiale (Stefanelli), the Pistoiese Apennines to 700 métres, Lucca (Verity); Emilia—Mantua, common (Speyer), Modena, rare (Caruccio); Venetia—Venice, Parma, Padua (Minà-Palumbo); Lombardy—near Milan, rather rare (Turati), Esino on Lake Como (Fountaine); Campania—Isle of Capri (Brown); Calabria (Costa); Sicily—Madonie mountains, up to 1500 métres, rare, Castelbuono, Pilati (Failla-Tedaldi), the Caronia mountains (Ragusa), Ficuzza, Marraccia (Marott), Osimo (Spada). Netherlands: throughout (Snellen). Portugal: Mount of S. José e Quinta dos Fornos (C. Mendes d'Azevedo). Roumania: very abundant at Grumazesti and Costischa, more rarely at Kloster-Neamtz, Dulcesti, and the frontier mountains of the Bucovina (Hormuzaki). Russia: Provinces of Casan, Orenburg, Saratov, and Sarepta (Eversman); Wiatka govt.—Sarapoul, Malmisch, Ourjoum districts (Kroulikowsky); Baltic Provinces—Revel, Esthonia (Teich), Rathen, near Libau (Gebhard), Weissenhof, near Riga, Sessau, Groesen, Kokenhusen, Pichtendahl (Nolcken); Transcaucasia—Borjom, Lagodekhi, Derbent, Adjikent, Kedabeg, Istidara, Lenkoran, by the borders of

Goktcha (Romanoff), Caucasus district (Fixsen); Crimea district (*teste* Dubus). Sardinia (Kane). Scandinavia: Norway, southwest very rarely—Aas, once in June (Siebke); Akershus, Bratsberg, Nedenaes (58° 38′ to 59° 40′ lat.) (Schöyen); Sweden, south and central, not uncommon—Skåne to Vestmanland (Lampa); Gottland, Stockholm (Wallengren). Servia: Ak Palanka (Hilf). Spain: Castile—Tragacete (Chapman); the cork-woods of Gibraltar (J. J. Walker); Andalusia—Granada district (Rambur), Huejar (Nicholson); Catalonia—Monserrat (Cunì y Martorell), Old Castile—La Granja (Chapman). Switzerland: throughout wherever oak grows and extending up as high as its foodplant—Basle district, Solothurn, Aargau, Bern, Waadt, Uri, Grisons, St. Gallen, Schaffhausen, Zürich (Frey); Geneva district—Salève, etc. (Muschamp), Gamsen (Anderegg); the Valais—Val d'Anniviers—Chippis, Sépey Road (A. H. Jones); between Roche and Yvonne (A. M. Cochrane), Aigle (Tasker), Sierre (Lemann), Folleterres de Fully, Mt. Chemin, Coteau de Ravoire, Saillon, Sion (Favre), Ollon Road, near Aigle, near Charpigny, Sépey, Gryon (Wheeler), Bex (Fountaine).

Genus: Ruralis [, Linne], Poda, Barbut.

Synonymy.—Genus: **Ruralis,** Barb., "Gen. Ins. Linn.," p. 173 (1781); Tutt, "Ent. Rec.," xvii., p. 212 (1905); xviii., pp. 130, 132 (1906); "Nat. Hist. Brit. Lep.," viii., p. 313 (1906). [**Papilio-**] **Plebeius,** Linn., "Sys. Nat.," xth ed., p. 482 (1758). **Papilio,** Linn., "Faun. Suec.," 2nd ed., p. 282 (1761); Hufn., "Berl. Mag.," ii., p. 68 (1766); Schiff., "Schmett. Wien.," 1st ed., p. 186 (1775); Fuess., "Verz.," p. 31 (1775); Müll., "Zool. Dan. Prod.," p. 111 (1776); Fuess., "Mag.," i., pt. 2, p. 262 (1778); Geoff., "Ent. Paris.," p. 243 (1783); Schneid., "Sys. Besch.," i., p. 217 (1785); Bork., "Sys. Besch.," i., p. 134 (1788); Lang, "Verz.," ii., p. 45 (1789); Bork., "Rhein. Mag.," i., p. 297 (1793); Don., "Brit. Ins.," p. 89, fig. 250 (1798); Hb., "Eur. Schmett.," pl. xlvii., figs. *a-b*, larv.; lxxvi., figs. 383-5 (1799); text, p. 58 (*circ.* 1805); "Raupen," etc., Pap. ii., Gens A.e., figs. 2*a-b* (*circ.* 1800); Ill., "Schmett. Wien.," 2nd ed., p. 278 (1801); "Ill. Mag.," iii., p. 187 (1803); Herbst, "Nat. Syst. Ins.," xi., pts. 10-11, p. 82, pl. 307, figs. 1-3 (1804); Ochs., "Die Schmett.," i., pt. 1, p. 113 (1808). [**Papilio-Plebeius-**] **Ruralis,** Poda, "Mus. Graec.," p. 75 (1761); Linn., "Sys. Nat.," xiith ed., p. 787 (1767); Fab., "Sys. Ent.," p. 520 (1775); Bergs., "Nomen.," etc., p. 56, pl. xxxviii., figs. 1-4 (1780); Goeze, "Ent. Beit.," p. 5 (1780); Fab., "Spec. Ins.," p. 118 (1781); "Mant. Ins.," p. 68 (1787); Brahm, "Ins. Kal.," p. 232 (1791); Schwarz, "Raup.-Kal.," p. 197 (1791); Haw., "Lep. Brit.," p. 37 (1803). [**Plebeius-**] **Ruralis,** Esp., "Schmett. Eur.," p. 256, pl. xix., fig. 1 cum *larv.* et *pup.* (1777). [**Papilio-**] **Ruralis,** de Vill., "Car. Linn. Ent. Fn. Suec.," p. 62 (1789). [**Hesperia-**] **Ruralis,** Fab., "Ent. Syst.," iii., pt. 1, p. 277 (1793); Panz., "Schaeff. Icon. Ins. Rat.," 2nd ed., p. 181, pl. ccxii., figs. 1-2; p. 215, pl. cclxxv., figs. 1-2 (1804). **Cupido,** Schrk., "Faun. Boica," ii., p. 219 (1801). **Polyommatus,** Latr., "Hist. Nat. Crust. et Ins.," xiv., p. 116 (1805); "Gen. Crust. Ins.," iv., p. 207 (1809); "Enc. Meth.," ix., p. 647 (1819); Godt., "Hist. Nat.," i., p. 181, pl. ix., fig. 1 (1821); Bdv., "Eur. Lep. Ind.," p. 10 (1829). **Thecla,** Fab., "Ill. Mag.," vi., p. 286 (1807); Oken, "Lehrb.," ii., p. 722 (1815); Leach, "Edin. Ency.," ix., pt. 1, p. 129 (1815); Sam., "Ent. Comp.," p. 24 (1819); Swains., "Zool. Illus.," p. 69 (1821); Stphs., "Illus. Haust.," i., p. 75 (1828); "Ins. Cat.," 1st ed., p. 19 (1829); Meig., "Eur. Schmett.," ii., p. 50 (1830); Curt., "Brit. Ent.," fo. 264 (1829); Dup., "Hist. Nat.," supp. i., p. 387 (1832); Wood, "Ind. Ent.," p. 7, pl. ii., fig. 50*a* (1839); Bdv., "Gen. et Ind. Meth.," p. 8 (1840); Zett., "Ins. Lapp.," p. 909 (1840); Westd., "Syn. Gen. Brit. Ins.," p. 88 (1840); Humph. and Westd., "Brit. Butts.," p. 85 (1841); Dup., "Cat. Meth.," p. 29 (1845); H.-Sch., "Sys. Bearb.," p. 137 (1843); West. and Hewits., "Gen. Diurn. Lep.," ii., p. 487 (1852); Led., "Verh. zool.-bot. Gesell.," p. 18 (1852); Gerh., "Schmett.," iii., p. 3, pl. i., figs. 1*a-c* (1853); Sta., "Man.," i., p. 52 (1857); Speyer, "Geog. Verb. Schmett.," p. 264 (1858); Dbldy., "Syn. List," 2nd ed., p. 2 (1859); Hein., "Schmett. Deutsch.," p. 93 (1859); Staud., "Cat.," 1st ed., p. 3 (1861); Kirby, "Eur. Butts.," p. 85 (1862); Snell., "De Vlind.," p. 68 (1867); Nolck., "Lep. Fn. Estl.," p. 50 (1868); Newm., "Brit. Butts.," p. 112 (1869); Butl., "Cat. Diurn. Lep.," p. 181 (1869); Staud., "Cat.," 2nd ed., p. 6 (1871); Curò, "Bull. Soc. Ent. Ital.," vi., p. 106 (1874); Frey, "Lep. Schweiz," p. 9 (1880); Lang, "Butts. Eur.," p. 75, pl. xviii., fig. 2 (1884); Buckl., "Larvæ," etc., i., p. 184, pl. xii., fig. 4 (1885); Kane, "Eur. Butts.," p. 21 (1885); Barr., "Lep. Brit. Isles," i., p. 43, pl. vii., figs. 2-2*d* (1893); Rühl, "Pal. Gross-Schmett.," i., p. 175 (1895); Meyr., "Handbook," etc., p. 343 (1895). **[Zephyrus-] Aurotis,** Dalm., "Vet. Ak. Handl.," i., p. 90 (1816). **Lycæna,** Ochs., "Die Schmett.," iv., p. 28 (1816); Treits., "Die Schmett.," supp. x., p. 79 (1834); Evers., "Faun. Volg.-Ural.," p. 67 (1844). **Strymon,** Hb., "Verz.," p. 74 (1816-1818); Stphs., "Illus. Haust.," iv., p. 404 (1835). **[Thecla-] Strymon,** Stphs., "List," 1st ed., p. 16 (1850); 2nd ed., p. 15 (1856). **Zephyrus,** Wallgrn., "Skand. Dagf.," p. 181 (1853); Kirby, "Syn. Cat.," p. 403 (1871); Scudd., "Hist. Sketch," p. 279 (1875); "Eur. Butts.," p. 58, pl. xv., figs. 5*a-b* (1879); Auriv., "Nord Fjär.," i., p. 7, pl. vii., fig. 5 (1888-1891); Leech, "Butts. China," ii., p. 383, pl. xxviii., figs. 8-11 (1894); Tutt, "Ent. Rec.," vii., p. 220 (1895); "Brit. Butts.," p. 202 (1896); Kirby, "Handbook," etc.. ii., p. 65, pl. xliv., figs. 1-3 (1896); Grote, "Schmett. v. Hildesheim," p. 41 (1897); Reut., "Ent. Rec.," x., p. 97 (1898); Staud. and Reb., "Cat.," 3rd ed., p. 71 (1901); Lamb., "Pap. Belg.," p. 200 (1902); Wheeler, "Butts. Switz.," p. 47 (1903). **[Thecla-] Bithys,** Dale, "Brit. Butts.," p. 38 (1890).

This, the typical genus of the tribe *Ruralidi*, subfamily *Ruralinae*, family *Ruralidae*, and the superfamily *Ruralides*, traces its name indirectly back to Linné, who, in 1758, designated *Rurales* one of the two main sections of the *Plebeii*, without, however, specially using a singular form for each individual species included therein. Poda, however, in 1761, applied this singular form to the individual species, and we find him calling the species in the group *Ruralis*, so that *betulae* becomes *Papilio Plebeius Ruralis betulae*, the three names agreeing more or less accurately with our present notions of family, subfamily or tribal, and generic, names. In fact, he really diagnosed the group with *betulae* as an example, describing the *Plebeii* and *Ruralis* thus:

PLEBEII: Parva.

RURALIS: *P. P.* alis fuscis maculis obscurioribus.

BETULÆ: *P. P.* alis fuscis subcaudatis: primoribus macula reniformi fulva, omnibus subtus lineis transversis albis. Habitat in *Betula*, *Pruno spinosa*.

β. B. alis subcaudatis fuscis: primoribus immaculatis, cæterum priori simillimus. In utroque alæ primores subtus lineola fusca, brevi, latiuscula.

Linné, in 1767, applied it in almost the same manner, but noted the lower group-name over the top of the page in which each species was named, whilst, in 1775, Fabricius gave it quite a generic value, and we find again (*Sys. Ent.*, p. 526) *Papilio Plebeius Ruralis betulae*, a similar grouping being followed by Sulzer, Goeze, Bergstrasser, and others, whilst Esper, having called the butterflies *Papilio*, is satisfied with naming the subdivisions, and *betulae* becomes *Plebeius Ruralis betulae.* In 1781, Barbut, in his *Genera Insectorum Linnaei*, applied to all Linné's lower sections modern generic values, and fixed the types of them by definitely naming one of the Linnean species, and so we find him giving us:

PAPILIO
  PLEBEII
    RURALES
      Ruralis example *P. P. R. betulae*, Linn., no. 220.
    URBICOLÆ
      Urbicola example *P. P. U. comma*, Linn., no. 256.

which fixed beyond cavil the type of *Ruralis*, which had been for some 20 years in common use, as the group name for the "hairstreaks," "coppers," and "blues." When Fabricius made the *Plebeii* of equal rank with the *Papiliones* under the name *Hesperia*, he still maintained the two lower sectional (modern generic) divisions in the *Hesperia*, calling the "hairstreaks" and their allies *Hesperia Rurales*, and the skippers *Hesperia Urbicolae*, the individual species in each case being called *Ruralis* or *Urbicola*, and *betulae* became *Hesperia Ruralis betulae*, *Ruralis* still being, in the modern sense, the genus to which the "hairstreaks," etc., were attached. It should be clear, therefore, from our contention (*Ent. Rec.*, xvii., pp. 211-212), that we do not use Linné's "plural adjectives," *Urbicolae* and *Rurales* as genera, as suggested by Carpenter (*Irish Nat.*, xvi., p. 172), but these, being the oldest plural forms by which the groups were known, are accepted as the superfamily, family, etc., names, with the addition of the recognised terminations, the singular forms as used by Poda, Barbut, Fabricius, and others, being what we apply as genera, and as Barbut exemplified *Ruralis* (not *Rurales*) by the Linnean species *betulae*, no. 220, we have no possible course open to us, but to accept *Ruralis betulae* as the accurate name for our brown "hairstreak" butterfly.

Barbut, having fixed *betulae* as the type of *Ruralis*, closed all the later genera of which *betulae* was made the type. Thus, in succession, we find *Thecla*, Fab., type fixed in 1821 by Swainson as *betulae*, Linn., *Zephyrus*, Dalm., type fixed by Dalman in 1816 as *betulae*, Linn. *Aurotis*, Dalm., is Dalman's section of *Zephyrus* containing *betulae*, and therefore falls as a synonym of *Zephyrus*, Dalm., *Thecla*, Fab., and *Ruralis*, Barbut.

One of the most amazing bits of synonymy is that by Scudder, in which he attempts to retain *Thecla* for *spini*, and other Strymonid species, although proving *betulae* to be the type of this genus. He correctly notes (*Historical Sketch of Genera*, p. 279) of *Thecla:*

1807.—Fabricius, "Ill. Mag.", vi., p. 286—*betulae, spini, quercûs*.
1815.—Oken, "Lehrb.", i., p. 721—employs it for the same and other species.
1815.—Leach, "Edinb. Encycl.", p. 718—*betulae, pruni, quercûs*.
1821-2.—Swainson, "Zool. Ill.", i. ii., p. 69—specifies *betulae* as type.
1829.—Curtis, "Brit. Ent.", fo. 264—designates *betulae* as the "type."
1840.—Westwood, "Gen. Syn.", p. 88—does the same.
1872.—Crotch, "Cist. Ent.", i., p. 66—says that *betulae* is "type."

Then he adds—

1870.—Kirby, "Journ. Linn. Soc. Lond.", x., p. 499—says "it would be far more convenient, and quite justifiable . . . . to take *spini* as type."
1872.—Scudder, "Sys Rev.", p. 29—specifies *spini* as type.

That is, after *betulae* had been for 50 years quite legitimately and accurately named and renamed the type of *Thecla* over and over again, a mere "ipse dixit" of convenience on the part of Kirby is to overthrow the legal method of selection. Scudder's acceptation of what is convenient is unfortunate, but his final bit of reasoning is astounding, *viz.*, that "*betulae* cannot be taken as the type on account of the foundation, in 1816, of Dalman's *Zephyrus*, and consequently *spini* must be chosen." It is unfortunate that Dalman renamed the Fabrician *Thecla* as *Zephyrus*, and chose for this, and one of its constituent sections *Aurotis*, *betulae* as type, as *betulae*, being shortly afterwards selected by Swainson as the type of *Thecla*, reduced both *Aurotis* and *Zephyrus* to the position of synonyms of this genus, and the latter to the position of a synonym of *Ruralis*, to which Barbut had already assigned the same type. The genus has never been diagnosed in its limited sense; even modern authors, who have separated it from the Strymonids have united it with *Bithys* (*anteà*, p. 274) under the name *Zephyrus*. We are indebted to Bethune-Baker for the following diagnosis (*betulae* being taken as the type):

Face broadish, very hairy, vertex hairy, antennæ fixed about the edge of the vertex, fairly widely apart, terminating in a gradually tapered club. Eyes hairy, not large. Palpi porrect, not long, scaled, 2nd segment fringed with hair below. Legs stout, shortish, scaled throughout; femora fringed closely with hair below. Forelegs with tarsi aborted into a single hook; hind tibia with one pair of short spurs. Wings: Primaries broad, nearly three-quarters of their length, costa slightly and evenly arched, termen nearly straight, inner margin very slightly excised in centre. Secondaries with termen slightly truncate (not excised) between the veins, except between veins 1 and 2, and 2 and 3, which are deeply excised to form the tail, lobe fairly developed. Neuration: Primaries with vein 2 from well before the angle, 3 from before the angle, 4 from the angle, discocellulars very weak in male, less so in female; 5 from above the middle of the discocellulars, 6 stalked at a third from the angle with 7 and 8, which are stalked close to the apex, 9 absent, 10 from the cell close to the angle, 11 from the cell just beyond the middle. Secondaries with two internal veins, 2 from well before the angle, 3 and 4 from the lower angle or stalked on a short stalk, 5 from above the middle of the discocellulars, 7 from the cell, 8 curved highly and sharply to the costa at the base, then in an even curve, shortish. Genitalia: Clasps, almost spherical, tapered off from the sphere slightly for the outer half, and truncate shortly at the apex. Girdle short, stoutish, curved forward, rapidly fused into the extremely ample tegumen, which is of unusual size, lobed at the back (*i.e.*, towards the abdomen), but of an evenly curved hood-shape in front, with strong deeply-curved falces, shortly serrated on the outer curve. Penis-sheath short, fairly stout, gradually tapering down in a waved outline to the extremity.

The species belonging to this group are almost purely eastern, *R. betulae*, in fact, being the only European species, as *B. quercûs* is the only European Bithynid. Superficially, on the upperside, the Ruralid species are not particularly like *R. betulae* as we know it, having the whole of the upperside of the wings, except the costal tip and outer margin of forewing, or the costal tip only, orange, the apex and margin, or apex alone, being of the fuscous colour that is familiar to us in the males of *R. betulae*. The mode of development of this particular facies is, however, well seen in what is probably an eastern form of *R. betulae* known as *elwesi*, Leech, and dealt with later, in which the female has the arrangement of colour characteristic of the allied eastern species. But, whilst the uppersides of the other species show such considerable resemblance to ♀ *elwesi*, the undersides are somewhat modified, and, in some instances differ very considerably from the *betulae* type; this difference extends in two directions, one in the development of an antemarginal, and not marginal, orange band with silvery edges (*see* group A, *infrà*), the other in the development of numerous transverse black lines, which gives it an appearance quite *sui generis*, and at the same time does away with all the markings more or less characteristic of the undersides of the other species of the group (*see* group C, *infrà*). The following summary of the Ruralid species in the British Museum collection may prove interesting:—

A. With antemarginal band of orange spots crossing underside of all wings, and edged with silvery lines.
   a. The first nervule of hindwing not developed into caudal appendage—Coreana—*raphaelis*, Obth. (type), *flamen*, Leech.
   b. The first nervule of hindwing developed into caudal appendage—Ussuriana—*michaelis*, Obth. (type), *gabrielis*, Leech.

B. With marginal band of orange spots bordering all wings on underside; hindwings tailed—

Photo. H. Main and A. E. Tonge.

Ruralis betulæ.

The Natural History of British Butterflies, etc., 1907.

Plate XI.

(To be bound facing Plate XI.)

Ruralis betulæ.

Fig. 1.—Ova ×10.

Fig. 2.—Ovum, empty shell after emergence of larva ×10.

Fig. 3.—Larva (dorsal view) on foodplant ×1.

Fig. 4.—Parasitised larva ×1.

Fig. 5.—Same larva shrunken, with empty *Microgaster* cocoons ×2.

Fig. 6.—Larva (lateral view) ×1.

Figs. 7-8.—Pupæ showing attachment to surface by means of cast larval skin ×1.

Fig. 9.—Pupa detached (lateral view) ×2.

Fig. 10.— ,, ,, (latero-ventral view) ×2.

Fig. 11.— ,, ,, (dorsal view) ×2.

Fig. 12.—Imago ×1.

(Figs. 1, 2, 3. 6, 12 by A. E. Tonge, the others by H. Main.)

a. With well-developed marginal underside markings—? Ruralis—*lutea*, Hew., *melpomene*, Leech, *thespis*, Leech, *comes*, Leech, *seraphim*, Obth., *minerva*, Leech.

b. With ill-developed marginal underside markings (*i.e.*, typical *betulae*-like arrangement)—Ruralis—*jonasi*, Jans., *elwesi*, Leech, *betulae*, Linn. (type).

C. With underside markings specialised in numerous black longitudinal lines—Japonica—*saepestriata*, Hew. (type).

That these species fall into at least four (if not five) genera, in the modern sense, appears to us to be certain. The first section, *Coreana*, and the last section, *Japonica*, are the most distinct, then *Ussuriana*, the groups B a, and B b being more closely allied than any others, and possibly both coming within the limits of *Ruralis* as we understand it.

Ruralis betulæ, Linné.

Synonymy.—Species: **Betulae**, Linn., "Sys. Nat.," 10th ed., p. 482 (1758); "Faun. Suec.," 2nd ed., p. 282 (1761); Poda, "Mus. Graec.," p. 75 (1761); Hufn., "Berl. Mag.," ii., p. 68 (1766); Linné, "Syst. Nat.," 12th ed., p. 787 (1767); Fab., "Sys. Ent.," p. 520 (1775); Schiff., "Schmett. Wien.," 1st ed., p. 186 (1775); Fuess., "Verz.," p. 31 (1775); Harr., "Eng. Lep.," p. 6 (1775); Müll., "Zool. Dan. Prod.," p. 111 (1776); Esp., "Schmett. Eur.," p. 256, pl. xix., fig. 1 (1777); Bergs., "Nomen.," p. 56, pl. xxxviii., figs. 1-4 (1780); Goeze, "Ent. Beit.," p. 5 (1780); Barb., "Linn. Gen. Ins.," p. 173 (1781); Fab., "Spec. Ins.," p, 118 (1781); Geoff., "Ent. Paris.," p. 243 (1783); Schneid., "Sys. Besch.," p. 217 (1785); Fab., "Mant. Ins.," p. 68 (1787); Bork., "Sys. Besch.," i., p. 134 (1788); de Vill., "Car. Linn. Ent. Fn. Suec.," p. 62 (1789); Lang, "Verz.," ii., p. 45 (1789); Brahm, "Ins.-Kal.," p. 232 (1791); Schwarz, "Raup.-Kal.," p. 177 (1791); Fab., "Ent. Syst.," iii., pt. 1, p. 277 (1793); Bork., "Rhein. Mag.," i., p. 297 (1793); Lewin, "Ins. Gt. Brit.," p. 88, pl. xlii., figs. 1-5 (1795); Don., "Brit. Ins.." vi., p. 89, fig. 250 (1798); Hb., "Eur Schmett.," pl. xlvii., figs. *a*—*b* (*larva*), pl. lxxvi., figs. 383-5 (1799); text p. 5 (*circ.* 1805), etc. [N.B.—All other references mentioned under the generic synonymy (*anteà*, pp. 273-274) are referable to *betulae*.]

Original description.—*Papilio Plebeius betulae*, alis subcaudatis fuscis; primoribus macula reniformi fulva, subtus luteis fascia fulva. ["Fn. Suec.," 792. Wilk., "Pap.," 61, t. 1, *a*, 2. Roes., "Ins.," 1, pap. 2, t. 6. Raj, "Ins.," 130, no. 10. Réaum., "Ins.," 1, t. 28, f. 1-7. Alb., "Ins.," t. 5, f. 7. Pet., "Gaz.," t. 11, f. 11.] Habitat in *Betula*, *Pruno spinosa*. [*Papilio* hexapus, alis secundariis angulato-dentatis; subtus flavo alboque flammeis, "Fn.," 792. Hoffn., "Ins.," t. 12, fig. 1. Pet., "Gaz.," p. 18, t. 11, f. 10. *Papilio* minor fuscus, duplici linea inferne præditus (Mas); f. 11, *Papilio* minor fuscus; campo aureo, linea gemina subtus ornatus (Fœmina). Raj, "Ins.," p. 120, no. 10. *Papilio* minor, alis exterioribus nigricantibus, macula in medio lata arcuata fulva.] Habitat in *Betula;* præsertim in Smolandia obvius. Descr.—Alæ subtus notatæ fascia postici attenuata linea alba incusa (Linné, *Sys. Nat.*, 10th ed., p. 482).

Imago.—32mm.-37mm. All the wings of a deep fuscous-brown; the hindwings with the outer margin somewhat crenulated, the lower caudal appendage well-developed, the upper less so, the anal angle somewhat extended; the fore- and hindwings with a well-marked, black, discoidal lunule, usually better marked on the fore- than on the hindwings; an orange spot at the anal angle of hindwings, another at the base of the larger "tail," and a third sometimes at the base of the small upper one. In the male a faint shade outside the discal area of forewings; in the female this is developed into a well-marked, transverse, orange band. The underside of all the wings orange-yellow, the hindwings rather darker; the discoidal lunule of all the wings well-marked; an incomplete, white, transverse line between discoidal lunule and outer margin of forewings, edged internally with darker; the hindwings with two white transverse lines, the inner incomplete, the area between these sometimes rather darker; a reddish marginal band; a small black spot at anal angle, and another at base of "tail" of hindwings.

Sexual dimorphism.—No specialised androconial scales have been yet discovered in the males of this species, but there are marked sexual differences in the colour and pattern. On the upperside the most marked difference is the presence of a well-developed, transverse, orange band, situated just outside the discal area. Aurivillius describes it as "normally occupying the centre of the second and third wing-cells, the entire inner half of the fourth and fifth, and the base of the sixth and seventh, besides forming a spot in the outer part of cell B." Apart from the conspicuous orange band of the forewings, the tails of the hindwings are usually somewhat better-developed in the female than in the male, whilst the ground colour of the undersides of all the wings is usually markedly brighter and more intensely coloured in the female than in the male, particularly is this the case in the marginal orange-red band of the hindwings, which is, in the female, often continued on the forewings. In *elwesi*, if this be considered a variety of this species, the sexual diversity is still more marked, for, in this form, the whole of the four wings, except for the apical patch and outer marginal band of the forewings, is wholly orange. The variation in the colour arrangement in both sexes is dealt with *infrà*, pp. 278-279. Of the European examples, Heron notes the smallest male in the British Museum collection as 40mm., the largest 44mm.; the smallest female 37mm., the largest 42mm. These measurements seem somewhat above the average.

Gynandromorphs.—The following are the only specimens of which we have knowledge:

α. Perfect gynandromorph. Right side ♂, left ♀. The sex characters sharply divided in form, coloration, and markings of the wings as noted. The orange-red spot of the forewings very bright on the left side, the costa and hind margin reddish tinted. Left antenna rather shorter than right. The abdomen in shape strongly ♀. The left wings shorter (19mm.) than the right wings (30mm.). Bred at Hamburg, 1897 (Wiskott, *Iris*, x., pp. 379-380).

β. A perfect gynandromorph. Right side ♀, left ♂. Bred at Eperjes, in Hungary, August 11th, 1876. The right (♀) side has a large orange spot; on the undersides the colour of the ♀ side also shows the sexual difference, being of a much brighter colour than the ♂ side. The example is now in the Hungarian National Museum (Aigner-Abafi, *in litt.*).

Variation.—There is considerable variation in the colour and size of *Ruralis betulae*, and, if *crassa*, Leech, and *elwesi*, Leech, be included as having only varietal rank, the size variation is indeed remarkable. Leaving these two forms for later consideration, the examples in the British Museum collection give the following range of variation on the upperside in the different sexes:

I. Males—

1. Entirely fuscous with no pale patches on forewings = *unicolor*, n. ab.
2. Entirely fuscous except for a pale orange shade on the outside of the discoidal lunule = ab. *subunicolor*, n. ab.
3. Fuscous with pale orange shade outside discoidal lunule and continued series (two) of pale orange interneural dashes below = ab. *spinosae*, Gerh.
4. As in 3, but the paler areas faintly yellowish = ab. *lutea*, n. ab.
5. As in 3, but the paler areas faintly grey = ab. *grisea*, n. ab.
6. As in 3, but the paler areas whitish = ab. *pallida*, Tutt.

II. Females—

1. With narrow orange patch crossed by black nervures = ab. *restricta-lineata*, n. ab.
2. With broad orange patch crossed by black nervures = ab. *lata-lineata*, n. ab.
3. With narrow orange patch not crossed by black nervures = ab. *restricta*, n. ab.
4. With broad orange patch not crossed by black nervures = ab. *lata*, n. ab.
5. The orange markings yellowish in colour = ab. *fisoni*, Wheeler.
6. With submarginal series of interneural orange streaks in hindwings pointing towards base = ab. *cuneata*, n. ab.

Blachier observes that, in the Swiss examples, the male has often a clear yellowish or greyish shade beyond the black cellular point, and one may say that, in European specimens, the male colour extends from being entirely dark fuscous to others with a moderately defined series of orange (=ab. *spinosae*, Gerh.), grey (=ab. *grisea*, n. ab.), or whitish (=ab. *pallida*, Tutt) markings, representing an obsolete transverse band. In the females there is great variation in the length and width of the orange bar, and in the intensity of the shading of the nervures crossing it, some being quite narrow (=ab. *restricta*, n. ab.), others quite broad (=ab. *lata*, n. ab.), whilst both forms are sometimes quite conspicuously lineated by the dark nervures crossing the band (=ab. *lineata*, n. ab.). The intensity of the orange is sometimes reduced to a distinct yellow (=*fisoni*, Wheeler), whilst the best marked females have a transverse interneural series of wedge-shaped or cuneate orange streaks, parallel with the hindmargin of the hindwings, and pointing towards the base (=ab. *cuneata*, n. ab.). Adkin notes (*in litt.*) that "a large number, bred from larvæ taken in the New Forest, exhibit considerable variation; the males, as to the pale marking on the forewing, in some cases nearly obsolete, in others of considerable size, and extending in some instances to three separate patches; in the females, the orange marking of the forewing, which usually extends across about three-quarters of the width of the forewing, is, in some cases, limited to less than one-half and slightly broken. The hindwings are also slightly radiated with the orange-coloured markings in some instances." There is distinct and marked size-variation in the European specimens of this species. Our British specimens, captured wild and not bred, are somewhat similar in size to those of central Europe, occasional ones being a little beyond the average. The usual size of European examples is between 35mm. and 40mm.; our long British series varies from 30mm.-38mm. Burrows reports (*in litt.*) "an enormous male, quite $1\frac{3}{8}$ ins. in expanse, and as large, if not larger, than the ordinary size of the females," and, for a British example, this may be considered fairly large, though quite a pigmy compared with the eastern var. *crassa*, which measures 56mm. (against the 34mm. of this example). Similarly, the specimens of the lateral valleys on the south side of the Valais, are normally from 32mm.-35mm. in expanse (Wheeler), and Aigner-Abafi gives the average size of the Hungarian examples as 30mm.-35mm., but the males taken at Certosa di Pesio, in 1892, average 1·75in. = 44mm. in expanse (Norris). Kaye records feeding up some larvæ, in 1906, in closed tin boxes, on plum, and the resulting butterflies were especially large, the largest female being 42·5mm. in expanse; the females, too, had quite a small amount of orange on the forewings (*Proceedings of the South London Entomological Society*, 1906-7, p. 73). Dwarf examples were exhibited at the meeting of the City of London

Entomological Society, August 1st, 1893 (Sequeira), and small specimens, below 30mm., are not rare, especially among those bred in confinement. We would call those below 30mm. in expanse, ab. *minor*, n. ab., those above 40mm., ab. *major*, n. ab. The western and central Asiatic specimens are no larger than normal European examples, but the eastern are of enormous size, and in *crassa* and *elwesi* reach a wing expanse of 50mm.-54mm. The undersides of this species, apart from the large eastern races, may be said to be, within certain limits, exceedingly variable, those of the males, on the whole, much paler than those of the females, the females much redder and more orange, the hindwings being particularly deeply coloured. The red marginal band of the hindwings is much more brilliant in the females than males; in the females, it is usually distinctly continued as a red band on the margin of the forewings; in the males, scarcely ever reaching red, the best developed examples being of a deep orange. There is also considerable variation in the amount of white surrounding the discoidal lunule of the forewings; some have no white; also in the length, direction, and intensity of the broken, white, transverse line on the forewings. There is also much difference in the intensity and direction of the outer white line on the hindwings, but less so than in that of the inner white line of the hindwing, which is particularly variable; frequently these two lines are complete, and the included area is darker than the rest of the wing, forming a well-defined transverse band=ab. *virgata*, n. ab. The discoidal lunule of the hindwing often makes some complications in the character of this inner line, and Raynor notes (*in litt.*) a female aberration in the "Hanbury coll.," in which the inner white line on the underside of the hindwings is curved upwards at the bottom in the form of a hook=ab. *uncilinea*, n. ab. He also notes a female, the underside of reddish-fulvous ground colour, in which the forewings have the usual transverse orange-brownish stripe, reduced to a single dark line edged with white; bred from Mundon, August 10th, 1901. There is also some little variation in the development of the small black anal spot as well as that inside the base of the tail. Mosley gives (*Illus. Vars. Brit. Lep.*, pt. 6, *Thecla*, pl. i., fig. 2) a figure of a specimen of this species with "ground colour beneath, as in *Bithys quercûs*," and adds that "Mr. Bond, to whom the specimen belonged, thought it might be a hybrid between the two species!!!" It appears to be an unusual form, in which the ground colour of the underside is grey, the brown confined to the outer margin of all the wings, the banded area between the white transverse lines, and the extreme base. Certainly, except the unusual ground colour, the underside is distinctly that of *R. betulae*, and it bears no resemblance whatever to that of *B. quercûs*. There is some variation in this species in the length of the tail; on the whole, those of the females are longer than those of the males. The following are the already described European aberrations:

α. ab. *spinosae*, Gerh., "Schmett.," p. 3, pl. iii., fig. 2 (1853); Kirby, "Cat.," p. 403 (1871); Rühl, "Pal. Gross-Schmett.," i., p. 176 (1892); Tutt, "Brit. Butts.," p. 203 (1896); Wheeler, "Butts. Switz.," p. 47 (1903).—This interesting ♂ form has the same yellow spots on the forewing as the ♀, like the var. *lynceus* of *spini*. The aberration is found everywhere with the type, but nowhere common. Of thirty ♂s bred from larvæ only three were of this form (Gerhard).

The form of the male in which the female markings are moderately well-developed is distinctly rare, although faint traces of them, as already noted, are seen in many. In some specimens, however, the faint pale shades noticeable in most males, at the outer edge of the disc, occupy occasionally nearly as much space as in the less strongly marked females. The three spots figured by Gerhard (in most copies of the work now badly discoloured) are one larger and two smaller, and Staudinger diagnoses (*Cat.*, 3rd ed., p. 71) it as "♂. Alis anter. mac. mag. conspicuis." Raynor notes (*in litt.*) a specially well-marked example with the two additional pale orange blotches beneath the usual one, bred from Mundon, July 27th, 1901. We have examples from the New Forest, Epping Forest, etc. Aigner-Abafi observes (*in litt.*) that the aberration has only occurred in Hungary, up to the present time, near Budapest, Lipik, and Eperjes. He adds that Dahlström has reported that, at Eperjes, a female form occurs, with the characteristic markings so reduced as to resemble somewhat this form, the orange band being divided by the nervures into two or three spots. Blachier observes (*in litt.*) that there is, in the "Reverdin coll.," a male, "with three pale spots on the disc, one arising from the extremity of the cell, two more faintly marked lower down; captured August 13th, 1886, in the Zermatt Valley," and Anderegg records this aberration from near Gamsen. Rühl only notes it from "Slavonia, end of July, and Thuringia," but this must be more on account of its not being recorded than its non-occurrence. One suspects that, as in Britain, it occurs fairly often with the type on the continent.

β. ab. *fisoni*, Wheeler, "Butts. Switz.," p. 47 (1903).—A ♀ form with yellow band, etc., instead of orange. Taken at Charpigny (Wheeler).

Occurs occasionally in Britain. Raynor notes one bred from Mundon, July 30th, 1901.

γ. ab. *pallida*, Tutt, "Brit. Butts.," p. 203 (1896); Wheeler, "Butts. Switz.," p. 47 (1903).—A ♂ in our collection has a white patch with two smaller white spots beneath; a very rare aberration. New Forest (Tutt).

Asiatic races.

The western and northeastern Asiatic examples differ little from the eastern European, but those from the mountains of central Asia assume apparently the *ongodai* form with dark ground colour and rather limited pale markings in the female, and tending distinctly to a yellow tint. The Chinese races are, however, of remarkable size, and *elwesi* exhibits, in the female, a very special development of the orange colour, a colour that is largely adopted by both sexes in all the other eastern species of the group. Romanoff observes (*Rom. Mémoires*, 1892, p. 147) that Radde is reported by Bremer to have taken this species at the mouth of the Ussuri, and Graeser also caught a female, on July 24th, 1889, near Chabarofka, but saw it nowhere else in the Amur district. Dorries reared specimens from the Sutschan district, in the Pamirs, which are almost like the European. Romanoff further observes that he has a specimen from East Siberia, and that it also occurs in West Siberia. Alphéraky notes (*Hor. Soc. Ent. Ross.*, xvi., p. 376) that he captured, in July and August, 1879, in the Kouldja district, near Kounguesse, a constant form of this species of large size, the females having the orange band wider than in European examples. Staudinger says (*Stett. Ent. Zeitg.*, 1881, p. 260) that, of twenty specimens under examination, taken by Haberhauer in the Tarbagatai and the Ala Tau, in July, 1877, although they differ somewhat, *inter se*, they show really little difference from European specimens; on the whole, perhaps, the underside is a trifle lighter, and generally the white spots on the underside are absent. Elwes reports (*Trans. Ent. Soc. Lond.*) that, at Ongodai, Jacobson caught several specimens, not differing from European ones, except that the females show a little less yellow in the forewing. There are a number of the Ongodai examples in the British Museum collection, and these, in comparison with the other examples there, show distinct racial characters, and we have named this form as:

α. var. *ongodai*, n. var.—♂s particularly dark and sooty, with well-marked discoidal lunule, no pale shading on forewings, and the two spots, one at the base of caudal appendage, the other at anal angle, pale orange in tint. The ♀s of same size, dark, the orange band very narrow and restricted, dark nervures passing through. Fringes of all wings particularly white, undersides (especially of ♂) particularly pale, in the ♂ pale yellow-ochreous. The Ongodai examples form quite a local race. About the same size as British specimens.

β. var. *crassa*, Leech, "Butts. China," ii., p. 384, pl. xxviii., fig. ii (1894); Staud., "Cat.," 3rd ed., p. 71 (1901).—♂. Agrees exactly in colour with dark specimens of the same sex from Europe, but the tails are longer and more slender. ♀. Differs only from European examples of the same sex in having longer tails. On the under surface there is no difference, except that the black spot above the tail is always distinct, and the outer transverse line of secondaries is rather less angulated. Expanse, ♂ 54mm.; ♀ 56mm. This form occurs at Moupin, western China, in July (Leech).

This form is only noted by Staudinger (*Cat.*, 3rd ed., p. 71) as "longius caudata." To us it appears a very striking race, of large size, and good colour. The examples in the British Museum collection from Moupin, captured by Kricheldorff, are very large in both sexes, the males very dark fuscous, as large as the females, no pale markings, the tails of hindwings well-developed, the orange-red marks at anal angle and base of tail of hindwings not specially strongly marked. The females also very dark, the orange patch of forewings exceedingly richly coloured, but not occupying more than the usual percentage of space; dark nervures crossing through it; the tails of hindwings strongly developed, the orange-red patches at anal angle and base of tail well-marked; also a small black streak just above base of tail (in next interneural space) parallel with hindmargin. The underside also well-marked, that of males of rather deep ground colour, the white line on forewings rather weak, on the hindwings pretty well-developed; the ground colour of the females nearly orange-brown; in the specimens in the British Museum collection there is great difference in the size of the dark triangular shade hanging from the costa; the white line on the forewings ill-developed, on the hindwings well-developed, as also is the red marginal band; the black anal spot and the one just above the base of the tail also well-marked.

γ. var. (an. spec.) *elwesi*, Leech, "Ent.," xxiii., p. 39 (1890); "Butts. China," ii., p. 384, pl. xxviii., fig. 8 ♀ (1894).—Expanse 50mm. Male fuscous-brown, the discal area of primaries tinged with reddish-orange, especially behind the black bar which closes the discoidal cell. Secondaries with some black spots and orange marks on outer margin at anal angle; tail reddish-orange, edged with black and tipped with white. Under-surface sandy-brown, dusky discoidal bar edged with white, followed by an oblique triangular streak darker than the ground colour and bordered on each side by a white-edged dark line; a dusky line, edged externally with paler, parallel with outer margin; secondaries with two white central transverse lines, the first edged externally with dusky, and not extending beyond the median nervure, the second slightly wavy, bordered internally with dusky, and curved inwards beyond the second median nervule; outer margin bordered with reddish-orange, edged internally with pale ochreous, wider towards anal angle, the orange colour extending halfway along the abdominal margin; a black spot at anal angle, and one on the second median interspace; fringes white, preceded by a black line which traverses the tail to the white tip. Female orange-brown, clouded with greyish-brown towards the base of all the wings, apex and outer margin black; a black spot on secondaries in second median interspace; fringes whitish, grey at the base and, on the secondaries, at the extremities of nervules. Undersurface of primaries reddish-orange, secondaries rather browner; markings as in the male, except that the first transverse line of secondaries extends farther across the wing. One female taken in July, and two males captured in August, at Chang Yang. Also two females taken in the latter month at Ichang; these have the basal half of all the wings suffused with greyish-brown and the marginal border of primaries is broader. The male bears a superficial resemblance to the same sex of *R. betulae* from Europe, but it is much larger, and the tails are longer and more slender (Leech).

Leech first described this as a distinct species, but later (*Butts. of China*, ii., p. 384) noted that, when he thus described it, he supposed that the larger size and different coloration of the upperside of the wings were of specific value, but, since receiving other specimens, not only of *elwesi*, but also of *crassa*, from Moupin, he "is inclined to consider both as exaggerated forms of *R. betulae*." Different as are the specimens of *elwesi* on the upperside from those of var. *crassa*, it is difficult to find any difference between the undersides of these insects. On the upperside, the ground colour of the males is somewhat paler, *i.e.*, not so dark fuscous, and with a tint of yellow in it, forming a vague shadowy band on the forewings, in the position of the ordinary pale band in some males, and in the females of *R. betulae*. The females, however, are very different, the forewings presenting a dark apex and outer margin, all the rest of the wing, from the outer margin of the usual female orange band to the base of the wing, deep orange, shaded with glossy brownish only on the long hairs of the base of all the wings; a conspicuous dark linear discoidal spot. The hindwings also entirely orange, except a black spot above the base of the tail; the orange tails identical with the ground colour. The fringes whitish. These notes are made from two males and two females from Chang Yang, August, 1888; Moupin, July, 1890 (Kricheldorff); and Ichang Gorge, September, 1887 (Pratt).

Egg-laying.—The egg of *Ruralis betulae* is of a pure white colour, laid at the base of a branch of a small twig, just like the figure of natural size given by Sepp (*Besch. Wond. Gods*, iii., pl. xii), but quite unlike his enlarged figure, still less like the curious pork-pie egg (whence copied ?) in Hofmann's *Larvae*, etc. (Chapman). The eggs of *R. betulae* are usually firmly attached to the main twigs of a blackthorn bush, at the base of a smaller twig, thorn, or small excrescence. Of some laid afterwards in confinement—August 27th-28th, 1895—five were placed on separate twigs, two on one twig a quarter of an inch apart, whilst two others on another twig were in actual contact (Wood). Gillmer notes (*Insecten-Börse*, xxiii., 1906, p. 42): "In the forenoon of October 4th, 1905, a rather rainy day on which the sun only shone intermittently for about a quarter of an hour at a time, Völker observed, during one of the sunny periods, a female butterfly on an isolated sloe-bush; she walked in the special Theclid manner along a twig from the top downwards, several times half opening the wings, and each time stopping still a moment. This was exactly the moment when the butterfly deposited an egg on the bark of the twig;

in doing this she usually chose that situation where a small lateral twig branched off, and fixed the egg usually just beneath this spot. Völker took the butterfly home, as well as a sloe branch, in order to watch more leisurely the further egg-laying; in this he succeeded perfectly. The butterfly and a branch of sloe (with as many twigs as possible), placed in water, were put into a glass cylinder, 30cm. high and 18cm. wide, closed with a piece of muslin, and the whole stood on a window-sill in the sunshine. In this the butterfly lived till October 15th, and laid exactly another two dozen eggs in the manner above described; some of these were, however, situated in the forks of the twigs. The butterfly only laid when the sun shone; on bright sunny days she sought shelter under the shade of the leaves, a proof that one ought to mitigate the sunshine and give the creature something to drink. In spite of the fact that the incipient warmth of the sun seemed to benefit the creature and induced her to spread her wings if the rays were allowed to play on them for a time, the fiercer heat in the still atmosphere of the glass cage compelled her soon to close her wings. The peculiarities of her egg-laying still continued; the walking about of the butterfly and the seeking of a suitable place for the egg, then the somewhat vibrating manner of half opening the wings, the action in egg-laying, the closing of the wings and renewed promenade. This female laid ten eggs on October 7th; the nearer, however, she approached her end, the fewer became the number; the last eggs were placed quite low down on the branch; no eggs were laid at all on the uppermost twigs. Völker was not able to observe the butterfly taking any nourishment. This female died with fully outspread wings in the sunshine; it fell off the leaves and remained lying on the upperside of the wings. The egg of *R. betulae* hybernates just as the eggs of *Edwardsia w-album*, *Strymon pruni*, and *Bithys quercûs*, and does not hatch till spring; it is protected sufficiently by its adhesion, but apparently little by its colour (being easily visible on the black bark of the sloe twigs). The darkly-coloured eggs of *E w-album* are exceptionally difficult to discover on the similarly-coloured elm twigs."

Ovum.—The egg is pure white in colour, and is of the ordinary bun-shape, 0·77mm. across, 0·42mm. high, regularly domed. It has also the usual Lycænid hollows (hexagonal), with eminences at the angles of the intervening walls, but these are elaborated in such a way as to give a very special result, difficult to describe. First assume the egg to be much smaller than stated, *viz.*, 0·33mm. high, and then to be overlaid by a coating, 0·09mm. thick on the top, of a pure white, glassy, or pith-like substance. Then make circular depressions in this, 0·06mm. apart (centre to centre), on the summit; let these almost reach the inner true shell and have hemispherical bases; let them widen a little at the top so as to cut one another almost half-way down their depth, leaving pillars between, especially at their angles, standing up to the original surface. More laterally, these circular holes will be closer together and much smaller, being 0·01mm. in diameter, but widening above in a crateriform manner and meeting each other so as to have a sharp edge between and sharp points at the angles. The result is that, on profile view, the tops show rather large, flat projections; laterally and basally there is a forest of fine spiculæ, but these can be traced as more or less in lines, as they follow the zigzag wall between two rows of pits. It forms an extremely curious and beautiful object, though to say more so than many others of these Lycænid eggs, might be going too far, though one inclines to make the assertion with regard to each one of such eggs that one happens to be examining. The examination of this egg demonstrates that the elaborate sculpture of these Lycænid eggs is in a superadded layer, distinct from the true eggshell; at some points one looks down the tubes or pits and sees them apparently widening out again below, and leaving nearly bare portions of the true shell (February, 1906). This egg is roughly a white ball. The superficial corky layer enveloping the Lycænid egg is in it especially developed as a white snowy layer, or rather, perhaps, as a sugar-icing. Assuming the typical form of this layer to be a more or less hexagonal network, of which the lines of reticulation are built up to a great height so as to form a honeycomb structure, in *R. betulae* the walls are so thickened that the cells of the comb are mere circular pits round the shoulder of the egg, about one-quarter or one-third the thickness of the walls in diameter, and round the micropylar area they are not much more than indicated. In this situation some eggs show a smooth surface with a few minute holes; in these the funnel-like widening of the top of the cell, which is marked elsewhere, obtains here also, and the walls form wide rounded ridges, about thirteen in number, more or less radiating from the centre, owing to the funnels of the cell, in lines of radiation, intersecting more freely than in other directions. The intersection of the funnels makes angular points project at the angular point of the network (or honeycomb), which are sharp about the shoulder or mid-zone of the egg, but lower down are more rounded, and more definitely project beyond the mere intersection of the funnel, and are, therefore, more spinous in character, though with blunter tips. The micropylar area is at the bottom of a very deep, central, circular pit, some 0·12mm. across. At the bottom of this is seen a star of six cells; each pear-shaped, with the point central, and especially remarkable in their outlines, being brilliantly white and the rest of the surface greyish, and the corky substance apparently dense enough to obscure any cells outside the star, which, therefore, stands out more brightly than in any other egg (at any rate of any one recently examined), and makes it very obvious though at the bottom of the pit, and obviates the necessity of getting a piece of an empty shell to observe it. The actual diameter of the micropylar rosette is 0·044mm. The depth of the micropylar pit is considerable, but not easy to measure. The egg is about 0·75mm. wide and 0·45mm. high, but the true egg, were the white coating absent, must be much less than this. The pitting (or honeycombing) round the slope of the egg is strictly hexagonal, about 0·06mm. from centre to centre. The lines of the cells are (1) circumferential and (2) oblique. They appear to be continued beneath the egg (Chapman, November 20th, 1906). Colour pure white. The egg rises in the shape of a depressed sphere to about five-sixths of its entire height, above which it is continued in the form of a cap. Under the lens the egg is seen to be beautifully and perfectly ribbed with minute ridges, which divide it into hexagonal cells, giving it a honeycomb appearance. The array of these cells is very conspicuous when viewed sideways. Before reaching the cap-like top, the cells gradually increase in size. At the topmost point there is a comparatively deep depression of small circumference (Wood, *Ent. Rec.*, viii., p. 186). The egg forms a portion of a sphere about 0·66mm. in diameter at the base and 0·33mm. in height; it is white, and, according to Völker, possessed exactly the same tint on March 7th, 1906, as it did when deposited ("a dull porcelain-white"): it is thickly covered with pits (depressions). Each depression forms a six-angled cell, the points at the six angles extend vertically outwards into a short projection. The cells are often not regularly formed but often deformed; the cells and pits also vary in size. The best illustration in this respect is offered by the cells on the shoulder. The base of the cells appears dark and lies somewhat deeply. The micropylar cell at the apex is the largest and deepest. This egg covered with these pit-like cells down to the base gives an impression of an *Echinus*, the spines of which are represented by the projections at the corners of the cells. (Magnified 100 diameters; described March 9th, 1906.) (Gillmer).

Habits of larva.—A larva hatched on March 24th, 1907, was placed on early plum (species used for hedges), and on this soon made itself at home on a second leaf that was still rolled up into a close cylinder, not attacking the first leaf that was well expanded. Here it ate portions of the whole thickness of the leaf; at first it got into the end of the cylinder from the tip, and was nearly hidden, afterwards (28th), it was on the outside. Like all these young Lycænid larvæ (*Plebeius aegon*, *Heodes virgaureae*, etc.), it was very difficult to examine without injuring it, as no matter how quiescent it was, as soon as brought into a sufficiently strong light for observation, it began searching for some way of getting into the shade. By March 29th, it had fed up a good deal, and was then more easily examined. It moulted on April 6th, when it ate all the cast skin except the head. By April 10th the larva was much grown, now nearly 6mm., and the colours much more clearly differentiated. When fullgrown in the second instar, the larva is in form and colour almost identical with the adult larva. On April 17th, the larva was eating vigorously, and, by April 23rd, 1906, had spun a pad of silk, and was apparently resting for its third moult. By the morning it had moulted, but had not eaten its skin, and, as the larva died when nearly fullfed, its debility was attributed to not having eaten this skin. In its last instar, the larva nearly always rests under a leaf, and eats either the sides or end of a leaf, but always goes to a whole leaf to rest. The difficulty of finding this larva of over half an inch long, on a little bit of sloe with 20 or 30 leaves is quite ridiculous. In looking for it, one sees its dorsal ridge in profile, it proves to be a margin of a leaf; one sees its "slope," it is the light shining through a curled portion of a young leaf; one sees it half-a-dozen times in this deceptive fashion before actually spotting it. Then one wonders how one could have missed it so long, it is so obvious, and taken altogether, not at all like a sloe leaf. Yet any view of the group of sloe leaves, gives several items that are very like portions of the larva (Chapman). Mathew says (*in litt.*): "In the autumn of 1900, Mr. Cornell sent me 30 or 40 ova of *R. betulae* which he had obtained by searching sloe-bushes in Epping Forest, and, upon examining these, on April 27th following, I found three of them had hatched, but could not discover the larvæ. No others emerged until May 9th, and by the 11th, they had all hatched, so I rather suspect the three found to have emerged on April 27th, might have been eggs of the previous year. On

May 25th I counted 31 larvæ, and noted that they vere growing very slowly. This, unfortunately, is the only note I appear to have made concerning this brood." Raynor says that, in nature, in Essex, the larvæ do not appear to hatch until May, and are usually very small at the end of the month,and are fullfed from June 15th-20th; but Rothschild says that, in Ashton Wold, they are not fullfed until the beginning of July, and we have some this year (1907) not yet quite fullfed on July 14th, whilst others are now pupating. Wood observes, that in nature, the species appears to haunt only the stunted bushes of its foodplant; in nature it appears to eat only just after daybreak and before sunset, and, from just after entering its second stadium, it feeds from the edges of a leaf, eating out large crescent-shaped patches, but seldom devouring the whole of a leaf; in the wild state it rests during the greater part of the day and night on the underside of a leaf of the foodplant, with head towards the base of the leaf; it is difficult to see in this position, assimilating, as it does, so well with the leaf. In confinement, as with so many other butterfly larvæ, it changes its habits considerably, and frequently feeds during the middle of the day, resting sometimes, as in nature, on the underside of a leaf, and often along the stem of the plant; it is usually fullfed at the end of June or early in July; the fullfed larva moves very slowly, grips lightly, and when beaten into a tray, falls very flat, at full length, remaining motionless for nearly a full minute. Hellins particularly notes that a larva that he was rearing in 1885, moulted on June 18th, and did not eat its cast skin. Newman says the larva generally conceals itself beneath the leaves, and, when fullfed, rests in a flat position on the surface of a leaf with its head, legs, and claspers concealed, and does not abandon this position readily, and, when compelled to do so, it falls about three inches, and hangs by a thread. Our own observations suggest that there is little to be said about the habits of the fullgrown larva of which we have at the present moment (July 4th, 1907) some eight examples under observation. As has already been noted, it distinctly prefers the underside of the leaf on which to rest, remains absolutely at rest all day if not disturbed, flattens itself against the resting surface until the lateral flange looks like a sort of raised marginal ruff, and, when it crawls, moves so slowly that one hardly recognises the movement; it is not particular as to its position, but usually rests lengthwise, parallel with, more often than on, the midrib, and its head generally towards the petiole. If a leaf be too small to accommodate it, it will spin an adjacent leaf loosely to the one it first selected rather than move to a larger one. Its mode of feeding is varied, and depends upon its position. If the larval head be in the middle of a leaf it gnaws through, first exposing its head, and then eating a more or less circular hole until the margin is reached, and continues until it has satisfied its hunger. If it be near the edge it will commence there; sometimes it begins towards the apex, at others towards the base, dependent on which way the head of the larva is pointing. It readily drops if disturbed, and its grip at any time on its foodplant is comparatively slight. It does not seem to be particular as to the species of *Prunus* offered for food, but an attempt to force four larvæ to feed on *Betula* led to two leaving the plant and resting for 24 hours on the paper beneath the jar covering them, one other to the jar itself, whilst the fourth appears to have eaten a fairly large piece out of a small leaf, at least the missing part was not noticed when the leaves were offered.

They were very hungry, though, at the end of the time, and attacked a piece of wild plum eagerly that was supplied to them. Prideaux observes (*in litt.*) that, in nature, the larvæ seem to rest on the leaves; so also do they in confinement, but, in the latter case, appear to retire to a flat surface to undergo a moult; usually they feed on the edge of the leaves, at all events in their later larval life; they grow rapidly, and leave their foodplant in captivity as soon as the colour-changes, prior to pupation, have commenced. Raynor adds that the earliest date on which he ever found *R. betulae* larvæ was on May 19th, 1904, when he beat a single one at Monk's Wood, Hunts; it was about the size of a pin's head, evidently only just hatched, and he has always regarded June 25th as a medium date for beating larvæ of this species, although no doubt a few may be obtained during the following fortnight. This supposition, he says, is borne out by the fact that he has to-day (June 27th, 1907) just received two dozen larvæ from Huntingdonshire, and they are of almost all sizes, from about ten days old to quite full-grown, some even having assumed the purple-brown tint which is a mark of maturity. They seem to feed chiefly by night, and prefer the tender tips of blackthorn shoots. Mathew says that both in North and South Devon the last fortnight in May and first fortnight in June is undoubtedly the best time to look for the larvæ, and they seem to prefer the little stunted bushes growing by the sides of streams, or low down in hedges, to those of more vigorous growth. He says: "I think the larvæ feed chiefly by night, though I have occasionally seen them do so by day. They do not eat holes in the leaves, but commence near the tip and eat right across the leaf, consuming the mid-rib to near the base. When not feeding they rest on the under surface of the leaves. Sometimes, when full-grown, they are quite conspicuous, for I remember on one occasion, when fishing between Totnes and Buckfastleigh, on a bright hot day early in June, I was passing some sloe-bushes on the bank above me, when, happening to look up, I saw a large larva of *R. betulae* on the underside of a leaf, its brilliant green contrasting strongly with the deeper shade of its food; the bush was quite twenty yards off. I put my rod down and went and got it, and, while picking the leaf, detected a couple more, and, in a short time, obtained more than a dozen without the aid of a beating-stick, for they were all full-grown and quite easy to see. I have also picked them off sloe-bushes in Lustleigh Cleeve: this used to be one of the best localities for them, for the stunted sloe-bushes occurred in the little open spaces between the granite boulders, and were easy to work, and the leaves, being much smaller than those on a strong-growing bush, scarcely hid a full-grown larva. I fancy that small larvæ can be beaten towards the end of April as soon as the young leaves begin to open. I have obtained them very small early in May, but, as a rule, I never tried for them until the end of that month, or beginning of June, for, in their early stages, the young larvæ grow slowly. The larvæ crawl in the usual slow slug-like fashion, and do not move in jerks when fullgrown as the larvæ of *Bithys quercûs* do." Lewin remarks that the larvæ are very singular in their form, and at first sight appear like woodlice, lying flat on a leaf or twig, without the least sign of feet, and when they travel, their motion is more like that of a slug than a caterpillar.

Turner says: "I have never seen the larvæ move in daytime in nature. They always sit on the underside of a leaf along the midrib, and are most difficult to see; they also appear to me to be advantaged, when young, by their resemblance to a *Syrphus*, so that in a sense they are doubly protected." Russell, too, notes that, in Monk's Wood, the larvæ lie under a leaf during the day, the stunted blackthorn bushes being the most productive, when beaten for larvae in June. Rothschild also notes, that in Ashton Wold, the larvæ appear to frequent stunted bushes only. Oldaker observes that the larvæ are found on old blackthorns at Ashtead, and Rogers obtains them from the old stunted blackthorns in the Teignmouth district. Heissler states (*in litt.*) that, in the neighbourhood of Neuburg-a. D., the larvæ are to be found on sloe-bushes, preferably with a sunny position; the larvæ keep to the underside of the leaves, not even changing their position when feeding; and the laziness of the larva is most noticeable. He states that he rarely saw one in motion, or seeking a fresh leaf, even when the one it was on had been more than half devoured. Pabst says that, at Chemnitz, the larvæ appear to emerge from the egg in May, and rest on the underside of the leaves of *Prunus domestica* and *P. spinosa*, but not on *Betula*. Fuchs says that, in the Oberursel district, the larvæ are to be found at the end of May, together with those of *Strymon pruni*, on blackthorn, but, at this time, are quite small, whilst those of the latter species are already almost full-grown. Koch notes the larvæ are often to be obtained in large numbers on the outskirts of the "Hegwaldchen," and of the "Stadtwald," in Hesse, from sloe, and in gardens throughout the district on apricot. Steinert says that Richter, the gardener to the court of Saxony, states that, in the Luisium garden, he found the larvæ on "*Amygdalus nana* cum flore pleno." The larva is to be found on plum and blackthorn in the Kingdom of Saxony, and is best obtained by beating. The collectors of Meissen further note it as occurring on birch. Schmid also finds the larvæ on apricot, as well as plum and sloe, in Bavaria, and Freyer observes that it is often to be found on the latter plant in large numbers at Augsburg. Borkhausen, in 1788, says that, in Germany, the larvæ are found during May and June on cherry, plum and peach, also on blackthorn and similar plants, but rarely on birch. He adds that, according to Esper, the larva prefers thin and ill-developed leaves to large and juicy ones. Caradja says that, in Roumania, the larvæ are to be beaten in May, from sloe and *Prunus padus*. Blachier observes that, in the Geneva district, it is found from about May 27th to June 25th on sloe, and that he once found a larva on apricot in his own garden in Geneva. Lambillion states that, in Belgium, the larva of this species is ordinarily not rare towards the end of May and during June; it is best obtained by beating blackthorn bushes, and is very easy to rear. The following are more detailed notes of the captures of larvæ:—Continental records: Larvæ abundant in May and June, 1888, at Wiesbaden (Prideaux); larvæ, June 5th-20th, 1890, at Digne (A. H. Jones); larvæ abundant on sloe at Glion, above Montreux, June 27th, 1907, rather less than halfgrown; also one picked up on a cultivated plum twig, June 17th, at Brigue—all these had commenced to change colour by July 2nd (Prideaux). British records: larvæ beaten June 20th, 1858, from *Prunus spinosa*, in

Epping Forest (Tugwell); larvæ in May, 1865, at Loughton (Cole); larvæ fullfed June 6th, 1870 (Newman); June 22nd, 1872, at Bickleigh (Bignell); May 30th, 1874, in Chattenden Woods; June 7th, 1874, at Loughton (A. H. Jones); June 7th, 1876, in Chattenden Woods; June 10th, 1876, in Epping Forest; June 5th, 1877, in Monk's Wood (Bower); larvæ common in June, 1881, in Epping Forest (Eedle); June 11th-18th, 1881, in Epping Forest (Mera); larvæ last week in May, 1882, in the New Forest (A. H. Jones); June 10th, 1882, in Chattenden Woods (Mera); June 11th, 1891, in Epping Forest (Dennis); June 10th, 1885, near Plymouth (Bignell); June 20th, 1891, in Epping Forest (Bayne); larvæ throughout June, 1892, in Epping Forest (Quail); a few quite small larvæ, May 3rd, 1893, a very early season, near Oundle; May 12th, 1893, in Chattenden Woods (Bower); June 7th, 1893, and June 8th-15th, 1895, in Epping Forest; May 20th, 1896, at Brockenhurst (Turner); May 29th-31st, 1896, about one-fourth grown, near Fairmead, in Epping Forest (Prideaux); May 30th, 1896, in Epping Forest (Turner); 26 larvæ beaten near Ashford, May 31st, 1896 (Wood); June 2nd-8th, 1896, at Langworth (Raynor); fullfed larvæ June 16th, 1896, in the New Forest; larvæ beaten from sloe June 19th, 1896, near Peterborough (Pearson); larvæ in considerable numbers in June, 1896, on sloe, at Lyndhurst (Edelsten); June 16th, 1898, in Barnwell Wold; June 19th, 1898, in the woods of Northamptonshire (Dixon); June 2nd, 1899, at Chingford (James); larvæ much more abundant in 1899, in the Epping district, than in 1898, the earliest taken on June 10th, when they were somewhat small (Lane); June 23rd, 1899, at Ringwood (Fowler); exceedingly abundant in June, 1900, in Epping Forest (Pickett); larvæ June 9th, 1900, at Chingford, small, but abundant, still more so on the 16th, and continued so until July 30th (Lane); June 19th-20th, 1901, at Mundon (Raynor); 110 larvæ beaten near Ashford, June 26th-29th, 1901 (Wood); June 27th, 1901, in Epping Forest (Enock); larvæ occurred freely first week of June, 1902, in several spots between Dawlish and Teignmouth, on stunted blackthorn bushes (Rogers); June 26th, 1902, at Mundon (Raynor); 40 larvæ beaten near Ashford, June 30th, 1902 (Wood); larvæ, June 11th, 1903, at Monk's Wood, from *Prunus communis*, and one from *Quercus robur* (Crisp, *Ent. Rec.*, xv., p. 243), a remarkable record! May 19th, 1904, in Monk's Wood, one only, just hatched (Raynor); half-a-dozen larvæ beaten from sloe-bushes, growing by the side of a rushy moor, near Instow, June 16th, 1905 (Mathew); 27 larvæ near Ashford, June 18th, 1905, June 28th, 1907, near Ashford (Wood).

Larva.—*First instar* (newly-hatched): Colour, pale slaty at first, now (one day old) rather green; head, polished black; antennæ, labrum (basal portion) and some lower mouth-parts white; four or five stout white hairs on each side. On the abdominal segments, tubercle i has a long hair, colourless, spiculated, curved upwards and backwards, length about 0·22mm.; the seta on ii is shorter, arising well behind and outside that of i, a very small hair on the anterior border at this level; then below tubercle ii there is a wide space, then a large lenticle, very like a spiracle, below this a very minute one, and another equally minute near the front margin of the segment; then comes the spiracle, then, on the flange, three hairs in line and one hair below; again, below this, on the next flange, a small solitary hair (vi ?) towards the front portion of the segment, with two hairs nearer proleg (vii) (March 25th). Four days later has fed up a good deal, and is now more easily examined. The head, at first as wide as, or wider than, the body, is now half the width of the prothorax, into which it can be retracted, and the "slopes" are now long and steep and contrast with the narrow level back, which were before more in one rounded surface. The colour is now green, with whitish patches round tubercles i and ii, and darker in the two slightly oblique hollows on the slope, the beginnings of oblique markings, so usual in Lycænids. The general surface is covered with dark skin-points, which are wanting between i and ii and on the white patch surrounding them. The note concerning the tubercles, etc., on the abdominal segment, given earlier, is correct, except that there is a lenticle above the solitary hair noted on the second flange. There is also a large lenticle on the front border of the segment just above the flange and below and in front of the spiracle on the 1st and 2nd, and on the 7th and 8th, abdominal segments, but wanting on the intermediate ones. On the prothorax the plate has a median suture; on each side towards the front is a large lenticle. There are also five hairs, two in front—if there were a third at the outer angle there would be three equally spaced; the largest hair is a little behind the middle, the two others are one inside and in front of this, another towards the outer back margin. There are three long hairs in a row below and in front of plate and two others below them. These are almost directly in front of the spiracle. Some way below the spiracle is a large lenticle with a small hair in front of it, and lower two small hairs (at base of legs). On the 2nd and 3rd thoracic segments the arrangement is almost as on the abdominal segments. There is, on the "slope," only the single lenticle, and a hair where the lenticle is on the 1st and 2nd abdominals, at the front corner above the flange. The flange has three hairs, without the fourth one below, and there follow only two hairs at the bases of the true legs. The prolegs have, at the end of the prop outside, a row of black hooks, then the usual central prolonged soft pads and the front and back pads, each with two (or three ?) hooks. On the 8th abdominal segment there is a dorsal hair (i ?), and then nothing to the spiracle. On the 7th abdominal segment, one lenticle only between ii and the spiracle, *i.e.*, the second minute lenticle above the spiracle is wanting. On the 7th, 8th, 9th and 10th abdominal segments the flange is continuous, with no segmental divisions, and carries ten hairs (on each side) in an upper row and about five in a lower, with other and smaller hairs behind. The anal plate has dark markings, but no hairs or lenticles. [See plate vi., fig. 3, for a clearer view of the disposition of hairs, lenticles, etc. It is slightly diagrammatic, but is believed to be all but, if not quite, accurate as to position, etc., of hairs and lenticles. The skin-points are not shown on any of the sketches (pl. vi., figs. 1-4). They are present in the first instar in all the species, but not after.] In the first instar, tubercles i and ii carry, as usual, a long and a short hair, that on i more upright, and together forming a crest down the dorsum. They arise from a joint base, at least skin-points are absent between them. Above the spiracles (abdominal) is a minute lenticle, with a more minute spot just below it, probably really a second lenticle. Below the spiracle, on the flange, are four hairs, a median the longest, one at same level behind, one a little higher in front, and a lower one a little behind the middle one; two fine hairs above the legs and an indication of a hair a little above and in front of these, or of a hair and minute lenticle. There is also a minute hair at the front margin of the segment just outside i, and on the 1st, 2nd, 7th and 8th abdominal segments a conspicuous lenticle at the front of the segment below the spiracle. On the prothorax is a plate, with a trace of median suture and four hairs and a lenticle on each side. The plate narrows to each side, but the ends are truncate, not pointed. There are three hairs in a row along the front outer margin of the plate, two more in front of the spiracle, a small lenticle and hair below, and marginal hairs on the leg. The mesothorax and metathorax are nearly like the abdominal segments. The mesothorax has a small lenticle in front of tubercle i + ii; the front hair of the four flange hairs is well above the others, so that the lateral flange hairs are only three; the marginal hairs at the base of the legs are two. Of surface sculpturing there appears to be a darkish hollow below and behind i + ii. The 7th, 8th, 9th, and 10th abdominal segments have a continuous lateral flange, with no incisions, or at any rate difficult to determine, carrying on each side ten hairs in an upper row, and five smaller ones in a lower. The anal plate has four blackish marks but no hairs or lenticles. The prolegs have the usual two pads each, with two hooklets, and the central transparent projection with broad, truncate, end. *Second instar* (April 6th): 3·5mm. long. Head black, shining, half as wide as prothorax. Light green, with whitish-, or yellowish-green dorsal lines and stripes. The dorsal stripes border the dorsal level, which is very narrow on the 1st to 7th abdominal segments: behind this the dorsal level flattens out into the posterior slopes of the 7th to 10th abdominal segments, which do not distinguish between the dorsal level and slopes, but are one curved surface. Forwards, the two yellow lines diverge on the thoracic segments, and pass on either side of the prothoracic plate, and become lost before reaching the margin of the segment. On the 1st to 6th abdominal segments the dorsal line runs down the posterior border of the segments (*i.e.*, the colour does), as well as starting obliquely at the front of the segments, and running downwards and backwards, the two lines meeting at the posterior border of segment, and ending in a darker area. Below, the oblique line is continued on the following segment by a finer line, or as a rounded patch. The lateral flange is pale. The prothoracic plate is green (colour of rest of larva), but in some lights is polished and shining; it seems to be without hairs. This is, however, hardly probable. The hairs of the dorsum and flange are much more numerous, those of the flange in a bright light making quite a haze round the larva. April 10th: The larva much grown, nearly 6mm. long, and colours much more distinctly differentiated. On the 2nd, 3rd, 4th, 5th, and 6th abdominal segments, the dorsal level is very narrow, and the two yellow lines bounding it are very close together, i and ii are rather close together, and close to those of opposite sides; they are of a pale brownish; i about 0·7mm. long. On the 7th to 10th abdominals the dorsal level rounds into slopes and the yellow lines diverge a little, apparently failing on the 10th, where a bright line, a little less dorsal, appears to be the same as the upper oblique line of slope. On the 1st abdominal segment the two lines diverge slightly, and then more rapidly on the thorax, joining the flange line at front corners of the prothorax. The skin is very glassy and transparent, and the skin-points are represented by fine complicated puckerings. It is to be noted that, in these larvæ, the first stage has numerous black skin-points, wanting in second stage, and represented (then and) after by a network of lines of pavement-epithelium pattern. The prothoracic plate has at least one (coloured) hair; all the hairs are finely spiculated. Hairs on the slopes very short, baton-like, and deflexed, not quite the same on all segments, sometimes one, sometimes two, at front margin in front of spiracle, one at posterior margin, and two on middle of slope; the three dorsal hairs are supplemented by two or three small ones on dorsal flange, behind the others. The lateral flange with ten or eleven hairs. On the thorax are three hairs on the dorsal flange of metathorax, two on mesothorax, with one below and behind, and two at front margin of segment. The widely separated dorsal flanges (?) on prothorax, carry three or four hairs; these are yellow, oblique (downwards and backwards) on the slope, and the flanges are also yellow; these two dorsal yellow lines are only about 0·12mm. apart, but are not what we ordinarily call dorsal lines, being the lines of i and ii, not lines much interior to them. There are eighteen hairs on each side of the lateral flange of the conjoined 7th to 10th abdominals, and sixteen on one side of the prothoracic margin. The hooks of the prolegs are very transparent and faintly tinted, apparently five on each pad. Seen laterally, the highest point of the larva is formed by the tops of the 3rd thoracic and the 1st abdominal segments. Thence it slopes acutely to the front margin, gradually behind to the 6th abdominal, where it has sunk about one fourth, thence it slopes more quickly to the end; from the metathorax to the 6th abdominal the segments are rounded dorsally. The prothorax and the 7th to 10th abdominal segments on the other hand, slope smoothly. Now, when fullgrown, in this second instar, the larva is in form and colour almost identical with the fullgrown larva, the chief difference being that the primary hairs are still more or less recognisable; but, in the extreme narrowness of the dorsal area and the length (or height) of the slopes, the identity is close. The first oblique lines become longitudinal on the 2nd, and wanting on the 1st, thoracic segment. The second one is straight on all three thoracic segments, and almost wanting on the first. There are some short yellow lines inside the dorsal lines, two on the prothorax where the space is greatest. *Third instar* (April 15th, moulted on the 14th): 8mm. long; much the same appearance as before moult; dark green, with yellow lines, the yellow is not very clear yellow, but is in sufficient amount to give the larva a general effect of light green. The two dorsal lines (and ridges) are very close together along the abdominal segments, so close as to make rather a single (but divided) ridge than a flat, with raised margins; the "slope" is very long, especially on the 1st and 2nd abdominal segments. The dorsal ridge on abdomen is about 0·15mm. wide, at front of prothorax about 1·0mm. The slope at anterior abdominal segment measures 1·4mm. or 1·5mm. The dorsum rises above the level of the lateral flange behind, up to the middle of the 1st abdominal segment, whence it slopes down again to the flange in front, at the same time that the dorsal ridges and lines separate, and along the prothorax are 1·0mm. apart; the front of the prothorax is nearly straightly transverse. The dorsum of the thorax between the ridges is without hairs; the rather large prothoracic plate is smooth and shining, but hardly otherwise distinguishable. The ridges carry a line of hairs, rather brownish, in front spiculated and curved backwards, about four large ones and some smaller ones on abdominal segments, five on mesothorax and six or seven on prothorax, the largest about 0·5mm. long. The margin of the ridge seen from the inner side is yellow. Each hair seems to have a yellow bulbous base, in addition to the yellow line. The lateral flange running all round is yellow, and has, on each segment, eight or nine long hairs and a good many short ones, all white and rather glistening, giving a hazy appearance to the margin; the longest of these is about 0·5mm. Besides the dorsal and lateral flanges are two oblique lines (downwards and backwards) on this slope, the lowest just above spiracle and sundry yellow spots in the intervals. On the metathorax, the lower line is horizontal; on the mesothorax, both are. The spots are fewer, the area being less, and on the prothorax is only a spot or two. In compensation some yellow longitudinal lines appear dorsally on the thoracic segments between the flange lines. The oblique lines similarly dwindle posteriorly, and on the 10th abdominal segment are only two longitudinal lines, a little wider apart than to correspond with the dorsal flange lines. The head is black, shining, about 0·7mm. across. On the slopes there are a number of very minute (microscopic) hairs, disposed over the green area, almost in rows along the margins of segments. April 17th: Eating vigorously. Now 10mm. long. The special form of the larva consists in the extreme flatness of the "slopes," the extreme narrowness of the dorsal ridge (ridge rather than ridges, they are so close together), the flatness of the front slopes (thoracic dorsum), and the angular appearance resulting. The lateral flange (on lateral view) is a straight line, and the dorsal yellow line or flange descends to it, from the angle on the 2nd abdominal segment, in a straight line in either direction. A mounted larva-skin in the third instar shows a prothoracic plate about 0·6mm. across, a little angular, but fairly round and quite circular on its posterior border. It has 25 or 30 very minute hairs and half-a-dozen lenticles. The hairs round the front are very numerous and fairly long, generally about 0·2mm., but up to 0·4mm., two or three between the plate and spiracle longer. One of the large spiracles appears to have a lenticle in its margin, the other to have three. There is also a lenticle attached to the posterior margin of each of the abdominal spiracles. (This incorporation of a lenticle into the margin of the spiracular plate has already been noted as more extended in the case of *Bithys quercûs*.) There are several lenticles near the spiracles and also just below the dorsal ridges, but elsewhere they are rare and solitary. A feature of the abdominal hairs is that there is a row of short (about 0·14mm.), ordinary, spiculated hairs along the margins of the segments, on the slopes, but on the slope between these are scattered hairs of less than half the length, smoother outline, thickened in the middle and with rounded end, forming peculiar club-like batons. On the prolegs the outer line of small hooks has about thirteen crochets, each of the pads has ten or eleven, much larger and, though in a single row of two alternating sizes, there is a clear hiatus between the two pads. *Fourth (last) instar* (April 26th, 1906, moulted April 25th): 12·5mm. when resting a day before the last moult; 13·2mm. (16mm.

stretched) a full day after the moult. Looks very like previous instar as to colour and marking, but the hairs are rather altered. The "slopes" quite plain and flat. Front slope also. Dorsal ridges very distinctly yellow, with five or six short (1mm.) brown-tinted hairs on each segment. The two ridges, however, and the valley between them, are only about 0·35mm. or 0·4mm. across. Viewed laterally, they are nicely crenulated, each hair being on a rounded base, yellow, continuous with the yellow line of the ridge. This depends, however, on the angle of view, as the hair-bases seem to be really colourless, and show the yellow only from certain directions. The yellow itself seems quite subcutaneous (as is common in colours of Lycænid larvæ). The head seems at first to be black, but this is true only of jaws, labrum, labium, and cheeks about eyes; the parts, in fact, that are much exposed, but, when on the move, the basal parts of the head are seen to be ochreous, fading backwards to cinereous (no trace of green as rest of larva). The slopes of each of the abdominal segments are margined with about ten minute white bristles, more on the larger segments, and various in the completeness of the row, and more if those, not easily distinguished from the flange series, are included; the upper point dorsad and the lower point ventrad. Over the rest of the slope are scattered 30 or 40 hairs of the same set as these, but even smaller, and various as to direction. They tend to fall into transverse rows, slightly oblique; in length they are under 0·1mm. The lateral flange carries ten to sixteen hairs on each segment, directed outwards, white, or nearly so, and about 1mm. in length. The yellow markings are almost exactly as in last instar, two oblique lines to an abdominal segment, with scraps of less obvious transverse lines in the intervals. The spiracles yellow or faintly brown. The front slope is studded with the minute hairs like the lateral slope. *April 27th:* Length 15mm. The "slope" is 3·5mm. on the side of the 1st abdominal segment, 2·2mm. on the 6th abdominal, and nothing at the side of the prothorax in front. Now that it has done some feeding, the line from the 1st abdominal to the tail is not straight, but descends more rapidly after the 6th abdominal segment. The 7th, 8th, 9th, and 10th abdominals seem to be without dividing sutures, except the 8th and 9th, where is a slight sinuation of the lateral flange, and dorsally the hairs and markings of the dorsal flange terminate at a transverse line. In the last skin it is difficult to make out the prothoracic plate, it is rather guessed as an area that does not give any puckers or wrinkles (and is, of course, of symmetrical form, and probable shape of the plate); it is about 1·5mm. long, and 1·8mm. wide, it has a large number of lenticles towards the outer angles; the central line, widened posteriorly (suture ?), is free from hairs or lenticles. The hairs are very various in form and size; along its posterior edge are hairs about 0·1mm. long, of oval form, at their widest nearly one-third of their length; when sufficiently magnified they are of remarkable structure, oval, of Indian club form; they have spicules arranged something of the pattern of a fir-cone, but, though apparently ending in a point hardly raised above the surface, each runs back a long way towards the base, so that what first strikes the eye is a longitudinal striation, almost like that of a lepidopterous wing-scale. Here and there, over the plate, are similar hairs of hardly more than half the length (0·05mm.). These graduate into others a little longer and much like ordinary spiculated hairs. Then there are longer hairs (0·3mm.) with the basal halves smooth, the further half with long spicules, longer than the thickness of the hair. Beside, but outside, the plate, are ordinary long hairs (0·7mm.) with very short spicules, mere points, but with long recurrent ridges. Similar hairs to all these occur on other segments; on the dorsum of the mesothorax are several short ones, 0·05mm., with short, smooth, thin shaft, and globular spiculated head. The hairs on the slopes are more numerous than in last skin, they are much like the fir-cone hairs of prothorax, except that they have sharp points and are curved, the spiculæ larger, and the recurrent lines not so marked. The spiracles are most elaborate and beautiful, defying any useful description; they have four or five lenticles in their margins, and lenticles are also plentiful about them, chiefly above, and at once distinct from hair-bases that have lost hairs by the finely dotted area of the lumen. The prolegs have about eleven hooks (0·5mm. long) in the upper outer row; the two sets (or two pads) of the foot proper are fused together, but distinguishable; each has about nine or ten long hooks (0·14mm.) and ten or twelve shorter ones (0·08mm.), these alternate with each other, there being an extra short one or two at each end and at the middle. On the last segment is a small (0·5mm. across) smooth area, with only four or five hairs and a lenticle or two, that is probably the anal plate. The longest hairs are round the posterior margin, where several are 1·3mm. long (Chapman). *Final instar* (not quite full-grown, June 29th, 1885): Length about 14mm., greatest width 4·5mm. at the 1st abdominal, where it also measured 4mm. in depth from the dorsal ridge to the venter; at that segment a transverse section would be triangular; the belly flat; through the 2nd to 10th abdominal segments the sides slope from the dorsal ridge down to the subspiracular ridge like the roof of a house; from the metathorax forwards the back widens out, the segments deeply cut, the head dark, small, and quite retractile under the prothorax; the skin generally dull, but shining along the middle of the back, thickly covered with very short pubescence; along the dorsal ridge a double row of longer, stiffer bristles, and a single row of them along the subspiracular ridge; the colour generally of a bright light green; two lines of pale yellow, being in fact two rows of short streaks, commence on the prothorax, where they are widest apart, drawing nearer through meso- and metathorax, and from thence running parallel along the back; the subspiracular ridge has a yellow line edging it, which goes all round the anal flap, but on the prothorax stops where it meets the dorsal yellow lines; on each segment from 1st abdominal backwards are two rows of small yellow streaks slanting downwards and backwards; on the metathorax there is only the upper streak, none on pro- and mesothorax; about the middle of the streak in the lower row comes the oval spiracle outlined with brown on a raised round whitish spot; belly and legs more whitish-green; the hinder pairs of trapezoidal dots (tubercles ii) can be detected, but not easily, being paler than the ground colour; the coloration gives the effect of a double dorsal ridge, but this is not so really (Hellins). The head is almost globular, but slightly produced towards the mouth; it is scarcely half so wide as the prothorax; indeed, the head may be said to be retractile within that segment; the body is shaped somewhat like a little boat turned keel upwards; the sides are dilated all round, even including the prothorax, the anterior margin of which projects beyond the head; the segments are deeply and distinctly divided, so much so as to give the back, when viewed sideways, a serrated appearance; the dilated sides and dorsal keel are each garnished with a fringe of stiff hairs; this fringe is double on the dorsal keel, but single on the lateral dilation; on the former, each hair is curved into the segment of a circle, and its end is directed backwards; on the margin, each hair is also curved, but more slightly, and its end is directed downwards. The colour of the head is brown, and its surface very glabrous; that of the body apple-green, with four narrow, longitudinal, whitish stripes, and two oblique lines of the same hue on each side of each segment; two of the longitudinal stripes are dorsal, they are distant on the pro- and mesothorax, gradually approach on the metathorax and 1st abdominal segment, and thence run parallel to the 9th abdominal segment; the other stripes are lateral, and, running completely round the margin of all the segments of the body, unite on the prothorax and 9th abdominal segment; on the prothorax are two short pale longitudinal lines, side by side; the ventral surface, including the legs and claspers, is pale, semi-transparent, glaucous-green, with a vague medioventral smoke-coloured stripe, probably due to the presence of food in the intestinal canal (Newman).

Colour change preceding pupation.—The full green colour was observed on the evening of July 5th; the specimen was not seen again till the morning of July 8th. The ground colour is now of a dull purplish or reddish-mauve hue, with a slightly greenish tinge along the lower area of the sides, above the lateral flange. This area is bounded by a very distinct purplish spiracular line, which extends downwards, and reaches the resting-margin of the larva at the 8th abdominal segment. The whole of the hinder abdominal segments distinctly more purple than the rest of the body, the thoracic area, front slope, and apices of the dorsal serrations, being still of a somewhat purplish-green tint. The oblique lines, from the bases of the dorsal humps to the spiracular line, quite white; the lateral edges of the dorsal serrations also white; as also is the marginal edge of the subspiracular flange, remarkably so on that part belonging to the 8th, 9th, and 10th abdominal segments. The ventral area (including all that below the subspiracular flange) of a rather dull greenish tint. Another commenced to change colour on July 13th. The next day it was of a deep mauve- or purplish-red colour, almost unicolorous in tint, except that the edges of the dorsal ridge and marginal flange were pale and shiny. The oblique lines now only show faintly, their tint being almost identical with that of the ground colour, the lower series being almost obsolete. The spiracles are slightly paler than the ground tint. Prideaux observes that, immediately before the final larval skin is cast, the larva is rather brightly coloured, the colours being a pinkish-mauve, with the dorsal and lateral skin-ridges translucent green.

Larva in quiescent stage preceding pupation.—When in the quiescent stage preceding pupation, the dorsum is regularly arched from the prothorax to the anus. The head is quite hidden ventrally, and the venter is pressed closely down to the surface, on which it has spun a strong silken web; the subspiracular flange, however, is well up, and the area between this and the base of the prolegs well-exposed. The apex of the 3rd abdominal segment is the highest point of the dome, and the segmental incisions show markedly, especially on the upper edge of the dorsal ridge. The hairs look like a pale covering surface, at some angles of a greenish-grey tint, this hue being particularly noticeable if looked at frontally. The spiracles are very distinct, especially looked at from above, from which direction, too, one can still trace distinctly the upper row of oblique stripes. As maturation takes place, a marked change is noticeable in the thoracic region; a distinct area, commencing on the mesothorax, directly behind the prothoracic spiracle, on either side, developing a clear green tint, which spreads over the lateral area of both the mesothoracic and metathoracic lateral areas as far as the subspiracular flange. By the end of the second day, these areas have extended to just beyond the 1st abdominal spiracles, and leave no doubt that they represent the developing pupal wings (July 13th, 1907).

Comparison of larvæ of Ruralis betulæ and Klugia spini.—[Both the larvæ here noted are in last instar but neither fullgrown.] The larva of *Ruralis betulae* has, in the extreme, the Lycænid character of dorsal flanges approximating and straight slopes. In these specimens the flanges or ridges along the 2nd to 7th abdominal segments are little more than 0·2mm. apart, the slope (on the 2nd abdominal) being quite 3·3mm. high and with the very slightest convexity. The oblique lines are very marked, crisply outlined, but narrow. In certain lights they suggest that they are raised ridges, but this is not so. On the 1st abdominal segment the dorsal ridges diverge, each being straight, to the middle of the prothorax, where they are 2·2mm. apart, then converge slightly and join the marginal flange in front. The included triangle is nearly flat, sloping down as it widens to the flange border of the prothorax. The larva is pure light green with yellow lines (dorsal, oblique, lateral, and some minor ones chiefly in spiracular region less easy to describe). Head deep brown, so as to look black, but graduating in pale rufous or ochreous over greater part of less often exposed vertex. The larva of *Klugia spini* is very different. It has the great hood of the mesothorax and the depression of the prothoracic plate. The dorsal ridges are 1·2mm. apart, not very prominent; slopes about 2·2mm. It resembles *R. betulae* in the outline of dorsal ridges on lateral view, *viz.*, a straight line cut into by incisions, but with the crest of hairs wanting, except at the extreme portion of angle, neither of the species with the humped outline of *Strymon pruni* and *Edwardsia w-album*. The colour is deep blue-green, and the hairs (very short) have a sparkling yellow appearance (in *R. betulae* they are less conspicuous, and silvery rather than golden). Head black throughout. The lines are blurred, hardly visible, and consist of a yellow mark, apparently so deep in the tissues as to be quite obscured. This specimen has no reddish colour. The constant absence of such colour in *R. betulae* also is probable, several specimens having been examined. The slopes of *K. spini* are slightly waved, not so smooth as in *R. betulae*, but are not convex. This comparison was made because the larvæ were available, but *K. spini* is almost of the Callophryid or "*rubi*" section, and not nearly allied to *R. betulae*, so that it is less valuable than it might be (Chapman).

Foodplants.—*Prunus spinosa* (Ochsenheimer, etc.), the general food in western and central Europe; *Prunus domestica* (Ochsenheimer, etc.), a common food throughout central Europe, more common than sloe in eastern Europe; *Prunus padus* (Caradja); apricot (Blachier, Stange, Koch, Kretschmer, Schmid, etc.); *Betula* (Linné); *Betula alba* (Ochsenheimer, Stainton, Snellen, Boie, Möschler, Nickerl, Richter, etc.); cherry, peach (Borkhausen); *Corylus* (Höfner, Paul and Plötz); *Amygdalus nana* cum flore pleno (Richter); oak (Höfner, Crisp); poplar (Höfner); alder (Donovan); buckthorn (Moses Harris).

Parasites.—*Agrypon flaveolatum*, Grav. (Bignell); *Campoplex pugillator*, Linn. (Eedle); *Campoplex eurynotus*, Först. (Eedle).

Pupation.—When fullfed and ready to pupate the larva changes to a rusty-brown colour. Albin observes that a larva of *Ruralis betulae* was taken on June 8th, 1720, and tied itself up after the manner of the "white" butterflies, and on July 16th came forth the "hairstreak" butterfly. This was probably the origin of the statement, by Borkhausen, that the pupa was smooth, round, and blunt, and "fixed the same as the pupa of the cabbage butterfly, *brassicae*." When fullfed and already of changed colour, the larvæ become more active, and often leave the foodplant, roaming restlessly until a suitable position for pupation has been found. This, however, is most frequently, in confinement, a leaf of the foodplant. Careful examination shows that the fullfed larva spins no girth, but forms a very fair silken pad, into which its prolegs, especially the last ventral and anal pairs, are tightly fixed, so that the cast larval skin remains over the anal segments of the pupa, and that this forms the means of attachment of the pupa. A larva was noticed, on July 8th, resting on the underside of one leaf, venter upwards, with another leaf pulled almost over it by means of a few loose threads, sufficient to retain the latter in position, but not sufficient to enclose the larva so as to prevent its being clearly seen on either side. It is resting as if it were supported by a silken girth, but there is no trace of one. Another larva, observed on July 12th, had spun a pad on the top of two plum leaves, so as to join them as a common base; it had then pulled over, and loosely attached to the leaf, some pieces of dried moss, that cover the dorsum and quite hide the larva, the threads having to be disturbed to inspect the larva. Yet another was observed, on July 12th, 1907, to pull a leaf together with a few silken threads, so as to cover itself, forming a weak sort of cocoon, but the silk threads can be severed without affecting the pupa, which evidently relies solely for support on its attachment to the cast larval skin adherent at the anal end of the pupa. The pupa resulting from this last larva was observed, on July 17th, to have the tail completely buried in the exuviated skin by which it is quite firmly attached, and this attachment is sufficient, even when the pupa is on the underside of a leaf, and resting horizontally thereon, dorsum downwards, to keep it in fixed position, but any outside pressure directly applied readily loosened the pupa from its position in the larval skin. Prideaux observes (*in litt.*) that, previously to pupation, the larva spins a pad of silk, either on the top or sides of the breeding-cage, or, in some cases, inside half-withered leaves of plum. The prolegs are very firmly fixed to the silk pad, a proceeding necessary enough, as this involves the sole means of pupal attachment. The larva spins no sort of silk girdle, the pupal attachment (as mentioned above) being entirely dependent on the larval skin, which is never completely cast, but adheres pretty firmly to the pad of silk by the empty larval prolegs. There are no cremastral hooks; the dumpy pupa can neither be said to be suspended, nor is it flush with the surface of the cage or leaf, but projects from it at an angle of, perhaps, 45°. A gentle push will remove the pupa entirely from its larval skin, the latter adhering firmly to its moorings, in most instances. Newman states that larvæ in his possession changed to pupæ of a pale, semitransparent, brown colour, unattached either by a belt or by anal hooks, at the bottom of the receptacle in which the larvæ had been fed. Bowles observes that the fullfed larvæ usually spins a loose web, and thus encloses itself, changing to a pupa, which is often unfixed, and at other times making a slight anal connection. Pabst says that the fullgrown larva leaves the bush or tree on which it has been feeding and pupates upon the ground among dry leaves and grass, the pupal period lasting three weeks. Rössler says that pupation takes place on the ground under leaves, etc. Gillmer states (*in litt.*) that Heissler informed him that "the larva fastens itself with a slight thread to a leaf or twig, but so weak is the thread that it breaks when the pupa is touched." He adds: "This statement, made by Heissler, disagreeing with that of Rössler, led me to obtain a supplementary account, in which Heissler states that 'the larva spins only a very weak girth, the larval skin in very many cases remaining clinging to the anal end of the pupa.'" Steinert states that "the pupa has the cast skin covering its anal end, but there is a terminal bunch of rust-coloured hairs; the skin, however, may be separated from the pupal end without harm resulting, and the loose pupa will produce a perfectly-formed imago. The pupa is perfectly incapable of movement, and one can only tell that it is alive by its change of colour before emergence." L. Newman states (*in litt.*) that the larvæ go to ground to pupate, and do so under moss or dead leaves, spinning the faintest possible semblance of a silk pad, with a few frail silken threads that are hardly a belt; the pupa, however, obtains little support from these, and falls away from them at the slightest disturbance. Harwood says (*in litt.*) that the larvæ do very little spinning, but usually manage to attach themselves to the underside of a leaf to undergo transformation. Having carefully examined the larvæ attached to the underside of leaves ready for changing, and also some freshly-changed pupæ, Harwood adds that he could find no trace of a silken girdle, nor is it easy to make out how they attach themselves, for the amount of silk they spin appears to be insufficient, but one observes that, in the case of the pupa, the cast larval skins remain attached to the anal extremity. Head adds (*in litt.*) that the larvæ spin a slight web on a leaf, and pass a fine thread or two over their back; they prefer to get into a curled-up leaf, and, in fact, appear sometimes to draw the leaf slightly round them, but they spin very little silk, and the pupal connection with the spinning is of the very slightest. Raynor writes (*in litt.*): "Twenty-two larvæ of *R. betulae* received from Monk's Wood, in June, 1907, I placed in two cardboard boxes, each one foot high. Nineteen of the larvæ formed loose surface cocoons, fastened with slight silken strands, and partly open at the top, placed on the surface of some oak leaf-mould. The other three, however, attached themselves to the surface of the cardboard boxes towards the top—one being actually in the northeast corner, 12 ins. from the ground, the other two about 10 ins. up. I examined these three pupæ carefully with a strong lens, and quite failed to detect any trace of a silken girth or fastening of any kind. The pupæ seemed to be attached to the cardboard surface by some glutinous substance, but were quite clear of the sloe leaves, although some of the latter, being in front of them, afforded partial concealment. The attachment of the pupæ was quite firm." Wood writes (*in litt.*): "The day previous to actual pupation, the three larvæ under observation crawled about in their confined space in their characteristic sluggish manner. One which had left its foodplant on the evening of July 14th, 1907, showed at noon on the following day first perceptible change of colour. Its bright green hue now had spread over it a reddish glow, the segmental furrows, lower segmental area, and greater portion of head-parts, however, still retaining the greenish hue. At 6 p.m. the reddish coloration had become more pronounced, and the larva appeared now of a general sickly, translucent, reddish hue. By 6 a.m. the following morning this had now assumed the final deep reddish tint, and at 5 p.m. on the 17th, the larva had lightly spun two fallen leaves of the foodplant together at the bottom of a box and was hidden from sight, except that a portion of the dorsal area (of the first few abdominal segments) could be seen through a chink between the leaves. These leaves were dead and dried, and concave on that side facing the bottom of the box. The larva was attached in this concave fold belly upwards. Of the nine larvæ upon which I made further observation, six were allowed to remain on leafy twigs of the foodplant placed in a bottle in a large earthenware pan, the bottom of which was covered with 2ins. of earth (for I was anxious to know if pupation ever actually took place below the surface of the earth), and the other three were placed, each in a chip-box, with two or three dead leaves, whilst the remaining subject was confined to a roomy cardboard box, which was absolutely bare. Of those in the chip-boxes with dead leaves, both behaved alike in spinning to the underside of the leaves supplied. That in the bare box went to the *top* and pupated without any attachment, except the anal pad, and this was so insufficient that, upon moving the box, the pupa fell to the bottom. My object, however, was to satisfy myself whether *R. betulae* really 'went to earth,' and the six larvæ which were left on their foodplant with earth to take to if they chose, and this earth covered with dead leaves, moss, etc., so as to imitate their natural surroundings, gave an unanimous reply that *R. betulae* does not go beneath the surface of the ground. All spun up between leaves, moss, etc. I have pretty regularly each year taken a number of *R. betulae* larvæ by beating the foodplant (blackthorn), and, although I must admit that, as the breeding of them has occurred during the rush of 'work,' I have never made careful notes, yet I am positive that never, in my experience, has a larva pupated beneath the surface of the earth, although there has always, in the breeding-chambers, been a layer of soil." The observations of such capable observers as these must be considered as most conclusive, and sufficient to dispose of the statement that the larvæ have been observed to suspend themselves by silken pad and girth in the orthodox fashion of *Strymon pruni* and *Edwardsia w-album*. They also go to prove that their pupation-habit is certainly not identical with, nor, indeed, so very similar to, that of *Bithys quercûs*. [See also Chapman, *anteà*, p. 229, on the cremastral structure of the pupa of *Ruralis betulae*.]

Maturation of pupal colours.—A larva that had been in the quiescent stage preceding pupation for at least three days, pupated on

July 12th, at about noon. The ventral part of the newly-formed pupa is of a whitish tint, with a faint internal tinge of green in the neighbourhood of the maxillæ, the tips of which project, at present, freely beyond the apices of the wings; the wings, too, are translucent greenish-white, the underlying red of those parts of the 1st-4th abdominal segments that they cover showing distinctly through them. The prothorax is bright crimson, the glassy eyes and mouth-parts being of the white translucent tint of the venter; the mesothorax looks more or less shiny translucent, with a somewhat corneous appearance, of a much paler tint than the prothorax, whilst the dorsum of the metathorax and of the abdominal segments are again of a bright red (almost crimson) hue; the incisions of the abdominal segments are much deeper red than the body of the segments both laterally and ventrally, and this difference between the colour of the incisions and that of the rest of the segments is marked to the metathorax, even through the translucent wings. The dorsum shows distinctly a fine, deep-seated, dark red, mediodorsal line from the front of prothorax to abdomen, and, on the 2nd-6th abdominal segments, the pale oblique lines stand out conspicuously above the spiracles, finely edged with darker reddish below, and enclosing a dark dorsal area between their upper ends—appearing like a broadish dorsal, almost crimson, band, looked at from above. As soon as changed, the newly-formed and soft pupa lifts itself slowly by its anal segments, stretching its head somewhat forward, and, by a slight backward movement, pushes, as it were, the wings farther down over the 4th abdominal segment, but these movements soon cease, and it shortens somewhat and rapidly attains its natural squat form. Another pupa was observed maturing its colours (after apparently pupating in the early morning of July 17th) about noon. Its abdomen is of a deep plum-red, the upper row of oblique lines subcutaneous and a shade paler, the spiracles somewhat ochreous, each situated in a slightly pale brownish subcutaneous patch. The mesothorax is getting brown, whilst, underlying all the thoracic and abdominal parts dorsally, there are a number of subcutaneous blackish dots. The wings are of a somewhat pale brownish tint, like the mesothorax, but the inner marginal area, to the anal angle, and the middle of the wings, have a distinctly green tinge yet; the wings also are thickly dotted with small, blackish, subcutaneous spots. Prideaux notes (*in litt.*): "The freshly-formed pupa has much the same colouring as the larva directly before pupation, the dorsal and abdominal parts being flesh-mauve colour, with translucent green wing-cases. Subsequently, the pupa is yellowish-brown, mottled and speckled with darker brown. Except about the head and wing-cases, and over the anal area, the pupa is covered rather sparsely with short glassy bristles, in some, but not in all, cases, these bristles possess very delicate, white, lateral spinules, such being specially observable in the spiracular regions."

Pupa.—The pupa of this species is paler, and gives the impression of being of more delicate texture, than those of *Edwardsia w-album*, *Callophrys rubi*, *Bithys quercûs*, etc. The second impression is that it is without hairs; this is not quite the case, but the hairs are very small and very few. The consequence is that the network, with the points at the intersections, is less interfered with, and forms a continuous ornamentation over a large part of the pupa. The points are small circles, of the same dark chitin as the ribs of the network; the centre of the circle contains a disc of paler chitin, in which is a central colourless point,

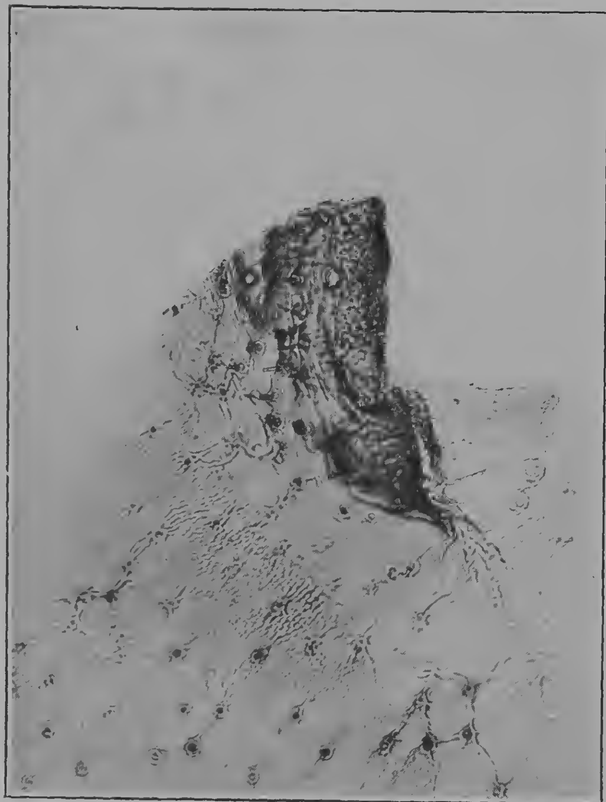


Photo. F. N. Clark.

Ruralis betulæ—portion of cremaster of pupa ×100.

The Natural History of British Butterflies, etc., 1907.

PLATE XIV.

(To be bound facing Plate XIV.)

RURALIS BETULÆ.

Portion of cremastral area of pupa × 100.

Shows irregular fracture, due to flattening for photographic purposes. Less than half the area broken away. It exhibits :—

1. The dorsal portion of the 10th abdominal segment with a pale (less chitinised) band, and a darker terminal portion on both these.

2. The cremastral hooks (?) reduced to very short blunt hairs.

3. The origin of these hairs at the intersections of the fine ribbings of the skin-sculpture.

4. A large lenticle in the middle of the dark area ; also one in the pale area (to left of lower part of the dark area) ; also two on the ventral area (to right). [Note that these are all repeated on the opposite side, but are not symmetrical, *i.e.*, they are near the same place on the other side, so near as to appear to correspond, but are sufficiently distant to make it possible that they do not.]

5. Fine skin-spiculæ, seen down on the right, *i.e.*, above or dorsal to the pale band.

6. The ribbing of the skin-sculpture, and the points they carry.

probably not actually vacant, but closed by delicate membrane; the disc sometimes shows some radiate structure. Lenticles are very abundant round the spiracles, and there are more hairs here than elsewhere—round the 5th abdominal spiracle some seven or eight, round the 4th, fourteen to sixteen. The lenticles are usually easily distinguished from the hair-bases from which the hairs have been broken, and the lumen is generally much larger, and always has a granulated or dotted membrane. The hairs are very short, 0·1mm. to 0·15mm. in length, rarely 0·2mm.; they are transparent, sometimes a little clubbed or baton-shaped, always spiculated, usually in the ordinary way, with fine spicules along the distal half, but some hairs have a few very large spicules towards the extremity, as if the hair wanted to branch, and, but for the slight clubbing and these larger spicules, there is no other approach to "umbrella" or "fungus" hairs. On the prothorax, which is very closely set with points, netting, hairs, and lenticles, a rather curious condition is noted. At first view, the ribs of the netting appear very often to run up to the hairs, so that hairs appear, in effect, to be on the netting, a condition which appears to be strenuously avoided on other pupæ examined. A closer examination shows that the ribs arise from the points whose margins are, in fact, produced into ribs as branches from them. The hair-base, however, is complete and perfect, and has no connection with the rib, which, nevertheless, passes under it and fades out; one is not prepared to find the pupal-skin to be thick enough for this super-position, or to quite understand what is exactly the structure. The network is not very unlike that of *Bithys quercûs*, the ribs forming meshes into which branches that do not cross the space or meet others, are, however, more abundant and conspicuous than in *B. quercûs*. The wings have a very beautiful pattern of sinuous lines, forming meshes of all shapes and sizes with waved margins. Neither on these nor on the other appendages are any points, hairs, or lenticles, except the points and lenticles at the tibio-tarsal articulations of the legs. There is a small diamond of labium present, about 0·2mm. long. Where points are present the ribs are less sinuous, almost straight from point to point. The black markings consist, essentially, to appearance, and no doubt really, by comparison with other Theclid pupæ, of dots of varying size. These run, however, together and form markings, difficult to describe satisfactorily, as they are, by their origin, rather irregular. The wings have the black so running together that, towards their bases, the pale is reduced to islets, something like a leopard's spots; towards the hindmargins the pale predominates, and the dark areas are the spots. The amount of dark varies in different pupæ. One specimen has hardly any. In another, the black on the wings remains in separate spots. On the abdominal dorsum the dark does not form markings of regular disposition, and the spots are often not definitely distinguished from the pale surroundings, *i.e.*, their margins fade into the pale surroundings. The cremaster consists of a number (40 or 50) of short blunt hairs or batons (0·04mm. long), without spicules, and arising from dark ridges that continue with the ribbing. They might help to maintain some connection with the larval skin, as occurs sometimes, and this might be assisted by the ventral surface of the abdominal segments (beyond the wings) having a nearly complete covering of fine sharp skin-spicules; they are especially strong on the terminal segments, and occur even dorsally along the margins (Chapman). The pupa increases gradually in width to the wing-bases, then again to apex of wings (where it attains its greatest width), then contracts to the blunt anal area. Colour—brown dorsally, with a dark central mediodorsal line down the abdominal segments. The head rounded; the mesothorax slightly raised, but scarcely any trace of metathoracic depression. The wings duller, mottled with darker subcutaneous markings, the wing-base slightly raised; the spiracles pale; a series of pale oblique dorsal stripes on abdominal segments as in larva. The ventral surface very flat; the wings very transparent; no properly developed cremaster, the cremastral area being sparingly sprinkled with black hairs (? hooks). *Dorsal view:* The prothorax narrower than the mesothorax, the latter slightly raised medially and carried backward into the centre of the metathorax; the latter and 1st abdominal segment very slightly contracted, a dark mediodorsal line beginning on the 2nd abdominal segment and continued to the 9th; a series of pale oblique subcutaneous marks on each abdominal segment nearer to the median line anteriorly. The 6th and posterior abdominal segments curved down and ending in a straight line with the ventral surface. The body surface very much reticulated with a roughly quadrilateral network. Each space appears to give rise to a hair (branched or plumose on the prothoracic segment), the branching occurring in the top third of the hair; in other areas the hairs appear to be only slightly clubbed. *Lateral view:* The median lateral line slightly raised. The base of the wing also raised with a dark patch, as is characteristic of so many pupæ; the 1st spiracle in suture between pro- and metathoracic segments, very long and conspicuous, of a pale flesh-colour, and at some distance from antennæ. The edge of the wing only markedly raised on the inner margin, the hindwing disappearing very early. The edges of the abdominal incisions raised, leaving a narrow, depressed, intersegmental ring between, but there are no free segments; the surface of the segments is thus concave. The abdominal spiracles smaller and rounder than the prothoracic. A series of black scars above and another below the spiracles, apparently representing the supra- and subspiracular tubercles. The anal segment blunt, rounded, with no proper cremaster. *Ventral view:* The head is rounded, slightly depressed medially, slightly protuberant just above the mouth; the maxillæ ending about two-thirds down the wings; the second pair of legs just above the termination of the maxillæ; the first pair above these, swelling out near their base and partly covering the base of the second pair (but not so completely as in *Bithys quercûs*). The glazed eye exists as a distinct lunule extending from base of first leg to near base of antennæ. The surface of the skin is much reticulated, the antennæ segmented. The whole of the ventral area, except the median part of abdominal segments, with irregular dusky subcutaneous markings. The apex of wing acute and in direct contact with tip of antennæ; the surface strongly reticulated, with hairs sparingly scattered over it. The reticulations often rough or irregular quadrilaterals, with a hair arising from centre. The abdominal segments with raised intersegmental membrane, but flattened ventrally. The 5th, 6th, and 7th abdominal segments fairly well-developed ventrally, the 8th with a long fissure, the 9th contracted and almost obsolete. The fissure on the 8th succeeded by the transverse anal flap on terminal segment (Tutt, June 13th, 1893).

Time of appearance.—This is no doubt the latest in its time of appearance of all our British "hairstreaks," not that late examples of *Bithys quercûs* do not often keep it company, or even occasionally outstay the first-emerging examples of the early autumn ; but its average time of emergence is later than that of *B. quercûs*, and its usual time of appearance over a series of years distinctly so. One rarely sees it, except in very early seasons, in nature until early August, and usually in our Kent woods not before mid- or even late-August. In late seasons it is to be found throughout September and on into early October, but the average time is from mid-August to mid-September, and the average individual life extends probably to about three weeks. In the valleys of the Alps, in the Val d'Hérens (about 3500 ft.-4000 ft. elevation) we found it in mid-August ; in the Visp-Thal (also at about 4000 ft.) it was in fine condition at about the same period; whilst in the Digne district it was out throughout the first three weeks of August, 1906 ; and in the Verdon Valley, at some 5000 ft. elevation, mid-August again found it just emerging. At the foot of the Grand Salève it was commencing to appear at the end of July, 1904, so that from 2000ft.-5000ft. there would appear to be little difference in the time of its appearance in the Alps of Central Europe. Doubleday observes (*Ent.*, iii., p. 35) that "Lewin, after describing the larva and pupa of *Ruralis betulae*, says: 'The ♂ butterfly appears on the wing about the middle of August, the ♀ is nearly fourteen days later before it comes from the chrysalis,'" and adds that he has "repeatedly proved the accuracy of this statement." Glaser also says that, in Germany, the ♂s are the first to emerge, and during the later part of its emergence-period ♀s are much more frequently observed. Our experience in Britain is somewhat similar, and the records of examples bred in confinement bear out the general statement, although appearing (as is usual under artificial conditions) rather earlier than in the woods. The following tabulated records by Adkin (1893) and Wood (1896-1905), bear out this observation :—

1893			1896			1901			1902			1905		
	♂	♀		♂	♀		♂	♀		♂	♀		♂	♀
July 16	2		July 26	1		July 28	2		Aug. 8		2	July 23		2
,, 18	4		,, 28		1	,, 30	5		,, 9		2	,, 24	1	
,, 20	3		,, 29	11		,, 31	3	1	,, 10	4	2	,, 25	1	
,, 21		1	,, 30	1		Aug. 1	7	4	,, 12	4	2	,, 26	4	
,, 23	1		,, 31		3	,, 2		7	,, 15		5	,, 29	1	1
,, 26	1		Aug. 1	2	2	,, 3	1	8	,, 21		5	,, 30		2
,, 28		3	,, 3	1	2	,, 4		4	,, 25		5	,, 31		1
,, 29		1	,, 4	1	1	,, 5		4				Aug. 1	1	
,, 30		1	,, 5		2	,, 6		4				,, 2	1	
Aug. 2		2	,, 7		2	,, 7		4				,, 3		1
,, 3		2	,, 8		5	,, 11		1				,, 4		4
,, 4		1				,, 14		2				,, 5		1
,, 9		1												
	11	12		16	18		18	39		8	23		9	12

Of a number reared in 1907, Raynor sends the following particulars: August 3rd, 1 ♀; August 6th, 1 ♂; August 7th, 2 ♂s; August 8th, 5 ♂s; August 11th, 1 ♂; August 13th, 2 ♀s; August 15th, 1 ♀; August 17th, 2 ♀s; August 18th, 3 ♀s; August 20th, 1 ♀; total, 9 ♂s, 10 ♀s. In Asia, it is recorded as occurring in July in Amurland (Staudinger), at Chabarofka (Graeser), and at the mouth of the Ussuri (Bremer); in July and August in western and central China, including the Moupin district (Leech), about mid-July in the Ala Tau and Tarbagatai (Haberhauer), in early August at Ongodai (Elwes), and in July and August in the Kouldja district and the neighbouring mountains (Alphéraky). In Russia, in June and July in the Ural district (Eversmann), July in the Vologda district; July and August in the Wiatka Govt. (Kroulikowsky), the end of August and September in Transcaucasia (Romanoff), whilst the dates extend from June 20th, throughout July, to the end of August, for the Baltic Provinces (Nolcken). In Bosnia and Hercegovina, it occurs from mid-July to mid-September (Rebel); from mid-July in Bulgaria (Bachmetjew), and from August 2nd to October 14th in different years in Roumania (Caradja). In Hungary, where the species is rather rare, it occurs from mid-July until the end of August (Aigner-Abafi). In Austria, it occurs generally from July to September (Höfner), *e.g.*, July to September in Bohemia (Hüttner), at Prague dates are recorded from August 7th to October 4th (Fritsch); mostly in July and August in Moravia (Schneider), dates are recorded from July 22nd to October 3rd at Brünn, from August 9th to September 21st at Neutitschein, and July 2nd to August 8th at Rottalowitz (Fritsch), and August and September in Upper Austria (Brittinger); Himsl, however, notes from June to September for Linz, whilst, for the same place, Fritsch gives actual records as August 19th and October 22nd. [We suspect June as a mere accident, and quite unusual, even if it be not an actual error.] In Lower Austria, July to October is noted; at Vienna, the species is recorded from July 30th to October 17th; at Gresten, August 4th-17th (Fritsch); in Salzburg, August to October (Richter), where actual records extend from July 8th to October 21st (Fritsch); in the Tyrol, at Taufers, August 26th is noted, but at Wilten, June 9th-26th (Fritsch); the latter dates are, we suspect, captures of larvæ, not imagines; similarly, Fritsch's records of May 15th for Admont, in Styria, and May 31st for Agram, in Croatia, are also possibly meant for larvæ; the real time of appearance for Styria is rightly recorded by Höfner as being from July to September. Fritsch suggests two broods in Moravia, but his dates, May 28th to June 27th, at Rottalowitz, no doubt refer to larvæ. It Italy, where the species appears to be very rare, it occurs in Piedmont—from end of July to mid-August in the Certosa di Pesio district (Norris), also in mid-August in the Pellice Valley (Tutt), at the beginning of August in Liguria (Curò), rather rare in September in Lombardy (Turati), in August and September near Florence, in the hills of Figliné (Stefanelli); [the record "in the spring a single example near Osimo, in Sicily (Spada)," is almost certainly an error]. In Switzerland, one long late summer brood only occurs, extending from the end of July far into the autumn (Frey); August and September in the Valais (Favre); early August in the Val d'Anniviers (Wheeler), mid-August in the Val d'Hérens and the Visp-Thal, also late July and August near Geneva (Tutt). In France, it is recorded as occurring in July in the

Haute-Garonne (Caradja); in July and August in Aube (Jourdheuille), and in the Gironde (Trimoulet); from July 24th to August 24th in Berry and Auvergne (Sand); July and August, and sometimes in early September, in Eure (Dupont); July to September throughout the whole range of the Pyrénées (Rondou); mid-July to September in Indre (Martin); end of July to mid-September in the Riviera (Bromilow); August in the Basses-Alpes (Rowland-Brown); in Doubs (Bruand), in the Alpes-Maritimes (Millière); August and September in Saône-et-Loire (Constant), in Morbihan (Griffith), and in Meurthe-et-Moselle (Cantener). In Germany, from July to October, Koch alone erroneously assuming that the specimens represent two broods in Hesse—one in July, the other in September—evidently a blunder. Other detailed records are—July to autumn in Thuringia (Krieghoff); end of July and August at Friedland (Stange), and at Zeitz (Wilde); July and August in the Hildesheim district (Grote); July to September in Brunswick (Fischer), in Baden (Gauckler), in Upper Lusatia (Schütze), in Hamburg and Schleswig-Holstein (Zimmermann), in Silesia (Wocke), in Hanover (Glitz), in the Erfurt district (*Ent. Ver. Erfurt*), and at Eutin (Dahl); end of July to mid-September in Waldeck (Speyer); end of July to September in Brandenburg (Bartel and Herz), and in Bavaria (Freyer); July to September, occasionally in October, in Hesse (Glaser); August in Pomerania (Paul and Plötz); late August at Biedenkopf (Jäger); August and September in east and west Prussia (Speiser), in the Rhine Provinces (Stollwerck), in the Hartz (Reinecke), in the Province of Saxony (Gillmer), and at Göttingen (Jordan); August to October at Halle (Stange), at Frankfurt-on-Oder (Kretschmer), and at Leipzig (*Leipzig. Ent. Verein*). In the Netherlands, in July and August (Snellen); from July to September in Belgium (Lambillion). In Denmark, from early July to early September (Bang-Haas). In Scandinavia, in August and September (Aurivillius). The following are more detailed records:—Continental records: bred August 13th, 1877, from larva found in the Eifel district (Bethune-Baker); July 24th, 1882, near Chabarofka, in Amurland (Graeser); July, 1885, at Bad Alveneu (Lemann); July, 1885, at Uriage; August 20th, 1885, in the Zermatt Valley (Reverdin); bred August 7th-September 1st, 1888, from larvæ taken in the Leipzig district (Bethune-Baker); September 8th, 1889, at Neuhausen (Lemann); late August, 1891, at Biedenkopf (Jäger); July 26th to mid-August, 1892, in the Certosa di Pesio district (Norris); August 28th, 1896, at Rjeto Bosna; July 15th, 1897, at Kosevo, near Sarajevo (Rebel); early August, 1897, near Aigle (Wheeler); August 4th, 1897, at Neuhausen (Lemann); end of August, 1897, about Gruyères (Rowland-Brown); August 2nd-8th, 1899, in the Val André (Turner); August 25th to September 6th, 1899, in the Lucerne district (Sanford); August 16th, 1900, at Charpigny (Wheeler); July 10th, 1901, near Sofia (Bachmetjew); mid-August, at Villeneuve (Wheeler); September 10th, 1901, near Fojnica (Simonys); August 4th, 1903, at Digne (Rowland-Brown); August 13th, 1903, between Useigne and Vex (Tutt); July 26th, 1904, at Brides-les-Bains (Reverdin); July 29th to August 1st, 1904, at the foot of the Grand Salève (Tutt); August 5th, 1904, at Fang, in the Val d'Anniviers (Wheeler); August 6th, 19th, 1906, at Digne (Tutt); August 13th, 1906, on the banks of the Arve, near Geneva (Muschamp); August 18th, 1906, between Allos and Lac d'Allos (Tutt);

August 24th to September 14th, 1906, at Mt. Salève (Blachier). British records: As the earliest and latest dates of captures wild over a long series of years have been noted—July 15th, 1826, August 5th, 1827, September 1st and October 8th, 1809 (J. C. Dale). Other dates are—August 31st, 1702, at Croydon (Ray); August, 1856, in the valley of the Dovey; August 9th, 1857, in North Wales (Crotch); August 20th to September 10th, 1856, in Darenth Wood (Harding); September 5th, 1857, in Darenth Wood (Baldwin); August, 1858, at Colchester (Harwood); August 3rd to September 17th, 1858, at Ashford (Russell); August 20th to September 7th, 1858, in Trench Woods (Edmunds); September 15th, 1858, worn, at Llwyngwern, Machynlleth (Alington); August 10th-25th, 1859, near Worcester; August 12th, 1860, in the Trench Woods (Edmunds); bred August 26th, 1860, from larvæ taken in Epping Forest (Eedle); September 1st, 1860, at Newton-in-Cartmel (Mason); August, 1863, in great numbers, near Galway (Birchall); September, 1863, in Westmorland (Hodgkinson); August, 1864, at Killarney (Birchall); early August, 1864, at Wallingford (Fenn); September 5th, 1864, near Cork (Mathew); July 11th-27th, 1865, near Worcester; July 21st-27th, 1866, eight males emerged, then a female, followed by two or three males, from larvæ taken near Worcester (Edmunds); October 2nd, 1871, one resting by night on a blackberry-bush at Cobham, Surrey (Waldegrave); August 7th to September 19th, 1877, at Petersfield (Robinson); July 30th, 1878, in Monk's Wood (Bower); August 30th, 1879, in the New Forest (Norgate); September 23rd, 1882, in Chattenden Woods (Bower); bred August 4th-8th, 1882, also bred July 25th-August 4th, 1887, from larvæ found on Dartmoor (Bethune-Baker); August 18th, 1890, in Epping Forest (Bayne); August 7th to September 5th, 1891, at Sidmouth (Wells); bred August 11th, 1891, from larva obtained at High Beech, on July 4th (Smith); September 13th, 1891, a female ovipositing, at Ashtead (T. B. Fletcher); bred June 24th-30th, 1893, from larvæ taken in Epping Forest (Dennis); July 1st-8th, 1893, at Ringwood (Fowler); bred July 16th to August 9th, 1893, from New Forest larvæ (Adkin); bred July 5th-11th, 1893, from larvæ taken at Loughton, May 30th, and that pupated from June 10th (Burrows); September 1st, 1894, females, at Ashtead (T. B. Fletcher); bred July 19th-28th, 1895, from Loughton larvæ (Burrows); August 15th, 1895, at Sherborne (Somerset); August 26th, 1895, near Ashford (Wood); bred July 10th, 1896, and following days, from larvæ taken at Fairmead, May 29th-31st, the first of which pupated June 17th (Prideaux); August 11th-24th, 1898, abundant, in Monk's Wood (Peed); July 26th to September 10th, 1900, between Burgess Hill and Hassocks Gate (Dollman); August, 1900, near Newtown (Tetley); August 8th, 1900, scarce, all females, at Monk's Wood (Cox); August 22nd, 1900, at Loughton (Carr); September 3rd, 1900, at Llanstephan (Bingham-Newland); September 4th-5th, 1900, on the South Devon coast (Porritt); bred July 25th to August 10th, 1901, from larvæ taken June 19th and 20th, at Mundon (Raynor); bred July 28th to August 19th, 1901, from larvæ that hatched May 9th-11th, from eggs found in Epping Forest (Mathew); August 17th, 1901, and August 16th, 1902, at Monk's Wood; also August 19th, 1902, at Coppingford Wood (Cox); September 21st, 1902, at Marlow (A. H. Clarke); bred August 5th-8th, 1903, from larvæ obtained at Ashtead, and that pupated July 8th-9th (Prideaux); bred July 27th, August 6th, 1904, from New Forest larvæ (Kaye); bred July 28th, 1904, from larva taken in Monk's Wood, on May 19th, 1904 (Raynor); September 17th to October 1st, 1904, near Oaklands (Barker); bred July 27th, 1905, also July 19th to August 8th, 1906, from Monk's Wood larvæ (Kaye); July, 1906, near Llandovery (Andrews *teste* Barker); August 3rd, 1907, first emergence of the year, a female, from Monk's Wood larvæ, others up to August 20th (Raynor); August 20th-23rd, 1907, bred from larvæ beaten at Ashford, Kent, July 18th, 1907 (Tutt).

Habits.—This species rests with its antennæ stretched out in front, its wings drawn closely together over its back, the forewings within the hindwings, so that the discoidal mark of the underside of the forewing is in line with the outer white transverse line of the hindwing, and the dark transverse line of the forewing in line with the darkish shade towards the outer margin of the hindwing, its abdomen and the inner margin of hindwings well raised from the surface to which the butterfly is clinging. When walking, the wings are drawn up back to back, and pressed somewhat closely together, and the abdomen is kept well within the inner margins of the hindwings. When disturbed, it is, however, much more active; the abdomen is dropped, the hindwings slightly separated, especially at the tails, the antennæ held forward at about an angle of 90°, and kept in a continuous state of motion, up and down, sometimes in the same direction, at others alternately in opposite directions. A female being placed in the sun on August 28th, 1907, its wings immediately opened, the deep blackish and orange colours looking the ideal of absorptive possibilities, whilst a distinct longitudinal purplish flush is seen in the discoidal area of the forewings. At this time, the wings are let down almost horizontally, perhaps at an angle of more than 160°, the forewings well forward and the hindwings far back, leaving a rather large space between the anal angle of the forewing and the apex of the hindwing. The butterfly soon, however, became restless, and moved backwards and forwards, its wings opened slightly, and the hindwings indulging slightly in the alternate up-and-down movement so characteristic of the Ruralids as a group. A piece of moistened sugar being inserted in the box was eagerly seized upon, and, with the wings drawn tightly together, and the tongue thrust into the sweet fluid exuding from the sugar, the antennæ, at an angle of about 45° from each other, moved up and down in a manner that showed clearly the delight and satisfaction of the insect. Rolling the sugar away, the butterfly put out its tongue in a most excited manner, folding and unfolding it, feeling all round for what it had lost, and moving slowly on until it was again discovered. The feeding went on for fully a quarter-of-an-hour, when the insect suddenly flew to the sunny side of the box, let down its wings so that the sun shone fully on them, and set to work to clean its tongue and antennæ most vigorously, with its front legs. The sunning continued for quite ten minutes, when it drew its wings up tightly over its back, placed its antennæ close together, so that they stood out in front in single line, and appeared to be on the alert, for, on the slightest approach to the box, it darted rapidly from side to side, and rarely rested quite still for more than a minute or two. Bethune-Baker mentions (*in litt.*) a specimen taken at Teignmouth at the previous night's "sugar." The species has a swift and jerky flight, rising suddenly from its resting-position and darting off suddenly, so that it is most difficult to keep in sight; and it appears to hide most effectually. It usually settles high up out of reach, and flies rapidly from one position to another, resting sometimes, however, for a very considerable space. We have seen it in late August flying thus about the oak-trees and tall sallow-bushes in Chattenden Woods, about the ash-trees far up the Visp Valley, between St. Niklaus and Zermatt, about the willows and birch-trees in the "glen" above the Baths in the Eaux-Chaudes Valley at Digne, above the bushes at the foot of the Grand Salève, and various other localities. Sometimes one sees it busily investigating the tops of the blackthorn bushes on the outskirts of the woods in Kent, or in the clearings in the woods, and, on one occasion, in Piedmont, we saw the insect busy about the scattered dwarf sloe-bushes that covered a rock-encumbered level, high up between Bobbie and Au Pra, that had evidently been at one time devastated by the foaming torrent of the Pellice. When thus engaged, there is not much chance of making a bag of *R. betulae*. The species, however, is, rather more than *Bithys quercûs*, attracted by the nectar of various flowers, and then it falls a ready prey. At the foot of the Grand Salève, the males choose the large blossoming heads of a tall Umbellifer, and in the Visp Valley they made a similar choice, although the species of plant may have been a different one, and here both sexes were at the flowers. Between Useigne and Vex, in the Val d'Hérens, they chose thistle-heads, and fought for a place against such sturdy hustlers as *Dryas paphia*, *Argynnis adippe*, *A. aglaia*, *A. niobe*, *Pyrameis atalanta*, *Agriades corydon*, etc. In the lovely glen, running into the Eaux-Chaudes, near Digne, they preferred the flowers of *Eupatorium cannabinum*, where they had for companions *Coenonympha dorus*, *Melitaea deione*, *Loweia dorilis*, *Hipparchia arethusa*, *Erebia neoridas*, *Polyommatus meleager*, *Callimorpha hera*, *Lithosia caniola*, *Anthrocera fausta*, and a host of other interesting and beautiful insects. Here, at Digne, however, most of those observed were sunning on willow-leaves before and about noon, keeping their wings closed during the time and flying off quickly when disturbed, and it was not till after noon that they were seen on the flowers of *Eupatorium*. These appeared to be all males. In the Upper Verdon valley, between Allos and the Lac d'Allos, in the early morning sun, between 9 a.m. and 10 a.m., on one of the hot slopes, a male was observed sucking greedily the nectar from a dwarf thistle flower; it was resting with its back to the sun, and would have been almost invisible if approached directly from behind or in front, but passing it at right angles, it was much more easily seen, but might easily have been mistaken for an example of *Epinephele lycaon* or *E. ianira*, except for its brighter tint. Whilst feeding, both on thistle and *Eupatorium*, the individuals kept their wings drawn down closely together, nor did we observe any of the usual movement of the hindwings so frequent in the species of this family. Carlier also observed it on *Eupatorium* flowers at Rochefort, in August, 1888. Lewin states that the insect loves best to fly over the tops of hedges, particularly over maple-trees, on which it delights to settle. Birchall observes that, in the south and west of Ireland, it is to be seen in August, frequenting the flowers of the bramble and settling the moment the sun is obscured, when it may readily be taken with the fingers; he observes it as being in profusion at flowers of bramble at Claring Park, in

Galway, and Dupont observes that it is particularly fond of, and rests commonly on, brambles in the forests round Pont de l'Arche. Newman says that it was always to be found resting on flowers on the outskirts of Birch Wood. Edelsten observes that the imagines fly high over oaks in Epping Forest, but come also to late bramble blossom; whilst one occasionally sees a female busy ovipositing on sloe bushes. The females are noted as visiting flowers of *Valeriana officinalis* at Pennin, in Pomerania (Spormann), and in Mecklenburg, at Blankenese, the males are said to be abundant on thistle flowers (Tessmann), whilst in Silesian Upper Lusatia the species is said to frequent *Solidago* flowers in gardens (Möschler), an observation repeated also for Saxon Upper Lusatia (Schütze), and in the Anhalt district it has been observed feasting on the flowers of thyme (Gillmer). Kretschmer notes it as having been observed, in gardens in Frankfurt-on-Oder, feasting on the fruit blown down by the wind. At Digne, in August, 1903, it was much attracted to the pods of a shrub that were covered with honeydew (Rowland-Brown). In Hungary, *R. betulae* usually flies around *Prunus domestica*, and visits especially the blooms of *Sambucus ebulus* (Aigner-Abafi). Seyffer notes that, of 100 imagines bred at Württemberg, over 90 were males. The species is of exceedingly retired habit, hiding amongst the leaves and branches of trees and flying but little, and, when pursued, the butterfly does not try to escape by flying rapidly away, but seeks a dark spot and comes to rest under the leaves of bushes, etc. (Rössler). It is to be observed also that the butterfly is very rarely seen on the wing compared with the abundance of the larvæ, a fact which seems to give colour to Rössler's suggestion that the butterfly chooses to hide in bushes and hedges beneath the leaves. It seems to prefer a solitary life, not seeking the society of its companions, and, when observed, is seen walking alone and sunning itself on the bushes (Glaser); it has also been observed sunning itself on the isolated blackthorn bushes, near the "Ziethe Busch," the butterfly walking on the leaves in sunshine, and one finds examples occasionally flying in the shade (Gillmer). As to its retired habits, Mathew observes that the perfect insect does not appear to show itself much on the wing; indeed, he adds, he has never once seen it, although he has beaten the larvæ in some numbers at the places named above, at Plymouth, Dartmouth, Lustleigh, etc., and Edmunds says that the species, in Trench Woods, rarely, if ever, flies unless the sun shines, and then only at intervals. Wood says that, in the Ashford district of Kent, even when the larvæ have been very abundant, only a few imagines have been observed; it prefers to keep to the woods, and, after its short flights, seems to choose oak-leaves upon which to rest, and adds that the few he has discovered, when working for lepidoptera by night, have always been at rest on the underside of oak-leaves. At Chemnitz, the butterfly loves to fly in orchards around plum- and pear-trees, settling suddenly from time to time, and then walking quickly on the upperside of the leaves (Pabst); Gillmer says, however, that its movements are at this time slow, and that has always been our impression, its walk being remarkably stately. Gebhard says (*Soc. Ent.*, xii., pp. 131-2) that, at Rathen, near Libau, it is a peculiarity of the butterfly to settle on withered leaves amongst the underwood and also on heath plants, both of which protect it on account of their colour. On the yellow withered leaves, amongst the underwood, he says, he has always observed them resting or walking with their wings closed, but, on the heath, they have always had their wings spread out. In Wales, it is recorded as being observed flying round the tops of trees, near Machynlleth, and Crotch states (*Zool.*, 1856, p. 5291) that, in August, 1856, he found the species excessively abundant throughout the Valley of the Dovey, in Montgomeryshire, where it had apparently departed from its usual habit, since, by far the greater number were captured on the tops of oak-trees, in company with *Bithys quercûs*, and, strange to say, the former were by far the more abundant. The following year he recorded (*Ent. Wk. Int.*, ii., p. 166) that, in North Wales (evidently not far removed from Shrewsbury), *R. betulae* commenced to appear on August 9th, 1857, the first appearances always consisting of males. This species, here, he says, usually accompanies, and fights furiously with, *B. quercûs* on the oak, but is rather more ready to settle, and thus falls an easier prey. A windy day drives them all to the lee of the wood, and then one is able to take them more freely, but wind certainly injures them more than rain, and fighting more than either. Burt also states (*in litt.*) that, in Pembrokeshire, the insect almost always rests on oak, from 15ft. to 20ft. from the ground, and is rarely to be seen down. Dollman states that, from July 26th to September 10th, 1900, between Burgess Hill and Hassocks Gate, he saw the species flitting over the bushes and trees by the plantations at the roadside. Spiller observed several examples in August, 1893, at rest upon blackthorn at Taunton; and Porritt says that he observed several females in September, 1902, flying about blackthorn bushes on the South Devon coast. In Germany, the habits of *R. betulae* have been little studied. It is noted as flying chiefly in gardens and orchards, and the outskirts of woods in Posen, Silesia, Brandenburg, Saxony, Mecklenburg, Hanover, etc., and Prideaux observed it flitting about on the outskirts of the woods at Wiesbaden. In Switzerland, Blachier says that it occurs even in the gardens of Geneva, flying about the fruit-trees. At Certosa di Pesio, Norris records (*Ent.*, xxv., p. 240) this species as flying over chestnut-trees, near the old castle of Chiusa, and having a strong predilection for certain trees, branches, and even leaves. Their flight, he says, is bold and rapid, and if by chance two met, they circled round each other up and out of sight. A pole quite twenty feet long fixed to the net, was necessary to take them. They appeared to fly chiefly from 9 a.m. to 11 a.m., and during the great noontide heat they were very inactive. Lambillion observes that, in Belgium, it loves to rest in the sun on the leaves of trees, on hedges, and on the flowers of waste places; it is, he says, not very wary, and one captures it easily. In England, in some years, it is much more abundant than in others, and the same fact is noted in some of its French localities, *e.g.*, Constant observes that in the dept. Saône-et-Loire it is usually very common, but not every year, for in some seasons it is almost altogether wanting.

Habitats.—The outskirts of woods, the clearings in woods, the rough overgrown hedges near woods, and the bush-covered slopes leading up to wooded heights where sloe grows abundantly, are the chief haunts of this species in south-eastern England. In Wales and Ireland, it rather affects lanes, but nowhere is it found as a common garden insect as in most parts of the continent, for, although essentially here restricted to blackthorn, on the continent it is equally addicted to plum, and to a less extent to apricot, as a foodplant, and so one finds it distributed throughout gardens and orchards, occurring sometimes in abundance. In its wilder haunts in central Europe, it appears to be not unusual to find it in the same localities as *Strymon pruni*, the larvæ feeding on the same bushes, but those of *Ruralis betulae* later than those of *S. pruni*, in fact, the larvæ of the latter are usually in their adult stadia when those of the former are quite tiny. The wilder situations, however, in which it is found are very varied, but it appears especially to love the lower alpine valleys, where the turbulent glacier streams rush through the wooded valley slopes, at a height not, perhaps, often exceeding 4500ft or 5000ft. Between Useigne and Vex in the Val d'Hérens, near the entrance to the Val d'Hérémence, where bushes of alder, sloe, birch, and oak slope down the valley side to the river, and the *Eupatorium* and thistle flowers are covered with *Dryas paphia*, *Argynnis adippe*, *A. niobe*, *Callimorpha hera*, etc., and between St. Niklaus and Zermatt, where similar slopes spread out into open and more level cultivated areas, where ash-trees are frequent, and blackthorn is found forming rude hedges, or scattered over the rocky slopes above—in both these places a fine large race of *R. betulae* occurs not at all uncommonly. At the foot of the Salève, near Geneva, a fine, overgrown, tangled wilderness of flowers climbs the stony slopes, amid bushes of blackthorn and birch, to the edge of the wood that runs up the sides of the mountain, whilst below, hedges, in which sloe is intermixed, run down to the orchards just beyond. This is another well-known haunt for this insect. Far down in the Basses-Alpes a sparkling stream forms the floor of a mountain glen, at the side of which birch and willow grow abundantly, whilst blackthorn and bramble climb the rock ledges above, and a wealth of wild flowers edges the sides, the stream being finally carried over the bed of the Eaux-Chaudes just above the Baths at Digne. This glen is another spot in which one can find *R. betulae* much at home in early August. A steep sloping path over the hot sunbaked black rocks of the Verdon Valley, leading up from Allos to the Lac d'Allos, leads out upon some cultivated fields that slope down to the torrent on one side, and are edged by the steep rocky sides of the slope, on which an abundance of barberry, dwarf blackthorn, and wild gooseberries have made their home, on the other, and where a few trees of wych elm are helped by blackthorn, bramble, and barberry to make thick, dense hedges that serve as a support to the road and a means of safety against falling rocks and stones. Here again *R. betulae* is at home, in a spot not, after all, so much unlike the rock-strewn level in the mountains between Bobbie and Au Pra, to which already reference has been made. These, at any rate, will give some idea of the various habitats in which we have found this species. Two hundred years ago the species was not uncommon in the woods that are now superseded by houses forming suburban London. In 1720, Albin records it as inhabiting the Hornsey Woods, where, in fact, it occurred more than 100 years later, when it was yet one of the then restricted bits of the old forest land that was still left on the outskirts of London, for Stephens noted that, in 1828, it was yet to be found there. Wherever these old forest remnants are still to be found, *R. betulae* still exists, *e.g.*, Darenth Wood, Epping Forest, etc. Stephens observes that it inhabited Birch Wood about the middle of August, Coombe and Darenth Woods being at the time its other best known haunts near

London, although Raydon Wood, near Ipswich, and certain woods in Berkshire, Dorsetshire, Devonshire, and Hants were then well-known habitats. Moses Harris, in 1775, and Lewin, in 1795, made it rather a hedge-loving species. Hedges and woods are still usually given as its chief haunts, *e.g.*, the woods and lanes about Sheldwich (Stowell), open places on the edges of woods in Berkshire (Hamm), hedges in the neighbourhood of Exeter, where the species is possibly kept rather scarce by clipping and trimming (Hellins), blackthorn hedges near Colchester and Langham (Harwood); lanes near Newtown, in Montgomeryshire (Tetley), abundant in the woodlands throughout the whole of the Dovey Valley (Crotch); in the Trench Woods of Worcestershire (Edmunds), in the plantations and woods on the Whitbarrow side of Underbarrow Moss (Gregson), etc. Now and again other kinds of localities are given. Arnold notes the sunny angle of a Dartmoor trout stream, on one side endless woods of beech and oak, and, on the other, the gorse and heather of great "tors" mounting up to the blue sky. Shut in thus from every wind, all the butterflies of the district seem to have accumulated here, and, among others, *R. betulae* were numerous on the oaksprays along the sunny hanger-sides; but *B. quercûs* were present in hundreds, dancing around the tall ash-bushes in half-dozens, the silver-grey of their underwings matching wonderfully, when at rest. the pale gloss of the leaves amongst which they lived. Mathew mentions the sloe-bushes, by the side of a rushy moor near Instow; on the Berwyns, it occurs on a hillside among birch (Sharp); whilst at Taunton, it is noted as a garden insect by Rawlinson. In Ireland, also, its haunts are much as in England, the species being very common in lanes and on roadside hedges in the south and west of the country (Birchall). In France, it is, in the lowlands, found in similar places to those in England, but it also extends for some distance into the mountains, *e.g.*, Digne and Allos, as already noted (*anteà*, p. 313). Constant observes that, in the dept. Saône-et-Loire, it is found principally by hedges and in bushy places; Dupont says that it occurs in the forest area of the Pont de l'Arche district; Gurney, in the forests of the Pas du Calais; in thickets and orchards of the dept. Doubs (Bruand), in Morbihan in woods and gardens (Griffith), in the Gironde about blackthorn hedges (Trimoulet), whilst in Meurthe-et-Moselle, as well as in Alsace, it is met principally on the outskirts of woods, by hedge-sides, and in gardens (Cantener). In the Basses-Alpes it loves rather rough ground, *e.g.*, the glen above the baths at Digne, the mountain-side at Allos (Tutt), also the rough ground at the top of the hill above the cemetery at Digne (Rowland-Brown); by roadsides, etc., in the Alpes-Maritimes (Bromilow); on rough ground among brambles and sloe-bushes throughout the whole chain of the Pyrenees (Rondou), etc. In Germany, it occurs on the outskirts of woods, by hedgerows and on bushy ground (Speyer); it prefers sunny hillsides in East and West Prussia (Speiser), and is especially abundant among the plum-trees on the bastion of Courbière, at Graudenz (Riesen); occurs freely among the sloe-bushes in the forest near Splietsdorf (Krüger); in Mecklenburg, prefers the outskirts of woods where blackthorn grows freely (Schmidt), but also occurs in gardens at Friedland (Stange), and in gardens and among sloe-bushes at Parchim, especially in the Eichbusch, and on the outskirts of the Sonnenberg (Gillmer); at Lübeck, too, it affects the outskirts of woods and "knicks," or overgrown hedges, as well as being found in gardens (Tessmann); in Hamburg and Schleswig-Holstein, it is pretty generally distributed, but is noted as being especially frequent on the shores of the river Elbe from Flottbeck to Blankenese (Zimmermann), and by overgrown hedges where blackthorn is abundant (Laplace); in Hanover, hedges and gardens are noted as its habitats (Glitz); in the Rhine Provinces also in gardens and bushy places, clearings in woods, and by hedgesides (Stollwerck); in Hesse, hedges and bushy ground are noted (Glaser), and the species is sometimes met with in great numbers on the outskirts of the "Hegwäldchen" and the "Stadtwald" (Koch); it is also very abundant in the Vogelsberg district (Glaser); in Waldeck, hedges, wood-clearings and gardens are particularly noted (Speyer), and, in Thuringia, it prefers orchards and hedges of sloe (Krieghoff); in the Province of Saxony, it occurs on the northern slope of the Steigerwald, also in gardens at Zeitz (Wilde), Halle (Stange), and Dessau (Richter); in the Mosigkauer Haide, it particularly chooses the northern outskirts (Amelang), whilst, at Cöthen, it occurs in gardens and plum-orchards, but is more frequent on the sloe-bushes of the "Ziethe Busch," and the forests of Klein-Zerbst, Diebzig, etc. (Gillmer); it occurs on the whole of the north-eastern slopes of the Hartz (Reinecke); in Brandenburg, at Frankfurt-on-the-Oder, it is found in gardens (Kretschmer), in Posen, in orchards (Schultz), also in orchards and by hedgesides throughout Silesia (Wocke), being particularly common in Upper Lusatia (Möschler); in the Kingdom of Saxony, it frequents sunny places in the neighbourhood of blackthorn bushes and plum orchards (Steinert), Pabst specially noting that, in the Chemnitz district, it does not occur among birches. In Baden it is found throughout the low country, from the valley of the Rhine to well above the lower mountains, but not reaching the higher levels (Meess and Spuler). In Austria it appears to be generally distributed, being common in forests, woods, and gardens in Bohemia, whilst in Upper Austria it is particularly noted as frequenting gardens, even in the midst of towns, *e.g.*, Linz (Himsl); in Lower Austria, gardens and their immediate vicinity are specially mentioned (Rogenhofer); in Salzburg, orchards, hedges, bush-covered ground, and the outskirts of woods in the lowest region, *i.e.*, not extending into the mountains (Richter); in the mountain districts of the Tyrol, it goes up to 6000 feet and is not rare (Weiler), and seems to be somewhat similarly distributed in Styria (Höfner). In Hungary, it occurs in the mountains above Budapest (Fountaine). In Roumania it is found among bushes and undergrowth in woods, as well as in fruit gardens (Caradja). In the Baltic Provinces, Nolcken says that it lives in open woods and among deciduous trees, on the borders of woods, and also in gardens, but always occurs singly and is rare. Gebhard notes (*Soc. Ent.*, xii., pp. 131-2): "In the neighbourhood of Libau, the species used to be very common, and was so until a few years ago, but of late has become rarer, probably on account of the clearing of the underwood. I have caught, in a small grove near the town of Rathen, as many as twenty males and females in a day, but now only get single examples; in other districts, however, there seems to be no diminution in numbers," and Eversmann says that it flies in woods and orchards in the northern provinces of Orenburg, Casan, etc., to the Lower Volga and Sarepta. In Switzerland, Favre says that it is not rare in the region of deciduous trees, and one finds it at least up to almost 5000 feet elevation in the sheltered valleys, *e.g.*, the Visp Thal, etc. (Tutt), and near the village "im Grund," below the refuge (Anderegg). It is found in the gardens of Geneva (Blachier), on the wooded slopes of the Grand Salève (Tutt), and on the banks of the Arve (Muschamp), on sloe and bramble hedges about Gruyères (Rowland-Brown), and on the slopes of Pilatus, between Hergiswyl and the summit (Keynes). In Belgium, it is common throughout in gardens and woods (Dubois), but, whilst generally distributed, is more frequently met with in limestone districts (Lambillion). The recorded Italian localities are few; in Piedmont, the bush-covered flats in the Pellice Valley, between Bobbie and Au Pra (Tutt), and the outskirts of the chestnut woods of the Certosa district (Norris); it is found by hedges, and on the outskirts of woods in Liguria (Curò), and on the hill of Fegliné, near Florence (Stefanelli). [The record of a single example in the spring, in a hollow at Scaricalasino, on a bush of birch (Spada), is more than doubtful.]

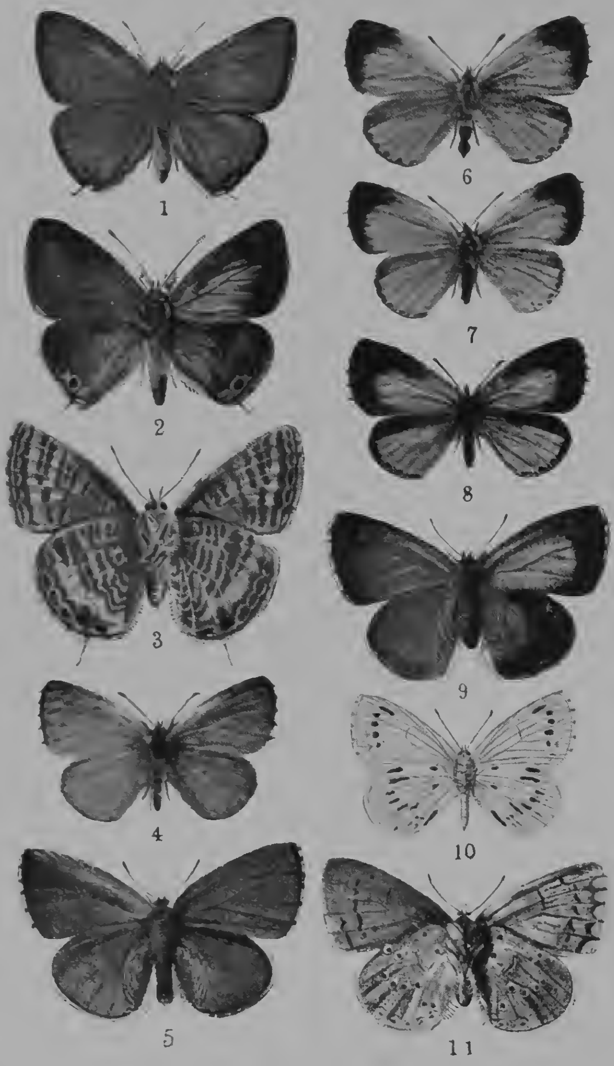
British localities.—Widely distributed (and possibly much overlooked), extending from Kent to Lincoln on the east, Kent to Cornwall on the south, Cornwall to Dumfries on the west, and from Lincoln to Dumfries on the north. In Ireland, it occurs from Wexford to Kerry, from Kerry to Galway, with practically no record of its distribution elsewhere, except that Kane says it is abundant in certain localities in Munster. It appears, however, not to be distributed in Scotland, Dumfries being the only county from which it is recorded. Beds: near Woburn (Studman). Berks: local—Burghfield, near Reading (Bird), Bradfield (Joy), Reading district, Bagley Wood (Hamm), Boar's Hill (Geldart), Wallingford (Fenn). Bucks: very local—near Claydon (Crewe). Marlow (A. H. Clarke), near High Wycombe (Peachell). [Cambridge: generally distributed—Cambridge, etc. (Brown).] Carmarthen: local—Oaklands (Barker), Kidwelly (Tytherleige), Llanstephan (Bingham-Newland), near Llandovery (Andrews). Carnarvon: Trefriew (Gardner). Cork: Blarney, near Cork (Mathew). Cornwall: Boscastle (Kaye), Millook (Allen), Poundstock (Peter), Bude, Kilkhampton, Trebartha, the valley of the Lynher (Clark). Cumberland: Barron Wood, near Carlisle, once (Hodgkinson). Denbigh: Berwyn Mountains (Sharp), near Chirk (Alderson). Devon: locally abundant—Exeter (Hellins), Bickleigh Vale, near the Cider House, Bickleigh Bridge, Shough Bridge, Horrabridge, Dewerstone (Bignell), Whitman's Wood, near Princetown, Moreton Hampstead, Tavy Vale, near Virtuous Lady Mine, Cann Wood Meadows, Plymbridge, Axminster (Reading), Sidmouth (Wells), Plymouth (Gatcombe), Honiton district (Riding), Instow, Totnes, Dartmouth, Buckfastleigh, Lustleigh, Cleave, near Plymouth (Mathew), Teignmouth district (Rogers), Torquay district (Crocker), Silverton (Ward), Torrington (Doidge), Paignton district (Goodale), Dartmoor (Arnold), Dawlish (V.C.H.). Dorset: Glanville's Wootton, Middlemarsh Wood (Dale), Sherborne (Somerset), Blandford (Stainton). Dumfries: near Dumfries (Lennon). Essex: locally abundant—Epping Forest, High Beech, Loughton (Argent), Chingford (Lane), Fairmead Bottom (Quail), near Colchester, Langham (Harwood), Witham Burnell), Bulmer, Lamarsh (Gaze), Mundon Furze, Hazeleigh Wood (Raynor). Galway: Claring Bridge, Oranmore (Birchall). Glamorgan: scarce (Evan John), nr. Cardiff (Drane). Gloucestershire: scarce—near Gloucester (Merrin), Dursley (Raynor). Hants: locally common—Basingstoke, Chineham, sometimes common (Hamm), Andover (Stephens), New Forest—near Brockenhurst (Corbin). Ringwood (Fowler), Lyndhurst (Lockyer), Kimpton—near Andover (Dale), Petersfield (Robinson, erroneously recorded as *Strymon pruni*, *Ent.*, x., p. 303), Liss, Thruxton (Hamm), Netley Abbey district (Swinton). Winchester (Stainton), Woolmer Forest, Forest of Bere (Hawker), Isle of Wight—Ryde, rare (Bond), Whippingham (Pristo), Freshwater (Grant). Hertford: Norton Green Woods, about a mile south-west of Stevenage (Matthews). Hunts: locally abundant—Monk's Wood (Raynor), Coppingford Wood (Cox), St. Ives' district (Norris). Kent: local—Darenth Wood (A. H.

Jones), Birch Wood (Curtis), Collier's Wood, Greenhithe (Stevens), Chattenden Woods (Tutt), Ashford (Wood), Sissinghurst (Bowell), Knock Wood, near Tenterden (Beale), Sheldwich (Stowell), Eastry (Hammond), Canterbury (*teste* Freke), Herne Bay (Butler), Margate district (Barrett). Kerry: Killarney (Birchall). Lancs: Newton-in-Cartmel (Mason, *E. W. I.*, iv., p. 194), Grange common (Mason, *teste* Gregson, *E. W. I.*, vii., p. 54), Silverdale (Murton), near Carnforth (Murray), Arnside (Hodgkinson). Lincoln: local—Newball, common, Langworth (Raynor), near Lincoln (Allis), Market Rasen (Lewington). [Middlesex: Hornsey, formerly (Stephens).] Monmouth: Pontnewydd (Conway). Montgomery: near Newtown (Tetley), Llwyngwern, Machynlleth (Alington). Norfolk: Sall (Marsh). Northampton: locally abundant—Ashton Wold (Rothschild), near Oundle (Bower), Peterborough (Stainton), Barnwell Wold (Dixon), near Towcester (Clark), Whittlebury Forest (Foddy). Oxford: Shotover (Geldart). Pembroke: Pembroke, once (Puckridge), Coedcanias, near Begelly, not uncommon (Burt). Shropshire: Wyre Forest, near Shrewsbury (Newnham). Somerset: local—near Bath (Terry), Taunton—Orchard Woods, Neroche Forest (Tetley), Brockley Coombe (Harvey), Yatton (Button). Staffs: Cannock Chase, Rugeley (Freer). Suffolk: very local—Saxham (Wratislaw), Ipswich (Berners), Raydon Wood, near Ipswich (Stephens), Dodnash Wood, Bentley (Harwood), Assington Thickets, Sennage Wood, near Lavenham, Haverhill (Gaze). Surrey: local—Coombe Wood, near Guildford (Stephens), Ashtead (T. B. Fletcher), Cobham (Waldegrave), Reigate district (Tonge), Dorking (S. Webb), between Redhill and Nutfield, Ashtead, Woods, near Epsom (Briggs). Sussex: local—Brighton district (Stainton), Newick (Jenner), Poynings Wood (Buckler), woods near Henfield (Draper), Charlton Forest (Edgell), East Marden (Christy), Holmbush (Image), Eartham (W. H. B. Fletcher), Horsham, Partridge Green, Slinfold (Goss). Warwick: Wolford, once (Wheeler). Westmorland: Kendal district (Moss), Witherslack (Hodgkinson), Underbarrow Moss, the woods on the Whitbarrow Side (Gregson, *E. W. I.*, vii., p. 55). Wexford: Kellaghoum Wood, Enniscorthy (Moffat). Wilts: Marlborough, Great Bedwyn, West Woods (Preston). Worcester: local—near Worcester, Trench Woods (Edmunds), Cowleigh, Wyre Forest (Edwards).

Distribution.—Central and northern Europe (excluding the polar regions), southern Russia, Armenia, Changai mountains, Mongolia, Amur and Ussuri districts (Staudinger and Rebel). The district extends as far north as Lapland, 66° N. lat. (Zetterstedt), as far east as Korea, 130° E. long., as far west as Clare, 10° W. long., as far south as Florence, Bulgaria, Bosnia, Transcaucasia, all between 41° N. lat. and 43° N. lat., whilst in Asia and western China it reaches 39° N. lat.* [Africa: Algeria (Mus. Paris *teste* Koch).] Asia: Korea, Altai mountains (Fixsen), east and west Siberia (Romanoff); Amurland—Chabarofka (Graeser), Sutschan district (Dorries), mouth of the Ussuri (Bremer), Ongodai district (Elwes), Lake Teletskoi (Mus. St. Petersburg *teste* Elwes); southwest China (Leech)—Moupin (Kricheldorff), Ichang Gorge (Pratt), south-western Altai (Kindermann, Ruckbeil, etc.), Thian-Shan mountains, Kouldja district and neighbouring mountains—Kounguesse, etc. (Alphéraky), the Ala Tau and Tarbagatai mountains (Haberhauer). Austro-Hungary: throughout, nowhere rare—Bohemia common—Karlsbad, Ewiges Leben, Schupfenwiese, Stadtgut, Veitsberg (Hüttner), Prague, Senftenberg (Fritsch); Moravia—Brünn, frequent (Schneider), Neutitschein, Rottalowitz (Fritsch); Upper Austria—near Linz, Steyer, Wels, etc. (Himsl); Lower Austria—Vienna, not rare (Rossi), above the Wiener Wald (Schleicher), Hernstein (Rogenhofer), Gresten (Fritsch); Mödling (Fountaine), Salzburg, nearly everywhere—Salzburg, etc. (Richter); Tyrol—in the valleys and up to 6000ft., not rare—Taufers Valley (Weiler), Wilten (Fritsch); Styria—Lavantthal, not rare, Friesach, Bleiberg district, Möllthal (Höfner), Admont (Fritsch); Dalmatia (Mann); Hungary—Budapest, Budafok, Nagyvárad, Peér, Eger, Pécs, Felsölövö, Sopron, Pozsony, Selmeczbánya, Szliács, Gács, Verebély, Tavarnok, Rozsnyó, Pelsöcz, Zsolna, Kocsócz, Gölniczbánya, Igló, Eperjes, Máramarosmegye, Kolozsvār, Elöpatak, Fogaras, Nagyszeben, Mehadia, Bálincz, Vinkovcze, Lipik, Zágráb, Buccari (Aigner-Abafi). Belgium: widely distributed—Namur, Arquet, Beez, Dave (Lambillion), Waulsort (Corbeau), Dinant, Yvoir, Warnant (Osodart), Assesse, Ciney (Castin), Vecquée,

* Speyer notes Algeria (*teste* Koch, an example in the Paris Museum coll.), but this appears doubtful. The Sicilian record by Spada carries error on the face of it, the example being captured in the spring!

Marlagne (Derenne), Hastières (Bertrand), Ardennes, Ortho, common (Slégers), Virton, Florennes (Cabeau), Rochefort (Carlier), Eifel district (Bethune-Baker). Bosnia and Hercegovina: local and rare—near Fojnica (Simonys), Kosevo near Sarajevo, Rjeto Bosna (Rebel), Velez (Hilf-Leonhard). Bulgaria and East Roumelia: very rare—near Sophia (Bachmetjew), Slivno (Pigulew). Denmark (Bang-Haas). Finland: Aland, Abö—Lojo, Merimasku, St. Karins, Nyland, Satakunta—Karkku, Birkkala, South Tavastia—Kangasala, Sysmä, Hauho, South Savonia—St. Michel, Karelia—Jaakkima (Federley). France: generally distributed, up to 5000ft. in the Basses-Alpes—Aisne—Wood of Urvillers, St. Quentin (Dubus); Alpes-Maritimes—Vallon Obscur, Nice, St. Martin-Vésubie, Val de Madone (Bromilow); Aube—les Riceys, Lusigny, Ervy (Jourdheuille); Basses-Alpes—Allos (Tutt), Digne (Rowland-Brown); Brittany—throughout (Griffith), Val André (Turner); Charente-Inférieure—Royan (Salis); Cher—St. Florent, Sologne (Sand); Creuse—Guéret (Sand); Calvados—Wood of Moult, Emieville, very rare (Moutiers); Sallenelles, Tilly, Balleray, etc. (Fauvel); Doubs (Bruand); Dordogne—rather rare—Bergerac (Tarel); Eure—Pont de l'Arche (Dupont); Eure-et-Loir (Guenée); Gironde—environs of Bordeaux, rather common (R. Brown); Bouliac, Florac, Farques, etc. (Trimoulet); Haute-Garonne—very rare (Caradja); Haute-Marne—Canton de Varennes—rather common, still more so at Praslay (Frionnet); Indre—Brenne (Martin), common at Nohant (Sand); Isère—Uriage (Reverdin); Jura—Arlay (Bentall); Loir-Inférieure—common at Nantes (Deherman-Roy); Maine-et-Loire—rather rare (Delahaye); Marne—Rheims, Epernay, rather common (Demaison); Meurthe-et-Moselle—Nancy, Wood of Vandœuvre, near Malzeville (Cantener); Morbihan—Vannes, Ploërmel (Griffith); Nord—Forest of Raismes, Château-d'Aremberg, Wood of Verlinghem, very rare (Paux); Pas-de-Calais—Boulogne-sur-Mer (Timins), forests of Leek, Guînes, and Boulogne (Gurney); Puy de Dôme—Auvergne district (Sand); Pyrénées-Orientales—Le Vernet, one example (Elwes); Pyrénées—throughout the chain (Rondou); Saône-et-Loire—generally (André); Sarthe (Desportes); Savoie—Brides-les-Bains (Reverdin); Seine-et-Oise—Senart, Montmorency, Lardy (H. Brown); Seine-Inférieure—Forest of Roumaire (Viret); Somme—Amiens (Rühl). Germany: everywhere on the plains, almost nowhere rare—east and west Prussia—Cranz, Dammhof, Königsberg, Insterburg, Rastenburg, Braunsberg, Mohrungen, Allenstein, Rominten, Willenburg, Thorn, Kulm, Graudenz, Marienwerder, Marienburg, Elbing, Danzig (Speiser); Pomerania, not rare—Greifswald, Strelow (Paul and Plötz), Stralsund, Pennin, Divitz near Barth (Spormann), Andershof (Tetschke), near Splietsdorf (Krüger); Mecklenburg, throughout, but not abundant—Neustrelitz, Bülow, Sülze, Wismar (Schmidt), Friedland (Stange), Schwerin, Waren, not rare, Parchim, in the Eichbusch, etc. (Gillmer), Lübeck, Blankenese (Tessmann), Eutin (Dahl); Hamburg, Schleswig-Holstein, common locally—Hamburg (Tessien), Niendorf, Borstel, Wohldorf, Flottbeck to Blankenese (Zimmermann), Bahrenfeld, Wellingsbüttel, Wandsbeck, Boberg, etc. (Laplace); Hanover—Lüneburg, not rare (Machleidt and Steinvorth), Bremen, frequent (Rehberg), Hanover, not rare (Glitz), Hildesheim on the Galgenberge (Grote); Osnabrück (Jammerath); Rhine Provinces, distributed but not common—Crefeld, Uerdingen, rare (Stollwerck), Nenenahr (Maassen), Elberfeld, Barmen (Weymer), Mündelheimer Damm, Linner Wiesen (Rothke); Hesse—Biedenkopf (Jäger), Oberursel (Fuchs), Hanau (Limpert and Röttelberg), Selters, singly (Schenck), the "Hegwäldchen" and the "Stadtwald," the Taunus, Homburg, Wiesbaden, Upper Hesse, throughout, Cassel (Koch), the Vogelsberg near Grünberg, abundant, rarer in the Hinterland near Giessen, Friedberg, Darmstadt, Frankfurt (Glaser); Waldeck not rare (Speyer); Thuringia throughout, not rare (Krieghoff)—Gera (*Ent. Ver. Gera*); Province of Saxony—Erfurt (Keferstein and Werneburg), the Steigerwald (*Ent. Ver. Erfurt*), Zeitz (Wilde), Halle, not frequent (Stange), Dessau (Richter), Mosigkauer Haide (Amelang), Cöthen, the "Ziethe Busch," forests of Klein-Zerbst, Diebzig, near Aken (Gillmer); Brunswick and Hartz—Brunswick not rare (Heinemann), Ballenstedt (Ahrens), Wernigerode, frequent, the Salzberg district (Fischer), Göttingen abundant (Jordan); Brandenburg, not rare—Berlin, Jungfernheide, Finkenkrug, Potsdam, Gross-Lichterfelde, Britz, Rüdersdorf Kalkberge (Bartel and Herz), Frankfurt-on-Oder (Kretschmer); Posen, rare—Solacz, Posen, Schroda (Schultz); Silesia, everywhere, not rare—Trebnitz mountains (Nohr), Upper Lusatia (Möschler), Sprottau near Wichelsdorf, Altkirch rare, Oberleschen (Pfitzner); Kingdom of Saxony, frequent—Freiberg, Upper Lusatia, throughout (Fritzsche), Chemnitz (Pabst), Leipzig, Lausigk, Leisnig, Geithain, Rosswein, Hainichen, Saubachthal, abundant, Lössnitz, Meissen, Dippoldiswalde not



Lampides bœticus and Celastrina argiolus.

The Natural History of British Butterflies, etc., 1907.

Plate XVIII.

(To be bound facing Plate XVIII.)

Lampides bœticus and Celastrina argiolus.

Fig. 1.—*Lampides boeticus* ♂.
Fig. 2.— ,, ,, ♀.
Fig. 3.— ,, ,, , underside.
Fig. 4.—*Celastrina argiolus* ♂ ab. *lilacina*.
Fig. 5.— ,, ,, ab. *major*.
Fig. 6.— ,, ,, ♀ spring form *clara*.
Fig. 7.— ,, ,, ♀ ,, ,, *lilacina*.
Fig. 8.— ,, ,, ♀ summer form *lilacina-lata*.
Fig. 9.— ,, ,, ♀ ab. *major*, summer form.
Fig. 10.— ,, ,, ab. *subtusradiata*, Obth.
Fig. 11.— ,, ,, ♀ ab. *major*, underside.

frequent, Crimmitzschau, Zwickau, Wolkenstein, Grünhainichen, Werdau, rare, Plauen, not frequent, Schneeberg, abundant (Winckler), Leipzig, not rare (*Ver. Faun. Leipzig*), Görlitz (Marschner); Bavaria—Regensburg (Hofmann and Herrich-Schäffer), Munich, frequent (Kranz), Augsburg (Freyer), Kempten (v.Kolb); Württemberg, throughout—Stuttgart, Tübingen, Reutlingen (Seyffer); Baden, almost everywhere, but not frequent—Karlsruhe, the Turmberg (Gauckler); from the Rhine Valley to midway up the mountains (Meess and Spuler); the Palatinate (Bertram); Alsace—Colmar, the outskirts of the Semmwald, Ste. Marie-aux-Mines, Vallée de Ste. Marie, Strasburg, Isle du Rhin, gardens of the Robertsau, Metz, the forest of Voipy, Lorry, Sarreguemines, the forest of Buckholz (Cantener). Greece: Attica (Merlin coll.). Italy: Liguria (Curò); Piedmont—Certosa di Pesio (Norris), near Bobbie (Tutt); Tuscany—Florence, hill of Figliné, Valdarno (Stefanelli), Collanzi (Verity); Lombardy (Turati); Emilia—Modena, rare (Caruccio); [Sicily—Scaricalasino, near Osimo (Spada), wants confirmation !]. Netherlands: Friesland, Gröningen, Overijssel, Gelderland, Limburg (Snellen). Roumania: Grumazesti, Costischa, Veatra, Jassy (Caradja), Dulcesti, Valeni, Valesaca (Hormuzaki). Russia: Baltic Provinces—throughout Kurland, where it is commoner than in Livland—Lechts, Pichtendahl, Riga, Kokenhusen (Nolcken), Rathen, near Libau (Gebhard), St. Petersburg district (*teste* Speyer); Viatka govt., rare—Sarapoul, Elabouga, Malmisch, Ourjoum; Vologda district—Eisenbahnstation, Kotlas (Kroulikowsky); Ural district—from the northern provinces of Orenburg, Casan, Simbirsk, and Saratov, to the Lower Volga district and Sarepta (Eversmann); Ekaterinoslav govt., northern part (Nordmann); Transcaucasia—Borjom (Romanoff), Elisabethpol (Lederer). Scandinavia: Lapland, very rare (Zetterstedt); up to 62°N. lat. (Aurivillius)—Norway, south and west, locally—near Christiania, common, some years, on the St. Hanshungen; Fredrikshald, Odalen, Risör, Naes-Vaerk, Parsgrund, Sarpsborg (Siebke), Smaalene, Akershus, Hedemarken, Baskerud, Bratsberg, Jarlsberg, Laurvik, Nedenaes (58° 38′-60° 18′N. lat.) (Schöyen); Sweden—Skania to Helsingland (Lampa), Stockholm, Upsala (Wallengren). Switzerland: somewhat common on the lowlands, but rarely reaching any great height (Frey), the highest points noted being Tarasp, common, 4000ft. (Killias), Tessin—Monte Generoso, 5199ft. (Jenner), Bergün, at 4500ft. (Zeller), Tasch, about 4700ft. (Tutt), etc.—the Valais, not rare in the region of deciduous trees—Martigny, Mt. Chemin, Folleterres de Fully, Lens, Sierre, Loèche, etc. (Favre), Glion above Montreux, Brigue (Prideaux), Montreux (Murray), near Aigle, between Veytaux and the Veraye Gorge, Charpigny, Villeneuve (Wheeler); Val d'Anniviers—Fang (Wheeler); Val d'Hérens—between Useigne and Vex; Visp Thal—between St. Niklaus and Tasch (Tutt); Geneva district (Blachier)—foot of Grand Salève (Tutt), banks of the Arve (Muschamp); Gruyères (Rowland-Brown); Lucerne district (Sanford)—between Hergiswyl and the summit of Pilatus (Keynes); Neuhausen, Uetliberg, Alveneu (Lemann), Thusis (Fountaine).

Subfamily: Lycæninæ.

The Lycænids, or "blues," form one of the most beautiful groups of butterflies known, and their habits are as interesting as their tints are beautiful. The subfamily is named after Leach's group name *Lycaenida*, an equivalent of the earlier Fabrician *Lycaena*. The species are particularly fond of flowers, and their quick bustling flight, pugnacious habits, and frequent abundance, attract attention. They are slender in build, with slight bodies and prominent outstanding antennæ, usually presenting marked sexual differences in coloration, whilst the undersides of both sexes are characterised by beautiful transverse series of ocellated spots, giving rise to Borkhausen's name of *Polyophthalmi*, and Latreille's name of *Polyommati*. These spots are sometimes modified into delicate pencillings, or slender streaks, either as a permanent pattern, or as occasional rare aberrations, although, in the former case, *e.g.*, *Lampides boeticus*, the pencillings are transverse, and, in the latter case, the lines are longitudinal, in direction. On the margins of the underside of the wings there is usually a series of orange marginal lunules, occasionally, on the hindwings, provided with scintillating metallic centres. The hindwings are comparatively rarely tailed, although very many species, including those of the genus *Everes*, found in the north temperate zones of both hemispheres, and the widely distributed *Lampides*, are thus provided. The subfamily is particularly characterised by the remarkable androconia, or "battledore scales," distributed over the upperside of the wings of the males, and not collected into special patches as in the *Ruralidi*. It is asserted that the dark species—*Aricia*, etc.—possess no androconia, but one suspects that they may be present, though not discernible, against the dark ordinary wing-scales. Speyer has noted (*Isis*, 1843, pp. 175-176) that the fore and middle tibiæ of many European Lycænids bear, at the top, above, a horny bristle of variable length, extending over the basal tarsal joint, its presence or absence sometimes being remarkable in closely allied species, *e.g.*, *bellargus* and *corydon*. Scudder asserts that this tibial bristle is never present in the Chrysophanids or Theclids.

In 1868, Watson published* (*Mem. Lit. Phil. Soc. Manch.*, 3rd series, iii., pp. 128 *et seq.*) some notes on the "plumules," or so-called "battledore scales," of the Lycænids. These are androconia, or male scent-scales, and they vary much in their development in different species, but must be examined in freshly-emerged examples if any real knowledge of their character is required. As is well known, the males of many of the Lycænids are blue in colour, and in these they are usually easily discovered; in those with brown males the androconia have not been discovered. Watson observes that these plumules are attached to the wings by an apparently hollow peduncle. They are he says, balloon-shaped, have striæ-like ribs, suitable for binding, strengthening, and distending or contracting their balloon-like forms; these ribs, he adds, are more or less beaded or articulated, so that, by them, different scales are bound or bent in various ways. The end opposite to that of insertion is closed, or covered with apparently ciliary apparatus, and they lie in rows between and under the ordinary scales, which may, therefore, be elevated or depressed at the pleasure of the insects, by the regulated inflation of the plumules. They differ in separate species in every

* Watson observes (*op. cit.*, pp. 261-262): "The best way of collecting and mounting is by gently pressing the wing of the insect against a glass slide, by which means a sufficient quantity of the scales will adhere. To get a clean mounting, it is necessary to brush off the dirt which may be on the wing with a camel-hair pencil, but then care must be taken that the pencil does not convey scales to slides of other species. In fact, suspicious care must be used when mounting a number of slides, as the light scales will often be floating in the air, and alight unexpectedly on the slide which is under operation. Then cover with a thin glass and fix with paper. In some small insects it is more convenient to take off the scales, in the first instance, on the thin cover, and then to affix it to the slide. The plumules are mostly of so delicate a membranous structure, and so deficient in pigment, as to become too transparent (and sometimes almost invisible) in *Canada balsam*, but it may be used with good effect where they carry some amount of pigment, and the structure of those of the Lycænids is thereby beautifully shown, although these are amongst the most hyaline. In some genera and species they are so small, and so finely striated, as to make an ⅛-inch object-glass desirable to resolve them satisfactorily, or at least a ¼-inch, with a B or C eye-piece, while a ½-inch is sufficient for others. The striæ particularly should be observed with high powers. Occasionally, scales of different species appear identical under a low power, but a higher one reveals a complete difference of structure. The plumules are generally to be found on the upper surfaces of the wings, sometimes they are most abundant on the primaries, sometimes on the secondaries, usually in, or near, the discoidal cells of both wings, but are, occasionally, very strangely placed."

conceivable way—in form, in the number and articulation of the ribs, in transparency, in size, and in the length and shape of the peduncle; among them are found some very anomalous forms, *e.g.*, that of *Lampides boeticus*. In some examples of the same species they are much more abundant than in others; whilst in some species they are plentiful, and in others scarce, and in some are only to be discovered with difficulty. Mr. Sidebotham illustrated this article with a number of excellent drawings (*op. cit.*, pl. i., figs. 1-29; pl. ii., figs. 30-41; pl. iii., figs. 42-53) which must be studied in order to understand their connection. The directions, in which Watson considers that the plumules give clear scientific indications, are:

1. The plumules are always identical in different individuals of the same species, and, therefore, mere geographical or other varieties may be detected by this test.

2. In species nearly allied, so closely as to make them difficult of distinction, these scales will be often found very different, forming very certain and unquestionable divisions; while, on the other hand, species of easy separation in other physiological peculiarities have sometimes very identical plumules.

In 1880, Aurivillius published (*Bidr. Svensk. Vet. Akad. Handlin.*, v., pp. 22-26, pl. ii and iii) descriptions and figures of the androconia of many Palæarctic species of "blues," and added a table giving the measurements of those of many species. He states that Deschamps first discovered and figured these androconia, which are a trifle longer than broad, almost square, with complete straight-edged sides, and a faint convex apex. He states that, in an undamaged wing, one notices, under the microscope, the bases of the androconia passing through the rows of the large wing-scales, being pale, unpigmented, and transparent, the scales being arranged so as to form distinct rows in the interspaces, but nearer the outer edge than centre of the interspace. There are also found, in the discal cell of the males of some species, long hair-like scales, with a broad open base absent in the females. The table he gives reads as follows:

Species.	Androconia.			Hair-scales.
	Length without stem.	Width.	Number of rows.	
Celastrina argiolus ...	0·072mm	0·05mm.	13	wanting
Cyaniris semiargus ...	0·054mm.	0 03mm.	8	,,
Cupido minima... ...	0·054mm.	0·04mm.	12	,,
Nomiades cyllarus ...	0·05mm.	0·045mm.	9-10	,,
Lycaena alcon	0·072mm.	0·05mm.	14-15	,,
L. arion	0·05mm.	0·027mm.	10-12	,,
Polyommatus pheretes...	0·054mm.	0·045mm.	14	numerous
P. amandus	0·045mm.	0·015mm.	8-9	,,
P. escheri	0·068mm.	0·021mm.	7-8	,,
P. icarus	0·054mm.	0·021mm.	5-6	,,
Agriades bellargus ...	0·054mm.	0·027mm.	8	,,
A. donzelii	0·07mm.	0·04mm.	17-19	wanting
A. aquilo	0·063mm.	0·045mm.	16-17	,,
Plebeius optilete ...	0·048mm.	0 04mm.	11-12	,,
P. aegon (*argus*) ...	0·054mm.	0·023mm.	8-9	,,
P. argus (*argyrognomon*)	0·054mm.	0·045mm.	10-11	numerous

Besides these characteristic androconia, there is usually considerable sexual diversity in the colour of the species, most of the males being of a bright blue tint on the upperside, the females brown or black, with a more or less complete marginal band of orange spots, although in some cases, *e.g.*, the typical genus *Lycaena* (*arion*, etc.), the ground colour of both sexes may be blue, the sexual difference being found in the spotting, etc., whilst in *Aricia* (*astrarche*, etc.) both sexes are brownish-black.

We have already, in the preceding volume (p. 317), given Scudder's comparison of the eggs of the "blues" with those of the "coppers" and "hairstreaks." The eggs are somewhat depressed, echinoid in shape, the cells with remarkably well-developed, strongly-projecting walls, joined by fine lines at the pillars of the angular points, these pillars being sometimes highly-developed, and helping to form an ornamentation of great beauty. The central depression varies considerably, but the gradual increase in the size of the cells, passing from the micropyle outwards, is very noticeable (see preceding vol., pl. iv., figs. 3-6). Comparison with the Chrysophanid egg (*op. cit.*, pl. iii., figs. 3-6) will show that the cells of the latter are much larger, coarser, and have an appearance quite *sui generis*. Chapman, however, notes (*in litt.*): "I am not at all sure that the eggs of Lycænids, Theclids, and Chrysophanids can be distinguished from each other either actually or by definition. It is not, however, difficult to note distinctions in the groups if we regard only the British species. All of them are notable as having a special adventitious coat outside the egg proper, a coat that is absent only over the micropylar rosette, but may be reduced to a very slight structure, as over the dome of *Edwardsia w-album*. This coating, either on its own account or following lines on the true egg beneath, has a netted structure, with meshes square or hexagonal, but more usually triangular, and often with knobs, pillars, or other projections at the intersections. As a summary one may note :

Chrysophanids.—Egg dome- or bun-shaped, meshes of network large and bold. (*Rumicia phlaeas*, *Heodes virgaureae*, and others are similar, have the pits of the network of spherical surface cutting each other in sharp margins and angles, hardly, therefore, submitting to the generalised description of a network of lines.)

Theclids.—Egg domed or bun-shaped, network of typical angular pattern, very thick (*Ruralis betulae*) or nearly wanting (top of *Edwardsia w-album*), projections at intersections tend to be hair-like rather than knobbed (*Callophrys rubi*, *Bithys quercûs*, *Edwardsia w-album*). (Several Theclid eggs figured by Scudder are like those of Lycænids. The differences in Scudder's table of eggs of the three groups seem no more inclusive and exclusive than those I note above.)

Lycænids.—Egg with flat top and bottom and rounded sides (cheese-shaped), adventitious coat always white (it is notably white also in some Theclids and Chrysophanids). Meshes smaller and coat thinner, in very regular gradation on the upper flat surface from margin to centre, where the micropylar depression and rosette are always distinct, but never either in a deep hole (*Ruralis betulae*) or on the level (*Edwardsia w-album*)."

The larvæ are particularly typical of those representing the so-called onisciform type, and are remarkable for the special development of the evaginable glands and caruncles on the 7th and 8th abdominal segments respectively, the former of which secrete the sweet fluid beloved of ants, which become their companions (see vol. i., pp. 30-37). They have a remarkably developed neck, particularly useful in those larvæ that bore a hole through the epidermis of the leaf, and then feed on the soft tissue around it for some distance, and also in the flower- and seed-eating species, where a good stretch is absolutely necesary to get at their food. The larvæ crawl slowly, and are somewhat slug-like in their motions; they appear to rely mostly for their protection on the similarity of their colours to their surroundings, those of many species responding most remarkably to their environment. Of the larva, Chapman writes (*in litt.*): "In the newly-hatched larva, my material is inadequate to distinguish many decided differences from those of Theclids and Chrysophanids; Scudder's table (see preceding volume, p. 317) is certainly quite erroneous. The 7th and 8th abdominal segments are equally distinct in all the groups from the 9th and 10th, which are more or less fused, at least, difficult to distinguish (they tend to fuse in all in the later stages). I should certainly have said the head was proportionally larger (not smaller) in Theclids if there was any difference. Two lenticles in the region of iii are certainly very usual in Lycænids, one in Theclids (but *Strymon pruni* has two). Scudder's 'large, sunken, subcircular area,' is the anal plate, and occurs very similarly in all groups on the 10th abdominal segment, and has very much the same relations to the hairs around in all. Concerning the adult larva, Scudder's table showing the head to be smaller in Lycænids, and prothoracic scutellum to be obscured in them, seems, so far, to be confirmed. He notes, however, that, in Theclids, the highest part of the larva is past the middle. This is clearly erroneous, some of his own figures contradicting it. It is somewhat true in some species, but the larva of *Ruralis betulae*, with the short anterior, and long posterior, slope, is much to the contrary. Theclid larvæ retain, to the last skin, more or less definitely, the two dorsal ridges or flanges. Lycænids retain them, so that they may be distinguished theoretically rather than practically, whilst in Chrysophanids they are quite lost, or, at least, it takes some imagination to see them clearly. The Theclid larva is more or less angular, as in the serrations of the dorsal ridges of *Strymon pruni*, depression of scutellum in *Thestor ballus* and others, etc. Lycænids are more or less rounded, the only angularity being the occasional sharpness of the lateral flange, whilst Chrysophanids tend to be very flattened (or to look so) and slug-like. A feature that is extremely common in Lycænids, and does not, so far as I have observed, occur in the other groups, is stellation or spiculation of the hair-bases (very marked in *Celastrina argiolus*)."

The connection of Lycænid larvæ with ants has already been somewhat fully noticed in the preceding volume (pp. 30-37). This connection was first noticed much more than a century ago by Esper, and has now been observed in many Palæarctic and Nearctic, as well as tropical, species. Many Lycænid larvæ, as has already been noticed, have the power of exuding, from a special evaginable gland on the dorsum of the 7th abdominal segment, at the solicitation of the ants, a drop of fluid which the ants greedily drink. The association of ants has been noticed with several species—*Plebeius argus* (*aegon*) with *Lasius niger* (Aurivillius, *Ent. Tids.*, v., pp. 190, 227), and with *L. alienus* (Viehmeyer, *in litt.*), *Plebeius argyrognomon* with *Formica cinerea* (Torka *teste* Viehmeyer, *in litt.*, and Thomann, *Beobach. Symb. L. argus*, etc., 1901, pp. 1-40). *Agriades corydon* with *Formica niger*, and more rarely with *F. rufa* (Krodel, *Allg. Zeits. für Ent.*, ix., pp. 103-4), also with *F. flava* (Rayward, *Entom.*, 1906, p. 197), *Agriades bellargus* with *Lasius niger* and *L. flavus* (Rayward, *Entom.*, xxxix., pp. 219-220), *Polyommatus icarus* with *L. flavus* (Rayward, *Entom.*, xxxix., p. 109), *Lycaena arion* with *F. flava* (Frohawk, *Entom.*, xxxvi., pp. 58-60), *Nomiades iolas* with large black ants (Guerney, *Entom.*, xl., p. 223), and *Aricia astrarche* with ants (sp. ?) (Harrison, *Ent. Rec.*, xvii., p. 268). Besides these there are many more general notes on the subject, *e.g.*, Aurivillius observes (*Ent. Tids.*, v., pp. 190, 227) that he found six pupæ of *Plebeius aegon* under the bark of a pine, in cavities made and frequented by *Lasius niger*. Powell mentions (*Ent. Rec.*, xviii., p. 214) that he found ants attending the larvæ of *Plebeius aegon*, and Chapman notes (*Ent. Rec.*, xviii., p. 244) that he found the best way of discovering the larvæ of *P. argus* (*argyrognomon*) was to follow up the ants that were busy with them. Thomann's dissertation on the "Symbiosis occurring between the larvæ of *P. argyrognomon* var. *aegidion* and *Formica cinerea*" (*Beobach. über eine Symb. zwischen Lycaena argus und Formica cinerea*, Chur, 1901, pp. 1-40, with one plate) should be referred to. Donisthorpe quotes (*Ent. Rec.*, xviii., p. 319) Wasmann as saying that the larvæ of *Polyommatus dorylas* (*hylas*) are always accompanied by ants, and Raynor observes (*Ent. Rec.*, xviii., p. 299) that larvæ of *Celastrina argiolus* are symbiotic with *Lasius niger*. Nicéville records (*Butts. of India*, iii., p. 205) that the three species of ants, *Camponotus rubripes* var. *compressus*, Fab., *Tapinoma melanocephalum*, Fab., *Prenolopis obscura* var. *clandestina*, Mayr., attend the larvæ of *Lampides boeticus*. Krodel observes (*Zeits. für Ent.*, 1904, pp. 103-4) that, whilst rearing the larvæ of *Polgommatus damon*, he observed the wonderful attraction the larvæ of this species had for ants; previous to keeping these larvæ, only an occasional ant entered the house from the garden, but after the arrival of the caterpillars, they became a veritable domestic plague, the walls, table, and furniture being alive with them, whilst the breeding-cages were black, the ants forcing themselves through the gauze meshes in order to reach the larvæ; now and then as many as ten were found busy with a single *damon* larva, the 2nd and 3rd as well as the 10th abdominal segment being thoroughly investigated, and he suggests that both *corydon* and *damon* have secretive glands on the front segments named, but brings nothing tangible forward to show their existenee. He further notes that the ants ran over the newly-formed pupæ, caressing them with their antennæ, but that this very soon ceased. One suspects the species to have been *Lasius niger*. It may be well to note that Graves (*Ent. Rec.*, xvi., p. 203) states explicitly that small black ants accompany the larvæ of *Hypolycaena livia* in Egypt, and eat their frass.

The pupa is of typical Ruralid form, rather more slender as a rule than that of the "hairstreaks," whilst the mode of pupation is as variable as in the latter group. Sometimes this appears to be effected by the ordinary anal pad and central girth; at other times by attachment to the cast larval skin, which retains firm hold of a silken carpet; other species again, form a slender cocoon near the surface of the ground, whilst yet others appear to take no precautions. All these methods are illustrated by different British species. Chapman observes (*in litt.*) that Scudder's account of the pupa (*Butts. New England*, ii., p. 798), and quoted *infrà*, is not to be improved upon.

The mode of hybernation varies extremely. It is possible that at least one interloper into the Palæarctic region, *Lampides boeticus*, hybernates (if at all in Europe) as imago, although Millière assumes that it does so as egg. Hybernation, however, may take place (1) in the egg stage, *Plebeius aegon*, *Agriades corydon*, *A. donzelii*: (2) in an early larval stage (third instar), *e.g.*, *Aricia astrarche*, *Agriades bellargus*, *Polyommatus icarus*, *Cyaniris semiargus*, *Lycaena arion;* (3) as the adult larva, *e.g.*, *Cupido minima;* (4) in the pupal stage, *e.g.*, *Celastrina argiolus*, *Nomiades cyllarus*, *N. melanops*. Those that hybernate in the egg-stage seem to have almost uniformly only a single-brood, in the Palæarctic area, per year, although *A. corydon* is on the wing in specially favourable spots in May, and is double-brooded, in the neighbourhood of Hyères. The others may be partially or wholly double-brooded, or even triple-brooded, although *Lycaena arion*, at least so far as we know the species in Europe, is certainly only single-brooded.

Seasonal dimorphism is not at all uncommon in the double-brooded species. The most complicated form yet worked out is that of *Celastrina pseudargiolus* (by some supposed to be distinct from *C. argiolus*) of which Edwards (*Butts. Nth. America*, ii., plates *Lycaena* ii and iii) and Scudder (*Butts. New England*, ii., p. 944) give excellent descriptions and figures. Among our double-brooded European species, some form of seasonal dimorphism is usually noticeable, *e.g.*, *Celastrina argiolus*, the females of the second-brood with broader marginal borders; *Aricia astrarche*, both sexes of the second-brood more spotted with orange marginally, and with browner undersides; *Agriades bellargus*, the first-brood, with bluer females, and so on, *i.e.*, in the Palæarctic region, the seasonal dimorphism is in the direction of the production of spring and summer forms. De Nicéville says (*Butts. of India*, iii., p. 11) that, in India, the Lycænid species seem to be restricted to wet and dry seasonal forms, but that, in Sikkim, the dry-season form which occurs at the end of the year, differs somewhat from the dry-season form which occurs in the spring, so that, with regard to some species, there may be said to be three forms—a spring, a wet-season, and a winter form.

Gynandromorphism is very prevalent in this tribe; indeed it is possible that more gynandromorphs have been recorded in this than any other group of butterflies. We propose dealing with those relating to each British species, when the latter are treated in detail. Of records that have been noted belonging to other than British species we may mention:

1.—Aricia eumedon, Wiskott, *Lep.-Zwitt.*, p. 12, pl. iii., fig. 20.

2.—Polyommatus eros, Knecht, *Mitt. der Schw. Ent. Gesell.*, ix., p. 157.

3.—Polyommatus escheri, Haase, *Korr. Ent. Ver. Iris Dresd.*, iii., p. 38 (1886); Wisk., *Lep.-Zwitt.*, p. 12, pl. iii., fig. 4.

4.—Polyommatus hylas, Ribbe, *Iris*, iii., p. 45; Rühl, *Pal. Gross-Schmett.*, i., p. 279.

5.—α. Polyommatus amandus, Schultz, *Woch. für Ent.*, i., p. 335. β. P. amandus, Wisk., *Lep.-Zwitter*, p. 12. γ. P. amandus, Wisk., *Lep.-Zwitter*, p. 12, pl. ii., fig. 2. δ-ζ. Schultz, *Woch. für Ent.*, ii., p. 365. η. Düberg, *Sitzungb. Berl. Ent. Ver.*, 1898, p. 14.

6.—Polyommatus hyrcana, Wisk., *Lep.-Zwitt.*, p. 11, pl. iii., fig. 19.

7.—Polyommatus orbitulus, Locke, *Ent. Zeits. Guben*, iv., p. 231.

8.—α. Agriades meleager, Wiskott, *Lep.-Zwitt.*, p. 14, pl. iii., fig. 3. β. A. meleager, Rühl, *Pal. Gross-Schmett.*, i., p. 282. γ. A. meleager, Rühl, *Pal. Gross-Schmett.*, i., p. 763.

9.—Agriades damon, Wiskott, *Lep.-Zwitt.*, p. 14.

10.—Nomiades cyllarus, Schultz, *Berl. Ent. Zeits.*, 1904, p. 82.

11.—Lycæna euphemus, Schultz, *Berl. Ent. Zeits.*, 1904, p. 82.

12.—α. Plebeius argus (argyrognomon), Nick., *Sys. Lep. Faun. Böhm.*, p. 19 (1850): *Verh. zool.-bot. Ges. Wien.*, 1872, p. 727. β. P. argus, ditto, p. 728. γ. P. argus, Rühl, *Pal. Gross-Schmett.*, p. 233. δ. P. argus, Jander, *Zeits. Ent. Bresl.*, 1897, p. xxiii. ε. P. ARGUS, Gillmer, *Allg. Zeits. für Ent.*, vii., p. 210. ζ. P. ARGUS, Schultz, *Berl. Ent. Zeits.*, 1904, p. 80.

Scudder gives the following diagnosis of the group under the name *Lycaenidi* (*Butts. New England*, ii., pp. 902-3). This must be studied, of course, in the light of Chapman's criticisms (*anteà*, pp. 323-324). It reads as follows :

IMAGO : Colours above principally violet ; club of antennæ usually equal throughout most of its extent, long and slender, being about three times as broad as the stalk, and from four to five times longer than broad. Patagia long and slender, usually about two-and-a-half times longer than broad ; subcostal nervure of forewings with three superior branches ; the outermost forked, the nervure itself running in a very direct course to just below the anal angle ; androconia battledore-shaped, linearly beaded ; tarsi armed beneath with only two or three rows of slender spines ; fore tarsi of male armed at tip with a single median claw, broad at base, and rapidly tapering, scarcely curved. Genitalia : Upper organ of male abdominal appendages furnished, not with broad alations, but with gibbous expansions, bearing backward- or downward-directed laminæ or hooks ; clasps broad at the base, and tapering more or less irregularly to a blunt or sharp point ; intromittent organ not so long as in *Theclidi*, but of similar shape.

EGG : Tiarate, almost equally truncate above and below, regularly studded on the sides with stout rounded prominences connected by a much thinner tracery of lower lines, forming cells of a size proportionally greater than in *Theclidi*. Micropylic pit comparatively shallow, minute, with sloping walls.

LARVA (newly-hatched) : Head barely narrower than the prothorax. Dorsal hairs arranged in a laterodorsal series, a long and a short hair to a segment in each row ; substigmatal series with three bristles to a segment.

LARVA (adult) : Body scarcely broader, proportionally, than in *Chrysophanidi*, but more so than in *Theclidi* ; posterior portions of segments slightly elevated ; body covered with raised, six-rayed, papillate dots, each giving rise to a very short hair, those at the extremities of the body and on the substigmatal fold twice as long as the others.

PUPA : Body very variable in proportions, but longer than in *Theclidi* in comparison with its height, and especially with a relatively longer abdomen ; dermal appendages consisting of cylindrical hairs, which are uniformly tapering, provided abundantly with minute spicules, which diverge from the stem at nearly right angles.

We may add here Pierce's description of the scaling of this subfamily. He writes (*in litt.*) :

The scales of the Lycænines may be roughly divided into five groups exclusive of the fringe-scales. It may be taken as a general rule that the female scales, as well as the underside scales of both sexes, tend to increase in the number of apical points or lobes.

1. The ordinary pigmented scale usually with parallel sides, the apex terminating in from two to six points.

2. A transparent scale more or less yellow, evidently very essential to the development of the bright blue coloration, being absent in the brown examples, whether male or female, but occurring in the blue forms of the various females. In the brightest blues this scale has no projections at the apex, but in the duller species there are rounded lobes, though never points.

3. A covering scale, which in *Agriades corydon* is merely a hair, in *Lampides boeticus* is a long scale gradually broadening out, and rounded at the apex.

4. The androconial scale, in this subfamily usually the familiar "battledore" scale, only present in the males when that sex is normally blue. In *Lampides boeticus* the scale is elongated and not "battledore"-shaped.

5. An asymmetrical scale only found in a minute patch on the inner margin at the extreme base of the underside of the forewing (well exemplified in *Aricia astrarche*).

The tribal and generic grouping of the species within the subfamily has not been really attempted. Species the most diverse are often lumped into one heterogeneous mass, of which Staudinger and Rebel's genus

Lycaena is characteristic. These authors (*Catalog*, 3rd ed., pp. 77-90) place no fewer than 110 Palæarctic species in the genus, *i.e.*, practically everything that certainly belongs to the main tribe of the "blues," usually termed *Lycaenidi*, but which should be rightly known as *Plebeiidi*, to the *Everidi*, *Cupididi*, *Scolitantidi*, and the *Lycaenidi* (*sens. rest.*), for it is very obvious that their *Cyaniris* (*Celastrina*) is tribally distinct, as *Lampides* certainly is. It is true that the great mass of our "blues" are closely allied, and belong to the tribe *Plebeiidi*, but the *Lampididi*, *Cyaniridi*, *Everidi*, *Cupididi*, *Scolitantidi*, and *Lycaenidi*, at least, of the Palæarctic "blues," have equal classificatory value. Most of these will be treated in detail in due course. We need only note here that the genitalia bear out very distinctly the divisions one is inclined to make on more or less superficial grounds.

The most crude and unsatisfactory comparatively recent attempt at subdivision is, however, that of Meyrick (*Handbook*, etc., pp. 344-9), who, on the basis of the imagines having hairy or smooth eyes, divides the British Lycænid and Chrysophanid species into two groups, called genera, *viz*:

Eyes glabrous—*Chrysophanus argiades*, *C. minimus*, *C. semiargus*, *C. astrarche*, *C. phlaeas*, *C. dispar*.

Eyes hairy—*Lycaena boetica*, *L. argiolus*, *L. corydon*, *L. bellargus*, *L. aegon*, *L. icarus*, *L. arion*.

One can hardly imagine anything more remarkable than this; the character does not even separate species belonging to different subfamilies, and this was the more astonishing as Scudder had just previously, in his *Butts. of New England*, given distinct clues as to the lines of division. We have already, in the preceding volume, pp. 313-314, dealt with the generic synonymy of the "blues," and we shall deal in some detail with the genera represented by our British species, as necessity arises. A thorough tribal and generic revision of the Palæarctic and Nearctic species is, however, badly needed, but is altogether outside the scope of this work.

Some of the species belonging to the *Celastrinidi* and *Lampididi*, and more markedly those belonging to certain subtropical tribes, are to be found flying about shrubs and bushes, but those of the *Everidi*, *Plebeiidi*, *Lycaenidi* (*sens. rest.*), and other allied tribes may, on the whole, be said to inhabit open ground, fields and meadows, slopes, and waste places, to be restricted almost entirely to low plants, and not to affect tall shrubs, bushes, or trees. The imagines, with the exceptions noted, rest on the flowers and foliage of low herbage, and, in the valleys of the Alps of Central Europe, are sometimes to be found in the hot sun in immense numbers at puddles and runnels of water that cross the narrow mountain-paths, but it is almost always the males only that are so found. This is not absolutely so, however, for, at damp places, near the Lac de Gaube, Chapman proved, by capture, that about one in twelve of the examples of *Polyommatus orbitulus* so taken were females. One of the most remarkable assemblages of Lycænids that we ever witnessed was observed on August 8th, 1907, near Piora, on the shores of Lake Ritom, between noon and 2 p.m. There was, indeed, a series of assemblages, for, throughout the space of quite half-a-mile, the little swarms were certainly not more than 20 to 25 yards apart, so that there must have been approximately 40 of them. We have often seen somewhat similar congregations in the Alpine valleys, but never anything quite on the same scale. It had rained hard during the two preceding days, and the earth forming the banks at the edge of the path round the lake was thoroughly damp, though not soppy, and just then steamy from the hot sun. As already stated, at a distance of every few yards, there was a congregation of butterflies, varying in numbers from about 250 to fully 1000, with many smaller ones at almost every step. The large companies consisted of *Erebia mnestra*, *E. melampus*, *E. tyndarus*, *E. euryale*, *Hesperia alveus*, *Argynnis aglaia*, and *A. niobe*, in comparatively small numbers, the great mass, however, of each group consisting of "blues"—*Plebeius argus* (*argyrognomon*), *Agriades corydon*, *Polyommatus eros*, and *Cupido minima*—the first-named outnumbering all the others by from 10 or 20 to 1. They sat motionless until one or two quarrelsome individuals pushed or hustled their nearest neighbours to the edge of the crowd, *A. corydon* being especially prominent in this respect. Small as *C. minima* is, the individuals held their own against the other species, and the specimens were in the best possible condition, having here, at 6000ft. above the sea, only quite recently emerged. The same habit is frequent in India, for de Nicéville says (p. 10): "The males of most of the Lycænids are particularly fond of sucking up the moisture from the damp sandy sides of hill streams . . . . The females probably fly much less than the males, and keep more to the jungles, settling on trees and bushes where they are difficult to follow and catch." Certainly, in the Alps, the females prefer the flowery banks rising above the zigzag paths that occur almost everywhere. The peculiar movement of the hindwings, common in both sexes, by means of which they are moved alternately up and down, and obtain what appears to be, in a measure, a rotary movement, must have been noticed by everyone. Trimen says (*South African Butts.*, i., p. 30): "This curious habit is practised by every member of the family that I have watched when settled, and it seems not improbable—looking to the brilliant eye-like metallic spot, and (very often) adjacent tail or tails at the posterior angle of the hindwings of these butterflies—that the movement may serve to accentuate these ornaments either in rivalry or menace." Bell's remark (*Ent. Mo. Mag.*, xlii., p. 128) on the meaning and use of the black, often silver- or orange-centred, anal spots of the hindwings of some Lycænids is interesting. He writes: "Put a 'blue' having such spots—*Virachola*, *Camena*, *Ops*, *Creon*, *Arhopala*, etc.—on a leaf or surface in its natural position, with the wings closed over the back; the black spots then come into juxtaposition with a flimsy tail to each one, which moves in the tiniest breeze. Looking one day at a 'blue' on a leaf in the jungle, I took the spots for the head of a *Mantis*, and, as if the resemblance were not strong enough when at rest, the movement so common among Lycænids, of the hindwings one on another (as if the butterfly were rubbing them together gently) gave the '*Mantis*' head' the appearance of moving from side to side. It was very quaint, and it struck me forcibly that it would do well to frighten small insects—ants, etc.—or, perhaps, birds and lizards would take it for a *Mantis*, and thus get the ends of the wing instead of the Lycænid's body."

The Lycænines are very largely represented in the Palæarctic region, almost one-sixth of the butterfly fauna of this district belonging to this group. The subfamily is distributed throughout the whole area, from the

British Isles to China and Japan. It is also fairly widely distributed in the Indian area, as may be readily gathered from de Nicéville's *Butterflies of India, Burmah, and Ceylon*, iii., p. 67, although there it occurs more particularly in the western Himalayas, especially on the inner ranges and Kashmir, whilst Scudder says that the group is also abundant in the western part of North America, but is rare in the eastern half, and very badly represented in South America.

Tribe: Lampididi.

Genus: Lampides, Hübner.

Synonymy.—Genus: **Lampides**, Hb., "Verz.," p. 70 (1816-1818); Newm., "Brit. Butts.," p. 117, fig. 39 (1869); Butl., "Cat. Diurn. Lep.," p. 165 (1869); Walk., "Ent.," p. 52 (1870); Scudd., "Hist. Rev. Gen.," p. 201 (1875); Butl., "Trans. Ent. Soc. Lond.," p. 547 (1879); Semper, "Journ. Mus. Godef.," xiv., p. 158 (1879); Tutt, "Ent. Rec.," vii., pp. 220, 300 (1895); "Brit. Butts.," p. 192, pl. ii., fig. 4 (1896); Kirby, "Handbook, etc.," ii., p. 82, pl. xlv., figs. 1-3 (1896); Reut., "Ent. Rec.," x., p. 97 (1898); Staud., "Cat.," 3rd ed., p. 76 (1901); Wheeler, "Butts. Switz.," p. 45 (1903); Tutt, "Ent. Rec.," xviii., p. 131 (1906); South, "Brit. Butts.," i., p. 154, pl. ciii., figs. 1-3 (1906). **[Papilio-Plebeius-] Ruralis**, Linn., "Syst. Nat.," 12th ed., i., p. 789 (1767); Fab., "Sys. Ent.," pp. 522, 526 (1775); "Spec. Ins.," ii., p. 119, 124 (1781); "Mant. Ins.," ii., pp. 69, 77 (1787); De Vill., "Car. Linn. Ent. Fn. Suec.," ii., p. 64 (1789). **Papilio**, Fuess., "Verz.," p. 31, fig. 2 (1775); Cram., "Pap. Ex.," ii., pl. clxxxi., fig. *c* (1777); Esp., "Schmett. Eur.," i., pt. 1, p. 273, pl. xxvii., figs. *3a-b* (1777); pt. 2, p. 181, pl. xci., fig. 3 (1784); Geoff., "Ent. Paris.," ii., p. 242 (1785); Schneid., "Sys. Besch.," p. 223 (1785); Bork., "Sys. Besch.," i., p. 268 (1788); Lang, "Verz.," p. 47 (1789); Scriba, "Journal," p. 211 (1791); Hüb., "Eur. Schmett.," p. 56, pl. lxxiv., figs. 373-5 (1796); text p. 56 (1805); Ill., "Ill. Mag.," iii., p. 188 (1803); Herbst, "Nat. Syst. Ins.," xi., p. 62 (1804); Rossi, "Mantissa," ii., p. 246 (1807); Ochs., "Die Schmett.," i., pt. 2, p. 99 (1808). **Polyommatus**, Latr., "Hist. Nat. Crust. Ins.," xiv., p. 117 (1805); "Gen. Crust. Ins.," iv., p. 207 (1809); "Enc. Méth.," ix., p. 653 (1819); Godt., "Hist. Nat.," i., p. 192, pl. ix. *text*., fig. 4, pl. x., fig. 2 (1821); Bdv., "Gen. Lep. Ind.," p. 10 (1829); Ramb., "Faun. And.," p. 276 (1839); Hein., "Schmett. Deutsch.," i., p. 85 (1859); Kirby, "Eur. Butts.," p. 98 (1862); "Eur. Butts. and Moths," p. 53 (1879); Butl., "Trans. Ent. Soc. Lond.," p. 31 (1882); Moore, "Lep. Ceyl.," i., p. 93 (1881); Dist., "Rhop. Mal.," p. 230, pl. xx., fig. 8 (1884); Dale, "Brit. Butts.," p. 51 (1890); Nicév., "Butts. India," iii., p. 204, pl. xxvii., fig. 190 (1890); Leech, "Butts. China," ii., p. 337 (1894); Nicév., "Butts. Sumatra," p. 462 (1895). **[Hesperia-] Ruralis**, Fab., "Ent. Syst.," iii., pt. 1, pp. 280, 303 (1793). **Hesperia**, Fab., "Ill. Mag.," vi., p. 285 (1807). **Thecla**, Oken, "Lehrb.," ii., p. 722 (1815); Meig., "Eur. Schmett.," ii., p. 48, pl. lii., fig. 4 (1830). **Lycaena**, Horsf., "Cat. Lep. East In. Com.," pp. 80-81 (1828); Dup., "Hist. Nat.," supp. i., p. 390 (1832); Treits., "Die Schmett.," supp. x., p. 239 (1834); Bdv., "Spec. Gen.," i., pl. vii., fig. 9 (1836); "Gen. et Ind. Meth.," p. 10 (1840); H.-Sch., "Sys. Bearb.," i., p. 130 (1843); Dup., "Cat. Méth.," p. 30 (1845); Heydnrch., "Lep. Eur. Cat. Meth.," p. 15 (1851); Westd. and Hew., "Gen. Diurn. Lep.," ii., p. 490 (1852); Led., "Verh. zool.-bot. Ges.," p. 19 (1852); Ramb., "Cat. Lep. And.," p. 43 (1855); Mill., "Icon.," livr. iv., p. 245, pl. iv., figs. 1-6 (1861); Staud., "Cat.," 1st ed., p. 4 (1861); Trim., "Rhop. Afr. Aust.," ii., p. 236 (1866); Guen., "Ann. Soc. Ent. Fr.," 4th ser., vii., p. 665, pl. xiii., figs. 9-12 (1867); Berce, "Faun. Franc.," i., p. 131 (1868); Staud., "Cat.," 2nd ed., p. 9 (1871); Curò, "Bull. Ent. Soc. Ital.," vi., p. 109 (1874); Cunì y Mart., "Lep. Barc.," p. 17 (1874); Mill., "Cat. Lép. Alp.-Mar.," p. 102 (1875); Mab., "Bull. Soc. Zool. Fr.," p. 215 (1877); Frey, "Lep. Schweiz," p. 14 (1880); Elw., "Proc. Zool. Soc. Lond.," p. 887 (1881); Lang, "Butts. Eur.," i., p. 99, pl. xxii., fig. 2 (1884); Kane, "Eur. Butts.," p. 34 (1885); Trimen, "Sth. Afr. Butts.," ii., p. 58 (1887); Pryer, "Rhop. Nihon.," p. 17, pl. iv., fig. 22 (1888); Barr., "Lep. Brit. Isl.," i., p. 65, pl. x., figs. 1-1*a* (1893); Rühl, "Pal. Gross-Schmett.," pp. 224, 749 (1895); Lamb., "Pap. Belg.," p. 216 (1902). **Cupido**, Kirb., "Sys. Cat.," p. 354 (1871); Wollast., "Ann. Mag. Nat. Hist.," 5th ser., iii., p. 223 (1879).

The heterotypical genus *Lampides* was described by Hübner as follows (*Verz.*, p. 70):—

The wings beneath with grey stripes, the hindwings beautifully marked.—*Lampides numerius*, Stoll, *L. zethus*, Hb. (*alexis*, Stoll), *L. helius*, Cram. (*esra*, Hbst.), *L. baalliston*, Hb., *L. boeticus*, Linn., Hb., figs. 373-5 (*boetica*, Fab.), *plato*, Fab., *archius*, Cram., *celerio*, Fab. (*celeno*, Cram.), *aratus*, Cram.

Of these, the species known personally to Hübner was *boeticus*, to which he refers the figs. 373-5 of his *Eur. Schmett.*, in the above diagnosis. Newman, about 1869, or 1870, restricted the name to *boeticus*, and this usage was followed by Kirby in 1896, so that there is no doubt that this is the true type of the genus. Scudder (*Hist. Gen.*, p. 201) after enumerating Hübner's list (*suprà*), notes:—

1869.—Butler, *Cat. Fab. Lep.*, p. 160, employs it for 19 species, including *minoreus*, *aelianus*, *boeticus*, *plato* and *celeno*.

1870.—Newman, *Brit. Butts.*, p. 117, employs it for *boeticus* only.

He then adds: "It cannot be employed for *boeticus*, as this became in 1810, the type of *Polyommatus*. *Ælianus* may be taken as type." Scudder is evidently here entirely at fault. In 1810, Latreille did not even use (*Consid. Gen.*, p. 440) *Polyommatus*, only the French name "Polyommate," although, already in 1804, Latreille had given (*Nouv. Dict. Hist. Nat.*, xxiv., pp. 184-185, pp. 199-200), a series of genera with their respective types of which one is:—

Genus: *Polyommatus*—*Hesperia argus*.

But the *argus* of Latreille was the species we now know as *icarus*, which must, therefore, be considered the type of *Polyommatus*, and this view was confirmed in 1817 when Latreille (*Cuvier's Regne Animal*, iii., p. 553), detailed at length one species as representing *Polyommatus*, which he notes as:—

Polyommatus.—L'argus bleu, Geoff., Engram., *Pap. Europ.*, xxxviii., no. 80, *g*, *h* (*Papilio alexis*, Hb., ix., pp. 292-294).

So that Scudder was entirely wrong as to the facts, and it follows that *boeticus* did not, in 1810, become the type of *Polyommatus*; that the fixing of *aelianus* as type was altogether *ultra vires*; and that the usage by Moore (1881), Nicéville (1893) and others, of *Polyommatus* for *boeticus*, is entirely unwarranted. These authors seem to have accepted Scudder's statements, without attempting to prove their accuracy.

Moore diagnoses (*Lep. Ceylon*, i., pl. 3) the genus, under the name *Polyommatus*, as follows:—

Forewing triangular; costa slightly arched, exterior margin oblique and slightly convex towards the apex, posterior margin straight; costal nervure extending to half length of wing; first subcostal nervure short, emitted at nearly one-half before the end of the discoidal cell, second subcostal short, emitted at one-fifth before the end of the discoidal cell, third subcostal bifid, and emitted close to the end of the cell, fourth subcostal at one-half from the third, and terminating at the apex, fifth subcostal (upper discoidal) from the end of the cell; (middle and lower) discocellular nervules nearly erect of equal length, radial (lower discoidal) nervule from their middle; discoidal cell broad, extending to a little beyond half length of the wing; third median nervule from the end of the cell, second median at one-fifth, and first median at one-third before the end of the cell; submedian nervure nearly straight. Hindwing bluntly oval, furnished with a single slender tail (at the termination of the first median nervule); costal nervure much arched from the base; first subcostal nervule curved, emitted at one-fourth before the end of the cell; discocellular nervules very slender, upper discocellular slightly concave, discoidal nervule from their middle; third and second median nervules from the end of the cell, first median at one-third before the end; submedian nervure straight, internal nervure recurved, short, Body stouter than in *Lampides*, Moore (*aelianus* group); palpi porrect, long, slender, flattened, fringed beneath; legs slender antennæ with the club stout, grooved; eyes hairy.

To this description, Nicéville adds (*Butts. India*, iii., p. 203) :—

Forewing has the first subcostal nervure emitted beyond the middle of the discoidal cell, quite free from the costal nervure, second subcostal emitted much nearer to the base of the upper discoidal than to the base of the first subcostal nervule, third subcostal emitted at about midway between the base of upper discoidal and apex of wing, middle and lower discocellular nervules nearly erect, of nearly equal length and slightly concave, the second median nervule emitted long before the apex of the cell. Hindwing with the discocellular nervules outwardly oblique, of equal length, concave; second median nervule emitted just before the apex of the cell.

It is difficult to determine, in the present state of our knowledge, just what the limits of the tribe are. It is quite clear from the structure of the genitalia, etc., that *boeticus* stands almost alone, and appears to be rather in alliance with certain African and Australian species, which, however, are not congeneric. We have already (*anteà*, p. 326) referred to the very peculiar androconial scales of *Lampides boeticus*, so different from those of the more typical "blues" (see also *posteà*, pp. 333, 334). It would be interesting to know whether any of the suggested allies have similar androconia.

Staudinger gives (*Cat.*, 3rd ed., pp. 76-77) the following Palæarctic species as belonging to the genus *Lampides*:—*boeticus*, Quin., *telicanus*, Lang, *balkanica*, Frr., *theophrastus*, Fab., *jesous*, Guér., *webbianus*, Brullé, *phiala*, Grum-Grsh., *eleusis* Demais., *thebana*, Staud., and *galba*, Led. This is a wonderfully heterogeneous lot of insects, of which *boeticus* certainly stands generically alone, with considerable doubt whether any of the other species are even Lampidid, *i.e.*, whether they are even tribally connected. The species *telicanus* and *webbianus*, are somewhat closely allied but they are certainly quite distinct tribally from *Lampides*, and we have placed the former in a new genus *Langia*. Of the Egyptian and Syrian species Graves notes (*Ent. Rec.*, xviii., p. 307), that *boeticus* and *telicanus* are very much more distantly allied than *telicanus* and *eleusis*; *jesous* (*gamra*) is some distance from these, and forms, perhaps, a connection between them and *theophrastus* and *balcanica*, whilst *thebana* and *galba* are somewhat close, and form a connection with *Chilades* (*trochilus*). Of Staudinger's conglomeration, Bethune-Baker writes: "*Boeticus* stands quite alone so far as Staudinger's genus is concerned, and is the only representative of the *Lampididi*. The remainder are quite outside the tribe. Of these, *telicanus*, Lang, and *webbianus*, Brullé, belong to the genus *Langia*, whilst *theophrastus*, Fab., and *balkanica*, Frr., belong to the genus *Tarucus*, Moore, who made the former species the type; *jesous*, Guér., belongs to the genus *Castalius*, Hb., whilst *phiala*, Grum-Grsh., *eleusis*, Demais., and *thebana*, Staud., belong to the genus *Azanus*, Moore, the type of which is *ubaldus*, Cra., although I am doubtful whether *Azanus* is really generically distinct from *Castalius*. I may add that I cannot separate *thebana*, Stdgr., from *azanus*, Bth., and believe they are the same species. But none of these belong to the Lampidids, which appears to be confined (with the exception of *boeticus*, L.) to the Indo-Malayan, Papuan, and Australian sub-regions. Even then *Lampides boeticus* appears to stand quite alone, without any very near allies, the nearest being probably the Australian genus *Eutycha*. The *Lampididi* may be found to include *Lampides*, *Jamides*, *Nacaduba*, and part of *Cato-*

chrysops, but this is a mere superficial suggestion, and wants carefully working out."

LAMPIDES BOETICUS, Linné.

SYNONYMY.—Species: **Boeticus,*** Linn., "Syst. Nat.," 12th ed., i., p. 789 (1767); Fab., "Sys. Ent.," p. 522 (1775); Esp., "Schmett. Eur.," i., pt. i., p. 273 (1779); pl. xxvii., figs. 3*a*-*b* (1777); pt. 2, p. 181, pl. xci., fig. 3 (1784); Bergs., "Nomen.," ii., p. 9, pl. lv., figs. 1-2 (1780); Fab., "Spec. Ins.," ii., p. 119 (1781); Schneid., "Sys. Besch.," p. 223 (1785); Fab., "Mant. Ins.," ii., p. 69 (1787); Bork., "Sys. Besch.," i., p. 268 (1788); De Vill., "Car. Linn. Ent. Fn. Suec.," ii., p. 64 (1789); Lang, "Verz.," p. 47 (1789); Scriba, "Journal," p. 211 (1791); Hb., "Eur. Schmett.," p. 56, pl. lxxiv., figs. 373-5 (1796); text p. 56 (1806); Ill., "Ill. Mag.," iii., p. 188 (1803); Herbst, "Nat. Syst. Ins.," xi., p. 62 (1804); Ochs., "Die Schmett.," i., pt. ii., p. 99 (1808); Latr., "Gen. Crust. Ins.," iv., p. 207 (1809); "Consid. Gen.," p. 440 (1810); Hübn., "Verz.," p. 70 (1816-18); Latr., "Enc. Meth.," ix., pp. 595, 605 (1819); Godt., "Hist. Nat.," i., p. 192, pl. ix *tert.*, fig. 4., pl. x., fig. 2 (1821); Bdv., "Eur. Lep. Ind.," p. 10 (1829); Dup., "Hist. Nat.," supp. i., p. 390 (1832); Treits., "Die Schmett.," x., pt. 1, p. 239 (1834); Butl., "Cat. Diurn. Lep.," p. 165 (1869); Scudd., "Hist. Revis. Gen.," p. 201 (1875); Snell., "Tijd. voor Ent.," xx., p. 66 (1877); xxi., p. 23 (1878); Kirby, "Eur. Butts.," p. 53 (1879); Wollast., "Ann. Mag. Nat. Hist.," 5th ser., iii., p. 223 (1879); Semp., "Journ. Mus. Godef.," xiv., p. 158 (1879); Dist., "Rhop. Mal.," p. 214, fig. 64 (1884); Dale, "Hist. Brit. Butts.," p. 51 (1890); Nicév., "Butts. India," iii., p. 204, pl. xxvii., fig. 190 (1890); Leech, "Butts. China," ii., p. 337 (1894); Nicév., "Butts. Sum.," p. 462 (1895); Staud., "Cat.," 3rd ed., p. 76 (1901); Lamb., "Pap. Belg.," p. 216 (1902); Wheel., "Butts. Switz.," p. 45 (1903); South, "Brit. Butts.," i., p. 154, pl. ciii., figs. 1-3 (1906). **Damoetes,** Fab., "Sys. Ent.," p. 526 (1775); "Spec. Ins.," ii., p. 124 (1781); "Mant. Ins.," ii., p. 77 (1787); "Ent. Syst.," iii., pt. 1, p. 303 (1793); Don., "Ins. New Holl.," pl. xxxi., fig. 2 (1805); Godt., "Enc. Méth.," ix., p. 680 (1823); Horsf., "Cat. Lep. East Ind. Co.," p. 81 (1829). **Coluteæ,** Fuess., "Verz.," p. 31, fig. 2 (1775); Rossi, "Mant.," ii., p. 246 (1807). **Archias,** Cram., "Pap. Ex.," ii., pl. clxxxi., fig. *c* (1777). **Pisorum,** Geoff., "Fourc. Ent. Paris.," ii., p. 242 (1785). **Boetica,** Fab., "Ent. Syst.," iii., pt. 1, p. 280 (1793); "Ill. Mag.," vi., p. 285 (1807); Horsf., "Cat. Lep. East Ind. Co.," p. 80 (1829); Bdv., "Spec. Gen.," i., pl. vii., fig. 9 (1836); "Gen. et Ind. Meth.," p. 10 (1840); Dup., "Cat. Meth.," p. 30 (1845); Led., "Verh. zool.-bot. Gesell.," p. 19 (1852); Mill. "Icon," livr. v., p. 245, pl. iv., figs. 1-6 (1861); Staud., "Cat." 1st ed., p. 4 (1861); Guen., "Ann. Soc. Ent. Fr.," 4th ser., vii., p. 665, pl. xiii., figs. 9-12 (1867); Newm., "Brit. Butts.," p. 117, fig. 39 (1869); Walk., "Ent.," v., p. 52 (1870); Staud., "Cat.," 2nd ed., p. 9 (1871); Curò, "Bull. Soc. Ent. Ital.," vi., p. 109 (1874); Cunì y Mart., "Lep. Barc.," p. 17 (1874); Lang, "Butts. Eur.," i., p. 99, pl. xxii., fig. 2 (1884); Barr., "Lep. Br. Isl.," i., p. 65, pl. x., figs. 1-1*a* (1893); Rühl, "Pal. Gross-Schmett.," pp. 224, 749 (1895); Tutt, "Brit. Butts.," i., p. 192, pl. ii., fig. 4 (1896). **Baeticus,** Latr., "Hist. Nat. Crust.," xiv., p. 117 (1805); Oken, "Lehrb.," vii., p. 722 (1815); Ramb., "Faun. And.," p. 276 (1839); Zell., "Isis," pp. 156-7 (1847); Hein., "Schmett. Deutsch.," i., p. 85 (1859); Kirby, "Eur. Butts.," p. 98 (1862); "Syn. Cat.," p. 354 (1871); Butl., "Tr. Linn. Soc. Lond.," 2nd ser., i., p. 547 (1877); Mab., "Bull. Soc. Zool. Fr.," p. 215 (1877); Wollast., "Ann. Mag. Nat.

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*As bearing on the amazing reason resulting in the very unsatisfactory action of some authors in altering the Linnean name of this species, Ochsenheimer writes (*Die Schmett.*, i., pt. ii.. p. 101): "There is a note in *Scriba's Journal*, iii., p. 211, by Scharfenberg, on the orthography of *boeticus*. According to some remarks communicated to me by Herr Stadtrath Laspeyres, of Berlin, it should most probably be written *baeticus;* for Linné says: 'Habitat in Barbaria.' All the insects of which he says this, have been found sooner or later in Spain; this species is also, without doubt, at home in Spain; and from Pliny's *Hist. Nat.*, lib. iii., c. 1, and Tacitus' *Hist.*, lib. i., c. 78, it may be seen that Baetica then comprised the whole of further Spain. This was surely the idea Linné had, only he wrote grammatically incorrectly *boeticus*, which either has no meaning, or, anyhow, only a far-fetched one, because it must then be derived from Boe(o)tia; but even then it must be written *boeoticus*."

Plate XIX.

(To be bound facing Plate XIX.)

Life-history details of Lampiees bœticus and Celastrina argiolus.

Fig. 1.—*Lampides boeticus.*— Ova $\times 10$.

Fig. 2.— ,, ,, Empty pupa-skin (dorsal view) $\times 2$.

Fig. 3.— ,, ,, Imago $\times 1$.

Fig. 4.—*Celastrina argiolus.*—Ova $\times 10$.

Fig. 5.— ,, ,, Larva, feeding on ivy-buds [Note round holes through which larva has eaten out the buds.] $\times 1$.

Fig. 6.— ,, ,, Pupa $\times 2$ (lateral view).

Fig. 7.— ,, ,, Pupa $\times 5$ (lateral view).

Fig. 8.— ,, ,, Pupa $\times 5$ (ventral view).

(Figs. 1, 3, and 4 by A. E. Tonge, the others by H. Main.)

LAMPIDES BŒTICUS (FIGS. 1-3) AND CELASTRINA ARGIOLUS (FIGS. 4-8). *Photo H. Main and A. E. Tonge.*

The Natural History of British Butterflies, etc., 1907.

Hist.," 5th ser. iii., p. 223 (1879); Moore, "Lep. Ceyl.," i., p. 93 (1881); Butl., "Trans. Ent. Soc. Lond.," p. 31 (1882); Dist., "Rhop. Mal.," p. 230, pl. xx., fig. i (1884); Kirby, "Handbook," etc., ii., p. 82, pl. xlv., figs. 1-3 (1896). **Baetica,** Meig., "Eur. Schmett.," ii., p. 48, pl. lii., fig. 4 (1830); Zell., "Isis," p. 129 (1840); Hch.-Sch., "Sys. Bearb.," i., p. 130 (1843); Heyd., "Lep. Eur. Cat. Meth.," p. 15(1851); West. and Hew., "Gen. Diurn. Lep.," ii., p. 490 (1852); Ramb., "Cat. Lep. And.," p. 43 (1858); Staud., "Cat.," 1st ed., p. 4 (1861); Trim., "Rhop. Afr. Austr.," ii., p. 236 (1866); Berce, "Faun. Franc.," i., p. 131 (1868); Mill., "Cat. Lep. Alp.-Mar.," p. 102 (1875); Frey, "Lep. Schw.," p. 14 (1880); Elwes, "Proc. Zool. Soc. Lond.," p. 887 (1881); Kane, "Eur. Butts.," p. 34 (1885); Trim., "Sth. Afr. Butts.," ii., p. 58 (1887); Pryer, "Rhop. Nihon.," p. 17, pl. iv., fig. 22 (1888); Meyr., "Handb.," p. 347 (1895).

Original description.—*Papilio Plebeius* alis caudatis fusco-cærulescentibus; subtus cinerascentibus albido undulatis; angulo ani ocellis duobus. Habitat in Barbaria. Magnitudo *Argi*. Alæ supra nigricantes rore viridi cærulescente obductæ. Subtus omnes glauco-cinerascentes, strigis albidis undulatæ. Angulus ani cauda setacea nigra albo margine. Ocelli ad angulum ani, supra duo, pupillæ nigra; interiore didyma (præter exteriores cæcas). Subtus ocellis etiam duobus antice fulvis, postice argentatis (Linné, *Syst. Nat.*, xiith ed., p. 789).

Imago.—19mm.-37mm. The upperside of the male is of a somewhat dull purple tint, narrowly fuscous along the costa and the outer margin; the hindwings delicately tailed, the black tail with white tip, and two pale-margined black spots towards the anal angle, one on either side of the base of the tail. The female fuscous, more or less sprinkled with brighter metallic violet, or bright blue scales towards the base of all the wings, and the median area of the forewings; the hindwings as in the male, but with an ill-defined marginal row of pale-edged spots, following the two well-marked anal ones; a transverse band of indistinct, pale spots between this and the centre of wing. The fringes of all the wings have the inner half grey, the outer white, but, towards the tail of the hindwings the fringes are white-tipped, and white at the base, the central portion being grey. The underside of all the wings brownish-fawn, transversely crossed with delicate white pencillings, and with two black spots near the anal angle of the hindwings, one on either side of the base of the tail, edged above with orange, and partly filled in below with bright metallic green.

Sexual dimorphism.—There is considerable difference in the coloration of the sexes, the males being more or less uniform in tint, iridescent purplish rather than violaceous, narrowly fuscous along the costa and outer margin; the hindwings finely tailed, and with two black spots at the anal angle, one on each side of the base of the tail. The female is fuscous sprinkled with very bright violaceous, hyacinthine or blue scales over the base or centre of all the wings, extending to the inner margin; the hindmarginal series of pale-edged spots on the hindwing, of which the two black anal spots are the most highly developed, more or less conspicuous; faint indications of the corresponding hindmarginal band on the forewings; a transverse series of pale spots between the hindmarginal bands and centre of hindwings. The male is provided with remarkably long and highly specialised androconial scales, entirely different from those of most other "blues" figured by Sidebotham (*Mem. Phil. Lit. Soc. Manch.*, 3rd ser., iii., pl. i, ii and iii). Of the scaling of this species, Pierce writes (*in litt.*): "*L. boeticus* has three layers of scales—(1) the pigmented and transparent scales; (2) projecting through these, in the male, the androconial scales, a thick mass completely hiding them; (3) projecting through these again and partially clothing them, the covering scales. The androconia average about ·012in. × ·0015in.; they are club-shaped in general outline, the stalk widening out for about one-fourth, then narrowing to a point; the surface has fine striations which often fork, like the nervures of the wings, but often finish abruptly, thus keeping the striæ at even distances; at the widest part there are about 20 striæ, these get fewer in number near the apex, where there are only about seven or eight; the apex appears to have little round bead-like processes. The clothing scales average ·025in. × ·001in., with parallel striations. The ordinary scales are variously shaped *e.g.*, the transparent scales are greenish in tint, average about ·005in. × ·002in., are plain at the apex, sometimes tending to show three small apical lobes; the scales of the underside are 4- and 5-pointed. The female has no covering scales; the dark scales, however, are similar to those of the male and are 4- and 5-pointed; the transparent scales are bright yellow in colour and tend to the development of five apical lobes." It may be well to give the descriptions of the male and female from South Europe, Africa and India, as described by standard authors, *e.g.*, Millière describes (*Icon.*, i., p. 245) the European imagines as follows:—

Male.—The upper wings brown-black, with the disc bright blue. The lower wings adorned with a long tail, quite filiform, possess, in addition, a series of black spots; the fringes are whitish. The undersides of the four wings, of an ashy-yellow, present several white transverse lines, cut by the nervures. The lower wings show at the anal angle two black oval spots, accompanied with fawn-colour, and circled below with very bright metallic green. *Female.*—A little larger than the male; the disc of a dull violet.

Trimen says (*Sth. Afr. Butts.*, ii., p. 58) that the South African specimens measure: ♂ 1in. 4½lin., ♀ 1in. 2lin.-1in. 5½lin., and describes them as follows:—

Male.—Silky violet-blue, with a fuscous hind-marginal edging. Hindwing: two well-marked black spots, outwardly whitish-edged, near anal angle, of which the larger is above the first median nervule. Underside: pale ochreous-grey, with undulated transverse white striæ, common to both wings; beyond middle, a fascia composed of a middle broad streak with a parallel line at equal distances on either side, variable in regularity, angulated in hindwing below first median, a white stripe, narrow in forewing, but wider and conspicuous in hindwing, excepting near inner margin touching the greater portion of outer line of fascia, followed by a lunulate stria, and a hind-marginal edging. Forewing: a short triple fascia, similar to the longer one described, across cell, and another like it at extremity of cell. Hindwing: base lightly irrorated with blackish, two to four transverse striæ in basal portion, in places more or less confluent; mixed up with these a triple-streak closing cell, two black spots exteriorly edged with bluish or greenish-silvery, and interiorly bordered by an orange lunule (indistinct in lower spot). *Female.*—Dull brownish, vividly shot with shining blue from base and over disc. Hindwing: sometimes almost devoid of blue, beyond middle a transverse row of broad, more or less conspicuous, white lunules; a row of thinner lunules near margin combine with a hind-marginal line to form bluish-white rings, of which the two next anal angle are complete, enclosing the two black spots. Underside: as in male, but marking more conspicuous, especially the white stripe in forewing. Cilia in both sexes greyish at origin, white on outer edge.

Nicéville gives (*Butts. India*, iii., pp. 204-5) a modification of Distant's description of the Malay race, as applicable to the Indian specimens as follows:—

Male.—Upperside both wings pale violaceous [thickly overlaid with long hair-like scales, giving the wings a frosted appearance]. Forewing with the costal margin narrowly, and the outer margin more broadly, pale fuscous. Hindwing with the costal and posterior margins pale fuscous; a large black marginal spot between the second and first median nervules, and two contiguous smaller black spots at the anal angle; [the tail black, outwardly fringed to near the tip, and the extreme tip white.] Underside of both wings pale brownish-ochraceous, with the following linear brownish fasciæ margined with greyish—forewing with two crossing the middle, and two near the end, of the cell, two (considerably fractured) crossing the wing between the end of the cell and the outer margin, commencing near the fourth subcostal nervure [terminal portion of subcostal nervure] and terminating at the submedian nervure, two submarginal [the innermost broadest], and the outer-margin narrowly pale fuscous; hindwing crossed from the base to beyond the middle with about eight linear fasciæ as on the forewing (more or less fused and broken), followed by a distinct and somewhat broad greyish fascia, and with two submarginal linear brownish fasciæ; two large marginal spots containing a few scattered greenish [metallic] scales, and inwardly margined with pale reddish-ochraceous, separated by the first median nervule; the outer margin narrowly fuscous. Cilia of both wings pale brownish, the tips greyish-white. Body above more or less concolorous, with the wings beneath greyish-white. Legs greyish-white, more or less streaked with brownish. *Female.*—Upperside of both wings pale brownish. Forewing with a discal bluish patch. Hindwing with [the base irrorated with iridescent blue,] two outer greyish submarginal fasciæ, the inner one broadest; the black anal-angle spots as in the male, distinctly margined with greyish. Underside both wings as in male (Distant). [The additions made by Nicéville are in square brackets.]

Variation.—For an insect with such an exceedingly wide distribution, this species shows very little, if any, local variation, suggesting comparatively powerful flight, and constant interchange of blood, between examples of different districts. The males differ everywhere but little in ground colour, except that some are rather redder-purplish than others; all are, however, distinctly purplish in hue, although some are rather greyer in appearance than others; this hoary appearance is due to the development of long coarse hair-like scales, and one example in the British Museum coll. is distinctly of "*orbitulus*" tint (=ab. *grisescens*, n. ab.). The females show much more variation—(1) in the ground colour, from deep fuscous to fuscous-greyish; (2) in the tint of the blue scaling; (3) in the development of the pale transverse fasciated band. In this sex there are three distinct shades of blue noticeable; (1) of a purplish tinge, rather brighter than that of the male; this is by far the most usual form; (2) of the more brilliant "*bellargus*" tint, fairly generally distributed but not common, but well marked in a fine series in the British Museum coll., from St. Helena, where the species is probably somewhat inbred; (3) of the bright blue "*hylas*" tint (sometimes seen in the brighter form of *bellargus*), and noticeable in specimens from Candahar, Palawan, Java, Amboyna, etc. Wholly grey females without any trace of blue are not uncommon in the hotter parts of Africa, Khartoum, Omdurman, etc., and are represented in the British Museum coll. also by specimens from Penang, etc. There is considerable variation in the amount of development of the series of hindmarginal spots of the hindwings (of which the two highly developed ones near the anal angle are always by far the most conspicuous), the spots being sometimes also faintly indicated on the forewings; the male sometimes shows a third spot on the hindwings, and, in one male from Java, the series is continued along the whole margin, as also is the development of the pale edging to this series. In some females, too, a transverse series of pale spots between the hindmargin and the centre of the hindwings is sufficiently developed to form a well-marked transverse band, in others, this shows only as a series of pale blotches or dashes, and in many is entirely absent. Faint traces of this band are sometimes continued on the forewings. In some females from Khartoum, Johannesburg, Loo-Choo, etc., a distinct reddish arch covers in the inner of the two black spots near the anal angle of the hindwings, a distinct repetition of the margin of the corresponding spots on the underside. The undersides also show considerable variation, *e.g.*, from Australia come examples of almost white ground colour, with pale fawn bands, the orange margin of the two anal metallic spots obsolete, yet the Banksian type of *damoetes* also from Australia has a very brown underside. In a small specimen from Poona, the ground is grey, the bands fawn, edged with white; whilst others from various localities are fawn, with bands almost of the ground colour, edged finely with paler, almost white. In the British Museum are several examples of both sexes with a tendency to ill-developed scaling on the upperside. One male, from the Transvaal, is particularly pallid, undersized, pale whitish-blue in colour. The following tabulation of the females in the British Museum coll. may prove interesting :—

1*a*. Fuscous, with metallic purplish scaling, the two black spots at anal angle of hindwings well marked, the remainder of the hind-marginal series ill-developed, edged faintly with pale = *boeticus*, Linn.

b. As in 1*a*, but, in addition, with an extra, well-developed, whitish, transverse band between the hind-margin and centre of hindwing = ab. *typica-fasciata*, n. ab.

c. As in 1*b*, but, in addition, with the hind-marginal series of spots on hindwings faintly indicated on forewings = ab. *typica-marginata*, n. ab.

2*a*. Fuscous, with bright violet- or "*bellargus*"-blue scaling; the remainder as in 1*a* = ab. *caerulea*, n. ab.

b. As in 2*a*, but with pale transverse band across hindwing as in 1*b* = ab. *caerulea-fasciata*, n. ab.

c. As in 2*b*, but with marginal series of spots on forewing indicated as in 1*c* = ab. *caerulea-marginata*, n. ab.

3*a*. Fuscous, with bright metallic "*hylas*"-blue scaling (tending to green in some lights), the remainder as in 1*a* = ab. *clara*, n. ab.

b. As in 3*a*, but with pale transverse band across hindwing as in 1*b* = ab. *clara-fasciata*, n. ab.

c. As in 3*b*, but with marginal series of spots on forewing indicated as in 1*c* = ab. *clara-marginata*, n. ab.

4*a*. Fuscous, with no blue scaling whatever, the remainder as in 1*a* = ab. *fusca*, n. ab.

b. As in 4*a*, but with pale transverse band across hindwing as in 1*b* = ab. *fusca-fasciata*, n. ab.

c. As in 3*b*, but with marginal series of spots on forewing indicated as in 1*c* = ab. *fusca-marginata*, n. ab.

There is considerable difference in the size of the specimens, and a small example labelled "*aestiva*, from Rössler, 1876," by Zeller, in the British Museum coll., is called *aestiva*, Zell. We have attempted to trace a description by Zeller, but have so far failed, although he notes (*Isis*, 1847, p. 157) that the size of the South European (Italian) specimens varies very considerably. This museum name was most probably the origin of Graves' use of the name (*Ent. Rec.*, xix., p. 211). Presumably Zeller's was a MS. name, and it is altogether wrong to suppose that there is any special permanent seasonal variation in size, at least in Europe. Lowe notes (*in litt.*): "Of a large number of specimens (above 100) taken in Guernsey, in September, 1899, the largest male measured exactly 1·5in., the smallest a trifle under ·9in.; in the case of the females the largest was 1·4in., the smallest just under 1in." The summer was dry, and would possibly explain the small specimens, if they were at all hurried in feeding up, but the fact of there being so many much larger ones occurring at the same time, suggests that some were better placed as regards more succulent and nutritious food, and we would call those specimens above 30mm., ab. *major*, n. ab., and those below 25mm., ab. *minor*, n. ab. As bearing on the fact, however, of the summer examples sometimes being smaller than usual, especially when hurried in their feeding, Sheldon observes that, in mid-July, 1905, *L. boeticus* was worn, but that, when he returned to the same spot in mid-August, another brood appeared already to be out, and of smaller size than those seen a month before. Graves notes some very small specimens, taken in the Ezbekiah Gardens at Cairo, on June 26th, 1907. On the other hand, Norris observes (*Ent.*, xxvi., p. 89) that, at Bordighera, in early October, 1892, he captured some males that were more thickly powdered with bright blue hairs than those taken a week or so earlier at San Dalmazzo di Tenda, and that some of these Bordighera specimens measured nearly 1½ins. in expanse. Reverting again to the Guernsey specimens of 1899 and 1904, Lowe notes (*in litt.*) that "those bred by Baker were mostly of large size; among the females bred and captured, there were two very distinct forms of the female, the difference being in the colour of the blue which occupies the central area of the forewings and base of hindwings; in one (typical) form, the blue is purplish, the colour of *Cyaniris semiargus* males; the blue of the other form is much lighter, brighter, and more metallic, approaching the colour of *Celastrina argiolus* female, but identical with the scarce ab. *metallica* of *Polyommatus pheretes*; the distinction is even more marked in bred than in captured specimens; for some reason the blue scales of this bright form appear more delicate and liable to be lost, but even then the specimens do not approach the purple-blue of the more usual female form." This is apparently our female ab. *caerulea*. Nicéville says (*Butts. India*, iii., p. 204) that the Indian specimens measure from ·9 to 1·6 inches. He also notes (p. 206) that the species varies but little except in size, "though curious aberrations or sports are not infrequent," but he gives no details of any such. Trimen says also (*Sth. Afr. Butts.*, ii., p. 58) "that the South African imagines vary but little except in size. The males differ slightly in depth of blue on the upperside, and the females in the development and distinctness of the discal and submarginal white lunules of the hindwing, while, on the underside, in both sexes, the submarginal white stripe and the orange lunule of the superior hind-marginal black spot of the hindwing present some variation." He adds: "The specimen of *damoëtes*, Fab. (*Syst. Ent.*, p. 526, no. 350, 1775), which I examined in the 'Banksian Collection' in the British Museum, is not separable from *baetica*," whilst he further notes that "examples, that he captured near Algiers in 1881, are slightly darker than the South African specimens." Bethune-Baker states that the Madeiran examples are not different from the European ones. Mabille observes that the Congo examples are a little darker than the European specimens, at the same time bluer and distinctly more narrow-winged. Walker says (*in litt.*) that the specimens taken in Eimeo Island, April 7th-8th, 1883, belong to a small pale form; whilst the specimens from New Caledonia and the Banks and Torres Islands, do not differ from European examples, except in being rather smaller and darker. Only three forms seem to have been noted under separate names. These are:—

a. ab. *armeniensis*, Gerh., "Berl. Ent. Zeits.," xxvi., pp. 125-6 (1882).—Differs considerably from the type in the female, in that the ground colour of *boeticus* is blackish-brown, and the broad blue spot of a shining dark blue tint, whilst the ground colour of *armeniensis* is greyish-brown, the blue spot being only indicated by an irregular dusting of pale blue. On the hindwings the five black, pale-bordered, marginal eye-spots are preceded by an extra row of five or six white spots. In the male the blue is paler than in *boeticus*, the underside is also paler. Taken by Becker at Krasnovodsk.

The female appears to be a slight modification of our ab. *caerulea-fasciata*, of greyer (paler) ground colour, and poorly-developed scaling; one suspects it to be a mere aberration rather than a local race. There is variation everywhere in the ground colour, as well as in the shade of the blue colour, but the remarkable point concerning the variation of this species is that nowhere does it really tend to form any well-defined local race.

β. var. *damoetes*, Fab., "Sys. Ent.," p. 526 (1775); "Spec. Ins.," p. 124 (1781); "Mant. Ins.," p. 77 (1787); Don., "Ins. New Holl.," pl. xxxi., fig. 2 (1805); Butl., "Cat. Fab. Lep. Brit. Mus.," p. 165 (1869).—*Papilio P.R. damoetes*, alis integerrimis, fuscis subtus cinereo-undatis; posticis ocello gemino aurato. Parvus ex hac familia, alæ omnes integerrimæ, supra fuscæ, immaculatæ, subtus griseæ, cinereoundatæ. Ocelli duo atri, annulo antice flavo, postice auro cincti, interiore minore ad angulum ani. Habitat in Nova Hollandia, Mus. Banks (Fabricius).

This is a fuscous form with a mere trace of blue shading. The type example has the "tails" broken off, a fact that accounts for the wings being said to be "integerrimæ." It is in the "Banks Coll.," in the British Museum, and is a small example of the Australian form, in very bad condition, without body, and with the right hindwing almost entirely absent. It has a mere shade of blue on the upperside, thus accounting for Fabricius' colour description "fuscus." It is set as "an underside," the latter being of a rather dark brownish colour, the pale, waved, transverse lines rather narrow, the hindwings only showing of these, conspicuously, the transverse band at some little distance from the hindmargin. It is labelled in Fabricius' handwriting, "*Papilio P. R. damoetes*, 'Fab. Entom.,' p. 526, no. 350," with a further note, "In Nova Hollandia (Australia), Fabr. 'Syst. Ent.'" The fact that one hindwing is largely missing, and the other without a tail, accounts for the Fabrician statement that the wings are "integerrimæ." Butler says (*Cat.*, p. 165) that "Donovan's figure of *damoetes* is scarcely intelligible." So far as the name has any value, it should be considered as comprising the small specimens of the Australasian race, the ♂ with little blue, and the underside of an exceptionally dark brownish tint.

γ. var. *taitensis*, Bdv., "Voyg. Astrolabe," p. 77 (1832).—Alis pallide violaceis; posticis caudatis; omnibus subtus pallide albidis strigis obsoletis obscurioribus maculaque nigra ad originem caudæ. Ailes d'un violet pâle, les inférieures avec une queue; dessous des quatre d'un blanchâtre pâle, avec des raies plus obscures, peu prononcées, et une petite tache noire à l'origine de la queue. Il est de la taille de *Catochrysops boeticus*.—Taiti.

The specimen in the Brit. Mus. is a ♀, somewhat worn, with a tinge of violet in a good light, and a series of pale arches parallel with the outer margin of hindwings. The anal spot is very poorly developed, the second one rather better. It is labelled "Espirito Santo. New Hebrides, 6, viii. '75."

Oviposition.—In June and July, 1906, I saw a good many *Lampides boeticus* in Galicia (north-west Spain), and observed several laying eggs. On one or two occasions the eggs were deposited on *Adenocarpus intermedius*, but this "broom" was almost entirely monopolised by *Langia telicanus*, whilst *Lampides boeticus* adhered very much to *Ulex nanus*. So far as I saw, a plant with no trace of blossoms was never selected, nor were branches with plenty of open flowers apparently pleasing. The chosen branch or plant was generally one with plenty of well-advanced flower-buds, with very few, if any, quite open. The end of a branch was obviously preferred, *i.e.*, within an inch or two of the terminal thorn, but well down the branch a well-developed lateral thorn was nearly as often chosen. The actual spot where the egg was placed was very generally on the stem of a lateral thorn, close above where a minor thorn (leaf ?) arose, so that the latter, though not quite touching the egg, was so close to it as almost to do so, and nearly hide it, and afford it protection from any violence such as that caused by a passing animal, or neighbouring plants waving in the wind, etc. The base of the egg was thus generally directed towards the main stem of the branch. It was rare for an egg to be placed on an actual flower-bud. [On the *Adenocarpus*, *Langia telicanus* very nearly invariably chose such a situation.] In laying her eggs, the female behaved much as many other butterflies do when so engaged, *i.e.*, instead of rushing about wildly, as *Lampides boeticus* seems usually to do, being a strong flyer, and apparently anxious to cover much ground, but not in the straightforward business-like way of, say, *Colias edusa*, she made short journeys of a few yards, sometimes laying several eggs on the same plant before leaving, but usually going to one near and returning. When only one desirable plant was available, the female usually went off to look for another, but returned, not apparently by memory but, by renewed attraction. The egglaying was quickly done, when a spot was selected; the female settled on the twig, looked round and retreated backwards, till the ovipositor discovered the desired spot, which was generally satisfactorily attained at the first trial, and the egg was at once laid. On such a plant as *Ulex nanus*, where each little twig is a complete *cheraux de frise* of thorns, a suitable spot was of course found easily on first trial, and the butterfly never, that I saw, as I have observed with one or two other Lycænids, left the spot dissatisfied. This position for the egg, on one surface and closely protected by another, is very common in Lycænids. *Callophrys rubi* must have the egg touch, and usually adhere to, both surfaces. *Cyaniris semiargus* and *Cupido minima* place the egg on one calyx with another close opposite it, sometimes touching the egg when laid. It must be necessary to these butterflies to feel the opposing and protecting surface with the dorsum of the ovipositor or abdomen, before they yield to the craving to deposit the egg. On June 27th, at a place near Vigo, where *Lampides boeticus* was very common, two females were specially observed laying on a species of *Ulex*, near *nanus*, but with longer and more slender, and with closer, finer prickles (still it might be the same). The butterfly was somewhat particular as to where she should lay them, but still the position chosen varied a good deal. She seemed most pleased with the end of a shoot, which terminated in a spine, and had very young flower-buds below, the eggs being laid on the base of the spine and protected by a young bud or leaflet ? (spinelet ?). She would also try, however, as much as five or six inches from the end of the shoot, and where no lower buds were visible, but always seemed, like *Langia telicanus*, to require to feel a protecting cover for the egg by the dorsum of the abdominal end. Over a score of eggs were seen to be laid, but, it being impossible to remember where they were, only some six or eight were found. A female *L. telicanus* came and laid an egg on the *Ulex* in precisely the same manner, whilst the *L. boeticus* was being watched; so that eggs found might be sometimes those of *L. telicanus*. Eggs of *L. telicanus*, when laid, are much greener than those of *L. boeticus*, which are whitish, even at first. The female flew only a few inches or a foot or so between each act of oviposition. At Luz, July 18th, 1906, I saw a female *L. boeticus* lay an egg on *Ulex*: it was laid at the base of the terminal spine, close down in the axil of a last small spine. On July 5th, 1907, at Guéthary, I came across a plant of *Ulex nanus* with a few open flowers, and, on this plant, I found near the end of one branch four or five eggs of *Lampides boeticus* and another on a well-developed flower-bud ($\frac{3}{8}$-inch long). The great mass of the *Ulex* was still much less advanced. I searched afterwards two or three other plants that were well forwards, but found no more eggs. Unfortunately I felt no certainty that these eggs were those of *L. boeticus*, and, having no proper apparatus for observation, made none on the young larvæ, and, in fact, all escaped in some way when newly-hatched, and I obtained only one larva, which fed up easily on *Lotus corniculatus*, and resulted in a butterfly, at Reigate, on August 28th. On August 6th, 1906, and a few days preceding, *Langia telicanus* and *Lampides boeticus* had been emerging, and, on the date mentioned, two males and two females of the latter were all sleeved over a flowering spray of *Colutea arborescens*, and, at 12.30 p.m., the most recently-emerged female was observed *in copulâ* with one of the males. They had paired since noon, and were still paired at 3 p.m., but separate at 3.40 p.m. Examination of the twigs on the morning of August 7th, resulted in a score of eggs being found on the *Colutea*, chiefly on the end of the spray on the youngest flower-buds, but an odd one or two on a leaf, a petiole, or a petal (Chapman). Graves observes (*in litt.*): At 3.40 p.m., on October 4th, 1907, near Cairo, a slightly worn female of *L. boeticus* was observed by me ovipositing on Lablab (*Dolichos lablab*, L.), a twining herb of the "pulse" family, with long-stalked racemes of flowers. After dropping on two or three flowers the insect settled on a bud, and, climbing to the extremity, deposited an egg about one-eighth of an inch below the termination of the bud, curving the abdomen almost to a semicircle at the moment of oviposition. After resting about a quarter of a minute it rose and flew over the plant twice, then alighted on one of the long stalks and walked rapidly along it, till it reached a nascent bud, when it repeated the process, moving the hindwings slightly up and down in opposite directions, one wing going down as the other was drawn up. The hindwings were very slightly apart at their anterior extremity, the forewings closed, the antennæ moving from side to side. After two eggs had been laid in about three minutes, the insect flew to a leaf and rested, perched on the edge thereof, opening the wings till they were at an angle of about 30° at most, and then closing them. On October 18th another female was seen ovipositing on Lablab at 11 a.m. In this case three eggs were laid on an unopened flower in two-and-a-half minutes. The alternate "rubbing" movement of the hindwings was noted. A female taken on the same day laid a large number of eggs in confinement, depositing nine on one unopened flower of Lablab, six of which were together in groups of two. Powell observes (*in litt.*) that, at Hyères, the eggs are, as a rule, laid upon the flowers or flower-buds of the selected foodplant, many leguminous plants being chosen, although *Medicago sativa* appears to be a favourite food, on the buds of which females have often been observed ovipositing. In captivity, a female *L. boeticus*, sleeved over a young lucerne plant in the early part of September, 1902, on which were no flower-buds, laid a number of eggs on the leaves. These eggs hatched, and one larva fed up on the leaves, but failed to pupate; on October 12th another ♀ was enclosed over a clover plant; in the pot with the plant there was also a small sponge which had been soaked with syrup to serve as food for the butterfly, and, strange to say, all the eggs she laid were deposited upon this sponge, none on the plant; probably she considered this syrup-soaked sponge the best substitute for flowers. In 1902 also the species was observed laying eggs amongst the white flowers of a climbing runner-bean, whilst *Wisteria* also is apparently a foodplant; and some surprise was occasioned when, on October 10th, 1902, a ♀ *L. boeticus* was observed ovipositing on the buds of a climbing convolvulus (*Ipomoea scandens*); an unopened flower, on which she had just deposited an egg, was picked, and she was also seen to lay other eggs out of reach; the egg hatched, but the larva was not reared owing to the dampness in the tube in which it was placed. In August, 1907, at Sebdou, two nearly full-fed larvæ were found in a pod of *Colutea arborescens;* here also a ♀ was observed flying round the bush at the same time seemingly on egg-laying intent. In early October, 1892, Norris observed females at Bordighera, in some fields near the mouth of the Nervia, depositing their eggs on the flowers and fruit, and more rarely on the leaves of *Medicago sativa* (*Ent.*, xxvi., p. 89). Baker observed females in Guernsey, on July 27th, 1900, laying eggs on the calyces of the flowers of *Colutea arborescens*, again on July 19th, 21st, and 22nd, 28th, and 31st, 1904, depositing eggs on the same plant growing in his garden; the females, he said, were always very battered, although quite quick and lively in their movements. Millière, who really knew very little of the life-history of this species, states (*Icon.*, i., p. 245) that the last females deposit their ova on the branches of *Colutea arborescens*. He then guardedly adds that "they ought not to hatch until the following year, when the seeds, destined to nourish the young larvæ, appear." Newman, however, translates this into the positive statement that "they do not hatch until the following summer," etc., of which, at present, we have no proof whatever, indeed all our information is directly opposed thereto, the egg-stage lasting everywhere only a few days. Newman's further remark (*Brit. Butts.*, p. 118) that "the eggs of *L. boeticus*, like those of several, and perhaps all, the British species of the family, do not hatch till the following summer," shows a great want of actual acquaintance with the early stages, not only of *L. boeticus*, but of the common British "blue" butterflies in nature. True, the eggs of *Plebeius aegon* and *Agriades corydon* hybernate in the egg-stage, but all the rest as larvæ with the exception of *Celastrina argiolus* which hybernates as pupa. Newman's record (*op. cit.*, p. 17) that *Aricia agestis* (*astrarche*) and *Polyommatus alexis* (*icarus*) hybernate as eggs, is contradicted by his quotations from Zeller (*op. cit.*, p. 124), Young (*op. cit.*, p. 127), etc., and his quotation concerning *Cupido minima* (*alsus*) from Gedge (*op. cit.*, p. 124), further contradicts the general statement above quoted, so far as it relates to this species. Kershaw notes that, in Hong-Kong, ♀ *L. boeticus* lays its eggs singly on flower-buds and young shoots of *Vigna sinensis.* Anderson states that, in Victoria (Australia), the egg is deposited on the flowers of various leguminous plants.

Ovum.—The egg is of ordinary Lycænid form, *i.e.*, having a flat top and bottom with nearly perpendicular but rounded sides. It is one of the smallest Lycænid eggs, being barely, if at all, larger than that of *Cupido minima.* The egg, when laid, is green, or yellowish-green, but soon becomes white, though, through a lens, a greenish tint can always be detected, the green contents being seen through the thin bottoms of the cells of the network. The greenness, when newly-laid, depends, no doubt, on the translucency of the white coating which is, when first laid, damp, and without porosities filled with air. Its dimensions are—maximum width, 0·46mm., width of flat top, 0·40mm., of the bottom, 0·44mm., height, 0·20mm.; the micropylar area or depression 0·06mm. across, cells of network about 0·03mm. in diameter. It has the usual character of the points of intersection of the network being raised into a knot round the sides and along the margins of the top. The flat tops of these Lycænid eggs are probably achieved, to some extent, by the greater thickness of the adventitious coat and the greater height of the knobs round the margin, the egg proper, beneath it, sloping a little from the centre to the margin of the top. The cells of the network look larger than on most Lycænid eggs; this is especially true of those round the micropylar depression, which are nearly as large as the others, and very nearly of the same form, showing very little of the radial stretching and circumferential narrowing of the cells, so marked in some species. The cells are very irregular in form (and a little in size), polygonal, often quadrangular. Here and there three or four cells follow a line of spiral (engine-turning) on top, but this seems rather accidental than really related to the obvious spiral arrangement on some eggs. There are about four cells to be crossed in drawing a straight line on the top from the micropylar area to the margin, about six, if a slightly spiral course be taken, *i.e.*, going from one cell to that which is the next furthest out, rather beside than beyond it. The cells of the micropylar area are large, the central rosette does not suggest a rosette by any means as much as usual, and consists of five cells, not specially pointed centrally; outside these are two or three rows of similar cells, the cells being 0·01mm. in diameter (Chapman).

Comparison of eggs of Lampides bœticus and Langia telicanus.—Comparing the eggs of *L. boeticus* and *L. telicanus* with a strong hand-lens, it seems to be very difficult to discriminate between them; both have prominences at intersection of network, and these lie in an engine-turned pattern on top (smaller centrally). Those in *L. boeticus* seem larger and whiter (because larger?), especially round the margins, where they are in both cases larger than on top. Both the eggs compared were laid about 12.20 p.m., at Tuy, July 18th, 1906 (Chapman).

Habits of larva.—Réaumur first reared this species August 14th-16th, 1736, from larvæ sent from Lucon by Baron (*Mém.*, ii., pp. 481-2). The larvæ were feeding in the pods of *Colutea*, of which they were eating the mature seeds; the larvæ themselves were of an olive-brown colour, the dorsum of the body marbled with reddish spots. When Réaumur received the larvæ they were very hungry, owing to the pods of the *Colutea* being quite dried, as well as the seeds; having no fresh pods of this plant to offer them, he tried them with green peas, to which they readily took, commencing at once to bore into the interior of them. Chapman observes that the young larva is very clever at hiding itself, probably by penetrating at once into a flower-bud and staying there till half-grown, when it may be found in half-open flowers. Some young larvæ, however, manage to live externally, and may be seen hiding squeezed in at the bases of the spines of *Ulex*. When well-grown, the larvæ are more easily detected, and expose themselves quite freely amongst the flowers. Of the excellent manner in which the small larva of *Lampides boeticus* is protected by its colour, Chapman gives a good illustration. He observes that, on July 18th, 1906, at Tuy, a very hot day, he had for some time been carefully examining a little branch of *Ulex* for eggs of *Langia telicanus*, and was just leaving, when, quite by accident, he detected a larva of *Lampides boeticus*, 3·5mm. long, on a main thorn, its head deeply buried in the axil, and almost exactly resembling in form, colour, and position, flower-buds occupying similar positions in other axils. He further notes that, he was never clearly able to distinguish between the larvæ of *Langia telicanus* and *Lampides boeticus* without a very close and detailed examination, also that the larvæ of the latter appear to be at home on almost any leguminous shrub, can be easily reared on *Lotus corniculatus*, affect *Adenocarpns* and *Ulex* in northwest Spain, the latter also being its foodplant in southwest France; the species appears, he says, to be continuously-brooded in its permanent haunts, and, although it feeds up in southwest France and northwest Spain with lightning rapidity in hot weather, and there appear to be several broods in the summer, whilst in suitable African localities there are possibly a dozen broods a year, yet it can probably not stand anywhere a real winter in any stage. At Vigo, or even Biarritz, it could possibly live through the winter, but taking three or four months, instead of three or four weeks, to complete its changes, no doubt many perishing, but probably enough surviving to make a start the following spring. Millière observes (*Icon.*, i., p. 245) that, in the Alpes-Maritimes, when young, the larva is almost black, and it then attacks only the very young (hardly formed) vesicular pods of *Colutea arborescens*. When older, it varies considerably, being sometimes of a bright green colour, more rarely brown. It lives, during August and September, in the pods of the bladder-senna (*Colutea arborescens*), eating the seeds whilst they are still green and unripe, and during its growth, it passes frequently from one pod to another. Millière further expresses his disbelief in the statement made by some naturalists who say that the larva is first found in June, remarking that the pods of *Colutea arborescens* are only found from July onwards, and that, as the larva only eats the seeds, it could not well appear before their development, and the earliest pods, in spite of constant searching, have never yet furnished, or shown signs of having been attacked by, the larvæ of this species. This statement is largely supported by Powell, who believes that the species has no permanent home in the French Riviera, and avers that only autumnal larvæ are to be found there. We may point out that the species is, however, not at all confined to *Colutea* in Europe, Godart recording it as feeding on the common garden-pea, and this is confirmed by Mrs. Wollaston (*Ann. Mag. Nat. Hist.*, 5th ser., iii., p. 224), in St. Helena and Mauritius, whilst our further notes give several other foodplants. Guenée observes (*Ann. Soc. Ent. Fr.*, 4th ser., vii., pp. 665-668) that *L. boeticus* is very exceptional in its habits, in central France, living in the siliquas of *Colutea*, of which it eats the seeds, instead of exposed on the leaves of trees or low plants, like its congeners. It is true, he adds, that *Lycaena iolas* shares in this habit, whilst, in India, *Virachola isocrates* lives in the interior of the fruit of *Punica*, and a North-American Lycænid acts similarly. Chapman says that, as already noted, from an ovum obtained at Guéthary on *Ulex nanus* on July 5th, 1907, a larva was fed on flowers of *Lotus corniculatus*, and laid up for pupation on August 10th. Zeller observes that in Catania, the larva feeds in the blossoms of *Spartium junceum*, whilst, at Messina, and Naples he found the imagines not rarely on the blossoms and on the leaves of a cultivated bean with long narrow pods, in which the larvæ fed. Rambur says (*Cat. Sys. And.*, pp. 43-44) that, in Andalusia, the larva lives, not only on *Colutea arborescens*, but on almost any leguminous plant, also that he has found it in the pods of *Phaca boetica;* it is, he adds, sometimes so abundant that, having eaten the pods and seeds, the larvæ devour the leaves of the plant, and spread themselves over everything that they meet, even on vegetable *débris*, and become then omnivorous. Aigner-Abafi says that the larva is sometimes found near Budapest and Pecs, always in the seedpods of *Colutea arborescens*, and is generally taken in August and September whilst searching for larvæ of *Lycaena iolas*. The larvæ, he adds, are not unlike those of the latter species, but are much more slender in build and essentially different in colour, never so rose-coloured, but dark lilac-coloured, and sometimes pale green; the diagonal stripes on the side also are more distinct, the head is brownish-black, and usually withdrawn in the prothorax, only being protruded when the larva is feeding. Baker took nearly fullfed larvæ, in Guernsey, in the seed-pods of *Colutea arborescens*, from August 11th-13th, 1900; these had mostly pupated by August 19th. From these, three males emerged, on September 11th, and on September 27th all had emerged, 170 in all, males and females in about equal numbers. In 1904, he bred a few more, the first emergence being on September 13th. He states that he is convinced the larvæ never leave a seed-pod after they have once entered it, except to pupate, thus contradicting Millière's observation (*suprà*). In this way he accounts for the variable size of the insect, and suggests that, if a larva has its nursery in a rich, well-filled pod, it grows to large size, if otherwise it produces a half-starved specimen and a small imago. The larva, he adds, is very active and will escape through the smallest crevice when it leaves the seed-pod, in which it never pupates, according to his experience, neither does it suspend itself in any way, but changes to pupa on the ground of the breeding-cage, among, or rather on the surface of, the moss and soil. Anderson says that, in Victoria (Australia), the larvæ feed on the flowers or in the seedpods of various leguminous plants, the common pea being a favourite foodplant, as well as various garden species, *e.g.*, *Swainsonia*, *Baptisia*, *Adenocarpus*, *Dolichos*, etc. He further notes that the larvæ are rapid feeders, very hardy, frequently turning to pupæ when only about half the usual size, if the supply of food fails. Green says (*in litt.*) that, in Ceylon, the larvæ of this species is a serious pest on *Crotalaria striata*, feeding in the pods, and often completely destroying the seed crop, in February, March, and April, although it appears to breed all the year round. He has also found the larvæ feeding in the pods of *Crotalaria laburnifolia*. Kershaw notes the larva, in Hong-Kong, as feeding, when young, on the flowers and buds of *Vigna sinensis*, but later boring into the seedpods and feeding on the seeds.

Larva.—*First instar* (newly-hatched): Hardly over 1mm. in length, nearly colourless, head black, legs tinted, prothoracic plate and anal plate less tinted, hairs dark; head 0·2mm. wide, neck hardly longer than head, body not much broader than head. Prothoracic plate broad, about 0·14mm.; oval in form, except that it is produced in the middle in front to a blunt angle; on each side it has, at the middle of the front margin, a large lenticle, at middle a moderate hair (0·035mm.), towards outer end of posterior margin, two very short hairs (0·01mm.). On each side, in front of it, are three long hairs (about 0·09mm.), another rather behind its outer angle; the prothoracic spiracle is large and somewhat raised, has a large lenticle immediately in front of it, and, quite in front, three hairs placed rather in a triangle; the upper longest (0·1mm.), the others shorter (about 0·08mm.); then there are two hairs near base of leg—the posterior very long (0·1mm. or 0·11mm.), the anterior shorter, about 0·03mm. From the mesothorax to the 8th abdominal segment there is, on each side (about one-fifth the width of larva apart, across middle line), a dorsal hair (0·035mm. long in front, 0·75mm. on the 9th abdominal segment), apparently the seta of tubercle i; there is no trace of ii detected; outside and in front of this is a large lenticle on the 2nd-8th abdominal segments; on the 8th abdominal segment, the hair, lenticle and large spiracle almost touch each other, tubercle iii (?) being absent. On the 1st abdominal segment this lenticle is not seen, but a smaller one occurs a little further out. A hair, that is probably the seta of iii, occurs on the 2nd and 3rd thoracic and the 1st-7th abdominal segments, and ranges with the hair on the prothorax close to the posterior outer corner of the plate; in size, this hair is almost the same as that of i, and appears to have no accessory. The spiracles are rather large and on raised bases. Below the spiracles are two hairs, the longer, about 0·08mm., really very long, is rather low and behind the spiracle, the other, a little in front of the spiracle and only half as far below it as the other, is much shorter (about 0·03mm.); these two hairs occur on all the abdominal segments, 1-8, and are represented on the 2nd and 3rd thoracic segments. Lower down, about the middle of the segment, is a long hair (0·09mm.) (=vi ?), and lower still a short one (0·03mm.). The abdominal segments 9 and 10 have no dorsal hairs; there is an anal plate of irregular shape, roughly circular, about 0·05mm. in diameter, faintly tinted, with no hairs or lenticles detected; more or less marginally are eight or nine hairs on each side, two very long, one nearly 0·10mm., one or two very minute. On the abdominal segments 1 to 6, there is a small lenticle above and a little behind tubercle iii, the one on the 1st abdominal segment is the one already noticed above. A marginal lenticle occurs apparently on the 8th abdominal. The prolegs have a front and back pair of hooks; the front has nearly always a rather larger and then a smaller one; the posterior is usually made up of the large hooks only, but a smaller is present sometimes; the anal claspers are the same, the hooks being slightly larger; the claws of the true legs are sharp, and those of the third leg are seen, in one specimen, to be accompanied by a battledore palpus on leg or the claw.* The general surface is closely-set with minute skin-points which are smooth and rounded and nearly colourless, only on the front margin, laterally and below, on the prothorax, are they anywhere found to be sharp and spicular. The hairs are very straight, unspiculated, and have smooth conical bases. The special points, in which this larva differs from those of more typical Lycænids, are—in the straightness and smoothness of the hairs, in tubercle ii being absent, in iii carrying a strong well-developed hair without an accessory one, and in iv and v being apparently present as such, and not represented by three hairs. The dorsal gland of the 7th abdominal is not to be detected in this instar. *Second instar:* About 1·6mm. long, 0·4mm. wide, with sides nearly parallel to the 7th abdominal segment; green with reddish lateral and dorsal flanges, and some tinting between (really the larva varies much in colour and is rarely as much coloured with reddish as is this specimen). No trace of the special glands of the 7th and 8th abdominal segments could be seen in first instar; those on the 8th cannot now be made out, but there is a distinct transverse line on the 7th, marking the honey-gland of that segment. The head is black, 0·4mm. wide, with a neck of at least its own length. On the prothorax there are about 25 hairs on either side above spiracular level (8 or 9 in first stage); the prothoracic plate cannot be clearly defined as it is of the same colour and texture as the rest of the segment; the longest hair is about 0·15mm., perhaps a dozen are very little shorter, the rest decrease to 0·02mm. or less. There are 5 or 6 lenticles (above spiracle) nearly symmetrically placed, and the spiracle is large, raised, with a sloping rim, about one-third of the width of the opening in height. The distribution of hairs seems very much alike on all the following segments to the 6th abdominal; there are, on each side, above the spiracle, about 12 or 13 hairs, not very clearly divided into a dorsal and a subdorsal group, nor is the dorsal distinctly divided from its fellow of the opposite side; on one or two segments there appears to be a mediodorsal hair; these hairs vary from about 0·8mm. to 0·14mm., one or two on some segments being perhaps even longer; there is a hair (about 0·1mm.) in front of, and one behind, the spiracle; the subspiracular, or flange, group contains six or sometimes seven hairs, usually with one about, or nearly, 0·2mm. long, the rest shorter. This group is more distinct and definable from the others than any of those above spiracle; below this is a group of three or four hairs, one long (0·16mm.) and one or two shorter ones ventrally; the hairs on the 7th, 8th, 9th, and 10th abdominal segments are disturbed by the dorsal gland of the 7th and the anal plate, the latter a rounded area, without hairs, about 0·07mm. across. The flange-hairs round these segments cannot be definitely assigned to each, but small hairs are very numerous behind the 10th. The spiracles are large (0·015mm. in diameter); they have a dark margin and a central circle (the real lumen?) about two-fifths of the total width. The skin is covered closely with rounded skin-points; they have, however, sharp points round the front of the prothorax. The lenticles are difficult to define; on the central abdominal segments is one a little above the spiracle, and

* I have not been able to prepare a skin, flat, and though I am fairly confident that the above description is accurate as far as it goes, the difficulty of making out minute detail may have resulted in some omissions, especially perhaps of lenticles.

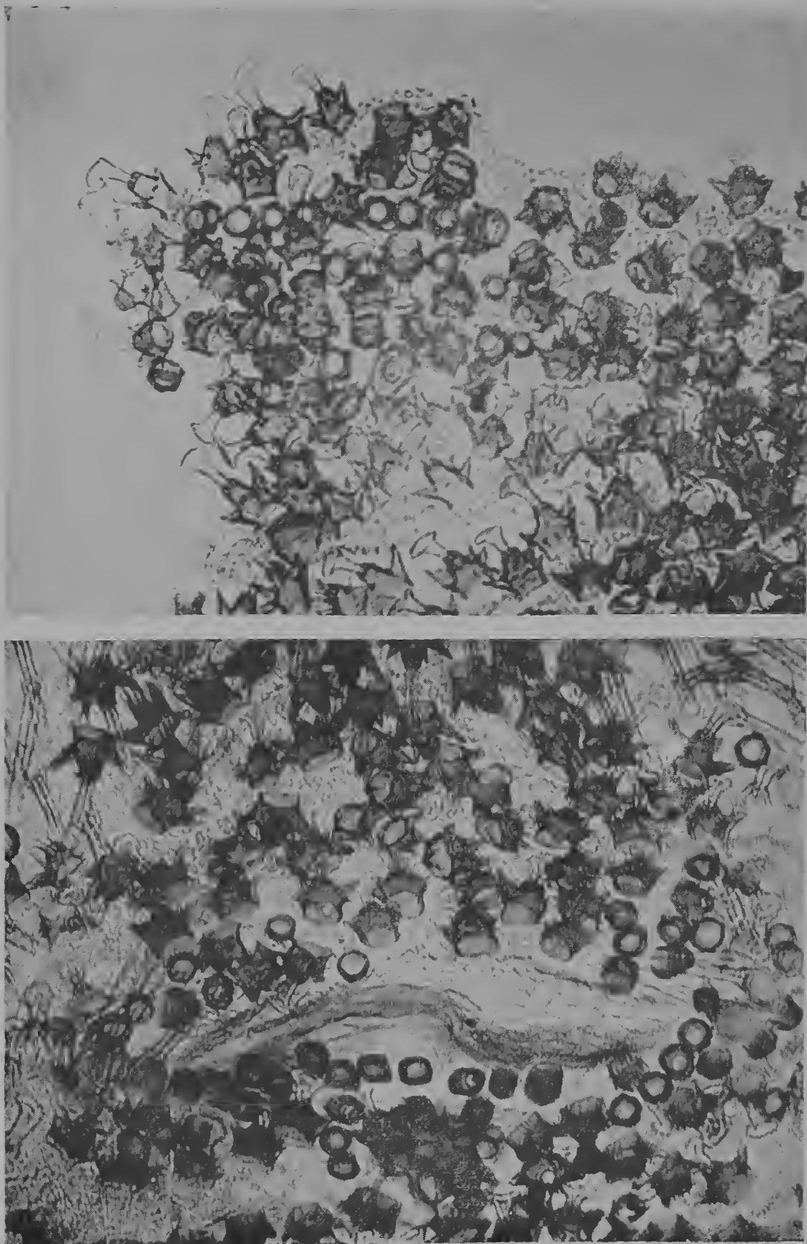

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Photo. F. N. Clark.

PORTION OF LARVAL SKIN OF LAMPIDES BŒTICUS SHOWING—(1) CALYCIFORM OR FUNNEL-SHAPED HAIRS, (2) HONEY-GLAND × 200.

Plate XX.

(To be bound facing Plate XX.

Portion of larval skin of Lampides bœticus in last instar × 200.

Fig. 1.—Calyciform or funnel-shaped hairs.

From the posterior border of the 7th abdominal segment, above spiracle. The upper part of the figure is the posterior border of segment, showing calyciform, funnel-, or fungus-shaped hairs of somewhat similar character to the "fungus-hairs" of Chrysophanid pupæ, but these have the same kind of base as the other larval hairs.

Fig. 2.—Honey-gland.

Part of the dorsum of the 7th abdominal segment (lower part of figure is posterior), showing the area of the honey-gland, the position of which is the twisted area free from hairs across the middle of the figure. The twisting of the gland, and the crowding of the hairs are due to the larval skin not having been fully and evenly spread out. Behind and at the sides of the gland is a row of closely-set lenticles. Close in front, and further back, funnel-hairs (better seen in fig. 1). Further to the front are ordinary hairs as in pl. xxi., fig. 2.

another a little higher, towards anterior margin of segment; there are certainly others, but not grouped clearly enough as to position to describe. The hairs all appear to have smooth conical bases, and the hairs themselves taper to a point, and, if spiculated, are too finely so to be detected. In both the first and second instars the hairs appear to be smooth and simple. The prolegs and claspers have two groups of hooks, an anterior and posterior, each with four hooks, generally two larger and two smaller, in one case a smaller one appears to be absent. The true legs are dark, short and thick, but with a rather slender sharp claw. *Final (? fourth) instar:* In the last skin, except a set of lateral flange hairs, the hairs are no longer than in the second instar, but are much thicker, much more complicated and varied in structure, and vastly more numerous, so that any question of counting them is almost absurd. In the larval coloration there is much variation; the ground colour is usually green, tinted with various amounts of red dorsally and laterally, but the larvæ are not so constantly or deeply coloured as are those of *Langia telicanus*, which occur with them, and are very difficult to distinguish therefrom. In this instar, the dorsal hairs are mostly darkly-tinted, especially are their bases so; beneath, they are pale and much more slender, and, on the whole, longer, and with simpler bases. The bases of the longer lateral hairs are very large, but their branches are comparatively small, and both hairs and bases are much paler than the dorsal hairs; except in size they resemble more those of the lower surface than of the upper; the shorter hairs of the lateral flange are more like those of the dorsum. Seen in a mounted skin, these are a wonderful assemblage, the most numerous variety is about 0·1mm. long, of which the base is about a third (say 0·03mm.); the hair itself is thick and short, more like a dagger than a hair, and is well spiculated; the base has five or six great thorns projected in a circle round it, pointing upwards and outwards from the centre, so that their points are about level with the top of the base and measure across, from those of one side to those of the other, as much as the height of the base. Some of this pattern of hair are shorter, others nearly twice as long, with both hairs and bases no thicker than the others, making both look more slender; amongst them are hairs just the same, but hardly visible, owing to both hairs and base being colourless and transparent. Another form of hair is decidedly shorter and with a much shorter and less spiculated base; this hair is club-shaped, and is finely spiculated all over; there are intermediates between this and the ordinary hair, like a dagger thickened in the middle. Lenticles scattered amongst these are very similar to the hair-bases, but are much wider at the top, and, therefore, cylindrical or barrel-shaped, with the side spicules much reduced, or represented by short knobs or points round the top circle; other lenticles, especially near the spiracles, are rather wider, but are very short, *i.e.*, very slightly raised circles; these have the margins more or less knobbed and spiculated, and show the dotted membrane of the opening. Another form of lenticle is like a tailor's thimble in form, with no spicules; this is rare. In the neighbourhood of the dorsal gland of the 7th abdominal segment, lenticles are extremely abundant, almost crowded together, generally of the flat form, with slight marginal spiculations. Amongst these are very remarkable hairs in considerable numbers; these are referred to in the living larva as being globular; here they are, therefore, probably collapsed. They have bases like the ordinary hairs, except that they are narrower above and at base, so that the rather smaller spicules stand out markedly as a somewhat projecting ring; the hairs themselves are very short, about as high as the bases, and are calyciform, somewhat like a convolvulus-flower; when best seen they are margined by a set of very fine spicules, the upper part of the globe probably exists, but fallen down into the cup, being, therefore, of much softer tissue than the cup-shaped portion. Further back are more similar hairs, if we assume that here there is no collapse, the hair having an expanded top, curved away, however, to one side or another; further back are also some much larger, half as large again, lenticles, comparatively slender hoops; other lenticles are high tubes, with margins incurved from the (faintly-marked) line of spicules, and the central dotted membrane convex; all these forms of hairs and lenticles, varied by excess or defect, are accompanied by intermediate forms, and are mixed in different proportions, making most marvellous combinations. The true legs are about 0·6mm. long, the three joints and claw being in proportion about 1 : 2 : 3 : 1, the claw being small compared with that of the early instars; the width of the joints are as about 3 : 2 : 1, very nearly in 0·1mm.; each joint carries several hairs, apparently unspiculated. The prolegs have two pads, each with 13-17 hooks, the alternate hooks slightly varying in size. The skin-surface is covered by fine rounded points; on the prothorax, at least, these vary to fine spiculations, and, in places, to a pavement-epithelium network. Some of the hairs in this prothoracic region have smooth, egg-shaped bases, and shafts with almost evanescent spiculations (Chapman). Of the spiracles, Guenée notes (*Ann. Soc. Ent. Fr.*, 4th ser., vii., pp. 665-666) that, "instead of being placed laterally along the usual stigmatal line, they are placed much higher, and almost on the back, so that the 9th, which, as one knows, is always placed above the line in question, and not in line with the preceding eight, is here placed absolutely in the same line; but this disposition does not belong exclusively to this species, for the larvæ of other Lycænids, show it equally; further, other larvæ of similar form, in which the dorsum is semi-ovoid and the venter flattened, also show more or less this abnormal situation of the stigmata; at least, I can affirm this to be so in the larvæ of the European Limacodids."

THE EVERSIBLE AND HONEY GLANDS OF THE LARVA OF LAMPIDES BŒTICUS.—On the middle of the dorsum of the 7th abdominal segment of the larva of this species is a gland that secretes a sweet fluid beloved by ants, whilst, on either side of the 8th abdominal segment, is an evaginable tentacular organ supposed to be used for attracting ants to the larva (see preceding volume, pp. 30 *et seq.*). These structures were figured and described at length by Guenée as they exist in the species under review. He writes (*Ann. Soc. Ent. Fr.*, 4th ser., vii., pp. 665-668): "The three terminal segments of the larva of *L. boeticus* appear to be united in one mass, and, instead of the usual well-defined segmental incisions of other larvæ, found also on the front segments of this, one can only detect with a lens, two slight irregular folds, which denote feebly their separation, whilst the circular ring of spiny hairs, which adorns the anterior incisions, is altogether wanting on the three terminal segments. Evidently all lateral flexion is impossible in these three

Plate XXI.

(To be bound facing Plate XXI.)

Comparative view of Theclid and Lycænid larval hair-bases in final instar.

Fig. 1.—Portion of larval skin of *Laeosopis roboris*, last instar ×100.

The larger hairs are from the lateral flange, the smaller those just above. The former are more pointed, the latter continue of nearly even thickness to the end; both are very finely, and especially at the ends of the smaller hairs very closely, spiculated. The bases are very like some flowers (*e.g.*, convolvulus), the hair being the stalk, with the margin of the petals attached to the skin. Several lenticles are also seen.

Fig. 2.—Portion of larval skin of *Lampides boeticus*, last instar ×200 (*i.e.*, twice that of fig. 1).

The hairs are very similar to those of *Laeosopis roboris* (fig. 1), but the hair-bases have 5 or 6 spines around them. Several curious tall lenticles appear in this figure. None of the curious hairs, some of which occur in pl. xvi, are seen in this fig.

N.B.—In both figures the hairs are squeezed down flat, and, so far, present an abnormal disposition.

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Photo. F. N. Clark.

COMPARATIVE VIEW OF THECLID AND LYCÆNID TYPES OF LARVAL HAIR-BASES.

1. LÆOSOPIS ROBORIS ×100. 2. LAMPIDES BŒTICUS ×200.

segments, which are almost soldered together, yet this soldering seems only apparent, for it is not reproduced in the chrysalis. [This structural explanation is necessary in order that there may be no mistake as to the number of segments, the position of the stigmata, or of the special organ, which I have discovered, and here describe.] On the 11th (8th abdominal) segment, a little behind and a little below the 9th (last) pair of stigmata, are two openings, almost exactly like the spiracles, and very nearly of the same size. I thought at first they were two extra breathing-organs, but, as I turned over the larva to examine the openings, which seemed different from those of the spiracles, the larva, which was very restless, suddenly threw out from these cavities a very specialised organ, which I may perhaps best compare with certain tentacles, similarly under the control of certain Polyps. The organ is soft, cylindrical, roughly pyriform, the extremity furnished with little, fleshy, hair-like points, sometimes almost flattened with the surface, at other times spread out around a centre placed at the apex of the caruncle. Under the microscope, it was seen that these apparent little hair-like structures were elongated tentacles, themselves bristling with fleshy spines. Those placed at the circumference are somewhat regularly disposed, and sometimes lie on the cylinder (probably as is necessary when the organ comes out or is withdrawn into the opening), sometimes erected in a menacing way; but the tentacles are very numerous, crowded together, and lying on one another on the summit, in such a manner that it is impossible to count them. The larva is able to eject these organs at will, sometimes singly, at others both together. They shoot them out then like the Y-like osmaterium of Papilionid larvæ, or the horns of the Limacodids. Sometimes they only protrude them halfway, and then the tentacles of the apex are expanded little or not at all; sometimes they are protruded entirely, and then the tentacles spread out on all sides. Sometimes the larvæ allow themselves to be handled, excited, or goaded, without having recourse to them, a fact which seems to exclude the idea that the organs are a means of defence or intimidation. Whilst at rest, or walking, they are concealed, but the observer can always obtain a view of them by pressing the larva from the head to the anus. It would be interesting to submit them to a greater magnifying power than I have at disposal, in order to study more thoroughly the interlacing fascicles at the summit, and to demonstrate the presence or absence of any opening whatever between them. I have, with my microscope, vainly endeavoured to detect such. But this is not all for this larva presents another peculiarity. On the summit (dorsum) of the 10th (7th abdominal) segment, another opening is to be observed, this time, however, placed transversely, and surrounded by a prominent cushion, around which the granulations which cover the whole of the body of the larva particularly accumulate. From the centre of this cushion the larva extrudes at will a sort of hemispherical transparent vesicle, from which exudes a very large drop of fluid, and which is replaced by another if the first one be absorbed. The larva only secretes this fluid when excited, imitating the larvæ of *Cucullia*, etc., which spit out from the mouth a coloured fluid, with the idea, no doubt, of injuring those who handle them; but, in these latter larvæ, the primitive use of this fluid appears to be sometimes to soften their food, as in the case of *Cossus*, at others to make the food more easily assimilated by aiding as a kind of salivation. Here, however, nothing of the kind takes place. One cannot fairly compare this vesicle with the tubercular eminences which many other larvæ carry in a similar position, and which are altogether independent of the trapezoidal warts, which, as I have elsewhere noted, are intimate structural parts of the general organisation of larvæ; these eminences are sometimes permanently fixed, sometimes retractile, as I have also explained, but I know none that have an aperture, and are able, in consequence, to allow the passage of any fluid whatever, but I assured myself, in skinning a larva of *L. boeticus*, that the integument has really an aperture at this point, and also that the droplet is not due simply to exudation. For the rest, the lymphatic temperament of this larva, added to the succulent nature of its food, disposes it strongly to these emissions of fluid. Such are the two singular points presented by the larva of *L. boeticus*, and it appears to me that they well deserve the attention of observers. The purpose and the nature of this exceptional structure are not easy to guess, and, in this case, as in so many others concerning which I have expressed my ignorance, the field of conjecture remains open. The explanations that have been suggested in certain analogous cases appear to be too far-fetched, and I have no new suggestions to offer." It appears to be a peculiar fact that, whilst many of the early authors noticed the connection between the Lycænid larva and ants, without observing, or even knowing of the existence of, the gland, Guenée described the gland without surmising that it had any connection with the ants. In fact, Guenée studied the larva, hoping to find some curiosity connected with its living inside the pod of *Colutea*, yet these glands are of use only when the larva is outside, and so accessible to ants (and enemies from which ants may protect them), also indirectly suggesting that *Colutea* is only one of many foodplants, and not by any means the principal one, as suggested by many authors.

Ants attending larvæ of Lampides bœticus.—Nicéville says (*Butts. of India*, iii., p. 205) that he has found three species of ants attending the larvæ of *L. boeticus* in India, at Calcutta, *viz.*, *Camponotus rubripes* var. *compressus*, Fab., *Tapinoma melanocephalum*, Fab., *Prenolepis obscura* var. *clandestina*, Mayr (identified by Forel).

Larva in quiescent stage preceding pupation.—8·5mm. long, fastened loosely by the tail and a few threads crossing over metathorax; the body a little arched, so that the prolegs are raised. The colour is pinkish-brown over a white interior; a redder dorsal band, and red oblique bands (straight on mesothorax) from the prothorax to the 6th abdominal segment; the lateral line not distinct. The larva has a transverse indented mark on the 7th abdominal segment, and a circular area free from spicules, and puckered to centre, behind (and a little outside) the 8th abdominal spiracle. The spiracles are large, with a plain outer brown line, and an inner one also smooth, except that it is not quite clear of a series of markings just outside it. The spiculæ are numerous and rather closely-set, very dark brown, darker than any other markings; they have a central straight spiculated shaft with some four to eight basal offsets, generally, however, five or six; the length of the central shaft varies a good deal; along the subdorsal line a number of these glisten like crystal, being transparent and colourless; they are more numerous on the later segments and on the

7th and 8th abdominal segments are remarkably modified; here the basal spines are much as in the others, but the central spine has a very short stalk and a globular top, which is glassy-white and glistening, and with apparently an extremely minutely-spiculated surface; amongst these are a few with the same form, but with stem and globe deep brown; there are no ordinary spines, and a few show no central spine, and might easily be taken for lenticles, some of which also occur. Each segment is divided into two subsegments by a median groove. The lenticles are not specially abundant near the spiracles, but, in the incisions a little higher up, are so; here they form rings with marginal serrations, and some appear to stand up like cups; the serrations are semiobsolete spicules, and occur several together and then a blank; only rarely is there a complete regular set round the margins. The prothoracic plate is obsolete, *i.e.*, it cannot be defined, unless these spots with slightly darker spines be its corners. The lateral hairs are longer than the others, 0·5mm. in many cases, the dorsal about 0·08mm. or less (Chapman).

Variation of larva.—The following notes on larvæ from far distant geographical districts may prove interesting:

(1) *South Africa:* Bright green, paler on the undersurface; a dark green dorsal line; beneath it, on each side, an indistinct line interrupted on each segment, followed by a row of short, oblique, indistinct streaks of the same dark green, and a pale green line just above the legs. Head small, shining reddish-brown. Two-thirds of an inch in length (Trimen).

(2) *India:* When full-grown seven-sixteenths of an inch in length, pale dull green throughout, slightly shagreened, but not hairy, except slightly so at the sides; the small retractile head smooth, pale ochreous-brown, shining; a dorsal line of a somewhat darker green than the ground, no other markings whatever, altogether a very plain-looking creature. The constrictions at the segments shallow, the spiracles black but inconspicuous, the usual extensile organs on the 12th segment very short (Nicéville).

(3) *Hawaiian Islands:* Onisciform. Obscure olive-green, pretty thickly sprinkled with short hairs (much the appearance of a bristly surface shaved); dorsal and subdorsal lines and the region included obscurely rosy; head testaceous, bearing a black V-shaped mark, which points backwards; the rosy markings vary in intensity, as also the ground colour; legs of the ground colour; spiracles white (Blackburn).

(4) *Europe:* Elongated oval form, convex above, flat underneath, olive-green, with somewhat reddish lozenge-shaped marks on the back. The vascular (dorsal) line is broad and uninterrupted. No subdorsal. The stigmatal flange (line) bright green, straight, uninterrupted. The stigmata are yellowish. There is a white line running the whole length of the ventral surface, which surface is of a bright green. The head small, black, very retractile, is almost entirely hidden under the first segment. The true legs are brown, the prolegs are concolorous with the body. The larva varies sometimes to bright green, and, but more rarely, to brown (Millière). [Millière figures two larvæ (*Icon.*, i., pl. xxviii., figs. 1 (green), 2 (brown).]

Godart describes the European larvæ as "variegated with red on the back," which leads Trimen to remark that Blackburn's Hawaiian larvæ, "described as of an 'obscure olive-green,' and as having the 'dorsal and subdorsal lines and the region included obscurely rosy,' accord in the latter character with Godart's description; the head is further described as 'testaceous, bearing a V-shaped mark which points backward,' and the spiracles as white. It thus seems evident that the larva varies considerably." One readily follows Trimen in this, by reading his description of the African larva (*suprà*). Anderson notes (*Victorian Butts.*, p. 84) that the Victorian larvæ vary in colour, some being very pale green, and others various shades of brown, but all have a reddish dorsal line and oblique streaks on the sides. It will be observed that the Indian and African forms are described without red on the dorsum, whilst the European, Australian, and Pacific Islands' forms have larvæ more or less marked with red.

Foodplants.—Apparently almost polyphagous on the flowers and young fruit of leguminous plants—*Colutea arborescens* (Réaumur), *Phaca boetica* (Rambur), *Spartium junceum* (Zeller), *Ulex nanus*, *Adenocarpus intermedius* (Chapman), *Spartium scoparium*, *Genista* sp.? (Stefanelli), *Medicago sativa* (Norris), *Lupinus mutabilis* (André), *Pisum sativum*, in confinement (Réaumur), *Lotus corniculatus*, in confinement (Chapman), cultivated runner-beans with white flowers, ? wisteria (Powell); *Phaseolus vulgaris*, *Sarothamnus* sp.? (Walker); a cultivated bean with long narrow pods (Zeller). Lablab beans (*Dolichos lablab*), sp. of broom, and *Colutea* sp.? (in the Lebanon) (Graves), *Vigna sinensis*, Bersim clover (*Trifolium* sp.) (Willcocks), *Pisum sativum*. and sweet pea (in gardens in Egypt), *Astragalus* sp.?, vetches sp.? (in the Egyptian deserts) (Graves). *Dolichos cultratus*, unfolded leaves, flowers, and young pods (in Japan) (Pryer). *Crotalaria striata* (in India) (Nicéville), *Crotalaria laburnifolia* (Ceylon) (Green). *Phaseolus vulgaris* (in Sumatra) (Martin). A yellow-flowered *Cassia* (sp.?) (at Hong-Kong) (Walker). *Crotalaria capensis* (South Africa) (Trimen). *Melilotus* sp.? (in Hawaiian Islands) (Blackburn). *Swainsonia*, *Baptisia*, *Adenocarpus*, *Dolichos*, etc. (in Australia) (Anderson). [Rosemary (Cunì y Martorell) wants confirmation.]

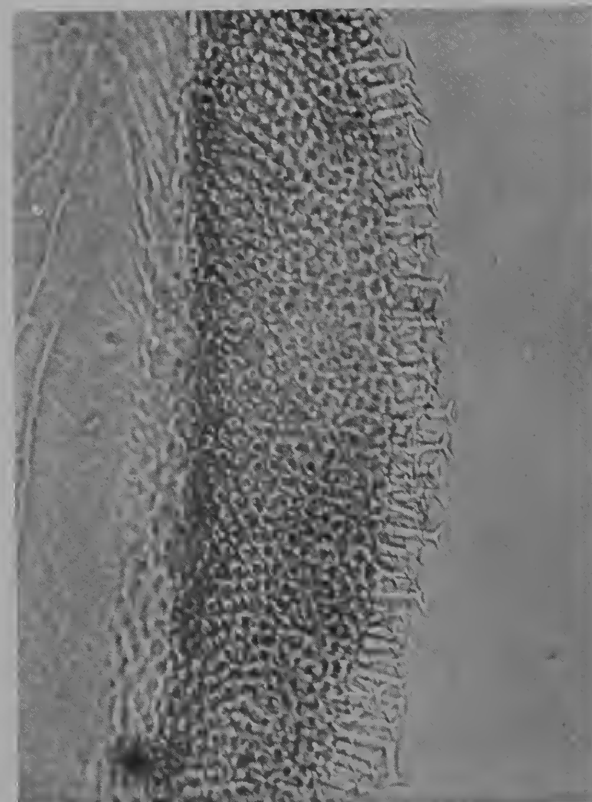
Parasites.—The larva of *L. boeticus* is rarely ichneumoned (in southern France); I have been able, however, to observe two larvæ which had been attacked by a parasite. Twelve or fifteen days after their transformation, which had taken place about the middle of September, this parasite came out to the number of fourteen or fifteen individuals from the body of each larva, and gave me the perfect insect. I refer it to *Microgaster glomeratus* (Millière). The larvæ, in 1847, in the Chartres district, were in many cases stung and destroyed by a Chalcid parasite (Bellier de la Chavignerie). *Alcimus stenurus*, Loew, ♀, was bred from a larva of *L. boeticus*, December 29th, 1900, at Umtali, Mashonaland; 3700ft. (G. A. K. Marshall).

Pupation.—Baker, who reared some 200 imagines from larvæ in 1900 and 1904, states that, in his experience, the larva never pupates in the seedpod in which it has fed, nor does it suspend itself in any way, but changes to pupa on the ground of the breeding-cage, among, or rather on, the surface of the moss and soil (*in litt.*). Réaumur, who bred this species in 1736, observes (*Mémoires*, ii., pp. 431-2) that two of the larvæ he had, fastened themselves against the sides of the box in which they were reared, after the manner of the "cloportes" larvæ previously described (*Edwardsia w-album*, etc.), and changed into pupæ, about equal on either side of the band by which they were supported, the pupal stage lasting from August 2nd to the 14th, and from August 5th to the 16th respectively. Chapman says that the fullfed larva is loosely fastened to a silken pad by its tail or cast skin, although it has no cremastral hooks, and is also supported by a median girth, the latter, however, only consisting of some four to six threads, across the metathorax or 1st abdominal segment. He adds: "The remarkable circumstance that this pupa suspends itself by a girth, albeit a poor one, yet has no cremastral hooks, requires to be elucidated with a little more detail, the pupa specially described below, got loose at the anal extremity as soon as I began to examine it, and I thought at first I must have used more violence than I was conscious of. I have examined six pupæ carefully, and find they all agree absolutely in having no hooks. The cremastral region has an interesting structure, to be taken in connection with that in *Callophrys rubi*, and other species with cremasters that are not functional, or, as here, obsolete. There are scattered hairs, of exactly the same pattern as those near the spiracles, about 0·025mm. to 0·03mm. long, with spicules towards their extremities, and there are a good many of the rosettes of the skin-netting, rather well-developed, but with no more trace of hair as part of them than elsewhere; the homologies with the other pupæ alluded to suggest that these skin-rosettes are the representatives of the vanished cremastral hooks. One larva was found to have made a very flimsy cocoon amongst the blossoms, apparently for pupation." Millière states (*Iconographie*, i., p. 245) that the larva does not pupate in the pod whose seeds have nourished it, but that, having attained its full growth, it leaves the pod, and either descends among the dried leaves or fixes itself, head uppermost to a branch of the shrub, the pupal stage not lasting more than five or six days. Millière's figure shows no anal attachment. Aigner-Abafi observes (*in litt.*) that the larva usually pupates in the seedpods of *Colutea arborescens* in the Budapest district, the pupa not being so large, nor so contracted, as that of *Lycaena iolas*, but smaller and much more slender (Uhryk, *Rovart. Lapok.*, x., p. 1275). Bellier de la Chavignerie records (*Bull. Soc. Ent. Fr.*, 1847, p. 105) that he reared several *L. boeticus* from larvæ taken at Chartres, that the larvæ pupated in August, most of the imagines emerging ten or twelve days after pupation, although two did not do so until November 17th, the larvæ and pupæ being in all cases kept in a room exposed to the north, the windows open day and night, so that the temperature was the same as outside. In South Africa, Trimen notes the pupal stage as lasting from ten to twelve days in the summer. Kershaw states that in Hong-Kong pupation takes place within a hollowed-out seed-pod or beneath leaves, etc., which it secures slightly together with silk; the pupa is attached by a band round the middle, but apparently has no cremastral attachment.

Pupa.—Length 8·5mm.*; width at the 3rd abdominal segment nearly 3mm., narrower thence to the rounded tail; the pupa is flat ventrally, and evenly rounded above except for a decided rise over the centre of the mesothorax; height at 6th abdominal segment 2mm., at the 4th 2·7mm., at the mesothoracic spine 2·6mm., at the 1st abdominal (waist) 2·4mm.; from the end of wings to cremaster 2mm., to the head 6·5mm. [A few threads pass over the 2nd abdominal; the cremaster has but slight hold.] Colour pale, slightly flesh-tinted ochreous, with scattered black dots; these are very minute over wings and appendages; dorsally, they are larger, and combine into a dorsal line and large black spots, two to each abdominal segment on each side, one just above spiracle, the other a little in front and nearly halfway to dorsum; the other smaller points seem irregularly distributed. The headpiece is spotted like the rest of the pupa (without spots in pale specimens); it is about 2mm. long antero-posteriorly,

* This specimen is a little dwarfed owing to having been fed in a tube on *Lotus corniculatus* (flowers), a not altogether congenial food.

2·5mm. across to extreme of eye-covers (in both cases along the curve, not direct); centrally and laterally it has a good many lenticles and short hairs, almost without on an intermediate line; the lines of network are rather transverse in front and laterally, longitudinal centrally and further back, less of a network than elsewhere, but essentially the same sort of reticulation. The eye-covers show a smoothly curved bounding-line, of darker tint, outside which the lines of the network of sculpturing fall on it perpendicularly, *i.e.*, radially; within the line is a broad arc of eye-points, and, centrally, is a portion of ordinary reticulated surface with five or six hairs and three or four lenticles. The labrum is a small square, about 0·25mm. across, with angles crosswise; it is fairly well-marked off. The mandibles are, on the other hand, continuous with the face-piece, with no suture, and meet in the middle line for about 0·25mm.; where no suture can be seen (as here) it is very possible the mandibles are absent or buried, and it is the face-pieces that carry them that meet each other; it is more probable, however, that the suture and not the whole mandible is evanescent, in any case, it is convenient to call the mandible anything that meets across below the labrum. A very minute diamond of tissue in the middle line, so small that one can hardly say it is between the mandible and the maxillæ, represents the labium. The maxillæ, broad at tip, extend down for 3·5mm. when they disappear, being covered for the rest of their course by the antennæ. The first legs, very broad at top, narrow rapidly and end in a sharp point, at 2mm. long; they touch the antennæ for about 0·5mm.; then the second legs begin as sharp points, widen, and terminate as the first pair, descending nearly 1mm. beyond them, and 0·5mm. before the maxillæ are also covered by the antennæ. The external appearance and the mass of filmy inner dissepiments present, strongly suggest that the legs (first and second) are not here, as in many pupæ, exposed to their extremities, but that a considerable portion of their extremities is covered up by the antennæ lapping over them, just as in the case of the maxillæ. This view is confirmed by finding that the traces of hairs and lenticles on them, and which occur (as already described under the Theclids) about the tibio-tarsal and tarsal joints, here occur close to the ends where they disappear; these would be on the tarsus, as there are others, representing the tibio-tarsal joint, a little higher up. The legs present no trace of sutures marking the tarsal joints. The antennæ are about 7·5mm. long, and meet in the middle line for the last 2·5mm. to 3mm. of their length, they are somewhat broader here, for a length greater than the club of the antennæ. The reticulations, like those of the legs, are delicate, almost faint, the lines largely transverse, but giving no indication of the antennal segments except for about their basal third. The prothorax has a median suture, about 1mm. long, margined in a very dark tint in coloured pupæ, each half about 2mm. to external, sharp, angular point; a large area a little beyond the middle of either half is crowded with lenticles as closely packed as possible; where, round the margin of the patch, they are separate enough for it to be seen, each is observed to occupy the centre of a cell of the network of the fine skin-sculpturing, which occurs everywhere on the pupa; this crowd does not intrude on the inner fourth or front third of the piece, which presents only one or two hairs and lenticles; there must be 300 to 400 lenticles in the patch of either side, in a space of about 1·0mm. × 0·3mm. To the front of the prothorax is



1. PUPAL STRUCTURE OF LAMPIDES BOETICUS. 2. *Photo. by F. N. Clark.*

1.—ABDOMINAL SPIRACULAR AREA (PUPAL SKIN AND SPIRACLE) OF PUPA OF LAMPIDES BŒTICUS × 150.

2.—COVER OF PROTHORACIC SPIRACLE OF PUPA OF LAMPIDES BŒTICUS × 300.

Plate XXII.

(*To be bound facing Plate XXII.*)

PUPAL STRUCTURE OF LAMPIDES BŒTICUS.

Fig. 1.—Spiracular area of 6th abdominal segment of pupa of *Lampides boeticus* ×150.

Showing ordinary pupal hairs, with finely and sharply spiculated extremities; also the crowd of lenticles in postspiracular region; and the network of the ribbing with minute rosettes at branchings. It shows, in addition to the ordinary network (which alone occurs in many pupæ), a fainter and minuter reticulation, clearly continnous with the weaker branches of the larger ribbing; this smaller network is on the same scale as the larval skin-points or reticulation (as found in *Lampides boeticus* and *Celastrina argiolus*), and demonstrates that the usual pupal network is a selection of lines from this fine network, the remainder being obsolete; here the obsolescence is incomplete.

Fig. 2.—Cover of prothoracic spiracle of pupa of *Lampides boeticus* ×300.

Nearly the whole (the ends are just out of the plate) cover of the prothoracic spiracle of pupa. The prothoracic spiracle-cover of all Lycænid pupæ examined are remarkable objects, of which the detailed structure is usually difficult to make out. They are all of similar shape, and present, as in the one in the plate, a dense forest of hairs. In most cases, the impression given is, that these hairs are more or less fused together in some way, so that it is very difficult to make out the nature of a single hair, and the tops are all level, so that, whether fused together or not, they present a level pavement. In this pupa, the hairs seem separate, and some appear in profile in the Plate; they are upright rods, expanded at top into rather flat open cups. The minute tessellation of the immediately neighbouring pupa-skin is also shown.

attached the dorsal headpiece, that of either side is about 0·8mm. long (from side to side), about 0·17mm. wide (front to back) in the middle narrowing to a point externally, and to a very minute (0·03mm.) margin, to articulate with its fellow, and most of this is beneath the margin of the prothorax; it is reticulated as the rest of the pupa, but appears to have no hairs or lenticles. The mesothorax has a length of about 3mm. down the dorsal suture, but is less than 2mm. long measured down to the sinus, into which the metathorax intrudes; its sinuous front margin, of about 2mm., has a large (0·34mm. long) elevation, beginning 0·25mm. from where it meets the antenna; this is the cover of the first spiracle, itself a very simple structure in a hollow beneath it; this operculum possesses an enormous number of fine processes, each of which is a little pillar, spreading out into a flat or rather cup-shaped top; the dorsum of the mesothorax possesses a very few scattered hairs and lenticles; there is a little fulness at the base of the wing, but nothing to be called a wing-spine; the wings have no hairs or lenticles; the netting over the dorsum has the transverse lines strong, like a number of parallel streams with short side affluents, since these longitudinal branches seldom meet each other; on the wings the arrangement is more irregular, but has the same dendritic character of principal ridges with branches not linked up, rather than a network. One sees here, as elsewhere, that, on the dark spots, the lines of reticulation are nearly black; in the less dark patches elsewhere, they are merely of a slightly darker tint than the general surface. The metathorax has the usual form of a narrow dorsal isthmus (about 0·25mm. long), widening to about 1·2mm. where it extends up into the mesothoracic sinus, and narrowing to a fine point at the 2nd abdominal segment; the narrow slip beside the 1st abdominal segment is really the hindwing, but there is nothing to mark it off from the rest of the segment; there are, on either side, perhaps, a dozen hairs, and as many lenticles, quite scattered; about the centre, on each side, is a comparatively large hair, of exceptional and delicate structure (0·2mm. or 0·25mm. long), so as to be somewhat injured (apparently) in my preparations. The 1st abdominal segment is about 2·3mm. long, and 0·45mm. wide, dorsally; the fine lines of netting are chiefly longitudinal, and it has more numerous skin-points (or intersections of lines of netting) than the thorax, and a few hairs and lenticles; it has a dark mark at the anterior and posterior angles of the outer margins. The 2nd abdominal segment has, of course, a pair of spiracles; it is 0·8mm. long in dorsal line, and about 2·6mm. wide; the spiracles have a crowd of lenticles, chiefly behind them, nearly 40 in number, with a number of hairs; the general surface has scattered hairs, lenticles, and skin-points. A similar description with obvious modification would apply to the 3rd, 4th, 5th, and 6th abdominal segments. The 7th abdominal segment has many fewer hairs and lenticles in attendance on the spiracles, and the 8th has no spiracle, but only the scar, where it is obsolete; on the 7th abdominal segment, the scar of the honey-gland is a marked feature; near the posterior border of the segment is a transverse line, about 0·15mm. long, of dark thick chitin with a small excrescence on either side; it is surrounded by an area 0·4mm. from back to front, and 0·8mm. wide, free from skin-points, reticulations, hairs, and lenticles, but with radiating lines as if there were some central contraction. On the 8th abdominal segment, a little outside the scar of the spiracle, and near the posterior border of the segment, is a similar, but small, scar of the eversible gland occupying that position in the larva: it is a little dark puckered line (slightly oblique), about 0·05mm. long, and with little or no altered surrounding area. The 9th and 10th abdominal segments are difficult to distinguish, except as one mass, with certain scars—anal and genital, that may belong to one or other. What is very notable is that there is no trace of any cremastral armature, and this notwithstanding the fact that the insect forms at least an apology for a girth for pupation. A few other points deserve notice. On the 3rd abdominal segment the netting in the dark patch above the spiracle often has the appearance of radiating from a centre; it is all thoroughly linked up with no loose ends, as is rather the rule on the general surface, and the meshes (as seen elsewhere) are filled in with smaller cells about a fourth the diameter of the others: these become fainter marginally, but may be detected on other parts of the surface, and are, therefore, probably everywhere present, but too faint to be seen, their evanescence explaining the frequent loose ends in the network as generally visible. The subdorsal mark of this segment is similarly provided with abundant small cells, but has a remarkable central structure, like a scar, forming an irregular centre as of several ill-formed lenticles surrounded by radiating lines, with an area about 0·08mm. in diameter; on the 2nd abdominal segment, this is represented by a slightly puckered fulness and prominence of the ordinary lines; it is repeated, well-developed in the 4th, 5th, and 6th abdominal segments, but is wanting on the 7th. The skin-points, or rosettes, which seems a tempting name for them in this pupa, that occur at the intersections of the network are comparatively few, perhaps a tenth of the number that a similar area would show on the pupa of *Thestor ballus*. In those of *T. ballus* is a small central rosette surrounded by a very wide border continuous with the broad lines of the network, the points being nearly 0·1mm. wide; here we have only the central rosette, not at all unlike in size or structure that in *T. ballus*, but still large enough to overlap the lines that meet against it. It consists of a minute central ring with from three to six branches. It is, indeed, very rose-like, with central ring (stamens), and the margin divided into (generally) five portions, much like rose-petals in form. Beneath these the lines of network enter and disappear; the width of the lines being perhaps 0·003mm. in *L. boeticus*, and about ten times that, 0·03mm., in *T. ballus*. The spiracles are about 0·12mm. across their long diameter (transverse to segment), and have a very elaborate grid-work. The hairs are more numerous near the spiracles and also longer there, about 0·03mm. to 0·04mm., half that or less on the thorax; they are of nearly uniform width from end to end, or even a little thicker terminally, and end in a sharp spicule with several others towards the end, sometimes long and spreading. The lenticles are most numerous, and largest, near the spiracles, where they are about 0·01mm. to 0·015mm. in diameter, or even a little larger sometimes; the margins are wide, only about the central third being occupied by the dotted membrane. In certain regions are areas of minute spiculated skin-points, which, in places, run along the lines of network, suggesting that the ribs of the network are formed by skin-points run together; these skin-points occur along the abdominal incisions, beginning on that of the 2nd-3rd incision, and are seen on the intersegmental membrane, but on this are quite colourless, and, for that reason, probably not always seen. They encroach somewhat on the segment behind the spiracles on the 5th abdominal segment, less so elsewhere on the rest of the segment; they are wider on each following segment, and occupy nearly the whole width of the venter of the 7th abdominal, still more on the 8th abdominal, and are almost everywhere interspersed amongst the sculpturing of lines on the 8th and 9th abdominal segments. They possibly afford the trifling hold of a cremastral nature the pupa sometimes takes. In one specimen I can detect no trace of any scar of prolegs; in another there is a point with radiating lines excluding the sculpture, just internal to the double ventral dark spots on the 5th and 6th abdominal segments, which are probably the scars of the prolegs; their presence in one case and absence in another confirm the idea that they are in some degree pathological, as was suggested by their usually being absent in healthy pupæ of *Amorpha populi*, but sometimes in weak and unhealthy ones very marked and exaggerated (Chapman).

Variation of pupa.—The pupa of *L. boeticus* varies very much in the development of the dark dotting, like a good many others of the group, so that a pupa may be quite pale or very dark. I have a pupa in which the wings and appendages are practically without spots; there being only 3 or 4 very minute ones on the wings. On the abdomen are a few small dorsal spots, but hardly any others except the three regular rows of spots, not at all strongly marked. These rows are a subdorsal row, at middle of segment, and less than half-way from the dorsum to the spiracle; a supraspiracular row above and behind the spiracle, *i.e.*, towards the posterior border of segment and rather nearer to the spiracle than to the subdorsal spot, a subspiracular row, visible only on the 5th, 6th and 7th abdominal segments, at the middle of each segment, and nearer the spiracle than the ventral line; on the 5th and 6th abdominal segments are also spots about half-way from the subspiracular spot to the venter; these are in pairs, one in front of the other, *i.e.*, one towards each border of segment. A dark pupa is so brindled over with dark spots, that it is more dark than light, and, though the regular row of larger spots, as just noted, is larger and darker than in a light pupa, the spots do not stand out so distinctly. The dots are also so massed as to give the idea of a darker dorsal band or row of spots (Chapman). It may be well to add here, the standard descriptions of the pupa as observed in South Africa, India and Europe:—

Africa.—About ·5in. in length; thickest and roundest in abdominal region; head blunt. Colour very pale greyish-ochreous, dusted unequally with blackish; the wing-covers more greenish in tint, a fuscous line down the back; some blackish spots on head and back; two rows of blackish spots on each side of back of abdomen (Trimen).

India.—The pupa smooth throughout; the head small; the posterior end very blunt and rounded; the abdominal segments larger than the anterior; the thorax slightly humped on the back; colour pale yellowish-green, a dark dorsal line, a double subdorsal series of small black spots (Nicéville).

Europe.—Rather elongated; somewhat plump; without projections. Colour yellowish or obscure reddish; spotted with numerous brown dots, principally towards the top of the head; a dark, mediodorsal, uninterrupted line, commencing on the thorax, reaches the anal segment. The black stigmata are visible to the naked eye (Millière.)

Dehiscence.—In dehiscence the front headpiece separates with the antennæ, legs and maxillæ, but is so loosely adherent to these that it separates from them on trifling interference, and the antennæ separate for a short distance from the legs. This head and appendages-cover only adheres by the inner dissepiments to the end of wings and the 4th abdominal segment. The thorax splits dorsally down its whole length, and then more or less from the abdomen, the wings separating slightly also from the abdominal segments; the wings do not separate from the abdominal segments on slight disturbance, but it is difficult to keep them from breaking apart on any manipulations, such as mounting the pupa. The abdominal incisions 4-5, 5-6, and 6-7 open, as they do in any pupa in which the 5th and 6th abdominal segments are "free," and the 7-8 incision opens easily in the empty pupa-case, suggesting that the 7th is also, or almost, a "free" segment. More probably, however, this is a mere obvious evidence of the fact that obtains throughout the whole pupa, that but little violence is necessary to separate parts at any suture. The only two incisions that show skin-points and facets in the intersegmental membrane, as is usual in such membranes, where movement actually takes place during life, are the incisions 4-5, 5-6, giving the 5th as a free segment. The prothorax also all but separates from the mesothorax, and is, in fact, wanting, by having fallen away in most empty pupa-cases. The minute dorsal headpiece adheres to the prothorax, without any separation exhibiting connecting membrane (Chapman).

Comparison of pupæ of Lampides bœticus and Langia telicanus.—A comparison of the very similar pupæ of *Lampides boeticus* and *Langia telicanus* shows that the latter has (1) more numerous and comparatively long and thick hairs, 0·12mm. (on the head some 0·2mm.), almost, indeed, a hairy pupa; (2) very few rosettes to the ribs of netting, and these small, apparently simple, with a central dot, but some radiating lines are faintly seen. The pupa of *Langia telicanus* also has a well-armed cremaster, with about 20 hooks in a posterior set, and 17 in each of the two anterior groups. The intersegmental structure suggests the 5-6 abdominal as a still free incision in *L. telicanus* (Chapman).

Time of appearance.—There appears to be no doubt that this species is almost everywhere, throughout the regular areas of its distribution, continuously-brooded. Even in southern France, although this is possibly not within its absolutely permanent limits of distribution, it has been taken in every month in the year from January to December. No doubt, the greater number of European emergences take place from late July or early August to November, in fact, its appearances in southern Europe are seemingly very similar to those of *Colias edusa* in England, occasional (immigrant) specimens being taken until June, a heavy brood in later July and August, another in fine seasons in September and October, then occasional examples in November and December, the mass of the specimens of this late brood becoming, however, exterminated in the larval stage. Further south, *e.g.*, in the Canary Isles, Egypt, India, Hong-Kong, etc., this winter brood is a very real one, and its continuous-broodedness is undoubted, whilst in the more northern parts of its range the specimens taken from late August to October are no doubt the progeny of July immigrants. Pryer's hints (*Rhop. Nihonica*, p. 17) suggest very strongly that an exactly similar time of appearance is to be accorded to the species in its extreme eastern as in its extreme western Palæarctic range, *viz.*, that, in the southern islands of Japan, it occurs all the year round, March, etc., at Ogasawara, whilst in the more northern parts, Yokohama, etc., it only occurs from August to October. It occurred in April, 1893, in the Chinese Province of Sé Tchouen (Potamine *teste* Alphéraky). Of its appearance in Central Asia, it has been noted as occurring in the Pamir in July, and in August and September in Persia (Hoffmann and Cholodkovsky). Longstaff gives (*Trans. Ent. Soc. Lond.*, 1905, pp. 61-144) a series of suggestive dates for India, based on observations made in 1903 and 1904. These read as follows: October 10th-17th, 1903, between Simla and Fágu, at about 8200ft.; October 23rd in the Khyber Pass, October 25th at Pesháwar, at 1165ft.; October 28th-29th at Malakand, at 3000ft.; November 5th-6th at Amritzar, at about 750ft.; November 17th at Naina Tal, at 8500ft.; November 28th-December 2nd at Benares, at about 270ft.; January 14th, 1904, at Burwa Ságar, February 6th-8th on Mount Abu, at 3000ft.; February 16th-17th, 1904, at Bijápúr, at 1500ft.; February 18th-23rd, 1904, at Anantápúr, at 1500ft.; February 25th at Konur, 5500ft.; February 28th, 1904, at Wakamand, 7500ft.; March 19th-21st in the Botanical Garden at Hakgála, at 4800ft. We also note, February 14th and April 2nd, 1896, in the Nilgiris, at 7500ft. (Cardew); August 27th, 1899, at Matale in Ceylon (Goodrich), whilst Mrs. Nicholl captured it in Ceylon, at 4600ft. elevation in March, but Green observes that it occurs apparently all the year round on the Island, and Atkinson notes it as occurring at Simla in May, 1867, and at Jounpore in July, 1867, and Annandale records June 5th, 1901, in the Siamese Malay States. These form an almost complete series of continuous appearance for India. Walker says that he found the insect at Hong-Kong from December to May, and supposed that it was on the wing all the year round (*Trans. Ent. Soc. Lond.*, 1895, p. 439); Fletcher observed it at Hong-Kong on November 22nd, 1899. On the time of appearance of the insect in Egypt, Graves writes (*in litt.*): "Worn imagines occurred commonly throughout January and February, 1903, at Cairo; fresh examples were well-out in April; the butterfly also occurred at the end of April in the desert east of the Nile, behind Helwân; it was also out in the Maryut Steppe the first week of May, and, on my return (after an absence lasting through June and July), it was found commonly in the Barrage Gardens, 12 miles north of Cairo, in the first week of August; it abounded in September, 1904, in my garden at Alexandria, and my observations lead me to conclude that this species, as well as *Danais chrysippus*, *Pieris rapae*, and *Pyrameis cardui*, is continuously-brooded, and occurs all the year round in Egypt. Mathew says that it is common in the Gallipoli district, several broods occurring during the summer of 1878, whilst examples were noted throughout November and December up to January 4th, 1879. Of dates connected with the eastern Mediterranean region (*sens. lat.*) we note—end of January, 1906, at Port Sudan, February 1st-3rd, 1906, swarming at Khartoum; February and March, 1904, in the Maryut Steppe (Graves); March 26th, 1902, in the Wied Kratal, Malta (Fletcher); April 5th-7th, 1890, at Aden (J. J. Walker), April 28th-May 7th, 1907, at the Wadi Rished (Graves); April 13th-14th, 1901, at Gharb el Arish, 11°N. lat.; April 21st, 1901, on the White Nile, near Kaka, 10°30′N.

lat. (Loat); April 30th-May 2nd, 1900, at Brummana, about ten miles east of Beyrout, also from April to June, 1900, from 2000ft.-6000ft. in the Lebanon (Nicholl); May 10th, 1905, near Jaffa; May 31st-June 8th, at 4000ft., at Ain Zahalta (Graves); May 13th in the Wied Kratal, Malta; June 2nd, 1902, in the Wied il Handak; June 3rd, very worn at Suda Bay, Crete (Fletcher); June 2nd-6th, 1896, at Jerusalem (Swinton); June 9th, 1878, at Port Baklar, also June 11th, July 6th-7th, 17th-27th, August 3rd, 1878 (Walker); June 26th, 1907, in the Ezbekiah Gardens (Graves); July 3rd, 1893, at Malta (Walker); July 9th, 1904, at Beyrout (Graves); July 16th, 1899. at Trebinje (Rebel); July 23rd, 1902, a female at Dubnica (Rebel); July 19th, 1901, on the Marsa, Malta (Fletcher); August 24th, 1898, at Ilidze (Winneguth); in August and September at Borjom, in Transcaucasia (Romanoff); fairly common throughout August and September, 1903, at Broussa (Fountaine); September 23rd, 1875, at Civita Vecchia (Walker); September, 1863, in Palestine (Tristram); September and October, 1901, at Nikosia and Troödos, 3000ft., in Cyprus (Bate); October 5th, 1901, fairly common at Lemnos (Fletcher); October 6th-23rd, 1896, at Salonica (Mathew); September 16th-28th, at Besika Bay (Walker); November 4th, 1903, in the Argotti Gardens, Malta (Fletcher); December 21st, 1904, very common, but males worn, at Sawákin, Sudan (Fletcher). In Nigeria, it is recorded from Jebba in November, from Rabba, also in November, and at Boussa in December (Christy *teste* Sharp, *Ent.*, xxxv., p. 102). In equatorial Africa, it was discovered from January to March, 1900, at Wadelai (Sykes, *Ent.*, xxxvi., p. 6). As another almost equatorial record, it may be observed that it was noted on August 10th, 1905, at Port Louis in Mauritius, on September 18th, October 31st and November 3rd, 1905, commonly, at Mahé, in the Seychelles (T. B. Fletcher); December 1906, at Lagos (Gladstone). The western Mediterranean area also gives interesting results. Kollmorgen notes that, in Corsica, imagines occur from June to November, extending up the mountains to 800 metres; Mrs. Nicholl writes: "In Spain there appears to be a succession of broods in the hot plains, but only two or one according to elevation in the mountains; I have taken it in April and May at Granada, in June and July, in Central Spain, in July at 6000ft. elevation on the Picos d'Europa." It occurs throughout the greater part of the year in the Barcelona district (Cuni y Martorell); Chapman took a worn specimen February, 1896, and another worn one March 7th, 1897, at Cannes. Rowland-Brown records a pair on April 3rd, 1898, at Hyères, yet Millière states that it only occurs in the autumn in the Alpes-Maritimes, being seen flying abundantly from the middle of August to the end of October and he adds that he believes it has only one time of appearance, *viz.*, August to October, but that, during this period, several generations follow each other without interruption, although Warburg writes (*Ent.*, xxii., p. 258) that it flies at Cannes on warm sunny days about the beginning of December, fresh specimens again appearing in July. Walker observes that, in the region of the Straits of Gibraltar, it is common almost all the year, and that he has dates for the district extending from February 28th to October 30th, and, as showing how it appears all the year round, notes that he captured it on October 30th, 1886 (fresh), February 28th, March 26th, June 21st, July 5th, September 8th, October 1st-20th (plentiful and in good condition) and October 28th, 1887. It is also noted as common at the end of June and in July at Catania (Zeller); also in June, 1896, near Messina (Fountaine), and in July at Oran and Sebdou (Oberthür); August, September, and October in Sicily (Failla-Tedaldi); also August, September, and October in Tuscany, being particularly abundant in September in the neighbourhood of Florence (Stefanelli); on the shores of Lucca, common in spring, but still more so in September (Verity); not very common in summer and autumn near Turin (Rocci); whilst Elliot found it continuously in Teneriffe from December 1901 to mid-March 1902. Meade-Waldo says that the species was fairly common and on the wing the whole summer of 1901 in Morocco, whilst one worn example was seen in December 1900. The following further details may prove interesting: February, 1884, in Madeira (Cockerell); February 24th, 1902, on the ridge above Hammam-es-Salahin, to the west of Biskra, also at Teneriffe in March (Nicholl); March, 1888, at Las Palmas (Poulton); March 7th, 1897, at Cannes (Chapman); March at Algiers (Oberthür); March 25th-26th 1902, on the mountain ridge between the Aurès and the desert of El Kantara (Nicholl); March 30th, 1900, at Tangier (Meade-Waldo); March 31st, 1902, in Teneriffe (Bellamy); April 22nd, 1902, at Malaga (Lang); April 3rd, 1898, at Hyères (Rowland-Brown); May 1866, in Capri (F. B. White); May 18th-20th, 1901, at Granada (Nicholl); May 29th, 1895, at Tangier (Nicholson); June 1884, at Souk Harras in Algeria (Bethune-Baker); June 2nd, 1887, at Benzûs Bay, Morocco (Walker); June 6th, 1888, at Cea (Eaton); June 23rd, 1893, in Corsica (A. H. Jones); June 26th, 1903, abundant at Barbadilla (Chapman); June 30th, 1901, at Gibraltar (T. B. Fletcher); June 30th-July 12th, 1887, at Vernet (Elwes); July 3rd-22nd, 1904, at Puerto de Pajares (Chapman); July 7th-17th, 1894, at Vernet (Nicholson); July 15th and August 12th, 1904, at Guéthary (Sheldon); July 16th, 1903, between Vizzavona and Tattone (Rowland-Brown); July 17th, 1902, and following days at Avila (Chapman); July 18th, 1905, at Vernet (Rowland-Brown); July 19th-22nd, 1905, at La Granja (Sheldon); July 21st-22nd, 1901, at La Granja (Poulton); July 20th-27th, 1887, at Gavarnie (Elwes); July 23rd-August 3rd, 1904, at La Granja (Chapman); July 25th-27th, 1894, at Biarritz (Nicholson); July 26th-28th, 1903, at St. Martin Vésubie (Rowland-Brown); July 20th, 1901, at Tragacete (Chapman); July 29th, 1887, on the Pic du Midi at 8000ft. (Elwes); August 1st, 1901, onwards, at Tangier (Meade-Waldo); throughout August, 1887, abundant at Gibraltar (Walker); August 2nd, 1905, at Biarritz (Rowland-Brown); bred August 2nd-6th, 1906, from larvæ collected in north-west Spain (Chapman); August 11th-20th, 1897, at Susa (Tutt); August 16th, 1897, at Brindisi (Mathew); August 29th, 1882, at Biarritz, September 1st, 1882, at Pierrefitte-Nestalas, at 1665ft., and in the Pyrenees, at nearly 5000ft., on September 7th, 1882, on the Pic du Midi de Bigorre (A. H. Jones); September 5th-30th, 1898, at 5000ft. at San Dalmazzo di Tenda (Norris); September 10th, 1892, at Nice (Bromilow); September 13th, 1874, at Tangier, September 15th-17th, 1874, at Gibraltar (Walker); throughout October to the 28th, 1893, at Nice (Bromilow); October 1st, 1892, at Bordighera (Norris): October 8th, 1887, a quite fresh female at

Nice (Bromilow); October 9th, 1902, on the Val Müerta, near Beaulieu (Rowland-Brown); October 11th, 1899, at Menaggio (A. H. Jones); October 12th, 1892, at Nice (Nicholson); October 13th-21st, 1899, at Stresa (Jones); October 20th, 1886, at Gibraltar (Walker); November 1st, 1894, in the Cirque de Tremouse, Hautes-Pyrénées (Rondou); and in December, 1900, at Tangier (Meade-Waldo). Of its occurrence in southern France, Powell says (*in litt.*) that he has no record of its appearance at Hyères until the month of August, though he feels sure that he has occasionally seen specimens towards the latter part of July; it becomes abundant, however, about the middle of August, and is fairly common throughout September and October, flying in warm, sheltered spots on the Maurettes and Oiseaux ranges until quite the end of November. He adds: "On July 25th and 28th, 1902, no *L. boeticus* were flying in likely spots on the Maurettes, and, in the same year, a visit to the lucerne fields near the Gapeau river, on August 6th, gave no better result, although *Langia telicanus* was flying and worn. On August 23rd I returned to the fields and then found *L. boeticus* common in one place, flying round some runner-beans with white flowers, many specimens being worn. The species is generally abundant in these lucerne fields in August and September, flying very rapidly. On September 27th, 1902, *Lampides boeticus*, in good condition, was flying, in spite of high wind, on slopes of the Maurettes near Fenouillet, amongst cork-oaks, something after the fashion of *Bithys quercûs*: I took a fine female and saw many males. On October 12th, of the same year, to the east of Hyères, I took one fresh female, and saw many more, more or less worn. In September, 1904, the species was fairly abundant at Costebelle, where I saw it almost every day flying around and settling upon the flowers and leaves of a wisteria. It appeared to me that the females were ovipositing on these flowers, but they were out of reach, and one could not be certain. On October 12th, 1906, a warm day after rain, *L. boeticus* was not uncommon near St. Maximin (dept. Var.), flying in lucerne fields and feeding upon the flowers of a mint by the roadside. I saw, also, several drinking at the edges of pools of water, left by the night's rain, in the road. On November 25th, 1906, I saw several specimens in a warm spot near the Sanatorium of the Mont des Oiseaux; they were not very fresh, but were extremely active, settling for rests on the rosemary and arbutus bushes; the sun was hot and there was no wind. The males of *L. boeticus*, like those of *Iphiclides podalirius*, *Papilio machaon*, *Charaxes jasius*, and some other species are fond of hilltops. They will also take up a position on a bush or branch, leaving it to fight some other butterfly and chase it, maybe, a long way, but always returning again to the original position. In Algeria, province of Oran, *L. boeticus* is well distributed, but I never came across it in numbers. It flew on the hills to the north of Misserghin (near Oran) early in May, where I took a very worn female on May 3rd. I came across it again at Sebdou (920 metres) on May 17th, one specimen in fresh condition, also worn, on June 13th; and again on the summit of the mountain called Lato on June 16th. On June 26th, in the cork-oak forest between Tlemceu and Terny (about 900 metres to 1000 metres), *L. boeticus* was not rare on the bramble-flowers, and I took a few quite fresh specimens with *Langia telicanus*. It was flying on a hilltop at Zebch (1200 metres) on July 11th, and was fresh at Mizab (1300 metres) on July

5th and 6th; it also occurred on Mont Ouargla (1714 metres) on July 24th and at Sebdou, August 3rd, 4th, and 12th. I have no notes of it after this." Assuming the Pyrenees and the Alps of Central Europe to form largely the northern boundary of the area in which the species can live all the year round, and that all districts north of this are supplied by immigration, one would suspect a few early immigrants to disperse themselves in July, lay their eggs and produce offspring during August, September and October. It would appear that almost all freshly-emerged examples seen in France, Britain, Switzerland and Germany are found during this time. The following notes may prove interesting:—France—Haute-Garonne, May-June and again in August and September (Caradja); Saône-et-Loire, the first fortnight of September, all smaller than those from the South of France (André); Eure-et-Loir, in October, abundant some years (Guenée); Haute-Marne, very rare, September (Frionnet); Berry and Auvergne, June-August, sometimes common (Sand); August and September in Doubs (Bruand); August in the Bordeaux district (Trimoulet), etc. Our choice of the Pyrenees as the dividing line would appear to be sound, for, against these occasional records from the more northern parts of France, Rondou says, "June and again in August to October, common everywhere from the lowest regions to 2800 metres, throughout the Hautes-Pyrénées." The following incidental dates of captures north of this dividing line are interesting —many in August, 1847, also two November 17th, 1847, from same batch of pupæ, at Chartres (Bellier de la Chavignerie); August 13th and October 6th, 1879, at Hottingen (Snell); September 7th, 1887, at Etretat, in Normandy (A. M. Reid); September 15th, 1892, a male, in Guernsey (Lowe); August 18th-24th, 1893, below Follaterre (Favre); October 3rd, 1898, at St. Triphon (Fison). First noticed July 19th, 1899, at Val André in the Côtes du Nord (Turner); then observed August 23rd, 1899, at Fontainebleau (Tutt); August 19th, 31st, 1899, at Sierre, August 21st, 1899, at Branson (Wheeler); one in June and another in September, 1899, at Florissant, near Geneva (Rehfous); September 1st-15th, 1899, abundant in Guernsey, more than 100 taken, after which date the wind and cold weather appeared to have destroyed them (Lowe). First noticed July 24th, 1900, in Guernsey (Lowe); captured five August 22nd, 1900, at Grésy-sur-Aix (Tutt); bred September 1st, 1900, and following days from larvæ taken in Guernsey during August (Baker); several captured wild between September 1st and September 14th, 1900, in Guernsey (Luff); many taken September 2nd-14th, 1900, in garden at Rennes (Oberthür). August 27th, 1901, at Branson (Wheeler). First observed egglaying July 19th, 1904, also others on July 21st, 28th and 31st, in Guernsey (Baker); on the wing August 1st, 1904, at foot of Grand Salève, Geneva (Tutt); bred September 22nd-October 4th, 1904, from larvæ taken in August and September, in Guernsey, some undersized (Baker). The notes relating to 1899, 1900 and 1904 are very suggestive both as to date of immigration (late July) and the emergence of the progeny of these immigrants. A short note of the time of appearance in some of the localities south of the equator, where summer and winter are changed about should be useful, *e.g.*. Trimen states that *L. boeticus* is generally distributed in southern Africa, occurs throughout the year, but is most abundant from October to April; Leigh particularly notes its capture on December 26th, 1900, in the Stella Bush near Durban. Walker gives us the following details from the Hope Museum collection—Natal: October 2nd, 1896, at Tugela Mouth (Heale); December 6th, 1896, at Frere, 3800ft., December 20th, 1896, on the Tugela River, April 6th, 1897, at Durban (G. A. K. Marshall). Mashonaland: December 25th, 1895, at Gadzina, 4200ft., December 5th, 1897; May 15th, 1898, at Salisbury, 5000ft.; October 30th, 1898, at Mazoe (G. A. K. Marshall). British East Africa: May 22nd, 1900, at Machoko's Road, 5400ft.; December 31st, 1898-January 14th, 1899, at Northern Gongo (Hinde); April 20th, 1899, on the west shores of Lake Nyassa (de Jersey); October 10th, 1905, at Melsetter, Gazaland, in South-East Rhodesia (G. A. K. Marshall). British Central Africa: June 20th, 1903, in Angoniland, at 4500ft.-5000ft. (Byatt); February 2nd, 1899, at Chitala, in the Mushinga Mountains (Pemberton). Uganda: May 18th-21st, 1900, at Mengo (Leakey); November-December, 1900, at Toro, 7000ft.-9000ft. (Neave); January 12th, 1902, in Northern Uganda, lat. 8° 5′ N. (Loat). British East Africa: November-December, 1902, at Nyangori, Victoria Nyanza, 0° 6′, S. lat., at 6000ft. (Wiggins). Somaliland: December, 1905-January, 1906, at Berbera, 5000ft., in Somaliland (Byatt); June 21st, 1907, in North Central Somaliland (Peel); January 1st-31st, 1903, on the north-east shore of Victoria Nyanza, 3800ft. (Wiggins). Anderson says that, in Victoria (Australia), it first appears in October, and remains in evidence until March, with a succession of broods during the interval. One does not doubt if there were more records from Australia, that, at any rate in the more northern parts, the species would be found to be continuously-brooded throughout the year, for Walker states that the species is common throughout most of the year in and about Sydney, New South Wales. In the Pacific Islands, Walker found it on March 31st, 1883, April 3rd, 1883, on high ground, about 2000ft., and also on April 5th, in Tahiti; on April 7th-8th, 1883, in Eimeo Island. At Batavia, it was observed abundantly on May 6th-9th, 1870; also November 13th-14th, 1891, at Amboyna; in January, 1892, at Hong-Kong, and May 13th, 1892, on Namoa Island, off south-east China; June 6th-8th, 1900, at Noumea, New Caledonia; September 9th, 1900, at Gaua Island, Banks' Islands; September 11th, 1900, on Tegna Island; June and September, 1900, common, in the New Hebrides; August 16th-20th, 1900, in Chepenehe Lifu in the Loyalty Islands; August 23rd, 1900, at Noumea, New Caledonia (Walker); February and March, at Luzon, Manila (Meyer); May 19th, 1905, at Bileling, in Bali Island (Shelford); May 8th, 1905, in Ternate Island (Shelford).

Habits.—A wanderer, if not quite of the same class as *Pyrameis cardui*, almost equally so, but unable even temporarily to reach so far north, and at present confined to the Old World, no record of its occurrence in the New World having yet been made, although it has been observed in many of the most isolated of the Pacific Islands. Within the tropical and subtropical countries of the Old World it is generally abundant in suitable localities, sometimes appearing in great numbers and occasionally attempting to extend its boundaries into the temperate regions directly north of its sedentary home. In this manner occasional examples are observed in Britain, Germany and Switzerland, Persia, Transcaucasia, the Pamir, and the eastern shore of the Old World, in the more temperate parts of Japan, etc., but almost always rarely and usually at irregular periods. At such times the immigrants are generally observed in July, *i.e.*, at a season when the climate of temperate regions will allow this rapid-brooded species to succeed in completing, at least, one emergence, before its progeny is exterminated, this brood appearing on the wing from the end of August to October, according to the meteorological conditions existing, during the time the larvæ are feeding up, in their adopted country; in a warm summer (1900) their metamorphoses do not occupy more than five or six weeks, in a cold summer (1904) some eight or nine weeks. Whatever period is taken makes little difference, for, bringing their subtropical habits into higher latitudes, they attempt to do in the latter what they do habitually in the former, *viz.*, produce continual broods, and are exterminated accordingly. In other words, the species is an immigrant in temperate regions, is dominated by the climatic conditions existing in the countries it reaches, finds a colder winter than it can possibly withstand, and so is unable to maintain a footing. The ♂ is excellently described by Réaumur (*Mém.*, ii., p. 482), who observes that, at rest, it holds its wings perpendicular to the plane on which it stands, but we owe almost all our knowledge of what we may call its personal habits to Graves, who writes: The newly-emerged female, resting on a leaf or twig, fans the wings, the male flying wildly around and attacking rivals with great vigour. As far as I can judge, having never seen the whole of the process of pairing, the female does not hold the wings at spread for so long a time as *Langia telicanus* or *Tarucus theophrastus*. After coupling, the pair perch on leaves, where I have observed them united more than once, flying off slowly and often dropping to leaves on the same shrub at a lower level if disturbed. I have not, to the best of my memory, seen the insect *in cop.* later than 2 p.m. Of the flowers it visits I may note that, in Syria, I once took *L. boeticus* near Aleih on a thistle-head; otherwise, I have usually seen it on broom, lablab, lubiyeh or māsh (*Vigna sinensis*) and sweet-pea, also (at Bludau, Anti-Lebanon) on bramble-flowers. In Egypt I have seen it on sweet-pea, lablab, lubiyeh, lythrum, alhagi or camel-thorn, flowers of the sunt acacia (*Acacia nilotica*, Del.), and the fitneh (*Acacia farnesiana*, Willd.) and once or twice on the blossoms of the lebbek (*Albizzia*). In the Maryut steppe, generally on wild vetches, once on "'Ansal" (*Asphodelus* sp.), and in the desert wadis near Helwan on the flowers of salt-wort (*Salsola* sp.) and on "Helga" (*Alhagi* and *Astragalus* sp.?) The flight of this insect is, as a rule, jerky and rapid, especially that of the male, which usually moves upwards, often to a considerable height, in a series of spirals, when rising or fighting a rival, but in rapid semicircular or straight dashes, from one to two yards above the ground under ordinary conditions. The insect is very pugnacious, attacking, in Egypt, such large insects as *Danais chrysippus* or *Pyrameis cardui*, as well as its fellow "blues." I should call it a very strong-winged insect for its size; its rapid jerky movements resemble those of *Hypolycaena livia* more than those of *Langia telicanus* or *L. eleusis*. *Tarucus theophrastus* is also a weaker flier, but, at times, has the *Lampides boeticus* habit of flying wildly, and apparently aimlessly, about. *L. boeticus* seldom rests long on flowers, but will often sun itself on leaves of bushes, etc., for two or three minutes at a time, expanding each pair of wings from right angles to about 30 degrees, and very often moving the hindwings up and down alternately while keeping the forewings still. It enjoys sunlight, and, when it has found a particular bush or plant that pleases it, will, at times, make it, so to speak, its base, darting off and returning again several times. The habits of the female resemble those of the male, but it is, as far as my observations go, less rapid in its flight, and I have once or twice seen females open their wings to about two-thirds spread. The female uses the front legs in walking. I have several times taken *L. boeticus* asleep on grass-stems, but, as a rule, like *Langia telicanus*, it prefers the leaves of bushes, etc., from which I have disturbed it shortly before sunset. The wings are drawn further back —perhaps 10 degrees, as far as I can judge—than when resting by day. The antennæ are often moved slowly from side to side when the insect is sunning itself. It is an early rising species but seems to retire earlier than *Tarucus theophrastus* or *Langia telicanus*, which I have seen flying as late as 5.30 p.m. in June at Cairo and Alexandria, whilst I have never seen *L. boeticus* on the move much after 5.30 p.m." T. B. Fletcher also notes (*in litt.*) that he observed a specimen at rest at dusk, on a grass-stem, November 20th, 1899, at Hong-Kong. Swinton states that, at Jerusalem, in June, 1896, it was observed settling on the bushes in the gardens after the manner of a "hairstreak." As to its habits in India, Nicéville says (*Butts. India*, iii., p. 206) that its flight is very rapid, but shortly sustained (except when migrating?), and it frequently settles." He adds that "Colonel Lang reports that at Naini Tal, large flights come up in April from the plains, flying northwards. Mackinnon has remarked the same thing at Masuri in the spring. If the species is given to migrating, this habit would, in conjunction with the almost universal presence of some spieces of plant, on which the larva can subsist, help to account for its wide distribution in the Old World." Pryer says that his observations in Labuan, Japan, etc., lead him to the conclusion that it is locally confined to the neighbourhood of its foodplant, never flying voluntarily very far therefrom, that, whilst occurring in southern Japan all the year round, it is found in the more northern parts only in the autumn, almost exactly the same, therefore, as in its most western habitats. T. B. Fletcher observes that, in Ceylon, etc., it appears to be everywhere common, but never abundant, *i.e.*, one never sees any large concourse of individuals as one sometimes sees in the case of the other "blues," *e.g.*, *Langia telicanus*. The butterfly usually flits about fairly swiftly close to the ground, and is fond of flowers, so that a good flower-garden usually attracts them. Trimen says that, in Southern Africa, the species occurs throughout the year, frequenting numerous leguminous plants when in flower, and is fond, among others, of *Virgilia capensis*. He further notes that, though it is able to fly with considerable swiftness, it seldom does so, but flutters about the plants that chiefly attract it, repeatedly settling on the flowers or leaves. Anderson says that the species is fairly common in Victoria (Australia), though more prevalent in some seasons than others. The occasional appearances of odd specimens of this species in Britain have been such as to give no clue to its habits, but these occasional visits are more frequent in the Channel Isles, where several examples appeared in July, 1899, 1900, and 1904, which gave rise to home-bred broods in September and October of these years. Observations on these, lead Lowe to remark (*in litt.*) that, "in habits and manner of flight, *L. boeticus* has a certain resemblance to *Celastrina argiolus*, *i.e.*, it is given to high, and apparently wild, flights, soaring over its foodplant, *Colutea arborescens*, as *Celastrina argiolus* does over holly- and ivy-bushes, and not often descending to low plants. Except in their wild flights, when it probably seeks other shrubs, it would seem always to be in the vicinity of its foodplant, *e.g.*, when abundant in my garden it was seldom seen in a field of lucerne in flower, in a field less than a quarter-of-a-mile away where *Polyommatus icarus* and *Aricia astrarche* had congregated in numbers. In the garden the imagines frequented scarlet-runner beans, and it may be observed that only about 7 per cent of those observed and captured were females." This was largely our experience, near Susa, in mid-August, 1897, when several where observed on two or three successive days in a charming wooded gorge behind the town, flying over and around the bushes of *Colutea arborescens*, and which, although covered with swollen pods, had still a few late flowers. In habit, the insect struck us as being very "hair-streak"-like, flying swiftly over the tops of the bushes, leaving one for a short time and then returning to the same bush. But they love flowers also, as we have already noted (*anteà*, p. 365), and, in two successive years, at Fontainebleau (1899) and Grésy-sur-Aix (1900), we found imagines at heather-blossom, quietly sucking the nectar in the afternoon sun, and oblivious of the approach of the collector. Caruana-Gatto notes its especial preference for flowers of *Duranta plumerii* and *Phaseolus caracella* in Malta, whilst Cockerell says they frequented flowers of pelargonium in Madeira, in February, 1884. Luff notes a female on flowers of blue annual lupin in Guernsey, in July, 1900. In Saône-et-Loire it appears occasionally in September, and the examples are smaller than those from the South of France (André), and, in Eure-et-Loir, Guenée says that it does not occur more than about once in 10 years, when it is found flying around shrubs in gardens and parks in October, whilst, in the Hautes-Pyrénées, a district perhaps just falling within its usual haunts, and where it is abundant in most years, the insect affects sunny pastures, settling on flowers of bramble, lathyrus, etc. (Rondou). At Nice, in October, 1893, the imagines were observed on flowers of *Cassia floribunda*, *Eriobotrya japonica* and *Mirabilis jalapa* (Bromilow); and, in Hong-Kong, they are sometimes to be met with in numbers flying about the flowers of a species of *Cassia* (Walker). It was abundant on broom in July, 1903, at the time radiant with a wealth of blossom, between Vizzavona and Tattone (Rowland-Brown), was observed flying freely in a field of kidney-beans at Brindisi in August, 1879 (Mathew), and also haunted flowery places at Port Baklar, near Gallipoli, in June, 1879, the imagines being sharp fliers, and appeared especially abundant in a field of kidney-beans (Walker). Jones observes that, in the south of France, it is usually taken with *Polyommatus icarus*, which it much resembles when on the wing; while Lowe states that he believes he passed the earlier specimens of *L. boeticus* seen in Guernsey, in 1899, thinking that they were *Polyommatus icarus*. Zeller states (*Isis*, 1847, pp. 156-7) that *L. boeticus* is the commonest blue in Catania at the end of June and July, flying among *Spartium junceum*, which grows among the lava there, or resting on the bloom of

Valeriana rubra; its flight and habit, he adds, here appear to be very similar to those of *Polyommatus icarus*, but, if disturbed, it flies wildly and to some distance but returns again after a time when it has recovered from its fright; sometimes several are seen flying together, and, at other times, it is seen flying with species of other genera or feeding with them on flowers; near Naples, it flies with *Polyommatus icarus* and *Langia telicanus*, at the blossoms of the common *Heliotropium*; at Pompeii, where the *Spartium* grows among the scoriæ, the butterfly is not rare flying in company with *Pontia daplidice* and *Pieris rapae*. Verity says (*Bull. Soc. Ent. Ital.*, xxxvi., p. 137) that, in the Lucca district, it occurs commonly in spring, but more so in the autumn; the ♂ having a particularly rapid flight, a practised eye being necessary to capture it on the wing; it prefers a thistle on which to rest, but flies off rapidly as one approaches, returning, however, to its chosen post as soon as the danger appears to be past, and from which it appears never to wander far during the whole of its existence; the only way to obtain the species in numbers is to hunt them in a field of "erba medica" (? lucerne), of the flowers of which they are very fond. Stefanelli says (*Bull. Soc. Ent. Ital.*, xxxii., p. 332) that, in Tuscany, it is common, both in the lowlands and on the hills, haunting meadows, fields, rocky and grassy places, hedges, and open woods, resting with especial fondness on *Colutea arborescens*. Rocci observes (*op. cit.*, xxxviii., p. 76) that it is not very common in the neighbourhood of Turin, where it occurs, however, in the meadows and low-lying ground. Failli-Tedaldi states (*Bull. Soc. Ent. Ital.*, 1878, p. 250) that, in Sicily, it loves to settle on the underside of vine-leaves, and, sometimes, in autumn, on the naked earth, and that, when disturbed from its resting-place, it quickly returns to the same spot; near Castelbuono, it haunts the black vetch, growing by the stream there.

PROBABLE HYBERNATING STAGE OF LAMPIDES BOETICUS.—In 1847, Bellier suggested (*Ann. Soc. Ent. Fr.*, p. 105) that *L. boeticus* hybernated in Central France in the imaginal state. In that year, in the neighbourhood of Chartres, the species was very abundant, and from a number of larvæ collected on *Colutea*, and that pupated in due course, he reared many imagines after a pupal period of ten or twelve days, whilst two examples did not appear till November 17th, after a pupal period of about three months. He considered that these late emergences were very extraordinary and thought, as stated above, that they tended to suggest that the species might hybernate as an imago, whilst it indicated a capacity for existing unharmed, in the pupal stage, for a considerable time at a cool period of the year. He considered it unlikely that the butterfly laid its eggs in the autumn and that the latter went through the winter, because the newly-hatched larvæ would possibly not be able to find the pods, in which the larvæ live, at some distance from the point at which they had been laid, and he thought it much more likely that the imago laid its eggs on the calyx of the flower, and that the newly-hatched larva thus found itself quite near its food, and he further opined that these hybernating imagines did not couple until such time as the flowers of the *Colutea* commence to show. Some years later (in 1860), Millière reared the species, and Newman, professing to quote Millière states (*Brit. Butts.*, p. 118) categorically, that the last disclosed females lay their eggs on the twigs of *Colutea arborescens*, but they do not hatch till the following summer. Millière, after describing the larva (already quoted *anteà* p. 351) writes:—

"This caterpillar lives in August and September in the pods of the bladder-senna, *Colutea arborescens*, L., of which it eats the still unripe seeds. Before becoming fullfed, it travels several times from one pod to another. When young it is nearly black, and only attacks the, as yet, hardly formed bladdery fruits. I do not believe, as several naturalists who have spoken of the larva of *L. boeticus* say, that it lives a first time in June. Such a fact can hardly be admitted when one recollects that the bladder-senna produces its first pods at the end of July. (The earliest fruits of the *Colutea*, in spite of constant examination, have never supplied me with larvæ, or given any indication of having contained them), and, as the larva eats only the seeds, it could not actually appear before their development. In my opinion, *L. boeticus* has only one season, although it may very well have several generations uninterruptedly. One sees it flying freely in our vicinity from the middle of August to the end of October in places where the *Colutea* grows. The last females of this charming *Lycaena* lay their eggs on the branches of *Colutea arborescens*. They ought not to hatch until the following year before the date of the seeds proper for the food of the young caterpillar."

Millière further says it descends to the lower part of the plant to pupate and the butterfly emerges in five or six days. He describes the chrysalis (see *anteà*, p. 357). In 1907, we discussed the question (*Ent. Rec.*, ix., pp. 250-251), and inclined to the opinion that, "*L. boeticus* hybernates, if it really exists in Europe in the winter in any numbers at all, in the imago state," and that Millière's statements, that "the larva lives in June and July, in the siliquas of *Colutea*," and "the imago occurs in August and September," suggest that, in Europe, the main brood is a late summer or early autumnal one, whilst the fact that eggs were laid in October at Bordighera (Norris), and the records of captures of imagines in October, in the Roman Campagna, and in "December, January and February," at Cannes, suggest strongly the "imaginal" as the hybernating stage. Evidence of an earlier generation than that known to Millière, *viz.*, in "June," in Spain, the Greek Islands (Naxos, etc.), and of another yet earlier in "March" for Cairo, Algiers, Bona, etc., was also discussed, and we concluded that "it appeared that, in North Africa, in suitable places, this cosmopolitan and migrating butterfly had many of the habits of *Pyrameis cardui*, emerging late in September and October (this brood living in the imaginal state some time), laying eggs, in due course, in winter and spring, fresh imagines appearing again in March and April, in June and July, and so on. These habits, ingrained into the species in its tropical habitats, it carries with it on its migrations, and presumably, attempts (with the result of some modification) to do elsewhere what it does there with safety, resulting in some uncertainty in its appearance in all those parts of the area where it only occurs sporadically, and, as a result, probably, of its migrating tendency." Chapman, on his wide knowledge of the early stage of this species, writes (*in litt.*, October, 1907): "I differ from Millière in my view of the life-history of *Lampides boeticus*. Our facts are very much the same, except that I have the advantage of him in one particular. He believed *Colutea arborescens* to be the only food of *L. boeticus*; I know that it is a very occasional one. My experience is, that it is at home on almost any leguminous shrub, and can be easily reared on *Lotus corniculatus*. In northwest Spain, it affects *Adenocarpus*, but, whilst this plant swarms much more with *Langia telicanus*, *Lampides boeticus* much prefers a species of *Ulex*, which is also its food-plant in southwest France. If *L. boeticus* could hybernate as an egg, it would be a common British insect, and our two species of gorse, with herbaceous *Papilionaceae*, would carry it easily through our summer. My view is that *L. boeticus* is continuously-brooded, like *Colias edusa* or *Pyrameis cardui*, but can, even less than these species, stand a real winter in any stage. As directly negativing Millière's hypothesis, for the wintering of the eggs is clearly a hypothesis and not in any way a record of observation, I found at Guéthary (near Biarritz) eggs of *L. boeticus* newly-laid on *Ulex nanus* on July 5th; and I took a slightly worn female on the same day. It is clear that this female, and the one that laid the eggs, had not fed in pods of *Colutea*. It had probably emerged from the pupa in mid-June. But whether at Guéthary or somewhere further south, is open to considerable doubt. The larva feeds up in hot weather with lightning rapidity, and the pupal stage may be as short as Millière states, and there may be, therefore, several broods in the summer, probably at the rate of a dozen a year, in suitable African localities. In a good locality, and season, it therefore multiplies rapidly, and, no doubt, distributes itself abundantly by migration, passing often from inland stations, too dry in summer to have flowers, to cooler coast localities, leaving these again in winter. Not that there is an organised migration, but simply that abundantly multiplied individuals scatter in all directions and sufficient manage to reach suitable districts. The larva will eat leaves of *Adenocarpus*, and the green, I can hardly say foliage, of gorse, but not with relish, so that I think it is very possible that a generation might very well live through the winter at Vigo, or even Biarritz, no matter what stage it were in, but taking three or four months, instead of three or four weeks, to complete their changes, and no doubt many perishing, but enough would get through to make a start the following spring, winter finding the species at all stages, so there would be all stages all through winter, except that the earlier stages would probably not be regularly replenished by fresh egglaying. Imagines, however, that died off, would be replaced by fresh emergences, and there would be enough of these in the early days of spring to start a few broods. My early July female at Guéthary was probably one of such a brood. Whether they failed to get through the winter or not, they would be replenished by immigrants from further south. My hypothesis, for it is after all nearly as much a hypothesis as Millière's, is that, south enough, the species is continuously-brooded all the year round. In the north (*e.g.*, northern France, England, etc.) it perishes every winter, even if it gets a footing in summer, but, in many localities between, and I think Vigo is probably such a place, it is also continuously-brooded all the year round, but the winter individuals progress very slowly compared with the summer broods, and suffer largely owing to undesirable or actual lack of food, much more than to climatic rigours, but they nowhere hybernate in any stage, in the sense of actual suspension of activity during the winter."

Habitats.—The real home of this species extends practically throughout the whole of the tropical and subtropical areas of the Old World. In these districts it is continuously-brooded and generally distributed. It appears to occur throughout Equatorial Africa, being observed at Wadelai, etc. (Sykes, *Ent.*, xxxvi., p. 6), throughout Nigeria, at Jebba, Rabba, Boussa, etc. (Christy *teste* Sharp, *Ent.*, xxv., p. 102), on the Anambara Creek, flowing into the Niger river just above Asaba (Braham *teste* Lathy, *Trans. Ent. Soc. Lond.*, 1903, pp. 183, 201). It is generally distributed throughout southern Africa (Trimen); on Table Mountain, at the back of Capetown, in the early springtime (mid-October) of 1904, among the fir-trees which cover the mountain for a good way up its northern face (Manders); in Mauritius it appeared almost confined to gardens, where it occurred on the cultivated pea (Trimen); it occurs also throughout Madeira (Bethune-Baker), and Teneriffe (Elliott); and appears freely in Morocco in the neighbourhood of Tangier (Meade-Waldo); and in Algeria, on the ridge above Hammam-es-Salahin to the west of Biskra; also with *Callophrys rubi* var. *fervida* on the thorn-bushes of the steep slopes of the long sharp-edged mountain, which may be considered as the dividing line between the Aurès and the desert at El Kantara (Nicholl). At Khartoum it swarms in the sandy gardens, planted with abundant trees and shrubs (Graves). It occurs throughout the delta of the Nile Valley, on closely cultivated alluvial ground, being found in all gardens, orchards, etc., often in large numbers; also from Port Said to Ismailia, in gardens and cultivated spots surrounded by salt lakes or desert, *e.g.*, the café gardens just south of the town on the banks of the canal; it is not uncommon on the Maryut Steppe, bare, open, wind-swept, grass land, stony and waterless save in winter and spring, when the rains are heavy and pools form in the water-courses. In February, March and April, flowers abound, numerous species of vetch, asphodels, anemones, poppies, gladiolus, etc., most of which I have seen the butterfly visiting; it also occurs at Ezbet el Nakhle and Marg, about ten miles northeast of Cairo, where the cultivation is less intense than in the immediate neighbourhood of the town. It also occurs in the desert wadis, east of the Nile, behind Helwan, on most unpromising-looking ground, hot, dry, water-courses, forming ravines in the limestone rock, and fringed with a scanty desert vegetation growing in tufts and patches. To get some idea of the locality, one must imagine a winding, rocky, trout stream, with steep banks, often rising to cliffs, of grey limestone, absolutely dry, and fringed with scrub and thorny bushes among which scattered flowers—*Erigeron*, a crucifer or two, a species of balsam, etc., grow here and there. The heat in these gullies can be terrific, the wind often blows a gale, and the whole aspect of the place leads one to believe that butterflies could not exist in it, except, perhaps, in winter, yet, here, with *Lampides boeticus*, *Anthocaris belia* var. *ausonia* occurs in some numbers, as well as *Melitaea* var. *deserticola*, *Pontia glauconome*, *Polyommatus lysimon*, *Pyrameis cardui*, etc. (Graves). In Syria, it occurs around Jaffa, in country resembling the Maryut steppe, but better-watered, and more hilly, and in the great orchards and gardens near the town; it was also found sparingly in the fields across the Nahr el Awaj, a pretty mill-stream that runs into the sea near Jaffa; near Beyrout it occurs in the hot moist valley of the Dog river; abounding on the terraces where "liblab" beans are plentiful; it also occurs in the gardens around the town with *Pontia daplidice*, *Idmais fausta*, etc. (Graves); it was also found at Brummana, ten miles east of Beyrout, some 2500ft. above the sea (Nicholl); in the Lebanon, it occurs on the lower and middle slopes, haunting broom, and gardens where liblab beans, sweet- and garden-peas, etc., are cultivated, occurring at 4500ft. at Ain-Zahalta on stony slopes, where broom grows in patches, and, in the Anti-

Lebanon at 4800ft. among the thick hedges of zizyphus, dog-rose and bramble, and in the orchards that surround Bludân (Graves); it was found commonly throughout the Lebanon from 2000ft. to 5000ft., from April to June, occurring among other places at Khan Sunnin, about 6000ft. above the sea, in a hollow directly below the highest summit of Djebel Sunnin, on the western side, in rough, half-cultivated, terraced fields, deep watercourses and snow-fed streams (Nicholl); at Damascus, it occurs in the thick orchards and plantations, and in the valley of the Barada; it also occurs in the great open plains of the Hauran where a splendid wheat crop grows on red volcanic soil; at Haifa, it occurs abundantly in the plain of the Mohatta river, in the gardens of the town, as well as on the bushy slopes of Mount Carmel (Graves). Nicéville says that the species occurs almost everywhere in India, except at great elevations in the Himalayas, and in perfectly desert regions; it most probably feeds, he thinks, on a great many leguminous plants and hence can exist almost everywhere; Elwes says that it is not common in Sikkim, which is probably too wet for it, but occurs up to 10000ft.; it is, however, more common in the interior towards Bhutan. In Ceylon, it appears to favour rather dry open country, and seems to frequent places where *Mimosa pudica* grows, the plant and butterfly often being found together (T. B. Fletcher). It is found everywhere in the Shan States and at all elevations, the specimens being very constant (Manders). This widely-spread butterfly occurs in Sumatra near the sea, as Martin has taken it in the Saentis Estate and at Loboe Dalam on the flowers of the common kidney-bean (*Phaseolus vulgaris*) and also very high in the mountains at Soengei Batoe, and on the Central Plateau, but it is never found in the intermediate area. Martin is quite unable to account for this fact which has also been observed by Hagen, who has taken *L. boeticus* near Laboean on abandoned indigo-plants, and believes that the butterfly was imported to this very low elevation from Singapore when the Malays first introduced the indigo-plant from thence (Nicéville). It was found in the Pamir, in the defile of Gang-Guirdak, in the western ramifications of the Ghessar Chain, in July (Grum-Grshimailo). So far, this insect has been found sparingly in all the Chinese localities visited by collectors, but, although also found in Japan, appears to be very rare in that country (Leech); Pryer, however, says that it is very local in Japan, occurring chiefly in gardens, but that it occurs in every eastern country in which he has collected, in Labuan, Ogasawara, etc., and possibly in all the intervening islands where its foodplant is cultivated. It occurs commonly at Hong-Kong especially in the low ground about the "Happy Valley" (*Trans. Ent. Soc. Lond.*, 1895, p. 439), where it is sometimes to be found in numbers flying about the flowers of a species of *Cassia* (Walker). In Europe, along the north Mediterranean littoral, the species is widely distributed, and Ochsenheimer, a century ago, recorded it as an European species only from Switzerland, Italy, Spain, Portugal and South France. It is found on the hillside of Crete where the air is laden with the scent of myrtle, wild thyme, sage, peppermint, etc., with which the hills are clothed (T. B. Fletcher); it is common in the Gallipoli district, wherever wild vetches grow, several broods occurring during the summer, and examples being netted through November, December and January (Mathew); it is found commonly in flowery places, and especially in fields of kidney-beans on the cliffs at Port Baklar, about twelve miles from Gallipoli, the road between the two passing through the famous lines of Bulair (J. J. Walker). In Malta, it is not uncommon with *Polyommatus icarus* in the wieds or deep narrow valleys scooped out of the rock by the torrential rains, and which are the principal home of the native vegetation of Malta (Fletcher). It also occurs throughout Corsica, and is noted as being abundant on the broom, between Vizzavona and Tattone, in July, 1903, the plant at this time being radiant with a wealth of golden blossom (Rowland-Brown). It is recorded as common in the Brindisi district, being observed in August, 1897, in a field of French beans, in the valley beyond Ponte Grande, where numerous wild flowers, especially fleabane and aster, grow in masses (Mathew). Zeller notes its haunts in Catania as being among the *Spartium* growing in the lava beds there ; at Pompeii on the same plant growing among the beds of scoriæ, etc., whilst in Tuscany, Lucca, etc., meadows, gardens, woods, etc., are chosen. It appears to be widely distributed throughout Spain, and occurs all round Gibraltar, having been taken even on the summit of the "Rock," near the Signal Station. It occurs at Granada, on a ridge about four miles in length, one mile in width, and 3000ft. in height, falling in steep and well-wooded declivities to the Darro, on the north, and in broken precipices and rocky glens to the Genal, on the south ; it was also found in great numbers from mid-May to the end of July, 1897, in the Barcelona district, and in central Spain from sea-level to 5000ft. elevation (Nicholl), whilst, also, throughout the Barcelona district, it is reported to fly during the greater part of the year in dry torrent-beds, frequenting broom and other plants (Cunì y Martorell); it is recorded as occurring in the Jucar glen near Tragacete, on abandoned patches, that had, at one time, been cultivated, and are now covered with a thick crop of a tall, yellow-flowered, ill-smelling sage that grows solitarily elsewhere, and seems to be immensely attractive to butterflies, which rest on them in thousands and tens of thousands, a sight to take its place in the memory with the most notable swarms of insects that we have ever seen (Chapman); it is also distributed over the La Granja district, and is particularly abundant on slopes about 2000ft. in height, covered with broom, cistus, and other shrubby plants (Sheldon). It would appear that, in the warmer northern valleys of the Pyrenees, the butterfly has an almost permanent home just as it has south of the range, *e.g.*, Rondou says that the insect is common in the Hautes-Pyrénées ; Chapman observes that it is abundant in a series of wooded hollows or swamps a mile or so inland from Guéthary, where it flies freely among furze, evidently its foodplant here ; Nicholson says that it occurs on heathy ground to the south of Biarritz, and in the marsh near the Statten. It is just possible that it is able to maintain a permanent existence in the warm corners of the French Riviera, of Italy generally, and of the Balkan peninsula, but north of these points its habitats are largely governed by chance, and warm, sunny spots where *Colutea arborescens* grows, or gardens with an abundance of leguminous plants —lupins, peas, beans, etc.—are its usual habitats. Thus in Piedmont we found it fairly commonly in a small, sheltered, sun-baked valley at the back of Susa, flying over the *Colutea* bushes. In one of its specially favourable years, 1900, we saw it on the warm Grésy hills, where also

Colutea grows, feeding on heather-flowers (but have only seen it here on this single occasion in some thirteen years); in another suitable year, 1899, we saw it on the heaths of Fontainebleau Forest, also busily feeding on heather-bloom, whilst in these same favourable years it also occurred in the Rhone valley, among the *Colutea* bushes at Branson and Sierre; in another good year, 1904, we saw it again among the *Colutea* bushes growing in the wild-flower wilderness at the foot of Mont Salève, and in those specially suitable years, it usually reaches Guernsey, Belgium, and even warm spots in Germany, and is then generally attached to gardens and exhibits the habits, which one is accustomed to see in it, at Nice, Cannes, and its chosen haunts along the shores of the Mediterranean. Weir observed a specimen, in August, 1878 (?), on the right bank of the Rhine, close to Coblenz, flying on a piece of waste ground sparsely clothed with vegetation and consisting principally of *Ononis arvensis* (*Ent.*, xii., p. 83), but it is of very rare occurrence in Germany, even as an immigrant. A few examples were recorded in August, 1828, near Aachen, once also at Basle, and in the "forties," it was noted, without details, from Alsace, and possibly two other specimens—one on the Schotzach, between Thalheim and Hookheim. in 1849, and another in the Stuttgart valley in the autumn of 1859, both recorded as *telicanus*, and these are the onlyrecords we have been able to obtain. As may be expected, the connection with the Mediterranean areas being more direct, it is not so rare in southern Austro-Hungary, and appears singly in most parts of central and northern Hungary, *e.g.*, Pecs, Eperjes, etc., but near Budapest more frequently in September and October, possibly more like its uncertain comparative abundance in the Channel Isles; in the southern parts, however, *e.g.*, Fiume, it occurs more commonly, evidently in the same way as along the rest of the Mediterranean littoral (Aigner-Abafi). It is also exceedingly rare and local in Switzerland, for, although recorded in the Valais in 1771, by Fuessly, 120 years passed before it was again noticed, yet, in what we may call "*boeticus*" years, it appears pretty regularly on the hot bush-covered slopes and gardens of the low-lying parts of the Rhone Valley, *e.g.*, near Geneva, the Folleterres de Fully, near Branson, near Aigle, etc., but only in these years. It is still more rare in Belgium, occurring sporadically in the large private parks where *Colutea* grows (Lambillion). It occurs in Transcaucasia in August and September, but appears not to be recorded from central Russia. The south of England, Belgium and Germany, appear to be the most northern limits of its occasional wanderings; and these wanderings from its Mediterranean haunts appear to be more frequent in central France than elsewhere. When found there, it usually haunts gardens, parks, the outskirts of woodlands, etc., *e.g.*, parks and gardens in Berry and Auvergne (Sand); the little thickets surrounding the gardens in Doubs (Bruand), gardens and pastures in the Gironde (Caradja), gardens where *Colutea* and *Genista* are grown in the Bordeaux district (Trimoulet), etc.

Reputed British examples of Lampides bœticus.—Of the following specimens reputed to have been captured in Britain, we must leave our readers to judge as to which are, and which are not, worthy of credence. [The species is known to have reached the Channel Islands in 1859, 1872, 1889, 1892, 1899, 1900, and 1904.] The unsatisfactory evidence relating to some of the examples is only too evident. The records to date are :—

1.—Near Christchurch; flying about everlasting-pea; August 4th, 1859, taken by Latour (Stainton, "Ent. Wk. Int.," viii., p. 82; Newm., "Brit. Butts.," p. 119; "Entom.," ix., p. 92) (where "Latour" is mis-spelt "Latimer").

2.—At Brighton; near the chalk downs; August 5th, 1859, taken by McArthur (Newm., "Zool.," 1859, p. 6732; Sta., "Ent. Ann.," 1859, pp. 126-127). [Newman mis-states (*Brit. Butts.*, p. 119) that McArthur captured "two" specimens, and repeated the inaccuracy (*Ent.*, ix., p. 92); McArthur himself corrected the error (*Ent.*, ix., p. 132), stating that he only took "one." South, however, repeated the error (*Butts.*, p. 155).]

3.—Near Freshwater; August 23rd, 1878 (Snell, *Entom.*, xii., p. 83). [It is curious to observe that, although Mr. Snell recorded this example on February 10th, 1879, he could not then remember whether he or his brother captured it. Also that two of the very few Swiss records outside the Rhone Valley are made by Mr. Snell, August and October, 1879 (*see* Wheeler, *Butts. Switzerland*, p. 45). South wrongly gives (*op. cit.*, p. 155) the date of the reputed British capture as 1879.]

4.—At Andover, Hants; captured by Elton, Trinity Coll., Cambridge. No other data. Produced 12s. at sale of the "Briggs' coll." (*Ent. Rec.*, viii., p. 272). Further noted as a ♂, underside, on large common pin, fair condition, "Dale" coll. (J. J. Walker, *Ent. Mo. Mag.*, xliii., p. 132). [No hint of the existence of this specimen is to be found until offered for sale in 1896. The date and place of its capture are alike unknown and unrecorded.]

5.—♂ in fair condition badly set. Now in the Hope Museum. Label in Dale's handwriting—"From J. G. Ross, 1882, who had it from a boy who took it in Devonshire." "Dartmouth (C.W.D.)." [Information, therefore, third hand. If Ross was satisfied with "Devonshire" one wonders why Dale localises it some years later to "Dartmouth."]

6.—Specimen reputed to have been purchased of a "local collector on the Cotswold Hills" by a friend of the recorder (McCaul), the friend having "long since lost sight of the collector"; from this friend McCaul obtained it for "the fine collection of A. F. Sheppard, of Lee" (*Ent.*, xii., p. 155). [Sheppard, of course, was a well-known dealer in the "seventies." On this evidence, McCaul "entertains no doubt that it is a really British specimen."]

7.—At Aldwick, near Bognor; a specimen at rest on a geranium in a garden; captured September 12th, 1880 (Durham, *Entom.*, xiii., p. 240).

8.—Near Bournemouth; captured by Miss Staples. October 2nd, 1882 (McRae, *Entom.*, xv., p. 260).

9.—At Heswall, Cheshire, in 1886 or 1887, by a boy named McFee (Newstead, *Ent. Rec.*, iii., pp. 271, 313). [This example was not recorded until 1892. One would like to believe that stray immigrants reached Cheshire, but it appears to be well out of the latitude of the immigrant range of the species.]

10.—At Brighton, on the downs; captured July, 1890 (Smith, *Entom.*, xxvi., p. 361). [In rather battered condition; supposed to be *Polyommatus icarus*; not recognised for a year, etc. (Smith).]

11.—Near Beckley, Sussex; in a rough meadow near hop grounds; captured August 28th, 1893 (Warner, *Entom.*, xxvi., p. 301).

12.—♂. Between Dartford and Erith; on the railway-embankment, settled on a flower; captured September 7th, 1893 (Sabine, *Entom.*, xxvi., pp. 300-301).

13.—At Hastings; captured in the third week in September, 1893, by a boy about ten years of age (Bath, *Entom.*, xxvi., p. 327).

14.—In a room at Wood Street, Woolwich; supposed to have entered the room through "French" windows; September 29th, 1898 (Brooks, *Ent. Rec.*, xi., p. 79). [One would like to know how this butterfly got into a room in Woolwich through "French" windows. Whether meant for a joke or not we should prefer to consider it one. It was not observed anywhere in Europe north of its most southern habitats this year.]

15.—♂. At Winchester, recently emerged; captured September 1st, 1899, sitting on a window (Shepheard-Walwyn, *Entom.*, xxxii., p. 281; xxxv., p. 221). [This is the first suggestion of a "recently emerged" specimen being found in Britain. What is the connection between this species and windows?]

16.—At Deal; captured September 16th, 1899, sitting on a window (Parry, *Entom.*, xxxii., p. 281). [This and the preceding example were recorded in the

November number of the *Entom.*, two months after the record of this species in abundance, in September, in Guernsey, by Lowe, Luff, etc.]

17.—♀. Near Truro; captured by a schoolboy, at a fuchsia; August 2nd, 1904 (*Entom.*, xxxviii., p. 91).

Distribution.—Africa, throughout; Australia, throughout; Europe, south, central (as a rare immigrant only), Asia throughout (except north and Amurland), East Indies, Pacific Islands (many). Africa: Canary Isles—Grand Canary, Las Palmas (Poulton), Teneriffe, everywhere (Alphéraky), Madeira, common (Bethune-Baker); Algeria—Algiers, Bona, Oran, Sebdou (Oberthür), Biskra, Hammam es Salahin, the mountain ridge dividing the Aurès and the desert at El Kantara (Nicholl), Souk-Harras (Bethune-Baker), El Kantara (Fountaine); Morocco—Tangier (Nicholson), Benzus Bay (Walker); Egypt—Cairo, Wadi Rished, Port Said, Ismailia, Helwan, Maryut Steppe, Port Sudan, Khartoum (Graves), Akeek Island, Harkeko (Lord); White Nile—Gharb el Arish, 11°N. lat., Kaka, 10° 5′N. lat. (Loat); Abyssinia—Shoa (Antinori); Soudan—Sawakin; Mauritius—Port Louis; Seychelles—Mahé (T. B. Fletcher); Equatorial Africa—Wadelai (Sykes); Anambara Creek—Asaba (Braham *teste* Lathy); Nigeria—Jebba, Rabba, Boussa (Christy *teste* Sharp), Lagos Island (Gladstone), Sierra Leone (Trimen), Island of San Thomé (Walker), St. Helena (Wollaston); British Central Africa—Angoniland, 4500ft.-5000ft. (Byatt), Mushinga Mountains, Loangira Valley, Chitala (Pemberton); Uganda—Toro, 7000ft.-9000ft. (Neave), Mengo (Mrs. Leakey), North Uganda, 8° 5′N. lat. (Loat); British East Africa—Nyangori, Victoria Nyanza, 0° 6′S. lat. at 6000ft. (Wiggins), Machocho's Road, 5400ft., N'Gongo (Hinde); Somaliland—Berbera, 5000ft. (Byatt); North Central Somaliland (Peel); Victoria Nyanza—north-east shore, 3800ft. (Wiggins); Lake Nyassa—west shore (Jersey); South-east Rhodesia—Melsetter, Gazaland, 3500ft. (Marshall), Zambesi Zombo (Rowley); Mashonaland—Gadzina, 4200′, Salisbury, 5000ft., Mazoe, 4000ft. (Marshall), Khama's Country (Barber), Mokloutze River (Selous); Congo—Kinsembo (Ansell), Damaraland (de Vylder); Bechuanaland—Motito (Frédoux), Delagoa Bay (Distant); Madagascar—Betsileo (Cowan), Bourbon Island (Boisduval and Guenée); Transvaal—Potchefstroom district (Ayres), Marico River (Selous); Zululand—east central district, Llabisa (Peachey), Napoleon Valley, St. Lucia Bay (Tower); Natal—abundant (Gooch), coast districts—Lower Umkomazi (Bowker), Durban, Frere, Tugela River (Marshall), Umvoti, Mapumulo (Trimen), Hermansburg, Greytown, Maritzburg (Colenso), Estcourt (Hutchinson); Kaffraria Proper—Butterworth, Bashee River (Bowker); Cape Colony—generally distributed, Cape Town, Table Mountain (Manders), Genadendal, Caledon district (Hettarsch), Knyona (Trimen), Plettenberg Bay, Van Wyk's Vley, Carnarvon district (Alston), Grahamstown, King Williamstown, Basutoland (Bowker). Asia: Asia Minor—Ephesus (Oken), Artaki, Beyrout, Marmarice, Tchanak (Mathew), near Broussa (Fountaine), Besika Bay (Walker); Syria—Brummana (Nicholl), the Dog River, Beyrout, Haîfa, Jaffa, near Damascus, Ain Zahalta, the Hauran (Graves), Jerusalem (Swinton), the Lebanon, throughout, from 2000ft. to 5000ft. (Nicholl), Cyprus—Nikosia, Troödos, 3000ft. (Bate); Arabia—Mount Sinai (Lord), Aden (Walker); Persia (Swinhoe); Turkestan—Tekke district, near Askhabad, Nuchur, Krasnowodsk (Christoph); the Pamir—defile of Gang-Guirdak, the western side of Ghissar (Grum-Grshimailo); Afghanistan—Khyber Pass, Malakand (Longstaff), Candahar (Distant); India—throughout (Nicéville), Bombay Presidency (Hearsey); South Bombay Presidency—Western Ghâts, North Kanara, Karwar (Keatinge), Kurrachee (Swinhoe); Rajputana—Mount Abu, 3000ft.; Gwalior—Bijápur (Longstaff); Central India—Saugor (Alexander), Jhansi; Himalaya—Naini Tal, 8500ft.; Punjaub—Peshâwar, 1165ft., Amritzar (Longstaff); North-west Provinces—Jounpore (Atkinson), Burwa Ságar, Benares, Simla, 7200ft.-8200ft. (Longstaff); Bengal—Sikkim, to 10000ft., Bhutan (Elwes); Madras—Anantapur-Hakgála; Nilgiris—Konur, 5500ft., Utakamund (Longstaff); Ceylon—to 4600ft. (Nicholl), Matale (Goodrich); Assam—Khasia Hills (Swinhoe); Siamese Malay States—Jambu (Annandale), The Shan States (Manders); Malay Peninsula—Penang, Sungei, Malacca (Distant); East Indies—Nias Island (Nicéville): British North Borneo—Sandakan (Cook and Pryer), Sumatra (Martin), Batchian, Waigiou (Nicéville), Java, Bantam, Celebes, Ceram Aru, Duke of York Island (Distant), Batavia (Walker); China—possibly throughout (Leech), Namoa Island, off south-east China, Hong-Kong (Walker), Shanghai (Distant), Sé Tchouen Province (Potamine *teste* Alphéraky); Japan—local, Yamato, Ogasawara, Yokohama, Rigukyu (Pryer). Pacific Islands: Tahiti, 2000ft., Eimeo Island (Walker); Philippine Islands—Luzon, Manila (Meyer); Bali Island—Bileling, Ternate Island (Shelford); Amboyna, New Caledonia—Nouméa, Gana Id., Banks Islands, Tégua Island; Loyalty Islands—Chepenche Lifu (J. J. Walker), Hawaiian Islands (Blackburn), Duke of York Island (Distant), Honolulu (Kirkaldy), New Hebrides (Walker). AUSTRALIA: Austro-Malayan Archipelago, Batchian, Waigiou (Distant), Queensland (Hope Museum), Brisbane (Culpin); New South Wales—Sydney (Walker); Victoria—Melbourne (Distant). EUROPE:—AUSTRO-HUNGARY: Hungary—Budapest, frequent, Pecs, Eperjes, once (Aigner-Abafi), Fiume, common (Nowicki *teste* Aigner). BELGIUM: very rare immigrant—Louvain, Visé, Namur (Donckier), Dinant (Lambillion). BOSNIA AND HERCEGOVINA: singly—Ilidzé (Winneguth), Trebinje (Rebel). BULGARIA AND EAST ROUMELIA: singly—Dubnica (Rebel), Slivno (Batmitsch). CHANNEL ISLES: immigrant, 1859, 1899, 1900, 1904, common, Guernsey—St. Peter's Port, etc. (Renouf), Jersey (Piquet), Sark (Luff). CORSICA: general, up to 2500ft. (Kollmorgen)—Vizzavona, Tattone (Rowland-Brown). FRANCE: Ain—Bagé (Combaud), Aisne, Lesdin, St. Quentin (Dubus); Alpes-Maritimes—Cannes (Chapman), St. Martin-Vésubie, Beaulieu (Rowland-Brown); Nice, St. Maurice, Raye (Bromilow); Ariége—Ax-les-Thermes (Rowland-Brown); Aube, very rare—les Riceys, Ervy, Bar-sur-Seine (Jourdheuille); Aude—common on the hills (Mabille); Auvergne — Clermont (Kane); Basses-Alpes — Digne (Rowland-Brown); Basses-Pyrenees — Biarritz, Pierrefitte Nestalas (A. H. Jones), Guéthary (Chapman); Bonches-du-Rhone (Frionnet); Charente-Inférieure—Royan (Salis); Calvados—Caen, Venoix, Maltot, common (Fauvel), but later seems to have disappeared, *e.g.*, one example only at Caen (Moutiers); Cher—St. Florent, Sologne (Sand); Côtes-du-Nord—Val André (Denis Turner); Côtes-d'Or—abundant in 1865 (Carteron); Creuse—Guéret (Sand), Dordogne, common (Tarel); Doubs (Bruand)—Besançon (Kane); Eure-et-Loire—abundant some years, rare others (Guenée), Chartres (Bellier de la Chavignerie); Gironde, common in 1847—environs of Bordeaux, double-brooded (Robert Brown), Bègles (Trimoulet); Haute-Garonne—Toulouse, Revel, Lacroix-Falgarde, St. Gaudens, Grenade, Muret (Caradja); Haute-Marne—very rare (Frionnet); Hautes-Pyrénées—Gavarnie, etc. (Rondou), Lucon (Réaumur), up fo 8000ft., *e.g.*, Pic du Midi (Elwes), Picos de Europa (Nicholl); Haute-Savoie—foot of Salève (Tutt); Ille-et-Vilaine—common occasionally, in the Botanical Gardens at Rennes, and elsewhere (Griffith and Oberthür); Indre—le Blanc, Brenne (Martin); Nohant—le Coudrai (Sand); Loire-Inférieure—Nantes, Préfailles, rather common (Deherman-Roy); Lozère—Florac, Mende (Rowland-Brown); Maine-et-Loire—sometimes rather common (Delahaye); Marne—very rare in gardens (Demaison); Morbihan—Vannes (Griffith); Puy-de-Dôme—Gravenoire, Royat (Sand); Saône-et-Loire—rare and very local, a small form, St. Clement-les-Macon (André); Pyrénées-Orientales—acclimatised where the foodplant exists (Constant), Vernet (Rowland-Brown); Seine—Paris district (Geoffroy); Seine-et-Marne—Fontainebleau (Tutt); Seine-Inférieure—Boisguillaume, two examples (Noel), Etretat (Reid); Seine-et-Oise—Osny railway station, and in gardens where foodplant is grown (Henry Brown); Savoie—Grésy-sur-Aix (Tutt); Var—Hyères (Rowland-Brown), Cannes (Chapman). GERMANY: exceedingly rare immigrant—several on the Lousberg, near Aachen, Augnst, 1828, not since recorded (Meigen); Baden—Basel, once, September 9th, 1847 (?), not since observed (Reutti); Württemberg—on the Schotzach, between Thalheim and Horkheim, one recorded in 1849 as *L. telicanus* (Seyffer), the Stuttgart Valley, one example in 1859, also recorded as *L. telicanus* (Hofmann) [Both these records are now supposed to have been *L. boeticus* (Gillmer).]; Rhine Provinces—once near Coblenz (Jenner-Weir), Alsace (Peyerimhoff). GREECE: Corfu, Phalerum, Poros, Salamis Bay (Mathew); Crete—Suda Bay (T. B. Fletcher), Piraeus (Walker). ITALY: Sicily, rare—Palermo, Madonie, San Martino (Minà-Palumbo), Osimo (Spada), Castelbuono (Failla-Tedaldi), Catania, Buon Retire, Messina (Zeller); Basilicata—Brindisi (Mathew), Pompeii, very common; Campania—Naples (Zeller), Capri (Buchanan-White); Roma district—Rome (Zeller); Tuscany, common—Florence, Pisa, Leghorn (Stefanelli); Emilia—Lucca district, common (Verity), Modena (Fiori); Liguria—Bordighera (Norris); Piedmont—Turin district, not common (Rocci), San Dalmazzo di Tenda (Norris), Susa (Tutt), Stresa, Menaggio (A. H. Jones); Lombardy—Brianza, once, September, 1874 (Turati). MALTA: Civita Vecchia, etc. (Walker). PORTUGAL: Lisbon (Mathew), Cea (Eaton). RUSSIA: south-west Russia (Höffmann and Cholodkovsky), Transcaucasia—Borjom, common, Igdir, Hankynda, Soukhoum, Kasikoporan (Romanoff). SARDINIA (Kane). SPAIN: abundant—Galicia—Tuy, etc. (Chapman); Catalonia—from sea-level to 5000ft. (Nicholl), Barcelona, Aragon, Teruel (Fountaine), Calella (Cuní y Martorell); Valencia—Valencia, Sagunto (Fountaine); New Castile—Barbadella, Tragacete, Avila, La Granja, Puerto de Pajares (Chapman), Sierra de Guadarrama (Poulton); Andalusia—common throughout (Rambur); Granada—Granada (Nicholl), Malaga (Lang), Lanjaron (Kane); Sevillia—Gibraltar (Walker). SWITZERLAND: rare immigrant—Neuchatel (Junod), Val de Moutier, St. Aubin (de Rougemont), Geneva (Blachier), foot of the Salève (Tutt), Florissant, near Geneva (Rehfous), Lausanne (La Harpe), St. Triphon (Fison), Aigle (Tasker), Follaterres de Fully, near Branson (Favre), Sierre (Wheeler), Basle (Diekenmann), Hottingen (Snell). TURKEY: Lemnos (T. B. Fletcher), Salonika (Mathew), Port Baklar, Gallipoli (Walker), Pera (Oken).

Tribe: CELASTRINIDI.

Genus: CELASTRINA, Tutt.

SYNONYMY.—Genus: **Celastrina,** Tutt, "Ent. Rec.," xviii., pp. 131-132 (1906); "Nat. Hist. Brit. Butts.," i., p. 314 (1906); West, "Ent. Rec.," xviii., p. 143 (1906); Raynor, "Ent. Rec.," xviii., p. 299 (1906). **[Papilio-] Plebeius,** Linn., "Syst. Nat.," 10th ed., p. 483 (1758); Poda, "Mus. Graec.," p. 76 (1761); Müll., "Faun. Frid.," i., p. 36 (1764). **Papilio, Linn.,** "Faun. Suec.," 2nd ed., p. 284 (1761); Hufn., "Berl. Mag.," p. 72 (1766); De Geer, "Mémoires," ii., p. 182 (1771); Schiff., "Schmett. Wien.," 1st ed., p. 184 (1775); Fuess., "Verz.," p. 31 (1775); Harris, "Eng. Lep.," p. 2 (1775); Rott., "Naturf.," vi., p. 7 (1775); Müll., "Zool. Dan. Prod.," i., p. 115 (1776); Sulz., "Gesch. Ins.," p. 146, pl. xviii., figs. 13-14 (1776); Retz., "Gen. Spec. Ins.," p. 30 (1783); Schneid., "Syst. Besch.," p. 269 (1785); Bork., "Syst. Besch.," i., pp. 173, 282 (1788); ii., p. 234 (1789); Lang, "Verz.," p. 57 (1789); Bork., "Rhein. Mag.," i., p. 285 (1793); Don., "Brit. Ins.," xiv., p. 39, pl. 481, figs. 1-3 (1795); Lewin, "Ins. Gt. Brit.," i., p. 76, pl. xxxvi., figs. 4-6 (1795); Hb., "Eur. Schmett.," pl. lvii., figs. 272-4 (1799); text p. 45 (1806); Ill., "Ill. Mag.," iii., p. 183 (1803); Herbst, "Nat. Syst. Ins.," xi., p. 180, pl. 310, figs. 4-6 (1804); Latr., "Hist. Nat. Crust.," xiv., p. 120 (1805); Ochs., "Die Schmett.," i., pt. 2, p. 17 (1808). **[Papilio-] Argus,** Scop., "Ent. Carn.," p. 177 (1763). **[Papilio-Plebeius-] Ruralis,** Linné, "Syst. Nat.," 12th ed., ii., p. 790 (1767); Fab., "Sys. Ent.," i., p. 525 (1775); Esper, "Schmett. Eur.," i., pt. 1, p. 360, pl. xl., supp. xvi., fig. 3 (1777); Bergs., "Nomen.," i., p. 74, pl. xlv., figs. 5-8 (1780); Fab., "Spec. Ins.," ii., p. 123 (1781); "Mant. Ins.," ii., p. 73 (1787); Brahm, "Ins.-Kal.," p. 327 (1791); Schwarz, "Raup.-Kal.," i., p. 178 (1791); Rossi, "Faun. Etrusc.," ii., p. 156 (1790); Haw., "Lep. Brit.," p. 47 (1803); Rossi, "Mant.," ii., p. 249 (1807). **[Plebeius-] Ruralis,** Esp., "Schmett. Eur.," i., pt. 2, p. 27, pl. liv. (cont. iv.), figs. 4*a-b* (1778). **[Papilio-] Ruralis,** de Vill., "Car. Linn. Ent. Fn. Suec.," ii., p. 67 (1789). **[Hesperia-] Ruralis,** Fab., "Ent. Syst.," iii., pt. 1, p. 295 (1793). **Cupido,** Schrank, "Faun. Boica," ii., p. 212 (1801); Kirby, "Syn. Cat.," p. 370 (1871). **Polyommatus,** Latr., "Hist. Nat. Crust. Ins.," xiv., p. 120 (1805); Godt., "Enc. Meth.," p. 611 (1819); "Hist. Nat.," i., p. 225, pl. xi. *sec.*, fig. 8, pl. xi. *quart.*, fig. 5 (1821); Curt., "Brit. Ent.," fo. 9 (1824); Stphs., "Illus. Haust.," i., p. 85 (1828); "Ins. Cat.," 1st ed., i., p. 22 (1829); Bdv., "Eur. Lep. Ind.," p. 13 (1829); Meig., "Eur. Schmett.," ii., p. 12, pl. xliv., figs. 2*a-b* (1830); Kirby, "Faun. Bor. Amer.," p. 299 (1837); Ramb., "Faun. And.," p. 274 (1839); Wood, "Ind. Ent.," p. 7, pl. ii., fig. 61 (1839); Westwd., "Syn. Gen.," ii., p. 88 (1840); Humph. and Westd., "Brit. Butts.," p. 101, pl. xxxi., figs. 1-3 (1841); Stphs., "List," 1st ed., p. 18 (1850); 2nd ed., p. 17 (1856); Stn., "Man.," i., p. 58 (1857); Hein., "Schmett. Deutsch.," i., p. 76 (1859); Kirby, "Eur. Butts.," i., p. 110 (1862); Kirby, "Eur. Butts.," i., p. 46, pl. xiv., figs. 4*a-b* (1879); Buckl., "Larvæ," etc., i., p. 94, pl. xiv., fig. 1 (1885); Dale, "Hist. Brit. Butts.," i., p. 54 (1890); Barr., "Lep. Brit. Is.," i., p. 88, pl. xiii., figs. 2-2*e* (1893); Buckl., "Larvæ," etc., i., pp. 94, 188, pl. xiv., fig. 1 (1886). **Lycaena,** Oken, "Lehrb.," ii., p. 718 (1815); Leach, "Ed. Enc.," ix., pt. 1, p. 130 (1815); Ochs., "Die Schmett.," iv., p. 25 (1816); Sam., "Ent. Comp.," i., p. 26 (1819); Treits., "Die Schmett.," ix. supp., p. 61 (1834); Bdv., "Gen. et Ind. Meth.," p. 13 (1840); H.-Sch., "Sys. Bearb.," i., p. 113 (1843); Evers., "Faun. Volg.-Ural.," p. 45 (1844); Freyer, "Neuere Beit.," v., p. 108, pl. 445, figs. 3-4 (1845); vii., p. 87, pl. 651, fig. 1 (1858); Dup., "Cat. Meth.," p. 31 (1845); Heydrch., "Lep. Eur. Cat.," ed. 3, p. 12 (1851); West. and Hewits., "Gen. Diurn. Lep.," ii., p. 491 (1852); Bdv., "Ann. Soc. Ent. France," 2nd ser., x., p. 299 (1852); Led., "Verh. zool.-bot. Gesell.," p. 19 (1852); Wallgrn., "Skand. Dagf.," i., p. 240 (1853); Ramb., "Cat. Lep. And.," p. 43 (1808); Speyer, "Geog. Verb. Schmett.," i., p. 85 (1858); Dbldy., "Syn. List," 2nd ed., p. 2 (1859); Staud., "Cat.," 1st ed., p. 6 (1861); Edw., "Proc. Acad. Nat. Sci. Phil.," p. 56 (1862); "Proc. Ent. Soc. Phil.," vi., p. 201 (1866); Snell., "De Vlind.," i., p. 58 (1867); Berce, "Faun. France," i., p. 146, pl. vii., fig. 7 (1868); Nolck., "Lep. Fn. Estl.," i., p. 57 (1868); Newm., "Brit. Butts.," i., p. 135, fig. 47 (1869); Butl., "Cat. Diurn. Lep.," i., p. 168 (1869); Bdv., "Lep. Guat.," p. 17 (1870); Staud., "Cat.," 2nd ed., p. 13 (1871); Bang-Haas, "Nat. Tids.," 3rd ser., ix., p. 394 (1874); Curò, "Bull. Soc. Ent. Ital.," vi., p. 113 (1874); Cunì y Mart., "Lep. Barc.," p. 19 (1874); Mill., "Cat. Lep. Alp.-Mar.," p. 105 (1875); Frey, "Lep. Schweiz," p. 21 (1880); Lang, "Butts. Eur.," i., p. 127, pl. xxxi., fig. 1 (1884); Lampa, "Ent. Tids.," vi., p. 15 (1885); Kane, "Eur. Butts.," i., p. 48 (1885); Auriv., "Nord. Fjär.," i., p. 14, pl. vi., fig. 4 (1888-91); Nicév., "Butts. India," iii., p. 107 (1890); Rühl, "Gross-Schmett.," i., p. 292 (1895); Meyr., "Handbook," p. 347 (1895). **[Zephyrus-]Cyaniris**, Dalm., "K. Vet. Acad. Handl.," xxxvii., pp. 63, 94 (1816). **Agriades**, Hb., "Verz.," p. 68 (1816-18); Stphs., "Illus.," iv., app. p. 404 (1834); Kirby, "List Brit. Rhop.," p. 3 (1858). **Argus**, Dup., "Hist. Nat.," supp. i., p. 390 (1832); Bdv. and Le Conte, "Lep. Amer. Sept.," p. 118, pl. xxxvi., figs. 1-5 (1833); Zett., "Ins. Lapp.," p. 912 (1840). **Cyaniris**, Scudd., "Sys. Rev. Amer. Butts.," p. 34 (1872); "Hist. Rev. Gen.," p. 150 (1875); Moore, "Lep. Ceyl.," i., p. 74 (1881); Scudd., "Butts. New Engld.," ii., p. 918 (1889); Leech, "Butts. China," ii., p. 320 (1894); Tutt, "Ent. Rec.," vii., pp. 220, 300 (1896); "Brit. Butts.," i., p. 187, pl. ii., figs. 6-7 (1896); Kirby, "Handbook," etc., ii., p. 103, pl. xlix., figs. 1-3 (1896); Grote, "Schmett. Hildesh.," p. 42 (1897); Reuter, "Ent. Rec.," x., p. 97 (1898); Staud., "Cat.," 3rd ed., p. 90 (1901); Wheel., "Butts. Switz.," p. 45 (1903); South, "Brit. Butts.," p. 172, pl. cxiii., figs. 1-9 (1906).

For a long period the species belonging to this genus were included by authors with all the other "blues" in one or other of the heterogeneous mixtures known as *Polyommatus* or *Lycaena*. Scudder was the first author who scientifically attempted to confine the group to its natural limits. He arranged the species, however, under the name *Cyaniris*, and, in his consideration of the genus *Cyaniris*, enumerates (*Hist. Rev. Gen.*, pp. 150 and 293) Dalman's list of species (*ântea*, vol. viii., p. 306), and adds—

1820.—Billberg, *Enum. Ins.*, p. 8, uses it for all Dalman's species excepting *alcon*, and for several additional species.

1835.—Vill.-Guenée, *Lep. Eur.*, p. 19, employ it for *corydon*, *argiolus*, and others.

1872.—Scudder, *Syst. Rev.*, p. 34, indicates *argiolus* as type.

Prout has pointed out to us that here Scudder overlooks the important detail that Dalman himself, in founding the genus, cites only *argianus* (=*semiargus*) in the generic synopsis (p. 63), and, therefore, fixed the type at its inception. *Cyaniris*, therefore, stands as the genus for *semiargus*, leaving the *argiolus* group without a separate generic name. This was supplied in 1906, when *Celastrina* was suggested (*Ent. Rec.*, xviii., p. 131), and *argiolus* noted, as type. The new name, therefore, stands for the genus already diagnosed in detail by Scudder, Meyrick, and others. Scudder describes (*Butterflies of New England*, ii., pp. 918 *et seq.*) the genus, under the name *Cyaniris*, as follows:—

Imago: Head small, densely clothed with scales, which are tufted about the base of the antennæ, and provided with a considerable mass of long erect hairs, longest and most abundant in the middle of the front. Front very gently curved transversely, very slightly fullest below; from a little above the middle, downward, barely surpassing the front of the eyes, not so elevated above, but vaguely grooved longitudinally; scarcely twice as high as broad, as broad as the front view of the eyes; sides parallel, upper border squarely excised, its angles slightly hollowed in front of the antennæ; lower border strongly rounded. Vertex not vaulted, but with a slight, low tubercle on either side, midway between the antennæ and the middle of the hind border, abruptly elevated behind the antennæ, forming a transverse ridge for their support; separated from the occiput by a rather deep, slightly curving groove, its middle curving forward, the sides forming a right angle with each other, the anterior slope of the groove the more abrupt. Eyes not very large, moderately full, delicately and distantly pilose on the lower two-thirds with very short hairs, increasing in length downward. Antennæ inserted in the middle of the summit, separated by a space equal to the width of the antennal pits, slightly longer than the abdomen, composed of about 34 joints, of which the last twelve or thirteen form a club similar in all respects to that of *Everes*, excepting that the tip is more broadly rounded. Palpi slender, scarcely more than half as long again as the eye, the apical joint very nearly half as long as the penultimate, the whole under surface, and particularly that of the basal and middle joints, furnished with a mass of long, erect, delicate hairs, as long as the apical joint, which becomes shorter apically, and which lie in a vertical plane, but not compressed. Patagia small, slender, nearly flat, scarcely arched longitudinally, two or three times longer than broad, tapering very gradually and rather regularly, but to a less degree near the apex, to a bluntly-pointed tip, which is scarcely turned downward. Forewing about two thirds as long again as broad, the cotsal margin very slightly and regularly bowed, scarcely more so at the base, the outer angle abrupt but rounded off, the outer border curved a little at either end, nearly straight in the middle half, perhaps a little fuller in the ♂, its general direction at an angle of abont 65° with the costal margin, the inner margin straight, the outer angle well rounded off. Costal nervure terminating a little before the tip of the cell; subcostal with three superior branches, the first arising at about three-fifths the distance from the base to the apex of the cell; the second at about one-fourth way from these to the apex of the cell; the third at some distance before the apex of the cell and opposite the base of the second median nervure, forking beyond its middle; the cross-veins closing the cell are bent at a considerable angle and are very faint excepting immediately next the main nervures. Cell half as long as the wing, and about three and a half times longer than broad. Hindwings with the costal margin gently convex at the base, beyond straight, the outer border pretty strongly rounded, rather fuller above than below and in the ♂ than in the ♀, the inner border a little convex, the outer angle very broad. Submedian nervure terminating at the anal angle; internal nervure terminating a little beyond the middle of the inner border. Androconia slightly fan-shaped, the lamina expanding a little from the base, the stem nearly half as long as the lamina. Fore tibiæ a little more than three-fifths the length of the hind tibiæ; the forelegs either of the same structure as the others (♀), or the claws are subconnate, nearly straight, and overlap at tip, and the paronychia are wanting (♂); excepting in diminished size they differ little from the other legs, but the tibial spur is naked and no longer than an ordinary spine, the tarsal spines are less frequent and confined to two rows, the space between them scaled. Middle tibiæ nearly five-sixths the length of the hind tibiæ, provided at tip with rather short slender spines, mostly concealed by scales. First joint of tarsi a little longer than the three succeeding combined; the second as long as the third and fourth together, or as the fifth alone; the fourth scarcely half so long as the second; joints furnished beneath with a triple row of slender spines, the apical spines of each joint longer; claws small, rather strong, considerably curved, tapering, finely pointed; paronychia bifid, the superior lobe nearly as long as the claw, curved a little in the same direction as it, tapering a little; inferior lobe tapering considerably, rather long, curved strongly inwards so as to be generally concealed from view; pulvillus wanting.

Genitalia: Upper organ of male abdominal appendages small but stout, gibbous, the lateral portions bearing each a posterior appressed lobe, provided at its posterior inner edge with an inward directed, delicate, slightly curving thorn, as long as the breadth of the lobe; clasps bulbous, or almost globular at base, emitting at tip a slender needle bent at base, so as to be directed inward and backward, crossing that of the opposite side.

Egg: Very depressed echinoid shaped, the whole upper surface hollowed, and increasingly so toward the centre, covered with not very prominent tubercles, connected by fine raised lines; between every set of three, four, or five of these a slighter prominence, connected by similar lines to the higher ones.

Larva (newly-hatched).—Head: Ocelli four* in number, arranged round a

* Six, *see* our plate, depicting first skin, where they are seen to be arranged in the usual manner, *viz.*, five as a lunule, and one away centrally.

circular black spot, the posterior one largest, the other three about equal, two of them situated at equal distances along the upper border, the fourth below, nearly as far from the largest as the front upper one is. Body subcylindrical, tapering, flattened beneath and a little above, but still as high as broad, the sides well rounded though subtectiform, and the lower margin produced laterally a little. First thoracic segment bearing above in the middle a slightly raised, large shield, the sides of which converge strongly anteriorly, making the anterior border very short, while the posterior is long and well rounded. It bears three arcuate rows of warts, emitting long, forward and upward-directed hairs, the anterior row consisting of three, the middle of five, and the posterior of six, warts*; besides these, the segment is furnished with a row of warts emitting long hairs, parallel to and outside of the front border and sides of the shield; the last segment of the abdomen bears a similar row in a reverse position; besides these, behind the 1st thoracic segment, there is a laterodorsal series of high, conical warts, one to a segment in each row, situated a little in advance of the middle, and emitting very long, curved, backward sweeping, tapering hairs†; also a ventrostigmatal row of small warts, three on each segment, not placed in a line, emitting straight, delicate, tapering, finely-pointed hairs, of which one, a central one, is longer than the other two, and all are directed outward and a little downward, so as to reach the surface upon which the animal rests. In addition, there are, on each side, four longitudinal series of smooth lenticles, two of them larger and two smaller; the two larger have each one lenticle to a segment, placed in the middle, and consist of a supralateral and an infrastigmatal series‡; the smaller ones consist of a suprastigmatal series, two on each segment at equal distance from either margin, and a laterostigmatal row, one on a segment, placed in the middle. Legs long and very slender, the basal joint short, conical, the remainder cylindrical and equal, claws pretty large, long, pretty strongly curved, tapering; prolegs short and rather stout, globular at base, beyond very short and half as broad, the hinder pair quite long, tapering but little.

Larva (adult): Head well-rounded, rather broader than high, broadest above, tapering very slightly below, with a rounded curve which is rather broad and full beneath, docked squarely at the labrum; it is apparently deepest in the middle, and has a front fall. Triangle very large, much higher than broad, extending nearly to the summit of the head; a very few long hairs at the lower part of the head. Basal joint of antennæ mammiform, pretty large, second about as long as broad, third not much smaller than the second, twice as long as broad, cylindrical, bearing at its apical edge a number of hairs, which conceal in part at least the fourth joint. Ocelli six in number, of uniform size, like a flattened hemisphere in shape, five placed in a strongly curving row, equidistant from each other, and separated by less than their own diameter, the lower two opposite the posterior base of the antenna, the others curving backward, the upper four on the arc of a pretty small circle, the sixth behind the others, a little further removed from the uppermost than from the fourth from the top, and forming with these rather less than a right angle. Labrum large, very broad, half as long as broad, the outer angles square but rounded off, the middle two-fifths of the front margin roundly and considerably excised. Mandibles armed at the tip with large, triangular, bluntly-pointed teeth, half as long again as broad. Maxillæ with the inner and outer palpi exactly similar in size and shape, the penultimate joint being about twice as long as broad, tapering, the apical minute, conical. The apical two joints of the labial palpi are similarly shaped but much smaller and proportionately slenderer. Spinneret long, and beyond the conical base equal and not very slender, the tip bluntly rounded, directed vertically. Body pretty regularly arched longitudinally, with the posterior edges of the segments elevated a little, and thus showing the divisions plainly; the sides of the body slope

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* In *Celastrina argiolus* the prothoracic plate of the newly-hatched larva has (described in terms of three rows): (1) A front straight row of four, *viz.*, two central hairs and a lenticle at each end; (2) a central row of a pair of large hairs; (3) a posterior, arcuate, row of four hairs—making altogether a total of eight hairs and two lenticles (four hairs and one lenticle on either side) (see detailed description, *posteà*). In this it agrees with *Aricia astrarche*, *Agriades corydon*, *Cyaniris semiargus*, but not with *Cupido minima*.—T.A.C.

† The hairs of tubercle ii are also present but not mentioned.—T.A.C.

‡ This account of the lenticles is erroneous; part of the error is due to mistaking one of the hairs (of tubercle iii?) for a lenticle.—T.A.C.

abruptly, widening considerably at the base. Viewed from above elliptical, about equally rounded in front and behind, covered with minute dots, which a closer inspection shows to be made up of a raised centre from which radiate six nearly horizontal, very short, rays, and from the centre a rather short hair; these are so thickly distributed as to give the appearance of a dense pile; provided also with a laterodorsal row of rather long hairs, four or five times longer, arising from simple papillæ, and with similar long hairs at either extremity of the body and along the ventrostigmatal fold. Vesicle of 7th, and lateral caruncles of 8th, abdominal segments present. Claws of legs long and very slender, heeled at the base, tapering, very gently curved; last joint of legs long and slender, equal; prolegs armed at the tip with a double, curving row of hooklets, about eighteen in number, very long and very slender, scarcely tapering, curving strongly and regularly, the tip bluntly pointed.

Pupa: Scarcely more than twice as long as broad; viewed from above, the sides are straight from the basal wing-tubercle to the middle of the abdomen, but diverging a little, so that the body is considerably broader at the latter place; the basal wing-tubercle scarcely breaks the continuity of the line forward, where it is well-arched, the front a little appressed; the posterior half of the abdomen has an elliptic curve, forming an arch whose height and breadth at base are equal. Viewed laterally, the thorax is highest in the middle of the posterior half of the mesothorax, scarcely falling posteriorly, in front curving at first a little more rapidly, and then directed about equally downward and forward, in nearly a straight line, to the front of the thorax. Abdomen highest, and very little higher than the thorax at the third segment, on either side of it for an equal distance, in front to the extremity, very broadly arched, beyond this point, posteriorly, curving very rapidly downward, so as to be perpendicular at the junction of the 8th and 9th segments, and below this curved a little forward; transversely, the middle of the thorax has the sides sloped toward each other at an angle of 80°, scarcely or not at all hollowed in the middle, the sides below, and the summit equally and rather broadly rounded; transversely the abdomen is regularly rounded, formimg a perfect semicircle; the tongue exposed three-fifths way to tip of antennæ, interposed between the inner edges of the legs; basal wing-prominence consisting of a very slight, rounded elevation. Body covered with a delicate, raised, interrupted network of lines, continuous in a transverse direction, not elevated at the intersection; surface between traversed by exceedingly delicate, impressed lines of varying depth, and furnished here and there with a wart bearing a straight, erect, short, tapering hair. Hooklets of cremaster very short and exceedingly slender, the stem equal and nearly straight, the apical lobe bent suddenly over and strongly appressed to the stalk, transversely ovate, broadest apically.

Of the neuration, de Nicéville notes (*Butterflies of India*, iii., p. 92):

In the forewing the costal nervure ends exactly opposite the apex of the discoidal cell; the 1st subcostal nervule in the type species is free from the costal nervure (in a male of *C. transpectus*, Moore, it lies along, and touches, the costal nervure for some little distance, while in a female of the same species it lies close to, but is free from, that nervure); 2nd subcostal with its base half as far from the base of the 1st subcostal as from the base of the upper discoidal; 3rd subcostal rather short, emitted from the subcostal nervure about midway between the apex of the wing and the base of the discoidal. The eyes are hairy.

De Nicéville adds (*op. cit.*) that this genus is very near that of *Lycaena*, Fab. (=our *Plebeiidi* and *Lycaenidi*). As far as the neuration goes, it is probable that, if all the species of both were examined, no constant character between them would be found. It is quite clear, therefore, that the division of the group into genera must be based on other and less uniform structures, *e.g.*, genitalia, etc.

The importance of the genitalic structures in the species of this tribe is very great. Whilst the specific differences exhibited in the structure of the genitalia in distinct species are most marked, the variation within the limits of the same species, however widely separated geographically the forms may be, is exceedingly small. Hence Chapman and Bethune-Baker have been able to assert that the

American *pseudargiolus*, the Central American *gozora*, the Indian *coelestina*, *sikkima*, *victoria*, and *huegelii*, the Japanese *ladonides*, the Corean *levettii*, etc., are all one widely-distributed species, although varying more in their facies than do some of the allied species, with entirely different genitalia structurally, from typical *argiolus*. [This point is dealt with at length in our consideration of the "Variation" of *Celastrina argiolus* (*posteà*, pp. 390-1).] The possibility of the various Indian forms mimicking other Celastrinid species, and, in one case, that of *victoria*, Swin., a non-Celastrinid species, is very great.

Of the general uniformity of the Celastrinid type, Bethune-Baker writes (*in. litt.*): "The tribe *Celastrinidi* is a very homogeneous one, unusually so considering the number of species and its very wide distribution, for it obtains, outside the Arctic circle, all over the world except in the Neotropical Region. It is difficult to divide the tribe into sections, for the general characters and pattern of the Celastrinid specific type are carried through its various species with a constancy not often met with. In India are to be found some twenty species or so of more or less specific value, and here it is that the group has developed more, perhaps, than elsewhere, for it has one or two almost white species in both sexes, whilst, in the other extreme, it has produced a considerable number with brilliant, lustrous blue, uppersides. The most remarkable species, however, is, perhaps, *C. vardhana*, Moore, a large bluish-grey insect, with a paucity of underside markings, those of the primaries being quite peculiar. It stands isolated and unique among the rest of its family. In the Papuan-Australian sub-region there are one or two more distinct, but still slight, sections, *e.g.*, *C. camena*, de N., *sonchus*, Druce, and *planta*, Druce, all from Borneo, have developed a cream-coloured underside, and might be recognised at once by this. In New Guinea there are one or two quite peculiar species. *C. acesina*, B.-B., has an underside an almost exact counterpart of the "*acesina*" section of the genus *Arhopala*, and it stands separated thus from all others, and here it has developed a very pretty pale chocolate-marked underside, quite different, however, from the darker brown, and heavily-marked, forms obtaining in India and also in North America. It is a peculiar fact that, in these two far-separated countries, with such different conditions, we should find a similar type of heavily-marked undersides. In Australia there are but two or three species, and in Africa the tribe is as poorly represented, with no special developments in either case. As to the American species, I have no doubt that *C. pseudargiolus* is only a form of *C. argiolus*, the genitalia being identical. There are no special developments in the Nearctic region."

The Celastrinid egg is of very pronounced Plebeiid type, that of *C. argiolus* being very similar to that of *Plebeius aegon*, etc., as may be seen by comparison of these and many other allied species (*Practical Hints*, pl. iii., figs. 2-8). Chapman says (*in litt.*) that it is remarkable in having the most regular arrangement of pillars, ribs, and cells, of any Lycænine egg examined. The cells are triangles placed so that, in groups of six, they form hexagons, and the latter rather than the former strike the eye. They have, of course, to accommodate themselves in places to the curvature of the shell. Most Lycænine eggs have an engine-turned pattern, giving many quadrangular cells, but with the regularity much disturbed (by curvature of shell, etc.).

Scudder says (*Butts. New. Engl.*, ii., p. 923) that, "the body of the juvenile larva, which is subcylindrical but tectiform, is covered with high conical papillæ, from which emerge long curved hairs, sweeping backward." Chapman notes (*in litt.*) that the young larva has six ocelli (not four as Scudder notes) like all other Lycænid larvæ, in which the organs can be clearly made out. It has two hairs at site of tubercle iii. on abdominal segments 1-6, as have most Lycænid larvæ, although those of *Lampides boeticus* and *Aricia astrarche* have only one; in *Celastrina* (*argiolus*) they are fairly long (the longer one in front), clubbed, and rounded at the tip; in other Lycænid larvæ they are usually very short (also very difficult to see, as, owing to transparency, they are in *C. argiolus*); if they are somewhat longer, as in some Lycænid larvæ, they are usually sharp-pointed, like ordinary setaceous hairs. The larva has also a subspiracular lenticle on the 1st abdominal segment (as in *Aricia astrarche*); *Cyaniris semiargus* has none; whilst *Agriades corydon*, *Cupido minima*, etc., have one also on the 2nd abdominal segment." Scudder adds that "the mature caterpillars are onisciform, about equally, and somewhat rapidly, sloped in front and behind, and have similar anterior and posterior curve. They have rather distinctly marked segments, are green in colour with straight dorsal markings, and oblique lateral stripes." Chapman observes that Scudder makes *Celastrina* (*argiolus*) retain, and *Lycaena* (= *Rusticus*) lose, the dorsal crest. This is not so, as the larvæ of *Plebeius aegon*, *Agriades bellargus*, etc., have the crest the same as *C. argiolus*. Our plates of the larva of *Celastrina argiolus* and its structures will give a good idea of its characteristic features, especially in the case of those of the extended skin of the newly-hatched larva, in which the character and position of the setæ, the ordinary body-hairs, the lenticles, and the spiracles, may be readily traced (pls. xxiii., xxiv.). The hairs, of course, multiply greatly after the 1st stadium, and, in this genus (as represented by *C. argiolus*), there is a great difference in the structure of the hairs in each instar. Comparison of plates xxiii., xxiv., xxv., and xxvi., will show the great difference that exists in the nature of the hairs in the 1st, 2nd, 3rd, and final instars. The single slightly-spiculated hairs in the 1st instar, the "scimitar- and dagger-hairs" of the 3rd instar, and the shorter, more conical, hairs of the final instar, are all essentially different in size and appearance.

The pupa is particularly stumpy in outline, thickest at the middle of the abdomen, the head and thorax rounded, although the mesothorax is slightly keeled; there is a slight waist at the metathorax and 1st abdominal segment, whilst the wings are long and reach down to the 5th abdominal segment; the pupal hairs are not present on the wings: the hooks of the cremaster well-developed (*see* pl. xxvii., fig. 1). The pupa is described by Scudder (*Butts. New Engl.*, ii., p. 923) as "well-rounded, of a dark green or ferruginous colour, with dusky markings, rather short and stout, the abdomen considerably higher than the thorax." Chapman says that the pupa has longer and more numerous hairs than those of most of the "blues," but this is probably correlated with the pupal hybernating habit, and has no really important generic value; that of *Everes* (*argiades*) has longer hairs, but they are less numerous. The species hybernate (at least so far as those whose life-histories are known are concerned) in the pupal stage. In our European species individuals of the first, second, and third broods may go over the winter all together in the pupal stage, only some of each brood emerging as imagines, in the same year.

Sexual dimorphism is very marked, the males of a delicate violet-blue, the females with a dark border varying in width in different species. Of the Indian species, de Nicéville writes (*Butts. of India*, iii., p. 93), the males of most of the different species can with a little study be made out satisfactorily, but, in the case of three common species occurring in Sikkim, *C. marginata*, de Nicév., *C. placida*, de Nicév., and *C. dilectus*, Moore, though literally hundreds of females have passed through my hands, I have quite failed to pair them with their respective males. Moore and Doherty have described the female of *C. marginata*, but from their descriptions I am unable to distinguish that sex from the female of *C. puspa*, Horsf."

It may be here noted that the general appearance of the undersides of the Celastrinid species is very characteristic, being usually of a whitish or pale silvery-grey colour, sometimes tinged with blue towards the base, whilst the usual rows of transverse ocellated spots are reduced to small linear black streaks, and the marginal spots or blotches are almost obsolete. We have already (*anteà*, p. 383), however, noted the peculiar undersides of the New Guinea species, as well as those with more heavily-marked undersides occurring in India. It is to be observed that the most heavily-marked undersides of *C. argiolus* are found in the spring-emerging examples of North America, more particularly in its more northern localities.

The common species of the Nearctic and Palæarctic regions (*pseudargiolus* = *argiolus*) now known to be the same species, is single-, double- or many-brooded, according to latitude and altitude. The seasonal dimorphism of these forms is well marked, that of *pseudargiolus* having been worked out in detail by Edwards (*Butts. North America*, ii., Lyc. pls. ii and iii), but that of our European *argiolus* is, no doubt, just as remarkable in its southern habitats. De Nicéville states (*Butts. India*, etc., iii., p. 93), that "in India, although it has not been proved by breeding, as it has been in North America, seasonal dimorphism almost certainly occurs to a considerable extent. This is especially marked in *C. marginata*, *C. transpectus*, less so in *C. puspa*, *C. jynteana*, *C. placida*, and *C. dilectus*. The dimorphism takes the usual form of darkening the coloration and markings in the rains, and of lightening the coloration and reducing the size and distinctness of the markings in the dry season. All these species occur in the Eastern Himalayas. Whether or not this dimorphism occurs in the species of the Western Himalayas I cannot say, but it certainly would not be of so marked a nature, as the rainy season is shorter, and not so severe there as it is to the eastward."

The species of this tribe are rarely seen near the ground, their habit being to fly around trees and bushes at considerable elevation. They are active, and, in spite of the delicacy of their appearance, usually emerge for the first time in the very earliest spring, whilst the specimens of the latest broods last until late autumn. The males of our own species, *C. argiolus*, may sometimes be seen two or three together, gambolling around a holly-tree, or high up round the ivied walls of a church, castle or other tall building. Of the American form of this species, Gosse writes (*Letters of Alabama*, pp. 144-5): "It appears to be very pugnacious, attacking with Quixotic knight errantry any intruder, no matter how much bigger than itself. It is particularly gamesome a few hours after sunrise; taking its stand on some prominent leaf of a bush, it rushes out upon every butterfly that passes by; then it performs such swift and tortuous evolutions that the eye is unable to follow it; this lasts only for a few seconds, for, having pursued the traveller three or four yards, the butterfly returns to the very same leaf to watch as before . . . This constancy of resort to the individual leaf or twig is very singular and unaccountable; sometimes on an approach to one so situated, it has been alarmed and flown to a considerable distance, but, taking a flight round, it returns to the place, and, presently, there is the little thing alighting on the very leaf again." Of the Indian Celastrinid species, de Nicéville says (*Butts. India, etc.*, iii., p. 93) that the butterflies chiefly affect trees and bushes, though the males may often be found in immense quantities sucking up the moisture on damp spots. He further notes (*Butts. of Sumatra*, p. 454) that the males of four of the Sumatran species, *C. limbatus*, *C. camenae*, *C. placida*, and *C. musina*, are caught in large numbers on wet spots on roads, and on the sandy banks of small hill-streams, but that the very scarce females can only be taken in the forest, where they are looking for, and ovipositing on, the food-plants of the larvæ, or feeding on the flowers of certain *Compositae*. Edwards notes (*Butts. Nth. Amer.*, i., Lyc., p. 149) that *C. pseudargiolus* is the earliest butterfly of the year on the Kanawha river, and that, by April 3rd-4th, on a hot day, the imagines swarm along the sandy sides of the creeks, gathering in clusters as close as they can sit in favourite spots, motionless, with wings erect and closed, wholly intent on extracting from the sand some fluid, no doubt delightful, etc. The form *gozora* also affects wet places on the roadside in Central America.

The species of this tribe are widely distributed over the Oriental, Palæarctic and Nearctic regions, extending all over the south of Asia to Ceylon and Sumatra, de Nicéville noting no fewer than eleven species in the latter island (*Butts. of Sumatra*, pp. 452-454). It also occurs throughout the East Indies to Borneo and New Guinea; and two or three species have been recorded from Australia (Bethune-Baker). The tribe occurs in both the Palæarctic and Tropical regions of India (de Nicéville); it is better represented in the tropics than is generally supposed; 10 species, including *C. haraldus*, Fab., have been taken in the Malay peninsula, 8 confined to high elevations; also 7 in the mountains of Eastern Java, and 4 in Celebes, besides *C. duponchelii*, God. (=? *C. puspa*, Horsf.) in Sumba and Sambawa, and *C. akasa* in Sambawa, at 4500ft. elevation (Doherty); of the 11 Sumatran species only two occur in the plains, *C. cossaea* and *C. puspa*, all the others are found in the mountains at high elevation, from Soengei Batoe to the Central Plateau, and on the Plateau itself. Kirby says that species of the genus are found in almost all parts of the world except South America and Australia, and, as we have noted, species have since been found in Australia. De Nicéville states (*Butts. of India*, etc., iii., p. 93) that, in India, it is found almost everywhere except in the desert regions of Sind, and occurs at considerable elevations in the Himalayas, whilst Doherty records *C. huegelii*, in Kumaon from 3500ft. to 12000ft.; and he (Doherty) has met with some species even at a greater elevation. He adds: "In the outer Himalayas one species or another is more plentiful in individuals than any other of the Lycænids. In Sikkim, not only do many species actually swarm, but the number of distinct species occurring there is very great. In the plains of India proper, *C. puspa* is the only species commonly met with, but, wherever hills occur, there will several species be found." Scudder says (*Butts. New England*, ii., p. 921): "This is a widely distributed genus, occurring in both hemispheres, from the southern limits of the Arctic region to 30° N. lat., and on the Asiatic continent even further south. The highest point it reaches in either hemisphere is about 63° N. lat. In the western world it occurs throughout the United States (except in the Florida peninsula, and perhaps the immediate borders of the Gulf of Mexico), and beyond almost to the treeless region of the north." It also extends south into Mexico, Guatemala, Costa Rica, and Panama.

Celastrina argiolus, Linné.

Synonymy.—Species: **Argiolus,** Linn., "Sys. Nat.," xth ed., i., p. 483 (1758); "Faun. Suec.," 2nd ed., i., p. 284 (1761); Poda, "Mus. Græc.," p. 76 (1761); [Scop., "Ent. Carn.," i., p. 177 (1763);] Müll., "Faun. Frid.," p. 36 (1764); Hufn., "Berl. Mag.," ii., p. 72 (1766); Schäff., "Icones," i., p. 163, pl. 211, figs. 1-2, pl. 185, figs. 1-2 (1766); Linné, "Syst. Nat.," xiith ed., ii., p. 790 (1767); De Geer, "Mémoires," ii., p. 182 (1771); Fab., "Syst. Ent.," i., p. 525 (1775); Schiff., "Schmett. Wien.," 1st ed., p. 184 (1775); Harris, "Eng. Lep.," p. 2 (1775); Rott., "Naturf.," vi., p. 7 (1775); Müll., "Zool. Dan. Prod.," p. 115 (1776): Göze, "De Geer's Mem." transl., p. 64 (1778); Bergs., "Nomen.," ii., p. 74, pl. xlv., figs. 5-8 (1778); iii., pl. liv., figs. 5-6 (1779); Fab., "Spec. Ins.," ii., p. 123 (1781); Retz., "Gen. Sp. Ins.," i., p. 30 (1783); Bork., "Sys. Besch.," i., pp. 173, 282 (1788); ii., p. 234 (1789); De Vill., "Car. Linn. Ent. Fn. Suec.," ii., p. 67 (1789); Lang, "Verz.," p. 57 (1789); Rossi, "Faun. Etrusc.," ii., p. 156 (1790); Brahm, "Ins. Kal.," p. 327 (1791); Schwarz, "Raup.-Kal.," i., pp. 178, 344, 492 (1791); Scriba, "Journal," p. 210 (1791); Bork., "Rhein. Mag.," i., p. 285 (1793); Don., "Brit. Ins.," xiv., p. 39, pl. 481, figs. 1-3 (1795); Lewin, "Ins. Gt. Brit.," i., p. 76, pl. xxxvi., figs. 4-6 (1795); Ill., "Schmett. Wien.," 2nd ed., p. 266 (1801); Schrank, "Fauna Boica," ii., p. 212 (1801); Haw., "Lep. Brit.," p. 47 (1803), etc. **Cleobis,** Sulz., "Abgek. Gesch. der Ins.," p. 146, pl. xviii., figs. 13-14 (1776); Esp., "Schmett. Eur.," i., pt. 1, p. 360, pl. xl. (supp. xvi.), fig. 3 (1777); p. 27, pl. liv. (cont. iv.), figs. 4*a*-*b* (1778); Fuess., "Mag.," i., pt. 2, p. 209 (1778); Göze, "Ent. Beit.," p. 60 (1780); Schneid., "Syst. Besch.," p. 268 (1789). **Thersanon,** Bergs., "Nom.," iii., p. 4, pl. xlix., figs. 5-6 (1779); Bkh., "Naturg.," etc., i., p. 174 (1788). **Argyphontes,** Bergs., "Nom.," iii., p. 15, pl. lviii., figs. 5-6 (1779). **Argalus,** Bergs., "Nom.," iii., p. 18, pl. lx., figs. 4-5 (1779). **Acis,** Fab., "Mant. Ins.," p. 73 (1787); "Ent. Syst.," iii., pt. i., p. 295 (1793); Hübn., "Eur. Schmett.," text p. 46 (1805); pl. lvii., figs. 272-274 (1799); Ill., "Ill. Mag.," iii., p. 183 (1803). **Argalaus,** Bkh., "Naturg.," etc., i., p. 174 (1788). **Cimon** var., Lewin, "Ins. Gt. Brit.," pl. xxxviii., figs. 6, 7 (1795). **Parvipuncta,** Fuchs, "Stett. Ent. Zeitg.," p. 116 (1880); Rühl, "Pal. Gross-Schmett.," p. 293 (1895); Tutt, "Brit. Butts.," p. 189 (1896); Staud., "Cat.," 3rd ed., p. 90 (1901); Wheeler, "Butts. Switz.," p. 45 (1903). [All other references mentioned under the generic synonymy (*anteà*, pp. 378-9) are referable to *argiolus* or, if American, *pseudargiolus*. For other details see the "synonymy" relating to the various varieties and aberrations, described *posteà*, pp. 398 *et seq.*]

Original description.—*P.P.* alis ecaudatis; supra cæruleis margine nigris; subtus cærulescentibus punctis nigris dispersis. Raj, "Ins.," 132, no. 6. Habitat in Europa. Præcedenti (*argus*) similis, sed minor; subtus puncta pauciora dissita absque ocellis nigris (Linné, *Sys. Nat.*, xth ed., p. 483). [*Descr.*—Statura duorum præcedentium. Alæ omnes supra cæruleæ limbo nigro; omnes subtus cano cærulescentes absque ocellis. Primores postice ordine e punctis 5, oblongiusculis, nigris, minutis; secundariæ punctis nigris, parvis, decem, sparsis. [Habitat in Ericetis.] (Linné, *Faun. Suec.*, 2nd ed., p. 284).]

Imago.—25mm.-32mm. ♂; all the wings azure-blue, with a delicate blackish margin, rather more defined in apical area; fringes white, delicately latticed with blackish at end of nervures. ♀. Somewhat paler blue, with ill-defined discoidal spot and broad blackish-fuscous margin to forewings; a fine black marginal edge to hindwings, followed by a series of interneural black marginal spots; fringes white, more distinctly latticed with blackish. Underside bluish-white, with indistinct linear discoidal spot, a transverse submarginal row of fine black linear marks across both wings, 3 to 5 scattered dots near base of hindwing, and an obsolete series of marginal lunules to both wings.

Sexual dimorphism.—The sexual dimorphism of *Celastrina argiolus* is superficially most marked, the male being almost entirely blue whilst the female exhibits a small black discoidal spot, as well as a broad black outer marginal band, varying in width and intensity, on the forewings, and a row of marginal spots on the hindwings. The scaling of the males, compared with the females, is noted by Pierce (*in litt.*) as follows: ♂ (1) The transparent scales, ·004 in. × ·002 in., yellow in tint, four-lobed at the apex. (2) The dark scales similar in shape; of a bluish-brown colour. (3) The underside scales ·006 in. × ·005 in., with four points. (4) The androconia ·002 in. × ·0015 in., almost square at the apex; striated with eleven or twelve stripes, each composed of about five spots, the remainder of the stripes coalescing into lines towards the base of the scales. ♀: (1) The transparent scales, ·004 in. × ·003 in., yellow in tint, many being six-lobed. (2) The dark scales, ·004 in. × ·0035 in., four-lobed. (3) The black apical and marginal scales of the forewing, ·005 in. × ·0015 in.; this area is without the yellow scales. (4) The underside scales, similar to those of ♂ with five points. Aurivillius notes (*Bidr. Svensk. Ak. Handl.*, v., pp. 22-23) that, in the ♂, there are certain scales ("bladder-scales"), a little longer than broad, almost square in outline, with quite straight sides, and a slightly convex point. There are nearly thirteen rows of these scales. If an uninjured wing be examined under the microscope, one can see how the apices of these scales protrude between the rows of the large wing-scales, being very pale, transparent, and unpigmented. One at once notices also, in the wing-membrane, a distinct difference in the ♂ and ♀, for the points of attachment of these scales form distinct rows in the intervals between the rows of wing-scales, a row in each. They do not, generally, occur in the middle of the interval, but nearer to its outer margin. The discs are distinctly different from those of the ordinary wing-scales, being thicker and apparently swollen. Scudder notes (*Butts. New Engl.*, ii., p. 934) that the androconia are scattered, without definite position, over the upper surface of the wings; these have slightly divergent sides, so that the regularly covered apex is nearly half as broad again as the sloping base; they are slightly longer than broad, and furnished with about ten parallel rows of exceptionally large bead-like spots, which are confluent in the basal half of each row; the stem tapers throughout, is almost half as long as the lamina, and gradually expands to it. The extreme length of the lamina is about ·0075mm., these being much smaller scales. He adds (*op. cit.*, p. 946) that, "the androconia, of the form *lucia* at least, are undoubtedly scent-scales; for, when the finger is

PLATE XXVIII.

(To be bound facing Plate XXVIII.)

GENITALIA OF CELASTRINA ARGIOLUS.

FIG. 1.—Genitalia of *Celastrina argiolus* var. *sikkima* ×45.
FIG. 2.— ,, ,, ,, ,, (from Aldbury) ×40.
FIG. 3.— ,, ,, ,, ,, var. *pseudargiolus* ×45.

[Note that fig. 2 is less magnified than the others.]

These photographs illustrate well the variation in the ancillary appendages of *C. argiolus*, too well, perhaps, in one way, that they may convey the impression that *C. argiolus* (English), has clasps considerably different from the American and Asiatic forms. This is not so. In each race there is considerable variation in the conspicuousness of the four or five teeth on the terminal piece of the clasp. Partly because they really vary in their prominence, partly because, in mounting them, one sometimes really gets a good profile view of them, in other specimens they are taken face view, and their outline is indistinct on the surface of their own colour. In all cases, however, there are the four or five teeth, and, in each race, considerable range in their development. On the whole, the Asiatic races have them less prominent, and in individuals sometimes almost evanescent, whilst, in European forms, they are more pronounced, the one selected for illustration (English) being especially favourable for showing them.

Fig. 1 is mounted in the way best suited to the appendages of *Celastrina*, *viz.*, the chitinous ring cut through dorsally and the parts spread out, the middle line of the figure being the ventral line, the extreme ends, being the dorsum of each side, widely represented. (The ædœagus is separated and is outside the figure.) This method of mounting is good in *Celastrina*, because the dorsal processes are well-developed on either side, but reduced in the middle line to a chitinous band of no structural specialisation. In nearly all other Lycænids the actual dorsal line is occupied by special structures. Figs. 2 and 3 have been similarly divided, but not satisfactorily spread. They are selected as giving different aspects of the structures, and so possibly a better idea of them to any one not familiar with them. In fig. 2 the ædœagus is shewn.

1. 2. 3. *Photo. F. Noad Clark.*

Genitalia of celastrina argiolus.

Fig. 1.—*C. argiolus* var. *sikkima* ×45. Fig. 2.—*C. argiolus* (England) ×40. Fig. 3.—*C.* var. *pseudargiolus* ×45.

rubbed over the upper surface of the forewing of the male, it will be found to have an odour, excessively faint, indeed, but perceptible, which can only be compared with the odour of crushed-violet stems, or perhaps, to newly-stirred earth in spring. No odour is perceptible when the same experiment is tried with the female."

MALE GENITALIA.—Clasps ovate but flattened on the lower side, deeply excavated in a curve at the lower frontal extremity, the upper extremity produced into a long, straightish, tapering hook, bearing on its outer edge a series of about four saw-like teeth. Girdle short and strong. Tegumen very ample, extending far down the girdle; "*in situ*" it is saddle-shaped, with a high pummel in front and at the back; the apex, represented by the front pummel, is raised into a narrow collar. The lower part of the front is produced forward, roughly quadrilaterally, and has two shortish teeth instead of the usually long hooks, for which I have used the term "falces." Penis-sheath shortish, fairly stout, slightly waved in outline, and tapering at the apex (Bethune-Baker). The upper organ furnished outside posteriorly with a bulbous, subtriangular lobe, bearing at its inner extremity a short, pointed, inward-directed thorn; clasps with the bulbous base rather large, the thorn a little curved and fully one-fourth as long again as the base (Scudder). [See also pp. 390-391.]

GYNANDROMORPHISM.—The following are the only references we have gathered concerning gynandromorphic examples of this species:—

1.—A very perfect gynandromorph. The right wings blue without black, the left wings with an unusually wide black margin; the latter pair of wings larger than the other pair. Captured July 10th, 1865 (Tuely, *Ent.*, ii., p. 295).

2.—Right side ♂, left side ♀. Sold with the "Briggs' coll.," October 27th, 1896, at Stevens' sale-rooms, for £3 3s. (*Ent. Rec.*, viii., pp. 221, 272). [Noted also *Nat. Journ.*, April, 1896, p. 10.]

3.—Right wings ♂, left wings ♀; the markings of the underside normal. The abdomen appears to possess the characters of a ♀. Wing expanse 1·25ins. Captured August 8th, 1904, at Torquay; the example was freshly-emerged, and settling in the middle of the road (Clutterbuck, *Ent.*, xxxviii., p. 91).

4.—Right wings ♂, entirely blue; left wings ♀, bordered with black. Captured September 3rd, 1902, at Hardwicke Heath, Bury St. Edmunds, caught flying around a holly-tree (Norgate, *in litt.*, June 23rd, 1907).

5.—Left ♂, right ♀. Wings of either side presenting the normal sexual peculiarities of size, colour, and markings. Left antenna somewhat longer than the right. The last abdominal segment curved round to the right. Genitalia of both sexes present. Found in the Lössnitz, near Dresden, by Peschke, on May 10th, 1896 (Wiskott, *Iris*, 1897, p. 380, pl. x., fig. 5; Steinert, *Iris*, ix., p. 345).

6.—Right side ♂, left side ♀. Small. The antennæ appear alike and proportionate with the size of the insect. The abdomen terminates on the ♂ side as ♂, the left side is not easily examined, as it curves round out of sight; on the whole, the abdomen is generally shorter and stouter than is normal in the ♂. The example was taken at Cranklow Wood, Yorkshire, May 4th, 1903. In Clark coll. Noted *Ent.*, xxxvii., p. 85; *Proc. Sth. Lond. Ent. Soc.*, 1903, p. 69 (Burrows, *in litt.*, December 5th, 1907).

7.—A gynandromorph of this species is in the Staudinger coll. (*in litt.*) (Schultz, *Ill. Woch. für Ent.*, ii., p. 380).

8.—Left wings ♂, right wings ♀. The genital organs appear to be those of a male (Edwards, *Butts. Nth. America*, ii., Lyc. pl. ii., fig. 23). Captured June 6th, 1880, at Coalburgh, (Edwards, *Can. Ent.*, xii., p. 160). Dr. Holland, in whose collection the specimen now is, removed about 150 scales from the ♂ side, among which androconia were discovered, an examination of the opposite side discovered no androconia, so that, in this strange example, the ♂ side preserves such microscopic features as the androconia (Scudder, *Butts. New Engl.*, ii., p. 934).

9.—A specimen of the summer form *neglecta*, the wings on the right side typical ♂, those on the left heavily-bordered with black and equally typical of the

♀ sex. Captured July 14th, 1901, at Fortunes Rock, near Biddeford, Maine (Winn, *Ent. News*, xiii., p. 78.)

In the British Museum coll. is a ♀ labelled—"Bagovitza, Podolia. Coll. Gr.," and, in Grum-Grshimailo's handwriting, another label is attached to it, with the word "hermaphrodite." It is a ♀, showing a peculiar aberrational development on the right forewing, the iridescent blue extending somewhat along the lower branch of the median nervure, and invading for some distance the black marginal band. This seems to have no sexual connection or origin.

Teratological example.—The following is the only teratological specimen we have noted :—

(1) A specimen taken at the end of May, 1883, at Woodford, with the hindwings distinctly angled in much the same way as *Gonepteryx rhamni*, but the angles not so prominent or acute (Bishop, *Ent.*, xvii., pp. 41-2).

Variation.—This is probably one of the most difficult species with the variation of which we shall have to deal, in our consideration of the British species, not that it is in itself so very variable an insect, although its exceedingly wide range of distribution, extending apparently over the whole Palæarctic and Nearctic, as well as a great part of the Oriental, regions, and its tendency to form local races with somewhat distinct facies, make the sum total of its variation considerable, but the fact that it is, as it were, the centre of a large number of closely-allied species with similar facies, from which the typical form varies superficially almost as little as from its own local races. As a result of this, the local races of this common species have been in almost every instance described as distinct species, whilst on mere superficial appearance it is difficult to say which forms are varietal and which entitled to specific rank. As an aid in forming a correct conclusion concerning these species, Chapman has carefully examined the male genitalia of several of the more doubtful forms, and he notes (*in litt.*) : "The general results of my examination show that specimen from Japan (=*ladonides*), Corea (=*levettii*), India (=*coelestina*), and China, are all very definitely *C. argiolus*, whilst American examples (=*pseudargiolus*) are very nearly identical; in this particular, too, *huegelii* (India) is practically the same as *argiolus*, showing the tiny teeth on the outside of the clasp. It may be further noted that *coelestina* (India), *levettii* (Corea), and *ladonides* (Japan) show some slight variation towards obsolescence in the size of the teeth, which is also discoverable in *pseudargiolus* (N. America); all of which would lead one to suppose that these are all hypothetically syngamic. In addition, however, to these races, more or less generally admitted to be forms of *argiolus*, there are also *sikkima*, Moore (a form perfectly good as against *jynteana*), a form, apparently undescribed, very like *albocaeruleus*, and mixed with that species, or at least labelled *albocaeruleus* in the collection at South Kensington (var. *albocaeruleoides*, n. var.), and *victoria*, Swinhoe. These forms are very remarkable deviations from typical *argiolus*, and require much fuller notice. Some Indian species, superficially very like these forms of *C. argiolus*, have very different appendages, those of *C. argiolus* having a very special form of clasp, long and pointed, with short microscopic teeth on its outer edge. Of others examined, the appendages of *C. puspa* make the nearest approach to those of *C. argiolus*, being of the same general type, but the spine on the clasp is short, thick, with very numerous short flat spines nearly throughout its length. The clasp of *C. oreas*, Leech, is different, and one suspects that *nebulosa*, Leech, goes with the latter." As supporting the above view, Bethune-Baker writes (*in litt.*) : "I have carefully compared the male genitalia of *argiolus*, *huegelii* and *pseudargiolus*, and am very doubtful if it would be possible to separate the species on these characters; there are slight points of difference between the first and second, but these appear to be due to the relative sizes of the two insects, *huegelii* being very much larger than *argiolus*; Japanese (*ladonides*) and American (*pseudargiolus*) examples have male genitalia exactly like those of our European specimens." Bethune-Baker also notes that, "one would, however, find no difficulty in separating the *coelestina*, *huegelii* and *argiolus* forms from one another, both by the appearance of the upper- and undersides," and adds that "all the eastern forms are entirely without the blue gloss on the underside, whilst Asia Minor specimens generally also lack this." On the strength of this very definite evidence, we have to admit the eastern and American (*pseudargiolus*) insects as mere geographical races of *C. argiolus*. Among the items in which variation may be noted in our European (and British) examples, are (1) the intensity and shade of the ground colour; (2) the width of the black marginal border (especially in the female), where it sometimes extends over the greater part of the wing; (3) the size; (4) the greater or less development of the black dots on the underside, including the marginal lunules. Besides the two different tints of blue—lilac or azure-blue and warm mauve—usually found in our British examples (♂), various aberrational colour-forms have been noted. Thus, Battley exhibited (*Ent. Rec.*, iii., p. 270), at a meeting of the City of London Ent. Soc., November 3rd, 1892, two males of a colour approaching that of *Agriades bellargus*, and Dennis is reported (*op. cit.*, viii., p. 149) to have exhibited at the South London Ent. Soc., June 25th, 1896, some very brilliant specimens from Horsley, also of a shade approaching *A. bellargus*. Sabine records (*Ent.*, xxxiii., p. 303) a pale lavender-coloured male, captured at Erith, in 1900, also three or four exceptionally dark males, another male having some of the colouring pigment absent on the right forewing; whilst yet another male is reported (*Ent. Rec.*, viii., p. 150) as having the left wings of a deep silvery greenish-blue colour, rather like that of *A. corydon*, the right wings normally coloured. Burrows notes that, in Clark's coll., there is a male with the right side of the normal violet-blue coloration, the left side being blue-green almost metallic, a tint usually recognised as distinctly female in character, but this example shows no sign of gynandromorphism: in the same coll., a large female from Epping Forest, May 5th, 1896, has the left forewing streaked longitudinally with yellowish-white. The detailed account of the variation of *Celastrina pseudargiolus*, by Edwards and Scudder, has led to a considerable amount of observation being paid to our European species, *C. argiolus*. The marked sexual variation of the species is accompanied by a more or less distinct seasonal variation, particularly in the females. As to this form of female variation, we have already noted (*Brit. Butts.*, p. 188) that "the width of the band on the forewings varies much, sometimes extending more than halfway between the apex and the thorax, and being sufficiently broad to unite with the discoidal spot; at other times it is not more than half this width. In some specimens, too, it scarcely reaches the anal angle, in others it is continued broadly along the inner margin." It is generally supposed that this difference in the width of the marginal band is essentially seasonal, the narrower band being characteristic of the females of the first, and the broader band of the second, brood, but this is only approximately true, as, even in Britain, either form may be occasionally met with in both broods, and, in southern Europe, the spring-emerging individuals often have bands quite as broad as those of the second brood in Britain; Kane observes that the females of the spring brood, in Ireland, appear to be very heavily banded, and Enoch notes (*Ent. Rec.*, iv., p. 306) that very dark-banded females sometimes occur in the spring brood, one very dark female was taken in April, 1893, at Torquay, whilst Sabine records (*Ent.*, xxxiii., p. 303) a female of the first brood, unusually suffused with black in all four wings, taken at Erith, in 1900; Lang states that, although in his experience all the broad-bordered females captured in England have been of the later brood, yet, on one occasion, he captured a narrow-bordered female in England, in August, and another in Switzerland, so that the narrow-bordered female evidently occurs as an aberrant form of the second generation (*Ent.*, xvii., p. 232). The autumnal females not only have the marginal band usually exceedingly broad on the forewings, but sometimes also very pronounced on the hindwings, uniting with the discoidal spot, and confining the blue to the central and basal areas of the wings. Raynor further notes (*in litt.*), that some third brood females, bred September, 1906, at Hazeleigh, were of the summer form, the dark marginal cloud extending far enough along the costal margin to touch the discoidal spot; Rowland-Brown states that the forewings of the females taken in July, 1903, in Corsica, between Tattone and Vizzavona, were nearly black and with the discoidal spots very marked, whilst Jones observes that those of the Balearic Isles are very like British examples, and not at all so fine as those taken in Corsica. In Piedmont, in the district of Pesio, Norris captured a female on August 31st, 1892, with very broad margin to forewings, and, in addition, a border of black dots to the hindwings, and discoidal spot on upper surface of forewings. Sheldon notes that the second-brood females taken mid-July, between Martigny and Vernayaz, had broad dark borders, identical with the British summer form; Aigner-Abafi says that, in Hungary, the black border of the female is often very broad and the ground colour more approaching violet. Further, as to this seasonal difference, Weir notes (*Entom.*, xvii., pp. 195-6) that, in the spring and autumn broods respectively:—

(1) The ♀ of the spring brood has a broad hindmarginal black band on the forewings, and a narrow, black, hindmarginal border on the hindwings, and, just within this, a series of six transversely oblong black spots. The ♀s of this spring emergence closely resemble Edwards' figures of *marginata* (*Butts. Nth. America*, ii., Lyc. pl. ii., fig. 4), but are lighter on the undersides of the wings than fig. 3 of the same plate, which shows the underside of the same variety.

(2) The ♀s of the autumnal brood are very much more suffused with black. It may be said that the ♀s of the first generation are blue on the upperside of the forewings with a black hindmargin; but the ♀s of the second generation are black on the upperside of the forewings, with the centre of the wings suffused with blue. Lang (*Butts. Europe*, pl. xxxi., fig 1) has figured the ♀ of the spring brood; his description, however, appears to be made from a specimen of the autumnal emergence. The ♀s of this second emergence have a more or less well-defined black discoidal spot on the upperside of the forewings, and agree very closely with *pseudargiolus* figured by Edwards, and later named by him var. *arizonensis* (*Butts. Nth. America*, ii., Lyc. pl.ii., fig, 19).

Weir concludes that "it thus appears that the female of the spring emergence of *argiolus* in England resembles that of one of the varieties of *pseudargiolus* that appears in the spring in America, whilst, in a similar manner, the second generation female in England is exactly like one of the varieties of the American species that also appears as a second generation." Not only is there great difference in the width of the dark marginal band of the ♀ s, but also in the depth and intensity of the tint of blue in the centre, and at the base of the wings. Usually the females are either of a lilacine or azure-blue tint resembling those of the male, or they may be of a much brighter, more metallic, pale blue, a form which we have already named ab. *clara* (*Brit. Butts.*, p. 188), the two extreme shades, indeed, being very similar to those found in ♀ *Lampides boeticus*. In Britain, all these forms occur at the spring emergence, and as marked British female colour forms are the only ones that have come directly under our notice. Hills notes a female, taken in the spring of 1897, at Folkestone, in which the ordinary violet-blue was replaced by a bright metallic blue, very similar in hue to that of *A. bellargus* (=*clara*). Anderson observes that some of the females occurring in the Chichester district are somewhat striking on account of the blue having a tinge of chalkiness in the tint, whilst the black margin of the costa and the hind marginal black band of the forewings are of considerable width (approaching *pallida*). This tendency to whiteness is very marked in the North American form, var. *neglecta*, as well as in some of the eastern forms. Raynor says that several of the females taken at Hazeleigh have a series of three white horizontal streaks, situated towards the apex of the forewing; generally they occur along the outer edge of the costa, so as not to be easily seen, but in one specimen they are situated further down, well within the broad black margin. This might be called ab. *trilinea*. Weir's further remarks (*Ent.*, xvii., p. 196) also bear on this phase of our subject, and he says that, "in a form of the female of *pseudargiolus*, figured by Edwards (*Butts. Nth. America*, 2nd ser., Lyc. pl. ii., fig. 9), the blue gives place on the upperside of the wings to a lovely silvery colour, somewhat that of *A. corydon*, the black edging on the costa and hindmargin of like the forewings very broad, and the discoidal spot much more marked than in the blue form." . . . He adds that he took a summer specimen at Brenchley, in Kent, coloured exactly in every respect like the individual figured by Edwards. . . . "Females of *C. argiolus* received from St. Petersburg are exceedingly dark on the fore- and hindwings on the upperside; the discoidal spot, absent in the American form *lucia*, is well-defined in these specimens, the forewings have but little blue, and the hindwings are merely shot with that colour; they most nearly resemble the var. *cinerea*, Edwards (*Butts. Nth. America*, ii., Lyc. pl. ii., fig 17). . . . An example taken at Vichy, in May, by Kane, is almost identical with that figured by Edwards (*op. cit.*, pl. ii., fig. 4), as *marginata*, except that the fringes of the hindwings are, in the European specimen, spotless, and in the American slightly spotted. . . . Another taken at Hyères, in March or early April, which should have a narrow black border to agree with the North European spring form, has instead nearly as broad borders to the fore- and hindwings as the Russian specimens above noted," and Weir adds that he would "have deemed it a typical specimen of the summer emergence. An individual closely resembling this was figured by Edwards (*Butts. Nth. Amer.*, ii., Lyc. ii., fig. 21), as *piasus*." Weir concludes that all the forms of *pseudargiolus*, from *lucia* to *piasus*, are merely races of *C. argiolus*. This has since been proved to be so by the identical structure of the genitalia. There would appear to be some seasonal variation in size noticeable, *e.g.*, Oldaker notes that examples of the second-brood, taken near St. Leonards, in August, 1902, were larger than those taken in the spring of the same year at Dorking; whilst Edwards states that, at Great Malvern, the spring specimens are larger and brighter than the autumnal ones. Aigner-Abafi states that, in Hungary, the first brood expands from 30mm.-35mm., the second being smaller, *i.e.*, from 23mm.-34mm., and Steinert that the second-brood examples are smaller in the Kingdom of Saxony. Swinton states that some examples taken in June, 1878, at Turin, were rather larger than British specimens, apart from season. Davis notes the capture of one very small female at Darenth, only 1in. in expanse, with the wings more suffused with black than usual. Jones, a ♀ as small as *C. minima*, about 22mm., taken in Majorca. Reverdin gives (*in litt.*), the maximum and minimum measurements (from apex to apex), in his collection (chiefly Swiss) as: maximum ♂ and ♀ =30mm , minimum ♂ =22mm., ♀ =25mm. Sommer notes (*Iris*, x., p. 263) a female, taken in Zitschewig, May 5th, 1897, with wings 25mm. in length, 8mm. wide, whilst another taken on the heath near Dresden, July 21st, 1896, measured 34mm. in length and was 11mm. broad. He further notes that, in this district, the spring examples are always small, the larger specimens belonging to the summer emergence, a remark exactly opposed to that of Aigner-Abafi, Steinert, Oldaker, etc. (*suprà*). We would call all those examples of 25mm. and less ab. *minor*, n. ab., and those of more than 30mm., ab. *major*, n. ab. Mathew records that the females taken at Canea and Suda Bay, in June, 1897, are both large and very strongly marked. Tetley observes (*in litt.*) that a ♀ taken in May, 1901, near Newtown, has a black spot on the forewings between 2 and 3 (the lower branches of the cubital), and a very small one above this, between 3 and 4 (the upper branches of the cubital). We may call this ab. *punctata*, n. ab. The Palæarctic examples in the British Museum coll., may be roughly grouped by their upperside variation as follows:—

MALES.

1. Warm mauve	=*lilacina*, n. ab.
2. Azure blue	=*argiolus*, Linn.
3. Violet-blue	=*clara*, n. ab.

FEMALES.

1. Mauve—forewings with narrow marginal and costal (to discoidal lunule) black borders; hindwings spotted marginally	=*lilacina*, n. ab.
1*a*. ,, forewings with broad marginal and costal borders; hindwings fairly clear, spotted marginally	=*lilacina-lata*, n. ab.
1*b*. ,, with broad marginal and costal borders; hindwings suffused and spotted marginally	=*lilacina-suffusa*, n. ab.
2. Azure-blue—otherwise as in 1	=*argiolus*, L.
2*a*. ,, ,, ,, 1*a*	=*argiolus-lata*, n. ab.
2*b*. ,, ,, ,, 1*b*	=*argiolus-suffusa*, n. ab.
3. Pallid washed-out violet, borders brownish-black—otherwise as in 1	=*pauper*, n. ab.
3*a*. Pallid washed-out violet, borders brownish-black—otherwise as in 1*a*	=*pauper-lata*, n. ab.
3*b*. Pallid washed-out violet, borders brownish-black—otherwise as in 1*b*	=*pauper-suffusa*, n. ab.
4. Bright "hylas-" or violet-blue—otherwise as in 1	=*clara*, n. ab.
4*a*. ,, ,, ,, ,, ,, ,, 1*a*	=*clara-lata*, n. ab.

4*b*. Bright "hylas-" or violet-blue—otherwise as in 1*b* =*clara-suffusa*, n. ab.
5. Violet-white—forewings with fairly narrow black marginal border, extending along costa from apex to discoidal lunule; outer margin of hindwing spotted (from Bagovitza) =*pallida*, n. ab.
5*a*. ,, forewings with broad black outermarginal and costal band; costa of hindwing suffused from apex to base, outer margin spotted =*pallida-lata*, n. ab.
5*b*. ,, forewings with broad outermarginal, costal, and inner marginal bands; hindwings also very much suffused (Nikko, 4000ft.-5000ft., July 2nd, 1904) =*pallida-suffusa*, n. ab.

As far back as 1788, Borkhausen classified and described the figures of Esper and Bergstrasser (*Naturg. Eur. Schmett.*, pp. 174-175). We have modified somewhat his descriptions in the following (taking our notes from the original figures):—

a. Two ♀ forms, blue, well-marked marginal bands on forewings, spotted margin to hindwings; underside well-spotted, especially marginally=*argiolus*, Bergs., *Nom.*, i., pp. 74-75, pl. xlv., figs. 5-6, 7-8.

b. ♀. With broad marginal border to all wings, that of hindwings containing a row of faint lunules; underside sparsely spotted, but trace of lunules on margin of forewings=*argiolus* ab. (or *cleobis*, Sulz., Esp., ab.), Bergs., *Nom.*, ii., p. 10, pl. liv., figs. 5-6.

c. ♂. Blue, but showing faint discoidal lunules on upperside; underside with a single strongly-marked transverse row of black dots crossing all wings (eight on forewings, nine on hindwings), two others towards base of hindwing and fainter discoidal lunules=*thersanon*, Bergs., *Nom.*, ii., p. 4, pl. xlix., figs. 5-6.

d. ♂, with overdrawn (?) black margin, etc.* Borkhausen says: Upperside bright blue, unspotted, forewings with narrow black-brown border; underside bluish-whitish grey, with a dark coloured lunule and tiny streaks and dots= *argalus*, Bergs., *Nom.*, ii., p. 18, pl. lx., figs. 4-5.

[*e*.† ♂, pale bluish; underside with slender obsolescent streaks and spots= *argyphontes*, Bergs., *Nom.*, pp. 15-16, pl. lviii., figs. 5-6.]

f. ♀. Spring form, azure-blue, black border to hindwings, hindwings darker, margin edged with black lunules, these again with white; underside white, fairly large, black, unringed spots; traces of marginal lunules=*cleobis* var., Esp., *Schmett. Eur.*, pl. liv. (contd. iv.), fig. 4*a*.‡

g. ♀. Highly-coloured; reminds one of purple of *Bithys quercûs*, possibly an attempt to get warm mauve (with red tinge showing through blue), [compare Esper's fig. of *icarus*, pl. lv., fig. 5.] Hindmarginal bands very unnatural. Underside blue-grey, with strong streaks and spots ringed with white=*cleobis*, Esp., *Schmett. Eur.*, pl. xl. (supp. xvi.), fig. 3.

h. ♂. Azure-blue, inclining to mauve, fine black marginal line to all wings; underside greyish-blue, bluer at base, streaks and spots unringed, but well-developed; no trace of marginal dots=*cleobis*, Esp., *Schmett. Eur.*, pl. liv. (contd. iv.), fig. 4*b*.

It may be here noted that there is considerable difference in the spotting of the underside of the wings. One observes much difference in the development of the usually obsolete lunules on the outer margin of the wings on the underside, sometimes these are fairly distinct, and Aigner-Abafi notes that, in some Hungarian males, they show on the forewings as a row of black dots before the outer margin, but rarely in Europe do they reach the development noticeable in some of Edwards' figures of the North American spring forms (*Butts. Nth. America*, ii., Lyc.

* The Zoological Society of London's copy of this work is apparently discoloured, and Bergstrasser's description (rather than figure) should be relied on.

† Borkhausen leaves out letter "*e*" and also omits this form. We wonder whether there was any connection between these omissions.

‡ Borkhausen, in his remarks, has mixed this up with Esper's pl. xl., fig. 3.

pl, ii., figs. 1, 2, 3, 4). Nor do our Palæarctic examples ever appear to show the remarkable blackish suffusion of the ground colour of the underside represented in these same figures (figs. 1, 2, 3, 4), both on the margin of all the wings (giving rise to Edwards' ab. *marginata*) and the discal area of the hindwing. Most of the other American forms are clear dead white or grey, never with the bluish suffusion so common in Europe, and perhaps better marked in Britain than elsewhere. In India, the *argiolus* races have the ground colour of the underside white, that of *huegelii* especially so, whilst the spots are, in this form, comparatively small and inclined to obsolescence, the marginal lunules, however, being usually very well-developed. Another of the commonest forms of variation is the difference in the number and size of the black spots on the underside of the wings. These extend from a purely spotless underside to a highly-developed series of black spots, or even into a series of short longitudinal streaks, as exhibited by a specimen figured by Oberthür (*Variation chez Lépidoptères*, pl. iii., fig. 24). It is, of course, merely a matter of chance that Linné describes a small (size of *argus*), sparsely-spotted form, "the underside of the forewings with a row of five minute elongated black spots, of the hindwings with ten small scattered black ones," and not a more liberally spotted one. Of this small and sparsely-spotted form Fuchs obtained two near Lemberg, apparently the only ones he had ever seen, and he immediately described the individuals at length, jumping to the conclusion that this form of spotting was characteristic of the second brood, and renaming the Linnean type, *parvipuncta*, and we have the amusing result of the type being renamed as an aestival form of itself.* It is a not uncommon form in Scandinavia, Strand reporting it from Vallö, Larkollen, etc., and, in Hungary, it occurs at Budapest, Mehadia, and probably everywhere among the second-brood, but some of the second-brood examples are quite heavily marked. As the name has been generally misused of recent years, it may be well to give a summary of Fuchs' inordinately long account of the two summer specimens he caught in 1879. This reads as follows:—

C. argiolus is double-brooded with us, and the summer specimens exhibit several differences from those emerging in the spring. A ♂ captured August 1st, and a ♀ August 21st, 1879, differed from the early brood as follows: (1) The fringes of the forewings are less distinctly splashed below. (2) The black spots beneath are fewer and smaller. (3) The faint white margins to the underside

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* (1) Linné (see *anteà* p. 387) gives a total of 5 minute dots on underside of forewings, and 10 on hindwings, Fuchs gives 4 in transverse row and 1 between 4th dot and margin = 5 in the ♂, and 5 and 3 faint lunular spots = 8 on the forewings of ♀; Linné gives a total of 10 on underside of hindwings, Fuchs gives the same number as typical *argiolus* (= 12, besides the discoidal lunule). Linné calls the spots on the underside "minutis," so that it is difficult to know what Fuchs means by saying that, in his *parvipuncta*, the spots are "fewer and smaller." (2) Linné says that the spots on the underside of *argiolus* are "nigris" and "absque ocellis," yet Fuchs makes one of the important differences between *parvipuncta* and the Linnean type, the fact that "the faint white margins to the underside spots (including the discoidal) are absent." Of his other characters, "the fringes of the forewings less distinctly splashed below," and "the metallic greenish-blue iridescence at the base of the underside of the hindwings rather fainter and restricted to a smaller area," one can only say that Linné does not say that "the fringes of the forewings are at all splashed below, nor that there is any iridescence at the base of the hindwings. One can only express the wish that isolated collectors would look up the literature of their subject before naming chance aberrations.

spots (including the discoidal) are absent. (4) The metallic greenish-blue iridescence at the base of the underside of the hindwings is rather fainter and restricted to a smaller area. The transverse row of black spots crossing the forewings of the ♂ is restricted to four, of which the 3rd is the most developed, the 2nd and 4th being very small and the 1st only a trifle larger. The spot which, in better-marked *argiolus*, is the 1st, and placed so much nearer the base that the line appears interrupted, is absent, and of the two lunular blackish spots, which the examples of the first generation show towards the anal angle of the forewings as a margin to the two lower obsolete eye-spots, only the top one is indicated, and this is placed between the 4th dot and the margin, the lower one, which, in *argiolus* stands nearest the anal angle, being absent. The number of spots on the underside of the hindwings of the ♂ is the same as in *argiolus*, but in the summer form they are decidedly smaller. The large, black, discoidal streak is, however, more distinct than in the spring ♂s taken locally, but the *argiolus* from Oberursel show it equally distinct. So much for the ♂. The ♀ of the summer form has, on the underside of the forewings, a row of five black dots, against the seven of normal ♀ *argiolus*. The 1st (upper) dot, placed more towards the base than the remainder, is present, though absent in the ♂, whilst the ♀ is without the two small dots, the lowest in the series, which all my ♀ *argiolus* and some of the ♂s exhibit. Of the three lunular marks, which the typical ♀ shows between the margin and the row of black dots, there are only faint traces in *parvipuncta*. The hindwings of this ♀ exhibit a peculiarity which, being absent in all my *argiolus*, as well as the summer ♂, appears to be a casual aberration exhibited by this particular specimen, *viz.*, that the point in cell 6, which is well-developed in typical *argiolus*, is not only smaller, but is placed further towards the base than usual. It is true that the position of this spot is variable, but I have seen none with it placed so far towards the base of the wing as in this ♀ var. of *parvipuncta*. Otherwise my ♀ *parvipuncta* follows the ♂ and has the spots of the hindwings smaller than in *argiolus*, those in the basal metallic area also being but feebly indicated.

Having thus described in detail two chance captures of the summer brood, Fuchs, "although the material before 'him' is far from complete," is quite prepared to give an opinion, that all the specimens of the summer brood carry "the indicated characters." In addition, an especially obsolete form was figured by Bergstrasser, in 1778, under the name *argyphontes* (*Nom.*, iii., p. 15, pl. lviii., figs. 5-6) only that it has traces of the marginal lunules. As already noted, the most extreme form in this direction is generally said to be *hypoleuca*, Koll., which is erroneously stated by Staudinger to have a spotless underside, a character that he observes to be particularly characteristic of Persian specimens, and to also exist as a local race in Cyprus. For the rest it is generally distributed as a rare aberration with the type. Bethune-Baker notes that he only took one example of this species at Guelma, in June, 1897, and that, in this, the spots on the underside were almost obliterated, whilst Lang remarks that the specimens taken in July, 1899, at Vizzavona, had very small spots, and a very light underside. The most strongly-marked example in the opposite direction we know is the aberration described and figured as ab. *subtusradiata* by Oberthür, *Var. chez Lep.*, pl. iii., fig. 24, and which we have, with the author's permission, reproduced pl. xviii., fig. 10. Briggs exhibited at the meeting of the South London Entomological Society, May 24th, 1894, an example of this species, in which some of the spots on the underside were lengthened into streaks, evidently similar to Oberthür's, whilst Courvoisier describes a "forma elongata" (*Mitt. Schw. Ent. Gesell.*, xi., p. 19), which he notes as generally "having several of the spots of the large curved row on the disc of the underside elongated, a feature much more common on the forewings than on the hindwings, often, however, on all the wings." Blachier notes (*in litt.*) a female (taken at Geneva, in May), which has the two black spots of the median series, on the underside of the hindwings, *i.e.*, those nearest the anal angle, united, so as to form a reversed letter C, strongly marked, and of a deep black colour (in coll. Samson); another in his own collection taken at the foot of the Salève in May, presents the same peculiarity, but less marked=ab. *c-nigrum*, n. ab. The underside variation in the spotting may be roughly classified as:

1. Without any of the transverse row of dots or basal dots or marginal lunules	=ab. *obsoleta*, n. ab.
2. With only faintest traces of a few dots	=ab. *hypoleuca*, Koll.
3. With minute dots but no marginal lunules	=*argiolus*, Linn. (*parvipuncta*, Fuchs).
4. With minute dots and streaks, and traces of marginal lunules	=ab. *argyphontes*, Bergs.
5. With a dark disc to forewings, a transverse rows of dots, but no marginal lunules	=ab. *argalus*, Bergs.
6. With a well-developed row of dots and streaks, but no marginal lunules	=ab. *transversa*, n. ab.
7. With a well-developed row of dots or streaks, and marginal lunules	=ab. *cleobis*, Sulz.
8. With a well-developed row of pale-ringed dots and streaks, but no marginal lunules	=ab. *albocincta*, n. ab.
9. With a well-developed row of pale-ringed dots and streaks, and marginal lunules	=ab. *albocincta-cleobis*, n. ab.

Sulzer described (*Abg. Ges.*, p. 146, pl. xviii., figs. 13-14) a strongly-spotted ♀ form as *cleobis*, his description reading: "Blue, towards the outer edge black, margined with white; on the forewings towards the costal edge, a small black hook; a similar one towards the hind margin of the hindwings; the underside silvery-white, the forewings with five, the hindwings with eleven black spots; Switzerland." The underside of this species varies in its ground colour. Possibly our British examples are more tinged with blue than those of any other district, although some are silvery-white with very little blue suffusion. As we go east, however, this suffusion appears to become smaller, and those from Asia Minor are already quite grey, with scarcely any trace of blue. In Asia, the spring forms are grey, the summer often particularly white, whilst in America, the white or grey ground is strongly dusted with fuscous and black, especially in the spring examples. Still, here some trace of blue is occasionally noted by authors. It may be well now to note the original descriptions of Bergstrasser's named forms, before dealing with the other named races and forms arranged geographically. Bergstrasser's descriptions read as follows:

a. ab. *thersanon*, Bergstr., "Nom.," iii., p. 4, pl. xlix., figs. 5-6 (1779); Bkh., "Naturg.," etc., i., p. 174 (1788).—*P.P.R.* alis rotundatis integerrimis cærulescentibus, fimbria alba, virgulis nigris ex adverso in disco utrimque binis; subtus solitario lineolarum punctorumque nigrorum ordine. Unicolorous blue wings with white border, and comma-like mark in the centre of each wing; the underside pale bluish with a single arcuate row of black lines and dots. This insect on the underside is very similar to the ♀ "buckthorn butterfly" (*argiolus*), but is without any trace of the black marginal lunules, which are, in the latter, very pale, and appear as if they were showing through from the upperside. Is this the ♂ of the "buckthorn butterfly" (*argiolus*, *Nom.*, pl. xlv., figs. 7-8)? Its size need be no bar, for one finds ♀s larger and as pale-margined as those figured (Bergstrasser).

This is a form, whose special character is a faint discoidal lunule showing on the disc of the upperside of each wing. This is most unusual in our Palæarctic examples, but is mentioned by Boisduval and Le Conte in the original description of *pseudargiolus* (see *posteà*, p. 407), and in that of *sikkima*, Moore (*posteà*, p. 403); it is also noted in the descriptions of other eastern and American forms.

β. ab. *argyphontes*, Bergstr., "Nom.," ii., p. 15, pl. lviii., figs. 5-6 (1779).—*P.P.R.* alis rotundatis integerrimis purpurascenti cœruleis; subtus canis, obsoletisque punctis et virgulis. Uniform purplish-blue in tint; the underside grey, with obsolescent streaks and stripes. In Dr. Gladbach's coll., Frankfurt. Can it be an aberration of our *thersanon*, *Nom.*, pl. xlix., figs. 5-6? (Bergstrassser).

The smallness of the size, and the obsolete nature, of the spots of the underside, are its main features. It differs from the Linnean type in having, in addition, faint traces of the marginal lunules on the underside of all the wings. In general appearance, the upper- and underside are not unlike the two examples pictured in Edwards' *Butts. Nth. Amer.*, ii., Lyc. pl. ii., figs. 13, 15, which he considers represent forms of his *neglecta* (second-brood) with very obsolescently-marked undersides.

γ. ab. *argalus*, Bergstr., "Nom.," ii., p. 18, pl. lx., figs. 4-5 (1779). *Argalaus*, Bkh., "Naturg.," etc., i., p. 174 (1788).—*P.P.R.* alis rotundatis integerrimis cœrulescentibus fimbria alba; subtus in primoribus disco saturatiore, solitarioque lineolarum punctorumque in utrisque ordine. Uniformly blue, margined with white; the underside with a dark area on the forewings and a single row of streaks and dots crossing both wings. In Schatzmann's coll. at Freidberg (Bergstrasser).

The figures are most unsatisfactory, and, in those in the copy of the work in the library of the Zool. Soc. of London, the colour has apparently changed, and does not agree with the description; the latter must, therefore, be followed. The main feature appears to be the presence of a dark area on the underside of the forewings.

Asiatic races.

Celastrina argiolus is a widely-spread and dominant form most probably on account of its flexibility of constitution, enabling it to face very different environments, and with an additional marked flexibility in colour, form, and markings, producing, as our investigation of the species has proved, a very much greater range of variation than that for which we had been previously prepared by a study of the previously usually recognised forms. The specimens from Corea, Japan, and China, incline to the form found in the mountains of India, whilst those of Persia and western Asia belong rather to the European race. Leech says (*Butts. China and Japan*, p. 320) that "all his specimens from eastern Asia differ from the European type in the greyer coloration of the underside, which is also without any bluish suffusion, and the marginal black borders are more pronounced on the upper surface; some of these specimens agree very well with *kasmira*, Moore=*coelestina*, Koll." He adds that Pryer states that there are several broods of *C. argiolus* in Japan, during the year, that he himself found the species common throughout Japan and Corea during the warm season, and noticed it as variable in those parts of eastern Asia as in Europe; whilst the same remark applies to the specimens from China, where the species has been found common in all places visited by collectors. Leech further notes: "In wing-expanse, the specimens vary from 27mm.-36mm., and in the width of the black marginal border of the forewings there is considerable diversity. The Indian *C. huegelii* does not appear to be specifically distinct from *C. argiolus*, L., and I think that it, and also *C. coelestina*, Koll., are really only forms of that species." Examination of the genitalia has proved that at least *levettii*, Butl., *ladonides*, De l'Orza, *coelestina*, Koll., *sikkima*, Moore, *victoria*, Swinh., *albocaeruleoides*, n. var., and *huegelii*, Moore, are merely forms of *C. argiolus*. We have, therefore, treated these in detail.

a. ab. (*et* var.) *hypoleuca*, Koll., "Ins. Pers.," p. 52 (1848); Rühl, "Pal. Gross-Schmett.," i., pp. 293, 765 (1892); Tutt, "Brit. Butts.," p. 189 (1896); [*nec* Staud., "Cat.," 3rd ed., p. 90 (1901)].—Alis supra violaceo-cæruleis, margine externo nigro-cincto, fimbriis albis; subtus alis omnibus albis; posticis punctis aliquot dispersis nigris, basi viridi squamosis. Expans. alar. 13‴. Species omnino ab omnibus europaeis diversa, colore paginæ superioris *L. iolas* similis, atque tamen colore paginæ inferioris albo magnopere differt et *L. argiolo* propius accedit (Kollar).

Staudinger (*Cat.*, 3rd ed., p. 90) says of this form: "Subtus maculis nullis, gen. æst. mer. ?, Persia, Cyprus, western Kurdistan, northern Mesopotamia, Fergana," etc. This, of course, disagrees with the original description, which distinctly says that "the posterior wings have, on the underside, a few scattered black dots." Rühl is much nearer the original, when he says that "the underside is almost spotless, only the three basal spots of the hindwings, as well as single faint outer-marginal spots of the forewings present, the row of black ocellated spots beyond the middle obsolete, the discoidal lunules scarcely indicated; from Denmark, Cyprus, Persia, Lepsa, and the Ala Tau," although Kollar does not specifically mention the position or number of spots. There is no doubt that the essential characteristic of this form is not its underside markings, for Kollar particularly says that it is altogether different from all European species, and observes that whilst the colour of the upperside is like that of *L. iolas*, yet that of the underside differs greatly in its white colour, and comes nearest to *C. argiolus*. The European examples of ab. *obsoleta* are, therefore, quite erroneously referred here, by various authors.

β. var. *levettii*, Butl., "Ann. and Mag. Nat. Hist.," 5th ser., xi., p. 111 (1883). *Argiolus* var. *hügeli*, Fixsen, "Rom. Mém.," iii., pp. 285-6 (1887). *Hügeli*, Rühl, "Pal. Gross-Schmett.," i., p. 293 (1892). *Levetti*, Rühl, "Pal. Gross-Schmett.," i., p. 765 (1895); Tutt, "Brit. Butts.," p. 189 (1896); Staud., "Cat.," 3rd ed., p. 91 (1901).—Allied to *L. argiolus* and *L. ladonides*. From the former the ♂ differs in the broader and less sharply-defined blackish border to the outer margins of the wings and the greyer tint of the under-surface; the female differs in its darker tint and broad, external, blackish border to the secondaries; the costal border is also broader, so that the silvery-blue area is confined to a triangular abdominal patch; below, the white is a trifle less pure, and the submarginal lunules a little better defined than in *L. argiolus*. From *L. ladonides* the male is readily distinguished by its lilacine instead of cærulean colour, and the female by its greyer tint throughout, and its more decided, broad, blackish, external border to secondaries, both sexes are decidedly smaller, as in *L. argiolus*, and have the submarginal lunules and spots below much less strongly defined. Expanse of wings, ♂ 30mm.-34mm., ♀ 33mm. Jinchuen, W. Corea (E. B. Levett). Seven examples in a more or less recognisable condition were obtained, two pairs being in very fair trim. As the characters given above seem to be quite constant, and do not admit of their being placed with any of the allied species, I am compelled, somewhat against my wish, to regard *L. levettii* as distinct (Butler).

This is the Corean form of *argiolus*, diagnosed by Staudinger as "Subt. signaturis præsertim marginalibus magis perspicuis." It is certainly the *argiolus* var. *hügeli*, Fixsen, the examples of which are described by the latter (*Rom. Mém.*, iii., pp. 285-6) as follows: "The specimens brought by Herz, incline rather to the Himalayan than the Europeo-

Siberian form. The males exhibit no difference on the upperside except the rather broader black border; on the underside, however, the faintly-indicated, marginal, lunular border is strongly-developed, and there is a row of spots between this and the outer margin, which is wanting in European examples; the hindwings of the Corean examples have this marginal row of spots and are also surrounded with strongly-marked lunules. The females have a broad black border on the upperside; that on the hindwings being particularly broad, absorbing the black marginal spots, but not so that they are completely lost therein; indeed, they show rather distinctly. These examples resemble *kaschmira*, Moore, in size and breadth of wings. Length of forewings, ♂, 17mm., ♀, 13mm.-17mm." [It may be here noted, that Moore himself states (*Proc. Zool. Soc. Lond.*, 1882, p. 144) that his *kasmira* is a synonym of the Indian *coelestina*, Koll.] The few Corean ♀ s in the B.M. coll. are very remarkable, with very broad costal and outer-marginal borders, the small blue area very brightly metallic and becoming white by iridescence when the light is thrown off it. One is labelled, "Gensan, August 1877."

γ. var. *ladonides*, De l'Orza, "Lep. Jap.," p. 20 (1867). *Ladon*, Mén., "Enum. Corp. Animal. Mus. Petrop.," pt. ii., pl. x., fig. 5 (1855).—Ménétriés has considered, certainly with some doubt, this Japanese Lycænid as being referable to *ladon*, Cram., a species from the Cape of Good Hope. We have inspected the true *ladon* in Boisduval's collection, and are satisfied that the Japanese insect is quite distinct (De l'Orza).

Leech refers (*Trans. Ent. Soc. Lond.*, 1899, p. 109) this, with *levettii*, Butl., to *argiolus*, a conclusion with which we agree; they are not, however, typical forms of the latter species, so that we prefer to retain this name for the Japanese form of the species, and *levettii*, Butl., for the Corean form. Of the Japanese form of *argiolus*, Pryer says (*Rhop. Nihon.*, p. 18): "There are several broods of this insect; while the male is constant, there are two very dissimilar temperature forms of the female; one has a large amount of black on the upperside; the other, which generally appears later, is much brighter. The second brood often exhibits both forms." The *ladonides* of the Brit. Mus. coll., forms a most interesting series, the Japanese examples show a strangely tinted male from Kobé, which at first suggests that it has been under the influence of damp, except that the two females from the same locality are almost exactly similar; the females, in the series, indeed, are all rather remarkable, one from Nikko (5000ft., 2. vi.'04) is intensely brilliant in its tint, with a tendency to form a white patch in the upper corner of the blue area (as a result of light effect), whilst the wide black band is also very striking; the two ♀ s from Kobé, 23. vi. 1900 (Scarlett), have equally wide and strongly developed bands, the ground colour, however, being rather of a pale blue-grey, and quite confined to the centre and bases of all the wings. The Chinese specimens in this series are somewhat different, and remind one much, especially in the borders of the males, of *oreas*, Leech, from the same or neighbouring districts.

δ. var. *kobei*, n. var.—A modification of *ladonides*, but a very special form; the ♂ of a slaty- or blue-grey ground-colour, the ♀ of the same tint, forewings with very broad bands along outer margin and costa, and much suffused towards base; the hindwings also very dark along costa and outer margin, only a small median area being of the slaty blue-grey ground-colour. One ♂ and two ♀ s, taken at Kobé, Japan, June 23rd, 1900.

At first we were inclined to think that this aberration was the result of exposure to damp, but the absolute similarity of the ground-colour in the male and females, and the peculiar character of the suffusion of the latter, leads us to believe it to be a marked local form.

ε. var. *coelestina*, Koll., "Hügel's Kaschmir.," iv., p. 423 (1848); Moore, "Proc. Zool. Soc. Lond.," p. 244 (1882); de Nicév., "Butts. India," iii., p. 106 (1890); Staud., "Cat.," 3rd ed., p. 91 (1901). *Kollari*, Wstwd., "Gen. Diurn. Lep.," ii., p. 491 (1852); Butl., "Proc. Zool. Soc. Lond.," p. 367 (1886); "Ann. Mag. Nat. Hist.," 6th ser., i., p. 148 (1888). *Kasmira*, Moore, "Proc. Zool. Soc. Lond.," p. 503, pl. xxxi., fig. 1, ♂ (1865); p. 271 (1874).—Alis supra saturate cyaneis unicoloribus, linea ante fimbrias tenuissima nigra; subtus albis, punctis nigris seriatim dispositis, fimbriis albis nigro maculatis. Expansio alarum 15‴. Habitat in Kaschmir. Allied to *L. argiolus*, but rather larger. All the wings on the upperside uniform dark sky-blue; the fringes bordered within by a narrow black line, the fringes themselves white, spotted with black at the end of the nervures. The underside is white, as in *argiolus;* on the forewings is a dark streak in the middle, before the hindmargin a connected row of shorter dashes, and just before the fringes a slender black line, preceded by some single darker dots. On the hindwings the black dots are more numerous than on the forewings, and not so regularly placed, but they are more distinct, and some blackish dots stand immediately before the fringes. The thorax and abdomen are brown above, clothed with dark blue down; white beneath. The antennæ black, slenderly ringed with white, the tip of the club white. Kashmir. Captured by Hügel (Kollar).

De Nicéville treats this as a distinct species, and deals with it at length (*Butts. India*, iii., pp. 106-7). He notes it as inhabiting the Western Himalayas; the ♂ varying from 1·0 in. to 1·35 in., the ♀ from 1·05in. to 1·35in. He quotes Moore's description of *kasmira* (*Proc. Zool. Soc. Lond.*, 1865, p. 503) and adds an independent description of the larva and pupa. These descriptions read as follows:—

Kasmira. ♂. Upperside, both wings purplish-lavender-blue, exterior margins blackish. Underside both wings cream-white. Forewings with an indistinct discocellular streak, beyond which, one-third from the apex, is a single white-encircled black spot, a transverse discal series of four white-encircled black spots, a marginal double row of indistinct blackish lunules. Hindwing with twelve basally disposed white-encircled black spots, a marginal row of blackish spots, bordered by a submarginal series of indistinct blackish lunules. ♀. Upperside, both wings brighter blue. Forewing with the costa and exterior margin, hindwing with the anterior margin, broadly dull black, the latter with a marginal row of blackish spots, bordered by a submarginal series of lunules. Underside, both wings as in the ♂. Cilia white (Moore). Larva: When full-grown, ·6in. in length; of the usual Lycænid shape, coloration pale light green, of the exact shade of young leaves: the very small head placed upon a long neck is intensely black and shining; the segments increase slightly in width to the 5th, then gradually decrease to the 13th; the whole surface is finely shagreened, but entirely without markings, except two dorsal lines of a pale bluish-green colour from the 2nd to the 10th segment, slightly converging posteriorly, the colour of the ground between these lines slightly darker than the rest of the surface; a few colourless short lateral hairs; the segments shallowly constructed; no mouth-like opening on the 11th, or erectile organs on the 12th segments. Feeds on *Prinsepia utilis*, native name Bhenkal. Pupa: ·40in. to ·45in. in length, of the usual Lycænid shape, pale brown, irregularly and obscurely spotted and blotched with darker brown, no regular markings whatever; the surface rough, with short colourless bristly hairs. From living examples of the larvæ and pupæ collected at Masuri in the Western Himalayas by P. W. Mackinnon, who informs me, after careful watching, that ants do not attend the larvæ (de Nicéville).

De Nicéville adds (*op. cit.*, p. 107) that there is no difficulty whatever in recognising *C. coelestina*. Both sexes are considerably smaller than *C. huegelii*, and the male has the outer black border on the upperside of the forewing broader, and considerably dilated at the apex. It is an extremely common species, occurring throughout the outer ranges of the Western Himalayas, at any rate from Kashmir and Murree to Naini Tal. Doherty records it from Bagheswar, Kumaon, as low as 3500ft., and from Garbyan also in Kumaon as high as 12000 ft. . . . Staudinger simply notes it (*Cat.*, p. 91) as "Forma minor Indiæ. Northwest Himalayas."

ξ. var. *huegelii*, Moore, "Proc. Zool. Soc. Lond.," p. 244 (1882); de Nicév., "Butts. India," iii., p. 107 (1890). *Argiolus*, Koll. (*nec* Linn.), "Hügel's Kaschmir," iv., pt. 2, p. 423 (1848). *Hügeli*, Rühl, "Pal. Gross-Schmett.," i., p. 765 (1895); Tutt, "Brit. Butts.," p. 189 (1896). *Huegelli*, Staud., "Cat.," 3rd ed., p. 91 (1901).—Differs from *C. coelestina* in its larger size. ♂, with the upperside similar in colour, but of a darker blue tint, forewing with a more slender, blackish, marginal band, hindwing with a clearly defined marginal line. Female more dusky throughout than in *C. coelestina*; forewings with broader, blackish, marginal borders and discocellular lunule, hindwing with the blackish costal border and marginal spots broader, the latter with well-defined, inner, pale, dentate marks, the inner area beyond the veins also dusky-black. Underside with similar but more distinct markings than in *C. coelestina*, the discal series on the hindwing more linear in shape, the marginal spots and submarginal lunular band much more prominent. Expanse: ♂ ♀ 1$\frac{5}{12}$ins. to 1$\frac{8}{12}$ins. Hab.: N.W. Himalaya—Kaschmir, Simla, Masuri, Dharmsala. In coll. F. Moore and Brit. Mus. This species has hitherto been considered to be Kollar's *L. coelestina*, but both his description and measurements undoubtedly agree with *C. kasmira* (Moore).

De Nicéville treats it as a distinct species, and quotes verbatim (*op. cit.*, pp. 107-8) the above description of Moore, and then adds: "This species has exactly the same range as *C. coelestina*, Koll., and is equally common. Doherty records it from all Kumaon, from as low as 3500 ft. at Bagheswar, and as high as 12000 ft. at Garbyan. It may at once be known by its large size, and the black border of the forewing of the male on the upperside being very narrow throughout." Staudinger simply diagnoses it as "Forma major Indiæ. Northwest Himalayas." There is a specially fine series in the British Museum collection; the ♂s very large, deep-coloured, lavender-blue, the white fringes somewhat defined against the narrow black border. The ♀s are equally large, with distinct discoidal lunule, deeply shaded costa and outer margin to the forewings, the hindwings also with blackish costa, dark marginal band, containing a series of well-defined marginal lunules of the ground colour; the nervures also somewhat dark. The underside is dead white, the marginal lunules exceptionally well-developed on both wings, but the usual streaks comparatively small and weak.

η. var. *sikkima*, Moore, "Proc. Zool. Soc. Lond.," p. 324, pl. xlviii., fig. 11 (♂) (1883); de Nicév., "Butts. India," iii., p. 105 (1898). *Jynteana* (in part), de Nicév., "Journ. As. Soc. Beng.," iii., pt. 2, p. 69 (1885); "Butts. India," iii., pp. 104-5 (1890).—Allied to *C. jynteana*. Forewing shorter, hindwing also shorter and comparatively broader. Upperside of both wings with the marginal blackish band broader, the forewings with a slender blackish discocellular streak. Underside of both wings similarly marked to *C. jynteana*, the discal oblique spots being shorter, and the submarginal dentate lunules broader. Expanse 1·2in. Habitat—Darjiling. In coll. F. Moore (Moore).

We are indebted to Chapman for unravelling this insect as a form of *C. argiolus*. Certain specimens of *Celastrina* from Assam and Simla, given him by Bingham, included four examples in poor condition with the general facies of *C. puspa* or *C. transpectus*, but which an examination of the genitalia proved to be a race of *C. argiolus*. Suspecting that they were *sikkima*, Moore, comparison with the types in the Moore coll. at the British Museum proved the surmise to be correct. Moore also described, in 1883, a species with very similar facies, but quite distinct genitalia, called *jynteana*. De Nicéville's *jynteana* (*Butts. India*, iii., pp. 104-5) appears to be a mixture of Moore's *sikkima* and *jynteana*, and even Moore himself, later, failed sometimes to appreciate the distinction, for, in the Brit. Mus. coll., there is a *sikkima* labelled *jynteana* by Moore himself, whilst in the Moore coll. there are several *sikkima* correctly placed under this name, but also several others mixed up with *jynteana*, which suggests that Moore did not later maintain his grip on the differences when dealing with the two insects. As a form of *C. argiolus*, it is very far from any other race, in the very broad dark border to the forewings (and sometimes the hindwings) and in the discal streak; there is considerable variation in breadth of this border, some specimens being nearly as dark as *C. puspa*. [*C. jynteana* appears to be without the discal streak, and also without the white shading on the forewing; at any rate, these are not usual, whilst in *sikkima* the discal streak is rarely absent, and white suffusion is not uncommon.] The undersides of *sikkima* and *jynteana* are very close; in the former the discal row of four spots is straighter, and the spots themselves more in line; in *C. jynteana* there is a greater tendency to their being *en echelon*, and the costal one is a little further in, making the distance between this one and the separated costal spot less than it is in *sikkima* (*argiolus*). The difference is, however, too slight to be noted except by comparison of specimens, and not by absolute description. In spite of this superficial similarity of wing-markings, the ♂ appendages have a very distinct and characteristic structure in *C. jynteana*, which is very different from that in *sikkima*, where they can be detected to differ in no way from those of *C. argiolus* (Chapman).

θ. var. *albocaeruleoides*, n. var.—Another Indian form of *C. argiolus* very much resembles *C. albocaeruleus*, and is mixed with that species in the British Museum; its genitalia are distinctly those of *C. argiolus*. It does not appear to be a named form, and might very properly be called *albocaeruleoides* (Chapman, *in litt.*, 12, II. 1908).

Chapman, besides having discovered *sikkima*, Moore, and *victoria*, Swinh., to be forms of *C. argiolus*, observed that he had two other specimens, without data, which he was unable to identify with any descriptions, but which happened to agree with a specimen in the South Kensington Museum Coll., labelled *albocaeruleus*, and mixed with that species. He says: "These examples much resemble *C. albocaeruleus*, but, perhaps, are even more like *C. marginata*; they are, however, quite distinct from both these species, and are, in fact, a form of *C. argiolus*. From the specimen that was mixed with *albocaeruleus*, I propose that this be called *albocaeruleoides*. It is, structurally, as far from *C. albocaeruleus* and *C. marginata* as any two species in the genus can be. The specimens resemble *sikkima* more than they do *albocaeruleus*; they differ from it in a wider dark border, a large white patch in the middle of the wing and in wanting the discal streak. The dark wing-margin is of the pattern of *sikkima* or *C. puspa* not of *C. albocaeruleus*. The var. *albocaeruleoides* is a very parallel form to the Central American var. *gozora*."

ι. var. *victoria*, Swinhoe, "Trans. Ent. Soc. Lond.," p. 293 (1893).—Expanse of wing—♂ $1\frac{1}{10}$in., ♀ $1\frac{3}{10}$in. ♂ upperside, dull pale bluish-grey; centres of both wings whitish; forewings with a brown band, attenuated hindwards; hindwing with a brown marginal line, and in some examples pale grey submarginal lunules; underside, greyish-white, with a dull glazed appearance; markings very faint and indistinct; forewing with a mark across end of cell and a discal row of pale lunules or transverse streaks; hindwing with a subcostal dot near base, another below it in middle of wing; a subcostal dot towards apex, terminating a discal outwardly curved irregular row of streaks, very indistinct, and often invisible. ♀ upperside darker than the males; marginal band blacker, deeper, especially at the apex, and running along costa; internal space whiter, as also is cilia, and a dark costal band; underside coloured and glazed like the male; markings more distinct, the discal streaks more or less joined together. Shillong 10♂s, 4♀s. Above something like a faded dry season form of *C. jynteana*, Moore; the underside like nothing I know of. I have submitted these insects to all the best Indian lepidopterists in England, and all agree that it is a good and new species; they came in one batch, April, 1892; I have never received any since (Swinhoe).

Chapman says that *victoria*, Swinh., astonished him by furnishing appendages of strictly *C. argiolus* type. The facies of this form, however, is very different from that of the latter species, and of most Indian Celastrinids, being nearly devoid of blue and of a dull leaden aspect. Its detailed markings agree with those of *C. argiolus*, but like the var. *sikkima*, it has much more black on the forewings. Indeed, all these forms suggest to one whose ideas are based on European *C. argiolus*, that they are not ♂ but ♀ specimens.

Nearctic races and forms.

Dyar quotes (*List Nth. Amer. Lep.*, p. 45) the American insect as *ladon*, Cram., basing his change of nomenclature on a statement made by Butler* (*Can. Ent.*, xxxii., p. 91; *Ent. Amer.*, i., p. 53), but there is

* Butler writes: "In 1782, Cramer described and figured a *Cyaniris* (pl. cclxx., figs. D, E) and incorrectly gave the Cape of Good Hope as its locality. In his *Rhopalocera Africae Australis*, Trimen described the species from a single example labelled 'S. Africa, in the British Museum collection,' and stated that this was the only example he had seen. . . . . On looking up the authority for the locality of the specimen mentioned by Trimen in our oldest 'Register of Accessions,' I find it entered as '*P. ladon*, Cram., n., S. Africa (?),' the locality having evidently been entered on Cramer's authority. As a matter of fact, Cramer's insect is undoubtedly *Cyaniris pseudargiolus*, which it necessarily supersedes, and our reputed African example is a large specimen of the form *marginata*, rather less suffused than usual on the undersurface . . . . *C. pseudargiolus* is not half so nearly related to *C. argiolus* as it is to the Sikkim species, *C. dilectus*." Here Butler appears to make several illogical statements. He notes that (1) Cramer described and figured a species giving the Cape of Good Hope as locality; (2) a specimen of *pseudargiolus* var. *marginata* is in the British Museum Coll. (referred to *ladon*, Cram.), and with the locality "? South Africa," and adds, apparently without the slightest warrant, that this had "evidently been entered on Cramer's authority." He then argues that because a specimen of *pseudargiolus* var. *marginata* has been referred to *ladon*, Cram., in the British Museum Coll., by some unknown person, the true *ladon* of Cramer is *pseudargiolus*, and concludes that the name must accordingly be changed, and Dyar accepts it, in spite of Elwes' timely warning (*Can. Ent.*, xxxii., p. 116). It is true that Cramer figured a *Cyaniris* under the name of *ladon*, that he erroneously gave it as coming from the Cape of Good Hope, that the specimen is not in existence in Britain (one suspects from de l'Orza's statement that it was 'in Boisduval's collection,' that Oberthür now has it). Cramer's species must be judged by the figure, and there are several eastern Asiatic species that this latter might equally well be. That the wrongly-called specimen in the British Museum Coll., which Butler says is *pseudargiolus* var. *marginata*, and labelled *ladon*, was merely misnamed by one of the Museum officials, and that there is nothing to connect this example with Cramer's figure of *ladon*, and that the latter, whatever it may be, is certainly not *pseudargiolus*, and that the name cannot possibly be changed on such evidence, appear certain. Bethune-Baker agrees (*in litt.*) that the specimen under the name *ladon*, in the British Museum coll., is a *pseudargiolus* from America, and adds that Cramer's figure most likely represents the Asiatic species *marginata*, de Nicév.

no doubt that the old name of *pseudargiolus* must stand. One would surmise from the marvellous details of Edwards (*Butts. Nth. America*, ii., Lyc. pls. ii and iii) that the Nearctic race of this species, with its wealth of variational and aberrational names, was almost polymorphic in its appearance, and most complicated in its life-history, but, as a matter of fact, the Nearctic insect appears to be practically identical with the Palæarctic race in both particulars. It exhibits the same colour tint variations in both sexes, the same marked seasonal variation in the females, and the same variation of single-, partially double-, and partially triple-brooded condition, according to latitude, altitude, or difference in the meteorological conditions of various seasons. As in our British examples the males are usually either (1) of the ordinary azure tint, or (2) of a somewhat distinct mauve, whilst the female may be mauve (inclining to whitish in certain areas) azure-blue, or bright almost metallic blue. The spring females may vary somewhat in the width of the black marginal border of the upperside of the forewing, but as a rule, this is (1) much narrower than, (2) not continued markedly along the costa so far as, in the summer form; whilst the latter may have in addition (1) a marked discoidal spot, (2) a darkened costa on hindwing, (3) a paler tint in central areas of both wings. Our Palæarctic summer forms are rarely as white as the most extreme of the Nearctic, whilst the undersides of our Palæarctic spring forms are rarely, if ever, as dark as the Nearctic. Based on a comparison of the figures in Edwards' work (*op. cit.*) one finds the following Nearctic forms dealt with :—

SPRING FORMS.

1. ♂. Azure-blue, with narrow black marginal edge to forewings. ♀ with comparatively narrow black marginal band on forewings and no discoidal lunule, and narrow line with marginal dots on hindwings. Underside ♂ and ♀ much shaded with blackish; hindwings with central patch, distinct marginal border on both wings = *lucia*, Edw., pl. ii., figs. 1-2.

2. As in 1, but median blackish patch on underside of hindwings wanting = *marginata*, Edw., pl. ii., figs. 3-4.

3. ♂. Rather less bright in tint, marginal line of forewings slightly extended at apex. ♀ also with marginal band of forewings slightly extended along costa, and no discoidal lunule. Underside ♂ and ♀, strongly spotted, but without blackish discal and marginal areas = *violacea*, Edw., pl. ii., figs. 5-6.

[4. ♂. Small form of 3; the ♀ with suggestions of summer brood in the discoidal lunule, and the extension of marginal band along costa to discoidal spot, and greater width at anal angle, margin of hindwings with distinct lunules. Underside ashy-grey, spots faint and small = *cinerea*, Edw., pl. ii., figs. 16-17.]

5. ♂. Uniform greyish- or sooty-black = *nigra*, Edw., pl. ii., fig. 7.

6. ♂. Mauve, with scarcely any trace of dark marginal edge; underside grey, with obsolete spots (almost certainly a summer example). ♀ bright blue, with narrow marginal border extending along costa in apical region; no discoidal lunule; hindwings with submarginal lunular band containing marginal dots; underside white, with well-marked spots = *piasus*, Edw., pl. ii., figs. 20-21; fig. 21, the ♀, is called *echo*, Edw., pp. 5, 9.

7. ♀s. Most like 2 on upperside = *piasus*, Edw., pl. iii., fig. 26 (called first brood), fig. 27 (called second brood). (Both almost certainly first brood females, though different in appearance from pl. ii., fig. 21).

SUMMER FORMS.

8. ♂. Inclining to mauve, with well-marked marginal black edge, strongly marked at apex. ♀. Violet becoming whitish externally where coming in contact with broad, black, marginal band; costa markedly dark, and uniting with discoidal lunule; hindwings with greyish lunular border = *arizonensis*, Edw., app. p. 7 = *pseudargiolus*, Edw., pl. ii., figs. 18-19. [*Cinerea*, figs. 16-17 (see *suprà*), form almost certainly a parallel small race of the same brood, they are so similar.]

9. ♂. Azure, with clear black marginal line, hindwings whitish towards

centre. ♀, delicate violet-white (violet at base), with broad marginal band to forewings extending along costa; strongly spotted margin to hindwings=*neglecta*, Edw., pl. ii., figs. 11-12.

10. ♂ and ♀. Exactly parallel pair only larger. Underside white, with contrasting black spots, many, however, obsolete=*pseudargiolus*, Edw., pl. ii., figs. 8-9=*neglecta*, large form, Scudder. (No doubt a summer form, which may be called *neglecta-major*, though Edwards insists that it comes from overwintering pupa).

11. ♂. Mauve, with hardly any marginal edge. ♀, ill-scaled and badly pigmented, ground colour and bands washed-out. Underside white, varying from well-marked to obsolete in the spotting=*neglecta*, Edw., pl. ii., figs. 10, 13, 15 ♂s, 14 ♀. (The rapidly-fed-up summer form, *pauper*, not characteristic *neglecta*.)

The above is a summary from our standpoint of Edwards' beautiful plates and his remarks thereon. With some of his conclusions we cannot agree; his facts, in many cases, too, are wofully insufficient or altogether wanting. He calls *pseudargiolus* a spring form and *neglecta* a summer one, but of *pseudargiolus*, he figures two quite different, but one undoubtedly, and two probably, summer, forms; indeed, there is no difference whatever in his *pseudargiolus*, figs. 8-9, and *neglecta*, figs. 11 and 12, except in size, and his data show that he bases his opinion concerning *pseudargiolus*, figs. 8-9, absolutely on specimens captured on the wing, which he states to be late spring, and which their appearance almost conclusively proves to be early summer, examples of large size. Besides the typical (?) *neglecta* (as defined by figs. 11 and 12) just noted, Edwards pictures three mauve males (practically without marginal borders), and an illscaled, and illpigmented female, with very weakly marked marginal band, under the same name. Under the name *piasus*, Edwards figures (pl. iii) two females of a lilac form, more like a warm-tinted *icarus*, and very different from the bright, metallic (?), blue female of the preceding plate (pl. ii., fig. 21), which is figured under the same name, but which, in the letterpress, he refers to as var. *echo*. Edwards notes (*Can. Ent.*, ix., p. 203) that, in May, 1877, at Coalburgh, he reared a large number of larvæ from eggs laid by *pseudargiolus*, the pupæ from which were later exposed in an ice-box, for varying times; only one, however, emerged in the summer of the same year, a female, which differed from the normal form in having the usual series of extra-discal spots on the underside entirely wanting, whilst the marginal crescents, very large and black, form a complete and conspicuous series along the edge of both wings. The other pupæ went over the winter.

a. var. *pseudargiolus*, Bdv. and Le Conte, "Lep. Amer. Sept.," p. 118, pl. xxxvi., figs. 1-5 (1833); Dbldy., "List Lep. Brit. Mus.," ii., p. 45 (1847); Morr., "Syn. Lep. Nth. Am.," pp. 82-83 (1862); Edw., "Proc. Ent. Soc. Phil.," vi., pp. 204-6 (1866); "Butts. Nth. Amer.," i., Lyc. pl. ii., figs. 1-3 (1870); Kirb., "Syn. Cat.," pp. 371, 653 (1871); Scudd., "Sys. Rev. Am. Butts.," p. 34 (1872); Edw., "Can. Ent.," v., pp. 223-4 (1873); vii., pp. 81-2 (1875); x., pp. 1-14, fig. 80 (1878); French, "Rept. Ins. Ill.," vii., p. 158 (1878); Scudd., "Butts.," pp. 174-9, 308, figs. 34, 35, 148-152 (1881); Middl., "Rep. Ins. Ill.," x., p. 95 (1881); Edw., "Pap.," iii., pp. 85-97 (1883); Fern., "Butts. Maine," pp. 90-2, and figs. 29-31 (1884); Edw., "Butts. Nth. Amer.," ii., Lyc. pls. ii.-iii., pp. 1-16 (1884); French, "Butts. E. Un. States," pp. 286-91, figs. 78-80 (1886); Mayn., "Butts. N. E.," pp. 39-40, pl. vi., figs. 49-49*d* (1886); Scudd., "Butts. New Engl.," ii., pp. 927-947 (1889); Elwes, "Can. Ent.," xxxii., p. 116 (1900). *Ladon*, Butl. (*nec* Cram.), "Ent. Amer.," i., p. 53 (1885); "Can. Ent.," xxxii., p. 91 (1900); Fletch., "Can. Ent.," xxxvi., p. 4 (1904); Dyar, "List Nth. Amer. Lep.," p. 45 (1902).—Alis integerrimis supra violaceo-cæruleis, feminæ anticis apice, posticis punctis marginalibus fuscis; maris fimbria alba nigro intersecta; alis omnibus subtus cano cinerascentibus, punctis simplicibus nigris. Larva viridis strigis obliquis obscuris, maculis dorsalibus rubris capiteque nigro. It is a little smaller than the *argiolus* of Europe to which it approaches closely. Above, the ♂ is of a delicate violet-blue, with a narrow marginal black line, which often widens on the forewings sufficiently to make a pronounced narrow border. The fringe is whitish, chequered with black. The upperside of the ♀ is of a paler, and less violet, blue, with a wide black border on the upper wings, and a marginal row of dots of the same colour, somewhat as in the corresponding sex of *argiolus*. At the end of the discoidal cell of the forewings, there is also a little blackish arc. The fringe of the forewings is chequered with black. The underside is of a very much darker grey than in *argiolus*, with a brown discoidal streak, a transverse wavy line made up of black dots, slightly edged with whitish, and a marginal row of triangular brownish lunules, each enclosing a darker marginal dot. Outside this is a transverse row of three black dots, well-marked at the base of the hindwings. The tint of the underside, the size of the black dots, and the marginal lunules readily distinguish this species from *argiolus*. The larva is green, pubescent, with the back slightly yellower, marked with a median red interrupted line, cut transversely, almost at the middle, by a somewhat large arc of the same colour of which the concavity is turned forward. The sides present, as in most analogous species, oblique streaks, darker than the ground colour; near the feet, also is a marginal line of dark green; the feet are of the colour of the body; the head is black. The pupa is reddish, with the wing-cases slightly greenish, and the back marked with four rows of spots darker than the ground colour. It lives throughout a great part of the United States, on many kinds of bushes, like our *argiolus*, of which it has many similar habits (Boisduval and Le Conte). Egglaying: The early spring ♀s lay their eggs on the flower-buds of *Cornus*. They are laid singly, low down on the side of a floret, and usually well within the flower-head. The earlier second-brood ♀s choose *Cimicifuga racemosa*, the eggs being laid on the greenish-white buds of the long flower-spikes. The ♀s of the later summer emergence lay their eggs on *Actinomeris squarrosa* (*Butts. Nth. Amer.*, ii., pl. iii., fig. 3) (Edwards). The eggs hatch in from four to eight days, according to season (Edwards), some laid in May hatched in six days (Scudder). A ♀ *lucia* was observed, June 4th, 1903, at Much Lake, Quebec, to lay her eggs upon the small buds of *Chrysanthemum leucanthemum*; settling on the top of a bud, the ♀ crawled to the edge, turned the abdomen beneath it, and thrust the egg out of sight as far as possible, placing four at the base of the bracts, where there is a slight swelling, which somewhat hides them (Young *teste* Fletcher). Egg: ·02in. in diameter; round, flat at base, the top flattened and depressed, the surface covered with a white lace-work, the meshes of which are largely lozenge-shaped, with a short rounded process at each angle; colour of the shell under this covering, delicate green (*op. cit.*, figs. *a-a'*). Duration of this stage—six to eight days in April, four to five days in May, June, and September. Habits of larva: As soon as hatched, the young larva eats a minute hole, the diameter of the head, into the lower part of the unopened bud of dogwood (*Cornus*), just above the calyx, and feeds upon the filaments of the stamens. After its first moult, it bores into the sides of the calyx, to get at the ovules; but, as the flowers mature and the ovary hardens, the boring is from the top, inside the tube of the calyx, and follows the stalk of the pistil to the ovule. Finally, belated larvæ are compelled to gnaw the seed-vessel after it has become woody, and, in several instances, have been found eating the stem below the flower. It is not unusual for the larvæ in confinement to eat of the white involucre of the flower, but I have never observed them eat of the leaves, even when no other food has been given them. The larvæ of the second brood bore into the side of a bud of *Cimicifuga racemosa*, gradually eating out the contents till a mere shell is left, then move to a fresh bud, etc. As the larva feeds, the prothorax is pressed hard against the bud, so as to permit the utmost elongation of the neck. Thus it is enabled to eat out the contents of the bud, and only desists when there remains but the empty shell. When so engaged, the anterior segments are curled up, and the others rest on the stalk of the plant; but very small larvæ rest wholly on the bud, curving around it. The larvæ feed on many other plants in confinement. Those on *Cornus*, in their later stages, vary greatly in colour and markings, having more or less green, either light or dull, with white, brown, and crimson, but, in the younger stages, they are much the colour of the flowers they feed on, and are thus, in some degree, protected from their numerous enemies—spiders, hemiptera, etc. In confinement, when food is scanty, they will prey on each other, burrowing into the body in the same way as they do into a flower (Edwards). Larvæ bred on *Vaccinium* ate away the surface of the leaf while young, and, later, ate the leaf entirely through (Dimmock); young larvæ on buckthorn ate circular holes ·25in. in diameter in the upper surface of the leaves (Scudder). LARVA: *First instar* (newly-hatched): Length ·04in.; head minute, obovoid, black, retractile; the underside flat, legs retractile, upperside round, the dorsum highest at segment 4, both dorsum and sides slope gradually to 13; surface pubescent; on either side of the mediodorsal line a row of white clubbed hairs, one at the posterior end of each segment; similar hairs about the base and in front of 2, making a complete fringe around the body; colour either greenish-white or brownish-yellow (*op. cit.*, pl. iii., fig. *b*). Duration of stage 4-5 days in spring, 3 in summer. *Second instar:* Length 0·07in.-0·08in. (after first moult); nearly same shape as before, with pubescent surface, and dorsal and basal hairs; colour in spring and autumn brownish-yellow; in summer the same, also greenish-white, and occasionally reddish (*op. cit.*, pl. iii., fig. *c*). Duration of this stage from 3-5 days. *Third instar:* Length ·12in.-·16in.; general shape as before, but the dorsum now covered from 3 to 10 by a low, broad, continuous, tuberculous ridge, cleft to the body at the junction of the segments, the anterior edge of each segment depressed, the sides incurved, 2 is more flattened than before, and the outer border is thickened into a rounded rim, leaving within, the curve, a flat, depressed, space; surface pubescent; about the base a fringe, as before, and a few short hairs on summit of dorsum; colour in spring pale green, the dorsum whitish, usually with a median reddish line or stripe from 3 to 10 often macular; in summer variable, buff or pale green, without spots, the 2nd segment brown; in some examples, the dorsum and sides are mottled with dark green and brown; occasionally one is wine-red throughout, or red with a white basal stripe and white along the edges of the dorsal tuberculations; in autumn, dull green, more or less marked brown (*op. cit.*, pl. iii., fig. *d*). Duration of stage 3 to 4 days. [*Fourth instar**: Length, ·18in. to ·2in.; in shape, nearly as before, the dorsum higher, segment 2 more produced and flattened; the long hairs on dorsum lost, but the basal fringe as before; colour variable, as in previous stage (*op. cit.*, pl. iii., figs. e-e^4). Duration of this stage 3 to 4 days.] *Fifth instar:* Length, directly after moult, ·25in.-·3in.; when mature in spring and autumn ·4in., in summer ·5in.-·55in.;† shape, long, oval, the base flat, dorsum high, and sloping both ways from about the middle, the last segments flattened, the second segment bent forward to the plane of base, produced, flattened, and wholly concealing the head when the larva is at rest; viewed from above the sides are nearly parallel, the two ends (segments 2 and 13) are about equally rounded, from 3 to 10 inclusive is a dorsal ridge, made of tuberculous processes closely joined at the junctions of the segments, the front edge of each depressed, the posterior edge raised and rounded, so that each process seems to fit into the next preceding; 2 is depressed in middle, and the whole outer edge is thickened and rounded. *Colour in spring:* Variable, usually as follows: The ridge whitish, often stained red, or it is brown, light or dark; the upper part of side olive-green, with a darker green, or sometimes a dull red, patch along the posterior edge of each segment; below this area pale green, and along base more or less brown; 11 to 13 are mottled in shades of green, often with brown, and 2 is either green or brown; if the latter, then with a brown patch in the depression; underside pale blue-green. *Colour in summer:* Sometimes all yellow-white or all delicate green, 2 being brown; or the ridge is light green and the sides dark, often with brown patches over all; or light green with a mediodorsal macular deep green band, and a similar one along base; or the whole surface may be wine-red, or even chocolate-brown. *Colour in autumn:* Green, with more or less brown in irregular patches (*op. cit.*, pl. iii., figs. f-f^6); head small, obovoid, dark brown, glossy, placed on the end of a long, conical neck, which can be thrust out to a length equal at least to the breadth of two of the body segments (pl. iii., figs. i^1-i^3), and, when withdrawn, is,

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* It is highly improbable that this insect has 5 larval instars. One suspects that Edwards' "Fourth instar" is, in reality, the larva well-grown in the "Third," and that his "Fifth instar" is the "Fourth."

† This bears on our opinion that Edwards' figures of *pseudargiolus* (pl. ii., figs. 8-9) are summer and not spring forms as he avers. Strangely, his figures (pl. ii., figs. 10-15), noted as the summer form *neglecta*, are either average or undersized, but as these are produced from the same batches of larvæ as the spring emergences, one suspects that there is no very marked difference, but that all the forms vary considerably.

together with the head, completely within segment 2; colour of neck blue-green (*op. cit.*, figs. *i-i*[4]). The surface of the body is velvety, and this appearance is owing to minute, stellate, glassy processes, scarcely raised above the surface, and only visible under a powerful magnifier, mostly six-rayed, and each sending up from the centre a filament which is a little longer than one of the rays; these stars are arranged in pretty regular rows, and are light except when on brown ground, in that case brown; but, in the autumn larvæ, the stars on brown ground are observed to be sometimes pink (*op. cit.*, fig. *n*). On 11, near the posterior edge, on middle of dorsum, is a transverse wavy slit, in an oval raised rim, out of which, at the will of the larva, is protruded, slightly, an ovoid green membrane (*op. cit.*, fig. *k*); and on 12, back of, and outside, the stigmata, is a mark like a stigma on either side, but a little larger; from this, also at will, may proceed a membranous cylinder, the top rounded, truncated, and turned in, but which, when fully expanded, displays a crown of tentacles (*op. cit.*, figs. *m-m*[2]). Before pupation the larva sometimes changes colour to pink, and from pink to brown, or becomes brown without the pink stage; others retain their natural hues, but these fade. From 4th moult to pupation, five or six days (Edwards). Foodplants.—*Cimicifuga racemosa*, *Cornus*, *Actinomeris squarrosa*, *A. helianthoides*, *Dimorphantes mantchuricus*, *Viburnum acerifolium* (Edwards), *Ceanothus americana* (Mead), *Æsculus californica* (Behr), *Ilex aquifolium*, *Erythrina herbacea*, *Apios tuberosa* (Abbot), *Spiraea salicifolia* (Sprague), *Vaccinium corymbosum* (Dimmock); in confinement—*Nasturtium*, *Begonia*, *Asclepias*, *Trifolium* (Edwards), *Rhamnus catharticus* (Scudder), *Salix* (Saunders), *Adenostoma fasciculatum* (Wright), *Chrysanthemum leucanthemum* (Fletcher). Pupation.—When the larvæ are ready to pupate, they fall to the ground, and doubtless conceal themselves under sticks and stones (Edwards). Pupa.—The ventral side straight, the dorsal rounded, and evenly, except for a slight depression below mesonotum, the abdomen broad and high; head narrow, rounded at top; mesonotum somewhat prominent, rounded; colour dark brown or yellow-brown, varying; the wings dark, sometimes green tinted; on abdomen two subdorsal rows of blackish dots, and sometimes a mediodorsal dark line from end to end (*op. cit.*, pl. iii., figs. *g*, *h*); surface covered with short fine hairs (*op. cit.*, fig. *g*[1]). Variable in size:—

Form.	Average Length.	Breadth at Mesonotum.	Across Abdomen.
5 pupæ from *violacea* ..	·263in.	·0916in.	·123in.
27 pupæ from *pseudargiolus*	·318in.	·119in.	·159in.
25 pupæ from *neglecta* (July eggs)	·298in.	·1in.	·14in.
3 pupæ from *neglecta* (Sept. eggs)	·293in.	·1in.	·136in.

Times of appearance: Single-brooded (as *lucia* or *violacea*) in the high-boreal regions of North America, above 45° N. lat., occurring in June and July: Yukon river, Lake Winnipeg, Anticosti, St. Michael's in Alaska, etc; also single-brooded at high elevations. Partially double-brooded, in May (as *lucia*, *marginata* and *violacea*) and July-August (as *neglecta*), from 45° N. lat. to as far south as Long Island. Partially triple-brooded, in April (as *violacea* and *nigra*), in June (as *neglecta*), in July-August (as *neglecta*), from about 40° N. lat. southward. In Colorado, 40° N. lat., it is double-brooded only, the first brood in May-June (as *lucia*, *violacea*, and *nigra*), the second in July and August (as *neglecta*). In Arizona, 33° N. lat., the first brood occurs as *cinerea*, the partial second and third broods as *neglecta*. In California and Arizona, it occurs in two broods, the first in May-June (as *piasus*), the second in July-August (as *piasus* and *echo*, the latter near *neglecta*). In West Virginia, it is possibly partially quadruple-brooded, the first from February-April (as *violacea*), the second from April-June (as *neglecta*), the third in July-August (as *neglecta*), others appearing occasionally until October (as small *neglecta*). Distribution: *North*—Alaska (Dall), Lower Saskatchewan (Kirby), Telegraph Creek (58° N. lat., 131° W. long.) (Dawson), Lake Winnipeg (Scudder), Martin's Falls, Albany River (Brit. Mus. Coll.), Southern Labrador, Anticosti (Couper). *West*—Dakota, Montana, Nevada (Edwards), Victoria (Fletcher), to boundaries of California and Arizona to Oregon (Edwards), throughout the Rocky Mountain Region of Utah, Colorado, and Wyoming (Scudder). *South*—Mexico, Honduras (Boisduval), the Gulf States—Central Texas (Belfrage), Central

Alabama (Gosse), Georgia (Abbot), but not in Florida, nor does it appear to touch the Gulf of Mexico. *East*—All the states on the Atlantic border, abundantly throughout New England (Scudder). Edwards (*Pap.*, iii., p. 85) gives:

TABLE OF LOCALITIES SHOWING WINTER AND SUMMER GENERATIONS.

LUCIA.	MARGINATA.	VIOLACEA.	NIGRA.	CINEREA.	NEGLECTA.	PSEUDARGIOLUS.	PIASUS.
Anticosti		Anticosti					
Winnipeg		Winnipeg					
Montreal	Montreal	Montreal			Montreal		
	London				London, O.		
Orono	Orono	Orono, Me.			Orono, Me.		
Boston		Boston			Boston		
Albany		Albany			Albany, NY		
Yonkers	Yonkers	Yonkers			Yonkers		
L. Island	L. Island	L. Island			L. Island		
Racine	Racine	Racine			Racine	Racine, Ws.	
		Coalburgh, W.V.	Coalburgh		Coalburgh	Coalburgh	
		Western N. Carolina	Wsrn. N. Carolina		Western N. Carolina	Western N. Carolina	
		Georgia	Georgia		Georgia	Georgia	
		E. Tennessee	E. Tennessee		E. Tennessee	E. Tennessee	
	Montana	Montana				Montana	
North Colorado					N. Colorado		
				S. Arizona		S. Arizona	
						Arizona	Arizona
		S. Colorado	S. Colorado		S. Colorado		
		Mt. H'd Or			S. California		California

SPRING AND SUMMER FORMS OF VAR. PSEUDARGIOLUS.—Accepting *pseudargiolus* as the general name for the Nearctic race of this species, we find various authors (Edwards, Scudder, etc.), describing in detail the different aberrational and racial developments set up in the spring and summer broods. We propose dealing with these in our usual manner, quoting the original descriptions of the various forms and leaving students to compare them with the later descriptions and applications of the names by the same and other authors, and in order to enable them to draw comparisons with the parallel Palæarctic developments. The following are the described forms :—

β. var. *lucia*, Kirby, "Faun. Bor. Americ.," iv., p. 299 (1837); Dbldy., "List Lep. Brit. Mus.," ii., p. 45 (1847); Morr., "Syn. Lep. N. Am.," pp. 90-91 (1862); Harr., "Ins. Inj. Veg.," 3rd. ed., p. 275, fig. 106 (1862); Scudd., "Syst. Rev.," p. 34 (1872); Streck., "Lep.," pp. 82-3 (1874); "Can. Ent.," viii., pp. 61-66 (1876); Edw., "Butts. Nth. Amer.," ii., Lyc. pl. ii., figs. 1-2 (1884); Scudd., "Butts. New. Eng.," p. 930 (1889); Dyar, "List Nth. Amer. Lep.," p. 45 (1902).—*Polyommatus* alis supra argenteo-cœruleis margine tenuissime nigro; primoribus subtus cinerascentibus, ocellis quatuor marginalibus indistinctis; fascia maculari, lunulaque disci, nigris, albido cinctis; secundariis subtus fuscocinereis, albido nigroque maculatis; ocellis in margine quinque. Wings above, silvery-blue, with a very slender black margin; primaries underneath cinerascent, with four indistinct eyelets in the margin; with a macular band and crescent in the disk, black edged with white; secondaries underneath, brownish ash-colour, spotted with black and white; with 5 eyelets in the margin (plate iii., figs. 8-9). Expanse of the wings 1 inch. One specimen taken with the preceding (*Lycaena dorcas*). Description: Wings above, silvery-blue, terminating, especially at the posterior margin, in a very slender black line; fringe white barred with black; primaries underneath ash-coloured mottled with white; in the disk is a black crescent and a curved macular band, consisting of, mostly, oblique black crescents edged with white, especially on their underside; the wing terminates posteriorly in a broadish, brown band, formed chiefly by obsolete eyelets; the secondaries are brown underneath, spotted and striped with black and white; towards the posterior margin the white spots are arranged in a transverse band parallel with it; and, as in the primaries, the wing terminates in several obsolete eyelets (Kirby). [See Edwards' different criticisms of this description, *posteà* pp. 414, 416, 423, included in our descriptions of ab. *marginata*, ab. *violacea*, and ab. *neglecta*.]

This is called by Scudder the early spring northern form, and is said to comprise the earliest-appearing examples of the spring brood, the later being *violacea*, and there appears to be every gradation between the two forms, although there is considerable segregation, according to the time of eclosion, towards one or other of these forms. Scudder gives a detailed account of its particular features (*Butts. New Engl.*, ii., pp. 930, 932). He notes it as "nearly uniform bluish-violet (scarcely in the least inclining to purplish). . . . the outer border edged as a mere thread with blackish, . . . the hindwings as deep as, and similar in tint to, the forewings, and edged with a blackish thread (followed by a submarginal row of small blackish spots in female), etc. Underside uniform pale ash-grey, with a faint bluish tinge; forewings with a . . . discal streak, . . . a curving series of six . . . short broad bars, . . . outer border edged with a thread of fuscous, followed by an obscure submarginal series of small, dark fuscous spots in the interspaces, followed at an equal distance by an obscure, dark fuscous series of continuous, strongly-curved, transverse bars, between which and the outer border the nervules are frequently infuscated, and the whole margin of the wing is usually washed in a dull obscure fuscous tinge, etc.; hindwings with a basal series of three, not very large, round spots faintly edged with pale, . . . a transverse, moderately slender, equal, fuscous discal streak; beyond this an extra-mesial transverse series of blackish or blackish-fuscous, quadrate spots, . . . arranged quite as in *violacea*, but with those in the two parts of the series almost, or quite, continuous, . . . usually the markings in the middle of the wing are blurred and run together, so as, in extreme examples, to present a greyish-fuscous, large, irregular, central, subtriangular patch, bounded externally by the outer limits of the extra-mesial spots, above by a line connecting the middle of the lower border of the cell and the lower subcostal nervule, with projections extending towards the two costo-subcostal spots, and below by a line connecting the middle of the lower border of the cell and the submedian nervure, where the extra-mesial band crosses it; the outer border of the wing is broadly bathed, usually to a considerable extent, . . . with dark-greyish fuscous, bounded interiorly by a zigzag line, formed by a series of strongly-bent narrow bars, in each interspace, darker than the rest of the outer border, within which, even in the darkest specimens, may be seen a submarginal row of rather small, blackish, round spots, and a blackish thread edging the border." Scudder further says that, "*lucia* is confined to the northern portion of the Nearctic region, not occurring south of New York and New England, excepting in the extreme west, where it has been taken in northern Colorado; in the east it has been found as far south as Yonkers and on Long Island, and in the west is not rare at Racine, Wis.; these points just about indicate its extreme southern limits: it has not been reported in the west beyond Montana. In New England, it has been everywhere found, being extremely abundant in the northern half, not at all uncommon in the central portions, but comparatively rare in the south." Reference must also be made to Edwards' notes on *lucia*, which he published with his original descriptions of *marginata*, *violacea*, and *neglecta*, and which are all quoted (*posteà*, pp. 414, 416, 423).

γ. ab. *brunnea*, n. ab. *Lucia* ab., Edw., "Butts Nth. Amer.," ii., Lyc. pl. ii., fig. 25, p. 10 (1884).—Fig. 25 is a suffused *lucia* sent by Hulst, from Brooklyn (Edwards). The underside has the ground-colour quite white; the marginal series of lunules on both fore- and hindwings are quite complete from apex to anal angle. It is peculiar in that the submarginal arches of the fore- and hindwings, filled in with blackish or blackish-fuscous in *lucia*, are bright yellow-brown, as also is the large central quadrangular blotch (also blackish in *lucia*) of the hindwings; in addition, the upper extra-mesial row of dots on the forewing are extended wedge-like in a direction pointing towards the discoidal lunule, the third one almost touching its lower point.

δ. ab. *fumida*, Scudd., "Butts N. Eng.," ii., p. 933 (1889).—The intensest amount of markings on the undersurface of the hindwings of this species is reached in individuals (the so-called form *marginata*) where the outer border is margined with a broad, fuliginous border having a distinctly crenulate interior edge and enclosing a series of submarginal dots, and in which the whole disc of the wing is covered with an extensive fuliginous patch, including all the spots, excepting those on the inner border, which thus become, to a greater or less extent, suffused together. In a single ♂ in the collection of Mr. Roland Thaxter, the extent of these fuliginous markings is so great that the spots on the inner margin also are included, and the whole wing is fuliginous (paler along the nervules) excepting a small basal patch crossing the entire wing, and a transverse, interrupted, rather narrow, arcuate, silvery-grey band, narrowing from above downwards, margined on either side with blackish-fuscous, running subparallel to the outer border of the wing, and at fully two interspaces distance from it. That this is truly a suffused variety is plain from the extreme narrowness, comparatively speaking, of the silvery-grey band, and from the fact that, on the forewing, not only is the fuliginous outer border of rather more than excessive breadth, but the extramesial spots are broadened, more or less blended, rather fuliginous than blackish, and those of the median interspaces accompanied by elongate, broad blotches of faint fuliginous, filling almost the entire remainder of the interspaces, toward the base of the wing. The fringe is less distinctly alternate than usual, the darker colour being much in excess. Expanse of this specimen 30mm. (Scudder).

According to Edwards (*Pap.*, iii., p. 86; *Butts. Nth. Amer.*, ii., Lyc. pl. ii., figs. 1, 3, 5) *lucia* has a black patch and dark margin on the hindwings, whilst "*lucia* without the black patch is *marginata*, and *marginata* without the black and heavy border is *violacea*." Scudder (*Butts. of New Engl.*, ii., p. 945) sinks *marginata*, and suggests that "it is only a phase in the variation of *lucia*," and further states (*op. cit.*, p. 933) contrary to fact, that *marginata* is the form with the intensest amount of markings on the under-surface of the hindwings. As a matter of fact, therefore, it appears that the ab. *fumida*, Scudder, is an extreme aberration of the *lucia*, and not of the *marginata*, form.

ε. ab. *pseudora*, Scudd., "Butts. New Engl.," ii., p. 933 (1889).—In the collection of the Boston Society of Natural History is a ♀ of this species, collected at Milford, N.H., on May 23rd, by Mr. Sanborn, which differs from the normal ♀ in a peculiar manner. The uppersurface varies only as we may expect occasionally to happen, the basal two-thirds of the costal border being heavily sprinkled with violet, and the outer portion of the hind scarcely showing any trace of submarginal spots; the latter feature is the more remarkable since the same part of the undersurface is quite heavily marked. On the undersurface, however, the extramesial series of spots, in both the fore- and hindwings, is removed outward, and has become confluent with the submarginal series of bent bars, making the markings of the outer border unusually heavy, while the spear-shaped markings of the submarginal row are retained, intensified, particularly on the hindwings; in the forewings the spot of the next to the lower subcostal interspace is retained independent of the outer markings, although removed far toward the border; at the base of the hindwings, the lower spot is absent, while the spots of the costo-subcostal interspace and of the cell are enlarged and deepened in tint, and are, perhaps, a very little nearer the base than usual; the apex of the cell is only marked by a slender, pale, fuscous streak, so that the centre of the hindwings, instead of being heavily blotched and infuscated, is almost entirely of the pale ash-grey of the basal colour of the wing, while the marginal markings are broadened, and, on their inner margin, deepened in tint, presenting an appearance in marked contrast with the normal type of *lucia*. The uppersurface, however, leaves no doubt to which of the forms of the species we should refer this aberrant individual. A very similar specimen*, but with the disc of the hindwings beneath heavily infuscated, is figured by Edwards in *The Butts. Nth. Amer.*, ii., Lyc. pl. ii., fig. 25 (Scudder).

This form would appear to be quite different from the ab. *subtus-radiata* of Oberthür, in which the extramesial row of spots is continued inwards, whilst the submarginal series of bent bows are quite unaffected. Nor is it, as suggested by Scudder, at all similar to Edwards' fig. 25, described above as ab. *brunnea*.

ζ. ab. *subtusjuncta*, n. ab. *Pseudargiolus* ab., Scudd., "Butts. New Engl.," ii., p. 934 (1889).—A rather curious ♀, showing an exceedingly early stage of suffusion in the same direction as the above (*pseudora*), was taken by Sprague, in Wollaston, Mass., on May 10th. The only way in which it differs from the ordinary ♀s, in which the submesial transverse band is distinct, is in the running together of the costo-subcostal spots of the series (which are here nearer the base than usual, being in direct and straight continuation of the dusky streak closing the cell) with the same spots of the basal series forming, in the costo-subcostal interspace, a striking, dumb-bell-shaped bar, whose outer extremity is connected beneath with a continuous, slenderer, curved streak, formed of the discal streak and the lower spots of the submesial series, and together forming a capital cursive T (*T*) upon one side, and its reverse on the other.

Scudder here uses the term "suffusion" in the sense of the union of the spots linearly. One is unable to tell from Scudder's description whether this union takes place on the forewing, the hindwing, or both. One suspects it is the hindwing from the description.

η. *ab. marginata*, Edw., "Pap.," iii., p. 86 (1883); "Butts. of Nth. Amer.," ii., Lyc. pl. i., figs. 3, 4, pp. 4, 5 (1884); Dyar, "List Nth. Amer. Lep.," p. 45 (1902).—[Kirby had described *lucia* in 1837, and had, fortunately, given a well-executed and coloured figure of it. His description does not agree with his figure, varying in several important particulars, but, as he says that only one specimen was taken by the Expedition, I apprehend that the careful figure should be our guide rather than the less careful description, especially as the figure really represents a common boreal form of the butterfly. The description says: "Wings above, silvery-blue," etc. The coloured figure shows the basal area of the underside of the secondaries to be whitey-brown, and there is a conspicuous blackish, triangular patch on the disk at the origin of the median nervules, of which the text is silent; the extra discal area is scarcely whiter than the basal, and is not composed of white spots, as would be understood by the description. It is merely the uninterrupted white ground of that part of the wing. Also the margins by no means represent obsolete eyelets, as stated, but heavy dark confluent crenations. I believe the typical *lucia*, as our collectors understand it, has a more or less conspicuous black discal patch, as indicated in Kirby's figure, and a heavy black border.* As witness to this, Scudder describes (*Can. Ent.*, viii., p. 62) *lucia* as having the spots of the under-

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* Edwards' fig. 25 (our ab. *brunnea*) certainly shows no approach, nor attempt at union, between the extramesial transverse row of spots and the curved arches on the margin of the wing, which is specially noted as the main feature in *pseudora*.

* Compare this with Edwards' early critical remarks on this species, in his original description of *violacea* (*posteà* p. 416).

side of the hindwing very large, usually completely confluent, and often suffusing nearly the whole base of the wing, whilst the marginal markings tend to form a broad band, etc. This agrees well with the figure, whereas the description might pass for *violacea* of a silver-blue shade, and on which the white scales of the underside had been partially denuded, so as to disclose the brown subcolour, thereby leaving the white area somewhat maculate. The fringes are white and black alternately. The typical *violacea* is violet-blue above, light grayish-white beneath, and all of one shade, there being nothing macular in it, with dark points across the disks, and pale dusky crenations in outline on the margins; but while, in West Virginia, violet is a prevailing colour, many are lavender-blue, or silver-, and some, especially females, are metallic-blue. The range of colour embraces all the shades which are to be found in the northern corresponding forms. The fringes are either white and black, as in *lucia*, or on the hindwing white altogether. At the extreme north the underside of *violacea* is not so white and pure as in the type, the brown subcolour appearing more or less. The southern *violacea* considerably approaches *neglecta* in colour of both sides.] Now, in addition to the above-named and described forms, which stand at the extremes of the series, there is another midway between *lucia* and *violacea*, and distinctly characterised. The males are silvery-blue and as often violet-blue, the females almost always metallic-blue, of the shade spoken of as sometimes seen in the Virginian *violacea*. The fringes white and black, as in *lucia*. The ground-colour of secondaries underneath is whitish and continuous, and the marginal crenations are very heavy, confluent, black, making a conspicuous band. There is no discal patch, and therein it differs from *lucia*; the marginal band separates it from *violacea*. This form is as unknown in Virginia, as is *lucia*, but seems to prevail in New York, New England, and Quebec, at least in the region about Montreal. I call this *marginata*. It has passed sometimes as *lucia*, sometimes as *violacea*, but, by separating it, we shall get a clearer idea of the species. Of course, these three forms, distinct as they are generally, all vary, and one approaches the other, or glides into the other, by intermediate examples, but I should say that 49 out of 50 individuals, no matter where found, would range under one of these names. They all belong to the same species. *Lucia* without the black patch is *marginata*, and *marginata* without the black and heavy border is *violacea*. They are 3 phases of the winter form of the species, and whether we call them trimorphic forms or three varieties makes no difference in the result. At any rate, the two extremes, *lucia* and *violacea*, differ materially. In West Virginia, *violacea* is the sole representative of these forms, there being no examples so far known approaching *lucia*, and very few, indeed, approaching *marginata*, even by a slight deepening of colour in the marginal band; but it has acquired a melanic male not before observed. Mr. Morrison took the same melanic male together with both *violacea* and *neglecta* in South Colorado. In many seasons, the blue males swarm in my neighbourhood, and assemblies of scores and hundreds may be met with along the water-courses early in April, or in the last days of March. The first generation vastly outnumbers its apparent second one, which is made up of *pseudargiolus* flying in May, and *neglecta* in June, and is now very abundant. Sometimes, with the early butterflies, a few individuals are taken which combine the features of both *violacea* and *pseudargiolus*, the males having the upper-surface coloured as in the latter, but the under-surface marked like the other, and often more emphatically than in the type. I have such a mixed example from South Colorado also. Precisely at what line *lucia* and *marginata* are suppressed, or where the melanic form comes in, I am not able to state, etc. (Edwards).

As Edwards points out in the above account, and, as shown by his figures (*Butts. Nth. Amer.*, ii., Lyc. ii., figs. 3 and 4), *marginata* is a slight aberration of *lucia*, chiefly characterised by having a dark marginal border to the undersides of the wings, and having lost the dark central area of the hindwings, which *lucia* has in addition. It occurs from about 45° N. lat. to 39° N. lat., the spring specimens above the former latitude being *lucia* or *violacea*, whilst south of 39° N. lat. they are entirely *violacea*. All three of the spring forms occur in Ontario, Quebec, New England and New York, and, to the west, as far south as Racine, Wis. In their territory they appear at the same time, no one preceding another, as shown by observations at Brooklyn (Hulst), Yonkers (Howe) and Cowansville (Fyles). Hulst notes, that, between April 17th and May 19th, he captured 118 males and 31 females: the first example was a male *marginata*, on April 17th; on the 19th he took 1 *marginata* male, and 1 *violacea* female; on the 22nd, 3 *lucia*, two of which displayed very large dark patches on the underside of hindwings, 7 *marginata*, and 4 *violacea*; on the 24th, 2 *lucia*, 11 *marginata* and 7 *violacea*: on May 1st, 6 *lucia*, 22 *marginata*, 23 *violacea*: on May 16th, 4 *lucia*, 7 *marginata*, and 3 *violacea*, etc. He further notes that, on one day in the spring of 1881, he captured 41 examples, of which 8 are *lucia*, all but three having the dark underside patch of large size, 24 are *marginata*, and 9 *violacea*. On the whole, at Brooklyn, *lucia* is common, *marginata* comprises the bulk of the specimens, whilst *violacea* is not infrequent. Fyles observes that, at Cowansville, he captured on May 22nd, 2 *marginata*, on May 27th, 2 *marginata*, on May 31st, 1 *marginata*, on June 2nd, 4 *marginata* and 2 *lucia*, on June 12th 1 *lucia*.

θ. ab. *inaequalis*, n. ab. *Pseudargiolus* ab., Edw., "Butts. N. America," ii., Lyc. pl. ii., fig. 24, p. 10 (1884).—This is the figure of an aberrant ♀ *marginata* taken by Hulst at Brooklyn. The left wings are fairly normal; the marginal band of the forewings somewhat narrow, on the hindwings wanting; the right forewing, however, has the marginal band reduced to a small patch or two inside the slender black marginal line, the right hindwing similar to the left. One suspects at first sight some element of gynandromorphism in the markings.

ι. ab. (et var.) *violacea*, Edw., "Proc. Ent. Soc. Phil.," vi., p. 201 (1866); "Trans. Am. Ent. Soc.," i., p. 287 (1867); "Butt. N. Am.," i., Lyc. pl. i., figs. 1-4 (1869); Scudd., "Can. Ent.," viii., pp. 61-66 (1876); "Bull. Buff. Soc. Nat. Sc.," iii., p. 114 (1876); Edw., "Butts. N. Amer.," ii., Lyc. pl. ii., figs. 5-6 (1884); Scudd., "Butts. N. Engl.," p. 929 (1889); Dyar, "List N. Amer. Lep.," p. 45 (1902). *Pseudargiolus*, Bdv. and Le Conte, "Lép. Am.-Sept.," pl. xxxvi., fig. 3 (1833) (*teste* Scudder).—*Male*.—Expands from ·9in. to 1·2in. Upperside usually deep glossy violet-blue, but sometimes with a pink tinge; costal margin of primaries silvery, hind margins of both wings edged by a black line, which is expanded on the apical half of primaries into a border; on this part of the wing the fringe is black, but on the lower half and on secondaries it is white, with black at the ends of the nervules; occasionally on secondaries it is entirely white, in many cases the black marginal line turns the anal angle and there thickens, so as to make a noticeable spot, as often there is a black elongated spot at the outer angle, and sometimes 5 or 6 dots between these along the margin. Underside of both wings greyish-white, of uniform colour entirely to the margin, primaries have a dark grey discal streak, a submarginal transverse row of 6 rather broad, mostly elongated, black spots, the first next costa in advance of the line, the others parallel to the margin, the 3rd, 4th, 5th standing obliquely; along the margin a row of 6 points, often partly obsolete, each preceded by a distinct dark grey crescent, these last uniting so as to make a crenated line. Secondaries have a discal streak; three black spots in a row halfway between the streak and base, one being on either margin; the third midway between them; a transverse row of 8 clear black spots across the disc, the two next costa largest, much in advance of the others, and over against the streak, with which and the 8th spot they form a direct line; the 3rd is separated from the 2nd by a considerable space, the 4th is turned obliquely, the 7th is long and lunular and back of the line, the 8th very near the margin, elongate; along the margin is a row of 6 blackish dots, palest at outer angle, that next anal angle double, the one preceding largest and conspicuous, each spot surmounted by a crescent as on primaries. Body above blue, beneath white; palpi white; antennæ black, ringed with white, club black, tipped with ferruginous. From upwards of 100 males taken on the Kanawha River, March and April, 1865, and April, 1866. *Female*.—Paler and dull-coloured, the hindmargin and apex of primaries with a broad blackish border; costa of both wings a little obscured by same colour. From two females taken near Philadelphia. These resemble the ♀ of *lucia* on the upperside, but are unicoloured below. I have myself taken but one ♀ of this species, and this is abnormal, resembling the male almost exactly in colour as well as markings, the only difference being that the disc of secondaries is paler than the margin. The underside is almost white, and the spots are large and clear-coloured. The 2nd and 3rd terminal segments of the abdomen are black above. Unfortunately, in both seasons, I left the Kanawha before the females would naturally be flying, which would be two weeks or more after the first appearance of the males. Probably they are equally abundant with the males, as is the case with the females of *pseudargiolus*, but, like the latter, they may be found in different localities from the males. *Violacea* appears in the first warm days of spring. I took it in 1865 on March 17th. It is gregarious, frequenting in great numbers the edges of the creeks and wet places in the road. I have thrown the net over a dozen or more at once, and have attracted them by the decoy of a dead specimen pinned to the ground. Occasionally one or two may be seen about the flowers of the peach-trees, which bloom at the same season, but they are not partial to flowers. I have noticed this species for several years, and was struck from the first by its deep shade of colour as well as its habits and its early appearance, but was inclined to consider it a variety of *lucia*, Kirby, a species widely spread, though apparently nowhere common, in the northern parts of the continent, but, after comparing large numbers of them with undoubted *lucia* from many localities, I am satisfied it is a distinct species. As the description of *lucia* is not copied in full in Morris's synopsis, I give it here for the purpose of comparison. "Primaries (below) cinerascent, with (four) indistinct eyelets in the margin; secondaries brownish ash-colour, spotted with black and white, with five eyelets in the margin. Wings above silvery-blue, terminating, especially at the posterior margin, in a slender black line; fringe white, barred with black; primaries, underneath, ash-coloured, mottled with white; on the disc is a black crescent and a curved macular band, consisting mostly of oblique black crescents edged with white, especially on their underside; the wing terminates posteriorly in a broadish brown band, formed chiefly by obsolete eyelets; the secondaries are brown, spotted, and striped with black and white; towards the posterior margin the white spots are arranged in a transverse band parallel with it, and, as in the primaries, the wing terminates in several obsolete eyelets." The present species is of a very different blue from *lucia*, which is whitish, and perhaps might be called "silvery" (though that term would seem to imply a metallic shade, which *lucia* has not), and the apical portion of the hind-margin of primaries bears a conspicuous black border. The entire surface of the underside of *violacea* is greyish-white, of the other the primaries are "ash-coloured mottled with white," the secondaries "brown spotted and striped with black and white," each wing terminating in a "brown band" co-extensive with the eyelets. The figure given by Kirby represents a large triangular patch of brown upon secondaries, in addition to the brown margins.* There is nothing of these features or of mottling in the Kanawha specimens. From Maine I have three ♂s of *lucia*, one of which displays the patch exactly as in the figure of Kirby, the other two want this, but all have the brown borders. One ♂ from London has both patch and borders. A pair taken by Mr. Ridings, at Pike's Peak, show the same. Of four ♂s and one ♀ taken at Fort Simpson, all have the brown borders and mottled surface, the ♀ only the triangular patch. The ♀s taken at Newburgh have the borders, but not the patch, and both are mottled with white. (The period of *lucia* is probably considerably later relatively than *violacea*. Those from Newburgh were taken about May 25th, some weeks after the blooming of the peach-trees, with which, in Kanawha, *violacea* is contemporary. The latter is the earliest butterfly of the spring. The former is preceded by several species.) I think, therefore, it will not be doubted that *violacea* is a distinct species. How widely it may be distributed I have not yet the means of knowing. Probably it will be found in Ohio and the lower Middle States (Edwards).

Fuller information has modified much of what Edwards has written above, and *violacea* may be shortly diagnosed as that particular form of the spring emergence, in which there is a tendency to purplish in the tint of the upperside, and a minimum of fuscous shading on the underside, especially of the hindwings. His critical remarks, too, on Kirby's figure of *lucia* (*suprà*), are not all in unison with his later

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* This critical note by Edwards on Kirby's figure, should be carefully compared with the later ones included in his original description of *marginata* (*anteà* p. 414) and *neglecta* (*posteà* p. 423). The differences suggest that Edwards was not always too particular in his choice of colour terms.

ones when describing *marginata* (*anteà* p. 414), and *neglecta* (*posteà* p. 423), and one is drawn to the conclusion that there was some elasticity in Edwards' judgment according to the particular point of view he was taking. Scudder notes (*Butts. New Engl.*, ii., pp. 929, 931) the ♂ of this form as "uniform bluish-violet, inclining to purplish above, the hindwings seldom any paler than the forewings, the costal edge of the forewings fuscous on the basal half, beyond hoary-blue, interrupted at the nervure tips with blackish; the outer border edged with black, in the forewings narrowly, in the hindwings as a mere thread. . . . The underside uniform pale ash-grey, occasionally begrimed slightly with fuscous, but generally with a faint, pale, bluish tinge, etc." Scudder further calls it "the typical spring form"; he says (*op. cit.*, p. 940) that *violacea* follows *lucia* (a statement not borne out by the records (see *anteà* p. 416), that it appears during the first week of May, in Massachusetts occasionally not until the 10th, both sexes becoming abundant towards the end of the month, and it still remains upon the wing throughout June, and one specimen, was taken in Walpole, N.H., by Smith, as late as July 7th. The appearance of this form is sometimes greatly delayed in northern New England, and in the White Mountains, where it is extremely abundant, the females are rarely seen till June, and, in the elevated localities, further south, it is equally late, its appearance extending to June 23rd-24th (Sauborn), and the 26th (Morrison); two ♀ *violacea* were also captured by Scudder, at Waltham, Mass. on August 3rd. In southern Labrador *violacea* was found in June and July (Couper), and at Moose, at the southern extremity of Hudson Bay, from June to September (Haydon *teste* Jenner-Weir). In the extreme north the spring brood is said to be made up only of *lucia* and *violacea*, whilst somewhat further south, *marginata* also occurs therewith, yet it is to be noted that, further south, the form *marginata* is the first to be lost, then *lucia*, so that, in the southern parts of its range, *violacea* alone remains to represent the spring brood." Edwards says (*Butts. Nth. Amer.*, ii., Lyc. pp. 4, 5) that at about 39° N. lat., on the Atlantic coast, *violacea* alone represents the spring generation, but it is somewhat altered, the blue colour having become darker, and the undersurface purer white. . . . In Arizona, at about 35° N. lat., *violacea* alone appears, but it is now in a modified form, figured as *cinerea* (*op. cit.*, Lyc. pl. i., figs. 16-17). . . . In 40° N. lat., in Colorado, *violacea* occurs with *lucia* as the spring form at a very great elevation. . . . At Coalburgh, in West Virginia, the first butterflies of early spring are *violacea*, and are generally abundant when the peach and wild plum trees are in blossom, *i.e.*, from about March 10th to the end of April, according as the season is early or late. This form is vastly more numerous in individuals, than any of the later ones, and sometimes they may be seen in thousands in a morning's walk. . . . The earliest appearance recorded in twenty years is February 17th, and the latest date of first appearance is April 7th. The females of this brood lay their eggs on the flowerbuds of dogwood. Pupæ obtained from these spring-laid *violacea* eggs may produce summer imagines = *neglecta*, or, living through summer, autumn, and winter, produce *violacea* the following spring; *violacea* also appears from overwintering pupæ resulting from eggs laid by the summer form *neglecta*.

κ. *ab. nigra*, Edw., "Butts. N. Amer.," ii., Lyc. pl. ii., fig. 7, pp. 4, 5 (1884); Scudd., "Butts. New Engl.," ii., pp. 928, 929, 944 (1889).—*Violacea* var., Edw., "Butts. N. Amer.," i., pl. xlix., fig. 4, p. 149 (1868-72); "Pap.," iii., p. 86 (1883).—At about 39° N. lat., on the Atlantic side, two of the forms of the first generation are found to have been suppressed, *viz.*, *lucia* and *marginata*, and the third alone, *violacea*, remains to represent that generation; but it is somewhat altered, the blue colour having become darker, and the under-surface purer white; whilst it has developed an entirely new form of its own, restricted to one sex, *viz.*, the black male (pl. ii., fig. 7). This was figured in vol. i as female. On its discovery in 1867, I took it to be ♀ without question, as melanism in butterflies, when confined to one sex, is almost invariably found in the ♀ . . . . In 1878 I was led to make an examination of the genital organs of one of these black examples and found it to be ♂. Since then I have made very many examinations in successive years, and have not seen a melanic ♀. In 40° N. lat., at the west, in Colorado, however, the original forms, *lucia* and *violacea*, are found, and, notwithstanding the high elevation, the latter discovers the melanic ♂ . . . . The form *violacea-nigra* is not known to have been taken to the north of Coalburgh, West Virginia, nor in Ohio or Illinois; but it flies in Tennessee, North Carolina and Georgia, as well as in Southern Colorado (Edwards).

This male aberration was first noted by Edwards (*Butts. Nth. Amer.* i., p. 149), and described as a female having "the upperside uniform blackish-brown, underside like the male *violacea*." It must be very abundant compared with the real females, for Edwards adds that "most of the females (!) are of the black var.; out of nearly 100 taken in 1867, only five were blue," *i.e.*, that 95 black males were taken against five ♀ s (and neglecting the numberless blue ♂ s): he notes the blue ♂ as "occurring in swarms along the sandy side of the creeks, standing in favourite spots motionless, with wings erect and closed, wholly intent on extracting from the sand some fluid no doubt delightful." Scudder observes (*Butts. of New Engl.*, ii., p. 944), that, at 38° N. lat. or 39° N. lat., the males of the first generation appear under two guises, one blue above, the normal *violacea*, the other dark brown, *nigra*, and this apparently continues as far towards the Gulf of Mexico as the species extends.

λ. var. *cinerea*, Edw., "Pap.," iii., p. 8 (1883); "Butts. Nth. Amer.," ii., Lyc. pl. ii., figs. 16-17, p. 5 (1884); Scudder, "Butts. New Engl.," p. 945 (1889); Dyar, "List Nth. Am. Lep.," p. 45 (1902).—*L. pseudargiolus* is a delicate and small species, found from the boreal regions to Mexico, in one phase or other, being polymorphic, but it is not a stranger like *Thecla laeta*, seen here and there occasionally. It possesses the whole country, and where found is abundant. Morrison sends (from Arizona) examples of both sexes of the form *pseudargiolus*, and also of the winter form *violacea*, but these last differ from any I have seen in having the underside dark grey. I call this form var. *cinerea* (Edwards).

Of these examples, Edwards later notes (*Butts. Nth. Amer.*, ii., Lyc. pp. 5, 10): "In Arizona, at about 33° N. lat., *violacea* alone appears in the spring, but in a modified form *cinerea* (*op. cit.*, Lyc. pl. ii., figs. 16-17); . . . so that *cinerea* appears to be the Arizona winter form, the underside ash-grey, all the markings obscure. Of these, Morrison brought many examples in 1882, from Mount Graham, at considerable elevation. With them, he brought others, nearly fullsized *pseudargiolus* (*op. cit.*, figs. 18-19), but of a deeper blue than is usual in the east; the underside is not pure white, but slightly grey." It is quite clear that these latter form quite a normal summer brood of Palæarctic types, and altogether different from the *neglecta*-looking examples, which Edwards also figures (*op. cit.*, pl. ii., figs. 8-9) under the name *pseudargiolus*. Edwards himself later observed this, and named the form *arizonensis* (*op. cit.*, app. no. 432).

μ. ab. *arizonensis*, Edw., "List Species Diurn. Lep. N. Amer." (app. "Butts. Nth. Amer."), ii., p. 7 (1884); Dyar, "List Nth. Amer. Lep.," p. 45 (1902).—*Pseudargiolus* var., Edw., "Butts. Nth. Amer.," ii., Lyc. pl. ii., figs. 18-19 (1884).—From Mt. Graham, in Arizona, taken at considerable elevation. They looked like nearly full-sized *pseudargiolus* (*i.e.*, *neglecta-major*), but were of a deeper blue than is usual in the east; the underside not pure white, but slightly grey (Edwards).

Edwards says that Morrison brought many examples of this form from Arizona with *cinerea* (see *suprà*). The ♂ figured by Edwards has an exceptionally strong border, and the ♀ is much more like our European summer form than is the American *neglecta;* the blue is slightly paled on the inside of the dark margin of the forewing, and the margin of the hindwing shows a border of greyish lunules, and not the intense black dots of *neglecta*. Edwards' *cinerea* also appears to us to be a summer form, almost identical with *arizonensis* on the upperside, except for its smaller size, but, according to the describer the underside is ashy-grey and all the markings obscure, whilst that of *arizonensis* is only slightly grey.

ν. var. *piasus*, Bdv., "Ann. Soc. Ent. France," 2nd ser. x., p. 299 (1852); Edw., "Butts. Nth. Amer.," ii., Lyc. pl. ii., figs. 20-21; pl. iii., figs. 26-27, pp. 9-10 (1884); Wright, "Can. Ent.," xx., p. 97 (1888); Scudd., "Butts. New Engl.," ii., p. 945 (1889); Dyar, "List Nth. Amer. Lep.," p. 45 (1902).—Alæ supra cœruleo-violaceæ, fimbria alba feminæ nigro-marginatæ; subtus albido-cinereæ punctis numerosis nigris ocellatis, fascia albida separatis. Of the shape of *argiolus* but a little larger. Above, the ♂ is nearly of the same tint, with the fringe whitish; the ♀ above with a very wide blackish border to the four wings, but less wide on the forewings than in ♀ *argiolus*. Beneath in both sexes of an ashy-white with a number of black ocellated dots, disposed as in the analogous species; those of the posterior row followed by a clear white, which forms a very wide, transverse band, and occupying all the area between the former and the lunules or crescents of the margin, which are almost effaced, and bound a greyish crenulated marginal band, darker than the ground colour. Flies among bushes in the spring (Boisduval).

Edwards says (*Butts. Nth. Amer.*, p. 9): "On the Pacific coast the species is represented in part by *echo* (fig. 21) but more by *piasus*, of which *echo* is a variety. In southern California there are two generations of the butterfly; the first appearing in February and early March, the second at the end of April and early May. Wright carefully watched the appearance of these broods during the past year, and sent me scores of examples of each; fig. 26 represents the female of the early brood, and fig. 27 of the later . . . . I do not discover any tangible difference between these two broods in either sex, except that some few of each are var. *echo*, which, as I have said, is close to *neglecta*. The usual *piasus*, as is seen by these figs. 26-27, most resembles *violacea*, having the black borders as in that form. The male *piasus* (fig. 20) is of a deep violet-blue; and the underside of all examples of both sexes is like *neglecta*. I look upon this western form as an offshoot of one of the eastern summer or secondary forms, the characters of the primary form of the species having been, in some degree, recovered, especially in the ♀s." Wright himself notes (*Can. Ent.*, xx., p. 97): "This is, in California, the first butterfly to emerge in the spring, appearing in February, though it is the accepted representative of the eastern *neglecta*, which is not the first to appear there. *Piasus* is doublebrooded, the second-brood coming in the later part of April, so between it and the first brood a few days intervene when no *piasus* are seen.* Both broods are very fond of water, being always found on damp sands at wet places and at the brookside crossings. They are also often seen feeding on willow blossoms. A large series gives an uniform expanse of one inch; I can detect no difference in the markings or size of the two broods. The larval foodplant of *piasus* is the buds of *Adenostoma fasciculatum*, an anomalous genus, which has no representative even approximate in the Eastern States. The Spanish name is 'chamiso,' which is Anglicized into 'chemise.' It is a heath-like plant, 4 to 6 feet high, resembling a juniper-bush more than any other eastern plant. Every part of it is brittle, dry, and rather resinous, burning freely when quite fresh and green. The leaves are very small, round, like pine-needles, and evergreen; they grow all along the stems in little bunches or 'fascicles,' whence the specific name. The flowers are minute, profuse, in dense terminal racemes on the tips of the twigs, white, scarcely or not at all fragrant, though forming one of the chief sources of honey in the country, and it is notable that, while the plant is abundant, and flowers so profusely as to whiten the landscape, the seeds have never been found. It grows upon the dry hillsides and covers uncounted square miles of waste land. This plant, growing at a distance from the usual haunts of *piasus*, is that butterfly's foodplant. While the flower-buds are as yet in their merest infancy, the female *piasus* of the first brood deposits her eggs singly on the bud and between it and the stem. The female of the second-brood finds the flowers in blossom. The egg is white, round, flattened, with a depressed point in the centre, like other Lycænid eggs. While *Adenostoma* is entirely foreign to any plant in the Atlantic States or Europe, it is placed by botanists in the order *Rosaceae* and among eastern plants, those nearest it are: *Alchemilla* (ladies' mantle), *Agrimonia*, and *Poterium* (burnet), though all of these are very unlike in appearance to *Adenostoma*. It is possible that the buds, or the immature seeds of other Rosaceous plants might feed *piasus* larvæ, as cherry, plum, strawberry," etc. Scudder (*Butts. of New Engl.*, ii., p. 945), repeats Edwards' statement that, "on the Pacific slope, we find a new form *piasus*, mostly resembling *neglecta*, which, so far as observations have gone, appears to be single-brooded in the north, double-brooded in the south, and to show no difference between the broods, as sharp a contrast as could well be found to the character of the species elsewhere; and it is the more strange, as, in Arizona (though it should be noted among the mountains), an ashen-tinted form of *violacea* occurs, to which Edwards has given the varietal name *cinerea*. The form *piasus* occurs as far north as central California." To us, Edwards' figs. 26 and 27, supposed to represent the ♀s of two broods, seem identical. They appear, on the upperside, to be almost exactly like Edwards' ♀ *marginata* (fig. 4), and certainly bear no resemblance to his ♀ *neglecta* (fig. 12), which he asserts it most resembles, whilst similarly his ♂ *echo* (fig. 20), which certainly is very like the ♂ *neglecta* (fig. 13), carries with it a ♀ (fig. 21), which again

* This intervening period appears to be the real cause for Edwards supposing two broods; Wright nowhere records breeding the insect, but he catches many; and the position of San Bernardino, in the S. Bernardino branch of the Rocky Mts., lends excellent support to our suspicion that here, as everywhere, the February and April examples are all members of a continuous spring brood. Certainly Edwards' figures indicate this.

is a marked spring form, like *violacea* ♀ (fig. 6), and not at all like ♀ *neglecta* (fig. 12), as again asserted. The resemblances on the underside may be as pointed out by Edwards, the underside of the ♀ *echo* (fig. 21) being not altogether unlike that of ♂ *neglecta* (fig. 10). On the whole, the uppersides of all three ♀s (figs. 21, 26 and 27) are distinctly of spring forms, and, as Wright has apparently not bred the later one, we feel strongly that our opinion is possibly correct.

ξ. ab. *echo*, Edw., "Proc. Ent. Soc. Phil.," ii., p. 506 (1864); "Butts. N. Amer.," ii., Lyc. pp. 9-10 (1884). *Piasus*, Edw., "Butts. Nth. Amer.," ii., Lyc. pl. ii., figs. 20-21 (1884).—*Male*.—Expands 1in. Upperside delicate light blue, silvery on costa of primaries, both wings bordered by a fine black line; fringe of secondaries white, brown at tips of nervules; of primaries brown towards the apex, and at tips of the nervules. Underside white; both wings have a marginal series of indistinct lunules; primaries have a transverse series of brown streaks, of which the second, third, fourth, and fifth are in a line parallel to the margin, each turned obliquely towards it; the first is forward of the line on the costa; the spots next inner angle obsolete; discal streak long. Secondaries have a transverse series of smaller streaks and spots, two being on the costa, followed, after a wide space, by four parallel to the margin; the sixth is below the line and lunular, the seventh upon the margin also lunular, towards the base are three small spots, one on costa, the second in the cell, the third on abdominal margin. *Female*.—Expands $1\frac{4}{10}$in. Primaries have a broad fuscous costal border, hind margin and discal streak, the disk blue. Secondaries fuscous, slightly sprinkled with blue upon the disk; a marginal series of rounded fuscous spots in grey circlets. California, from Dr. Behr. This is the western representative of *pseudargiolus*. It is much smaller than that species, but otherwise very like it (Edwards).

This description suggests most strongly that of *nigrescens*, Fletcher (see *posteà*), which is stated by Cockle to be "the common spring form at Kaslo, on Kootenay Lake, British Columbia. It does not agree, in either sex, with Edwards' figures 20, 21, which he refers (*Butts. Nth. Amer.*, ii., Lyc. p. 9) to *echo*, and where he states that, "on the Pacific coast, the species is represented in part by individuals not distinguishable from *neglecta*, *viz.*, *echo* (fig. 21)." Certainly in our opinion, fig. 21 bears no resemblance to his *neglecta* (fig. 12), and both fail entirely to satisfy this original description of *echo*, the form here described being certainly that to which the name must be attached. We are as unable to unravel Edwards' detailed references to *echo* as those he makes to *piasus*. The Californian race certainly wants carefully breeding. The fact seems to be that Edwards' figures 20, 21, represent spring examples of the Californian insect, whilst his description of *echo*, is, one suspects, of the summer form.

ο. ab. *nigrescens*, Fletch., "Can. Ent.," xxxvi., p. 127 (with fig.) (1904).—The most conspicuous difference between this and the other described varieties of the stem species is the large amount of black on the upper side of the females. This darkening forms a wide black border on the costal and outer margins of primaries, and spreads over the whole surface of the secondaries, which merely show a little blue on the folds between the veins. The blue of the disc of primaries is a dark purplish-blue, as in var. *piasus*, and is frequently irrorated with black scales. The upperside of the male is a deep rich violet-blue, almost of the same shade as in *amyntula*. The underside of this variety is remarkable, and specimens of both sexes may be found which, if the underside alone were seen, might be referred to *neglecta*, *violacea*, *lucia*, or *marginata*, and some even combine characters of all of these. One beautiful form which frequently occurs has an irregular discal dark blotch of confluent spots on the secondaries beneath, as in *lucia*, and the clear marginal and submarginal spots of *violacea*. This form Mr. Cockle, who has collected this butterfly for several years and has been much interested in it, considers to be most typical of the variety. In all forms of this Kaslo Blue, the eye-like spots of the marginal band are distinct, a character in which it differs from *piasus*, some specimens beneath showing the marginal band of *marginata* either with or without the confluent discal patch. Described from 16 specimens (8 ♂s and 8 ♀s). Types of both sexes deposited in the U.S. National Museum (Fletcher).

The common spring form at Kaslo, on Kootenay Lake, British Columbia (*teste* Cockle). The peculiar feature seems to be that, whilst the ♂ and the underside of both sexes are generally of the type associated with the spring forms, the upperside of the ♀ has the wide costal and outer marginal border of the forewings, and, in addition, specially suffused hindwings, features usually associated, in our Palæarctic forms, with the summer brood. The description appears, as already noted, to agree very closely with that of *echo*, Edw.

π. var. *neglecta*, Edw., "Proc. Acad. Sci. Phil.," p. 56 (1862); Saund., "Can. Ent.," i., p. 100 (1869); Edw., "Butts. N. Amer.," i., Lyc. pl. ii., figs. 4-6 (1870); Scudd., "Sys. Rev. Amer. Butts.," p. 34 (1872); "Can. Ent.," viii., pp. 61-66 (1876); Lintn., "Can. Ent.," vii., pp. 122-123 (1875); "Ent. Contr.," iv., pp. 55-56 (1878); Middl., "Rept. Ins. Ill.," x., p. 96 (1881); Edw., "Butts. N. Amer.," ii., Lyc. pl. ii., figs. 10-15 (1884); Scudd., "Butts. N. Engl.," p. 930 (1889); Dyar, "List N. Amer. Lep.," p. 45 (1902). *Argiolus*, Smith and Abb., "Lep. Ins. Georg.," pp. 29-30, pl. xv (1787), "Drawings of Ins. of Geor. Brit. Mus.," xvi., 57, 212 (*circa* 1800); Harr., "Hitch. Rep.," p. 590 (1833). *Pseudargiolus*, Gosse, "Lett. Alab.," pp. 144, 145 (1867); Harr., "Ins. Inj. Veg.," 3rd ed., p. 274, fig. 105 (1862); Edw., "Butts. N. Amer.," ii., Lyc. pl. ii., figs. 4-6, 8, 9, 18, 19 (1884). *Deutargiolus*, Harr., "MSS. Ent. Corr.," p. 105 (1869).—Expanse 1·1 in. ♂. *Male:* Upperside of primaries delicate azure-blue, paler in the disk and silvery on costal margin, secondaries greyish-blue, with a broad azure margin; a black line edges the hind-margin of both wings, expanding towards apex of primaries into a border, and running a little way along the costal margin; fringe of primaries white, cut with black by the nervures: of secondaries, sometimes barred with black, but usually wholly white. Underside pure white, or white with a bluish tinge; primaries with a dark discal streak and a transverse series of six black streaks set obliquely; secondaries have a discal streak, three points near base, and eight points or streaks crossing the disk in a tortuous line; both wings bordered by confluent spots, forming a crenated band, each spot enclosing a darker point. *Female:* Upperside of both wings of a deeper and more metallic blue; the primaries have a broad fuscous hind-margin; in some cases this colour extends along the costal margin to the base, where it is sprinkled with blue; a faint discal streak; hind-margin of secondaries bordered by a row of small fuscous spots. Underside dark grey, sprinkled with blue at the base of both wings; the fuscous spots disposed as in the ♂, but larger and coarser. [Variety *a.* Upperside wholly fuscous.†] Massachusetts, New York, Wisconsin, Lake Winnipeg. There are three species of *Lycaenae* in North America that much resemble each other, *viz.*, *lucia*, of Kirby; *pseudargiolus*, of Boisduval; and a third, hitherto confounded with the latter, which I describe as *neglecta*. *Pseudargiolus* resembles *argiolus*, of Europe, in form, size, and colour above, and was considered by Abbott and Smith as identical with it. Both wings are wholly violet-blue, with a pinkish tinge; the underside is greyish-white, and the hind margins are bordered by a broad serrated band, the teeth of which are separated almost to their bases. This band appears as if stamped on the wing. The colour of *neglecta* is azure-blue on primaries, of secondaries grey-blue, with an azure margin; the underside is pure white or bluish-white, and the marginal band is confluent and serrated. *Lucia* is uniform light silvery-blue above and cinereous below, with a border as in *neglecta*.* The number, shape and arrangement of the spots on the underside of these species are similar, mostly differing in degree of fineness; in *pseudargiolus* they are very delicate; in *neglecta* much less so; in *lucia* heavy and coarse. *Pseudargiolus* varies much in size; it appears to be rather a southern species; and is common on the mountains of Western Virginia, and is occasionally met with in New York. *Neglecta* is common in New York, and I have received it from Wisconsin and from Lake Winnipeg. *Lucia* seems to be confined to the northern parts of the continent (Edwards).

Edwards' *neglecta* has been generally considered to be the usual

† Afterwards proved to be ♂ (see *anteà*, p. 419).
* Compare with Edwards' further statements on this point (*anteà*, pp. 414, 417).

southern second-brood form of *pseudargiolus*; his reference to the broad costal and outer marginal bands of the ♀ is characteristic, although the colour description does not, even broadly, tally with his later figures that he repeatedly refers to this form (*Butts. Nth. Amer.*, ii., Lyc. pl. ii., fig. 12), whilst his early localities, as here noted, are by no means southern. Under the name of *pseudargiolus*, he figures also another *neglecta* ♀ of large size (*op. cit.*, fig. 9). We doubt very much whether there is any justification for this change, or whether such modification of the original description should be allowed as to include both these forms. It is quite clear that Edwards' later figures do not conform with his original description. As a rule, the name *neglecta* is now applied, in America, to the progeny of the spring imagines, appearing in May and June, as a partial second, or between July and October, as a partial third, brood. Scudder notes (*Butts. New Engl.*, ii., pp. 929, 930) that in ♂ *neglecta* the wings are nearly uniform, slightly pale bluish-violet with no approach to purplish, the central parts of the wings occasionally very slightly paler, the hindwings usually to a considerable extent being whitish-blue excepting near the base, and the outer border and in the vicinity of the nervules, . . . the outer border edged with black, in the hindwings as a mere thread, in the forewings narrowly but slightly infringing on the costal margin above, alternating to a mere thread below; hindwings with a submarginal row of small, indistinct, sometimes obsolete, deeper blue spots (♂); the ♀ forewings slightly fainter violet, as far as the middle of the discal cell; the outer margin, the costal margin, and the slender discal lunule blackish-brown; the broad middle and outer portion of the violaceous space becoming suddenly rather pale; the hindwings only violaceous along the basal half of the median and submedian nervures, most of the rest of the wings being pale, almost white . . . the outer border in the ♀ edged with a thread of blackish, followed by a slender pale line, and this by a submarginal row of blackish-fuscous spots in the interspaces, etc. The underside of an uniform, very pale, ash-grey, scarcely tinged with pale bluish, and forewings with a slender, transverse, obscure, pale fuscous, discal streak, edged faintly with pale, the middle of the outer two-fifths with a transverse, usually mostly obliterated, series of pale (occasionally dark) fuscous, very slender, short bars, arranged, so far as present, as in the other forms; outer margin edged very faintly with a thread of pale fuscous, within which is sometimes a submarginal series of faint, pale fuscous, small, round spots, and, more frequently, a series of slightly darker . . . lunules . . . wanting or less distinct on the upper half of wing; hindwings with the small dots arranged as in *violacea*, usually small, and some occasionally absent; the marginal fuscous thread faint, the submarginal series of small round spots largest and blackest on lower half of wing, the arched linear marginal lunules darkest near the anal angle. Fringes above pale, latticed with dark at ends of nervures, beneath silvery-white, flecked slightly with pale fuscous." This is, of course, the form that Edwards figured in 1884 as *neglecta*, but not that which he first described under this name in 1862. According to Edwards (*Butts. Nth. Amer.*, ii., Lyc. p. 4), at about 45° N. lat., the species becomes double-brooded, the members of the second-brood being *neglecta*; the second-brood in lat. 40° N., in Colorado, at considerable elevation (on Pike's Peak), is also *neglecta*.

Edwards asserts that the large form of *neglecta*, which he calls *pseudargiolus*, is distinct in origin from summer *neglecta*, the latter being directly descended from the spring form *violacea*, and the former not, although Edwards adduces no satisfactory evidence that this form, identical in every detail, except its large size, with the second-brood *neglecta*, has come from over-wintering pupæ. Further, he notes that, from June to October, a few examples, that might, for size and appearance, be either his *pseudargiolus* or *neglecta*, are to be found; these presumably are a partial third brood (Edwards says that there is no general brood in this period). The form *neglecta* then, may be progeny of *violacea* (first brood) or *neglecta* (second brood), whilst the progeny of *neglecta*, if emerging the same autumn, produce *neglecta*, although the brothers and sisters going over as pupæ to the spring, then emerge as *violacea*. Edwards quotes Lintner (*op. cit.*, p. 9), as saying that "*neglecta* appears in swarms at Centre, New York," as *violacea* sometimes does in Virginia, but *neglecta* never, "the air seemed blue from the myriads," and adds that "they fly at Centre, and in the vicinity of Albany, from mid-May to mid-June, while the winter forms have been unknown to collectors till recently, a single example having been taken here and there; the myriads, of course, are from hybernating chrysalids. May at Albany is early spring, and *neglecta* comes with the first blossoms, just as *violacea*, in Virginia, comes in April, with the blossoms. *Neglecta* in Albany is the winter form; but, two degrees further south, or about New York city, the three primary winter forms abound in early spring." All of which may look very clear, but one would like to compare the so-called *neglecta* taken in Albany, in May, and coming from over-wintering chrysalids, from those in other districts, that have undoubtedly been bred in the summer from spring-laid eggs. The difference between the summer form *neglecta*, and the spring or winter-forms, is a real one, due to climatic and physiological differences, and one supposes here some want of definiteness in the naming of the forms under discussion, due to Edwards' own extension of opinion as to what constituted *neglecta*. One suspects that Lintner is here writing of the form Edwards first described under this name, and not that which he figured some 22 years later.

ρ. var. *gozora*, Bdv., "Lép. Guat.," p. 17 (1870); Godm. and Salv., "Biol. Centr. Amer.," ii., p. 104 (1887-1891); Dyar, "List Nth. Amer. Lep.," p. 45 (1902).—Appearance and shape as in *argiolus*. Above the wings are of a more violet-blue, with a slender blackish border, and the fringe greyish-white; the centre of each wing offers, in certain lights, a whitish tinge, which shines through the blue colour. Below the four wings are white, slightly ashy, with some small blackish dots, of which one on the forewing is lunular in shape, and the others, scattered between the base and the middle of the hindwings; one sees, moreover, towards the outer edge of each wing, a blackish line, in festoon, followed by little obsolete dots of the same colour. The ♀ differs from the ♂ in that the disc of the wing is whitish, tinged with violet. It is found also in Honduras. It appears to be very much commoner in Mexico (Boisduval). Localities: — Mexico — Milpas (Farrer), Jalapa (Höge), Oaxaca (Fenechio); Guatemala—Los Altos, Dueñas (Godman and Salvin), Guatemala City, Cerro Zunil, San Geronimo, Perula, Chiacam, Sabo (Champion); Costa Rica—Cache (Rogers); Panama—Chiriqui (Ribbe), Bugaba (Champion), Pinal, Puebla, Orizaba (Elwes), Sierra Madre de Tepic, Jalisco (Richardson), Acaguizotla, Omilteme, Xucumanatlan (H. H. Smith), Patzcuaro (Godman), Solola, Volcan de Santa Maria (Richardson).

This is a real southern subtropical form of *pseudargiolus*, with all the general modifications that accompany the lightening of the ground-colour, the development of the white patches on the outer part of the discal area of the wing, and as different from typical *pseudargiolus* as is *sikkima* from our European *argiolus*. Chapman writes (*in litt.*):—"*Gozora* is one of the most surprising forms of *C. argiolus*. The appendages are typical *argiolus*. The upperside is very like that of *C. dilectus*, a very pale blue, with a large area of the forewing, and a larger of the hindwing, white. The underside, also, has the discal row of spots not typical of *argiolus*; they are nearer the margin, large and blurred, and the costal one is also further out. One wonders how so much change in appearance can occur with no difference in the ancillary appendages. It is clearly a highly-developed summer or tropical variation, possibly it has seasonal forms, some nearer in colour, etc., to typical *C. argiolus*." Godman and Salvin note (*Biol. Centr.-Amer.*, ii., p. 104) that *gozora* is the Mexican and Central American form of *pseudargiolus*, which it closely resembles in the markings of the underside, but it differs in the tint of the blue of the upper-surface, which is considerably darker and more violet; moreover, the ♂ has a distinct whitish discal patch; in specimens from Costa Rica and the State of Panama this patch is not nearly so clearly shown nor so constant. In Guatemala *gozora* is very common in the highlands, especially in the neighbourhood of Dueñas, where numbers may be seen on a sunny morning in the rainy season flying round wet places on the roadside.

ς. var. *argentata*, Fletcher, "Can. Ent.," xxxvi., p. 127, fig. (1904).—Differs from *neglecta*, by which name it has usually been known, by the collectors of Manitoba, in having the black marks of the underside less distinct; in some specimens these are almost entirely obliterated, so as to present a clear, nearly unspotted, surface of silvery-white. The illustration given herewith does not quite represent the colour of the underside, rather too much of the red pigment having been used, which gives it a warm tint not seen in nature. The shade of blue of the upper surface in both sexes is, as a rule, paler than in other forms (or varieties) of *pseudargiolus*. In the females the discal area of primaries is silvery-white, with a blue reflection and a more decided flush of blue at the base. Described from 18 specimens (12 males and 6 females) collected at Cartwright and other places in southern Manitoba, as well as in south-eastern Assiniboia. The types of both sexes are deposited in the U.S. National Museum at Washington. This beautiful variety is the prevailing form of the common Spring Blue Butterfly in Central and Southern Manitoba, where it has usually been named by collectors var. *neglecta* (Fletcher).

This appears to be, so far as the description of the upperside is concerned, a specially pale ♀ form of *neglecta*, although Scudder notes the ♀s of the latter as having "the middle and whole of the outer portion of the usual violaceous space of the forewings pale, with scarcely a violaceous tinge, and the middle area of the hindwing almost white," whilst he describes the spots of the underside as "usually mostly obliterated," neither character, of course, agreeing with Edwards' original description of *neglecta*. Fletcher notes it as the prevalent form of the common "spring blue" butterfly in central and southern Manitoba, but, although not so stated, one suspects it to be the summer form. It is to be noted that, in the Palæarctic forms, the imagines of the summer emergences are often much more sparsely-spotted on the underside than are the spring forms. In this respect var. *argentata* approaches the extreme ab. *obsoleta-lunulata* (*infrà*).

τ. ab. *obsoleta-lunulata*, n. ab. *Marginata* ab., Edw., "Butts. of Nth. Amer.," ii., Lyc. pl. ii., fig. 22, p.10 (1884).—A ♀, reared from an egg laid by *pseudargiolus*, the chrysalis having been laid on ice for seven days, the butterfly emerging in 31 days after removal. In the pattern of underside, it approaches *marginata* (Edwards). The peculiarity of this aberration is that, on the underside, all the usual small spots are entirely absent, there being no marks whatever, except the very faint discoidal lunules, and the series of marginal arches on the outer borders of fore- and hindwings.

It is, of course, practically identical with the eastern ab. *obsoleta*, except that it has, distinctly marked, the marginal lunules on the underside of all the wings. The absence and reduction of the spots on the underside, as is well-known, are practically always characteristic of the summer form. The general appearance of the underside of this aberration of Edwards', in our opinion, rather approaches *neglecta* than *marginata*, so that it would appear that great extremes of temperature, in either direction, during development, may tend to reduce the spotting.

Egglaying.—Normally, in the spring, the eggs are laid on the footstalks of flowers of holly, also on young shoots of ivy, in August, just beneath the flower-heads of an umbel of ivy (Buckler); eggs of ♀s of the first brood, found at Reigate and in South Devon, were laid upon holly-twigs, on which they are deposited far more indiscriminately than those of the second brood on immature ivy-umbels, the base of the calyx, however, being chosen in most cases, (Prideaux); the eggs are laid in April, in Sutton Park, on the underside of the calyx of buds of holly, singly, and beneath each bud, from four to five eggs being divided amongst each cluster of flowers; when the flowers open, the petals fold entirely over the egg, hiding it altogether from sight. It is interesting to note how "natural selection" has taught the insect to always lay its eggs on the calyx, for, should it lay them a fraction of an inch higher up, they would be almost certain to be destroyed, as, when the buds once open they are very easily blown away by the wind; the egg-stage lasted ten days in 1893, from April 22nd-25th to May 2nd-6th (Johnson); at Harwich, the ♀s of the spring brood deposit their eggs chiefly on the flower-buds of holly and bramble, but, upon several occasions, they have also been seen laying them on the flower-buds of bay and euonymus, and once, in June, a larva was found on the flowers of escallonia (Mathew). Raynor says that, on May 10th, 1901, at Hazeleigh, he observed a ♀ flying round a rhododendron bush, and, later, saw her settle, and deposit an egg on one of the unexpanded flower-buds. Chapman observes that, on April 24th, 1904, at Ste. Maxime, Var, he observed a female laying eggs on flower-buds of *Cytisus junceus*, *i.e.*, on shoots that had as yet, only a few flowers open; whilst, again, on April 25th, 1907, at the same place, he watched a ♀ lay an egg on the same plant; she flew about the plant and seemed about to alight on different spikes of buds, but did not do so till after several refusals, and finally selected one about half-way up the plant, one not at all hidden in the bush, yet behind and below one or two others. Here she settled, and shortly appeared about to lay an egg but did not do so, and for four or five times she appeared to lay, or be about to lay, an egg, and finally she did so, and then, raising her abdomen and assuming a resting position, sat perfectly quiet for some seconds before flying off; she had previously been on the move all the time with her wings over her back. The position of the egg was amongst the smaller buds about $\frac{1}{4}$ inch from the end, wedged down in a cranny between two buds, but unlike that of *Callophrys rubi*, adhering only to the one on which its base rested. Her fastidiousness was very marked, quite different from the one noticed at the same place three years earlier, laying on the same species of plant, and that seemed to find the right place at almost always the first trial, and was seen to lay several eggs, also amongst small buds. It is well to note here that, in Carmarthenshire, on June 1st, 1900, Jefferys observed a ♀ depositing ova on the needles or shoots of *Ulex europaeus*. There is no record as to the mode of oviposition when *Erica arborea* or *E. vulgaris* is chosen. In *Societas Entomologica*, xiv., p. 99, it is stated that "*C. argiolus* lays its eggs on *Rhamnus frangula* and young oak-leaves." This statement concerning "oak-leaves" is almost certainly an error. Of the summer brood, the following notes are interesting:—Mathew observes that, in this country, the ♀s seem to confine themselves almost entirely to flower-buds of ivy; a ♀, captured at Harwich, on August 15th, was confined under a glass cylinder with some flower-heads of ivy and placed in the sun, and, in a short time, she deposited eighteen eggs, some of which were fastened to the stalks of the young buds, and others upon the leaf-stalks; the larvæ began to hatch on August 22nd; at Corfu, the same observer records (*Ent.*, xxxi., p. 112) the species as common about bramble, from August 4th-12th, 1897, the ♀s depositing their eggs upon terminal shoots and small unripe fruit; Luff also notes (*Ent.*, ix., p. 257) that he observed eggs laid, in 1876, on the blossom of blackberry (*Rubus*) in preference to ivy, the larvæ therefrom feeding up on the pollen of the bramble-flowers. Raynor says that, on July 27th, 1905, he watched two ♀ *C. argiolus* at 10.30 a.m. ovipositing on a small-leaved variegated ivy, which clothes his house on the north and east sides, and adds, "the ♀ butterfly settles leisurely on an unfolded flower-head, and deposits one or two eggs at the base by twisting her body round; the eggs harmonise very well in colour with the pale green flower-buds; about 6ft. from the ground was the lowest, and 15ft. to 20ft. the highest, distance at which the ♀s were observed ovipositing, but they certainly laid the majority of their eggs high up." He further notes that a ♀ was seen at Hazeleigh, on August 23rd, 1906, ovipositing about 10.40 a.m., on the unopened buds of a very late-flowering ivy, which scrambled over part of a western wall, and, from the observations made, it would appear that the ♀ *C. argiolus* lays her eggs on ivy-buds that will be just ready to burst into flower when the larvæ are full-fed. Prideaux observes that a ♀ captured near Carisbrooke, August 7th, 1895, was confined in a glass cage containing sprays of immature ivy-bloom, that eggs were noticed three days later, deposited on the ivy-stems at the base of the flower-umbels, and on each of the ensuing three days more eggs were laid, the same situation being almost invariably chosen; the ♀ then ceased laying, and, although she lived for 15 days longer, no more eggs were obtained. Search was, during this time, made on a bush of ivy in the neighbourhood, and, by examining the ivy, eggs were found, always laid in the same place at the base of the umbels, rarely two on one umbel, though three were recorded in one instance; all were discovered on the north-easterly side of the bush, a fact that may be accounted for by the persistent and violent westerly winds that had prevailed earlier in the month, when the butterflies were flying. The eggs hatched in from three to five days after being deposited. He further notes that ova were laid freely on immature ivy-umbels during August, 1899, in the Reigate and Dorking districts, and that those found in the same district in May, 1900, had been laid upon holly-twigs much more indiscriminately than those of the second brood on the ivy-umbels, the base of the calyx being chosen in most cases. Adkin observes that, in the Hastings and St. Leonards' districts, the ♀ of the summer brood (August 17th-19th, 1896) selects one of the umbels of ivy-bloom, now quite small, many yet forming compact green heads, closely resembling an unripe blackberry in shape, settles upon its top, closes her wings over her back, and, bending her abdomen down and underneath the buds, affixes an egg to the underside of one of the slender single-bud stalks, at a point about one-third of its length from the crown of the main stalk whence the bud-stalks spring; but, occasionally, a more advanced head is selected, the buds of which have separated from each other, and the total circumference of which is consequently increased, so that the butterfly, resting on the top of the head of buds, cannot reach the stalks of the lowest row with her abdomen, but the position on the stalk, rather than the particular stalk, appears to be the object she has in view, for she then thrusts her abdomen between the buds and thus attains the desired position on the stalk for depositing the egg. Generally one egg only is laid on a head of buds, but, occasionally, two or even three or four are so deposited. Raynor further notes that he has once or twice reared *C. argiolus* from eggs deposited by a ♀ sleeved on *Rhamnus frangula*, whilst Fletcher states that the larvæ are to be found on Worthing Downs feeding on the umbels of *Cornus sanguinea* or may be beaten therefrom, and, on which the eggs, therefore, must have been laid. [For further notes on "Egglaying" see *anteà* p. 408.]

Egg.—The egg is 0·33mm. high, 0·65mm. in diameter. It is flat top and bottom, but the top rounds off into the side rather early, *i.e.*, the actually flat portion is small (about 0·35mm. across), and the egg makes rather nearer an approach to a bun-shape (as in the Theclid or Chrysophanid eggs), than do most Lycænid eggs. The flat portion appears also somewhat readily to sink in (on losing mositure), forming a wide, but very shallow, hollow, in the centre of which is the small micropylar depression, as usual free from the white adventitious coat, and only 0·06mm. across. The white coating is, as usual, arranged in cells, with narrow walls and raised pillars or mounds at the angles. The cells are, for the most part, quadrangular, nearly square, with angles radial and circumferential, and are placed in rows spirally diverging from the centre (engine-turning) with fewer irregularities and deviations than are frequently seen in the pattern of Lycænid eggs. Round the sides, however, where the curvature is greatest, there is much variation in the form of the cells; here and there are diagonal rows of square cells much as on the top; in places, the more elegant (and usual) arrangement of triangular cells arranged in hexagons and pentagons prevails; here and there the septa run in long continuous diagonal lines, those crossing them being less regular. Sometimes no special disposition can be described, but the cells are always of about the same size and have a most pleasing effect, being, in fact, disposed in apparently every possible way that will give the essential structure on a curved surface. Here and there, however, a pillar seems in reality to be two, not completely fused, a difficulty of arrangement not completely surmounted. Broadly, the arrangement is quadrangular on the upper surface, triangles on the sides, but with quadrangles interspersed to make the fitting easier. As usual the pillars are largest and highest at the top of the sides, where they curve over on to the top of the egg, and become gradually smaller towards the centre, where they are still very distinct, contrasting with such flat smooth-topped eggs as *Agriades corydon*, where the top contrasts markedly, and somewhat suddenly, with the sides; the pillars are rather cones than pillars, *i.e.*, the ribs run up into them, meeting in a rounded summit, with little or nothing of the frequently-seen knob-like top, though they have something of this round the margin where they are largest, the smaller pillars, however, in this area, showing it most. The largest cells are about 0·05mm. in their largest diameter, and they are half this size, or a little less, near the micropylar depression, with the very fine cells of which they are fairly continuous in arrangement. The cells appear to have a thickening or eminence of the white coating material in the centre of their floors, and their walls are thinner near the shell beneath, than if they spread out across the floor in a catenary curve, as they do in some eggs (Chapman). Clark figures the egg, *Ent. Record*, xii., pl. xi., fig. 8. The egg is very much like that of *P. icarus* (compare preceding vol., pl. iv., fig. 4 and pl. xix., fig. 4 of current vol.), except that it is rather larger, being circular, flattened, and rather depressed in the centre; the whole surface, except just a central spot, is overlaid with raised reticulation with little knobs at the angles; the shell is pale bluish-green, with the raised reticulation whitish (Buckler). The egg resembles that of *Agriades corydon*, etc. [compare preceding vol., pl. iv., fig. 6 (*A. corydon*), and current vol., pl. xix., fig. 4 (*C. argiolus*)], is circular, flattened, and slightly concave towards the centre, in colour translucent greenish-white; the entire surface, except a small central area, covered with a raised network pattern, the mesh longer at the equator, whilst at each point where the lines converge is a prominent glassy tubercle (Prideaux). Spheroid in form; depressed at crown; flattened at base by which it is firmly attached; the colour a delicate very faint green; the surface reticulated or pitted with excessively fine partition-walls between the pits. The empty shell is colourless, resembling white porcelain; the inside lined with a glittering substance like tinfoil (Newman). See also description by Edwards (*anteà* p. 408).

Habits of larva.—The larva escapes from the eggs hellby means of a hole that it makes near the centre of the upper surface. The young larvæ are slow in their movements and have the power of suspending themselves by means of a thread if disturbed. Those that hatch during May are fullfed in about 30 days, and pupate in late June or early July, the pupal stage lasting about 18 days, or otherwise throughout the autumn and winter until the following spring (one noted by Buckler as 334 days in pupal stage). The larvæ of the second brood leave the egg during August, one that hatched on August 8th, 1875, moulted for the first time on the 12th, again on the 16th, then on the 20th; yet again between September 1st and 5th, being fully grown on the 10th; it fixed itself for pupation on the 13th and pupated on the 17th, thus passing just 40 days in the larval state. The imago from this emerged April 6th, 1876, with a pupal period of 202 days (Buckler). *Spring brood:* The young larvæ of the spring brood commence to feed on the buds and flowers of holly amongst which they find themselves, but soon climb on the young tender leaves and shoots, upon which they thrive. They will also feed on ivy leaves, but when both they and holly are to be had, prefer the latter. The larva when disturbed has the power of lowering itself by a silken thread (Johnson). The older larvæ, resulting from the eggs laid by spring ♀s of *C. argiolus*, are ust as well content to eat the young leaves at the top of a holly-spray, as to mine out the contents of the green berries, but, in my experience the leaves of the ivy are never touched, either in captivity or at large, by the larvæ of this species (Prideaux). On May 16th, 1907, wishing to give a larva just entered on its third stadium some fresh food, I was a little rough, and, in its haste to free itself from the bud on which it had begun to feed, it showed quite a large blob, looking almost like fluid, between the prothorax and the head, which it could not at once disengage from the hole in the bud. Very shortly after it had attacked a new bud, the larva looked as if resting on the bud, the lateral flange, where it passes round the front part of the larva, touching the bud, and hiding the head; the head, however, was inside the bud. The larva in fact was actively feeding, yet no evidence whatever of movement to betray its presence appeared. The long extensile neck of the larva enables the interior of a holly- or ivy-bud to be cleared out as far as desired (in the first stage, it is not cleared out, the reach not being sufficient) by the mere stretching of the neck (membrane between head and thorax); the remainder of the larva continues outside and appears to be at rest (pl. xix., fig. 5). [Other Lycænid larvæ, *e.g.*, *Callophrys rubi*, introduce the prothorax, and even further segments, into the buds (of *Cytisus*, etc.). In this matter there is no doubt much difference in individuals, according to the actual foodplant, in species like *Callophrys rubi* and *Celastrina argiolus* with very varied foods, but there is also a specific difference, of which these two species almost mark the extremes, *C. argiolus* making a very small hole and staying outside if circumstances at all favour, *C. rubi* making a comparatively large one, and going in if it possibly can.] When this larva was ready to moult, it spun a small pad of silk, and the group of holly-buds it left to do this has eight buds that look sound, but each has a small hole and is quite hollow. The larva appears always to eat the cast skin at its moults. This larva is as typical as any of the Lycænids in its way of feeding (Chapman). Some larvæ (hatched May 19th, 1871) were supplied, with the tender young shoots of holly, on the soft leaves of which they immediately began to feed, settling themselves on the underside of the leaves. They moulted for the first time on June 2nd, and the second time on the 12th. By the 20th they appeared to be fullgrown, and to be preparing to enter the pupal state, the succulent leaves at this time exhibiting the operations of the larva, in the form of small round holes, like shot holes, on the disk; on no occasion were the margins of the leaves observed to be eaten. When fullfed, the larvæ rest on the young leaves of the holly in a flat position, with the ventral surface appressed to the polished surface of the leaf, and the head, legs, and claspers entirely concealed. If annoyed they fall to the ground and lie for a few seconds with both extremities slightly incurved. Only two moults were observed; no opinion is expressed as to this being the normal number (Newman). *Summer brood:* The larva of the second brood gnaws a hole in the centre of the egg, but the rim is left entire, nor is the shell subsequently eaten; the young larva is cylindrical at first with long white hairs pointing backwards, but, after a few meals, and before the first moult, it becomes stouter in the middle, and soon develops the usual Lycænid shape. In nature, a tiny larva was discovered, just hatched, on one of the pedicels of an umbel, the larva resembling, at this stage, with wonderful fidelity, the small concave bracts which occur at the base of each pedicel on the umbel, this fact rendering the changing of their food, when in captivity, anything but an easy matter, so readily are they overlooked. All the larvæ in their earlier stages are of an uniform pale green colour; the pink markings on the sides and dorsal area, which some specimens later developed, did not appear till they were half-grown. The method of feeding is peculiar, and the same throughout the entire larval period, but is seen to the best advantage in the adult larva. A small circular hole is drilled in the side of an unexpanded corolla of the ivy-flower, the petals are not further eaten, but an entire clearance of the inside of the bud is made, the larva protruding its long, retractile neck, leech-like, into the interior of the bud, whilst the third ridged segment seems firmly glued to the side of it. The stamens being consumed, the corolla soon becomes an empty bag under the caterpillar's persistent though unseen, ravages. It is noteworthy that no attempt on the part of the larva is ever made to enter the bud entirely, even when quite young, but, if unable to effect an entire clearance from the first vantage ground, a fresh hole is gnawed for this purpose opposite the first. The frass is at first black, but is yellowish-white while the stamens are being eaten. In nature, the presence of a fairly-sized larva is readily evidenced by the appearance of the frass, some of which is apt to cling round the stellate hairs which cover the young buds, also by the fact that such of the latter as have afforded a meal to the larva have a habit of opening prematurely, discovering the empty corolla. The larvæ are very sluggish, and it would appear that one good-sized umbel affords one sufficient nourishment until pupation. They feed indiscriminately by night or by day, and it was found that, when, towards the end of their larval existence, the expanded ivy-blooms were offered them, these were neglected for the unopened buds. The first two moults are effected on the flower-umbel itself, but for the subsequent one the larva descends a few inches down the stem, on which a few threads are spun, to which it attaches itself; the cast skin appears pure white. Larvæ placed on clematis blossoms took to them readily; the larva usually ascended the filament of an immature stamen and rifled the still moist pollen-sacs. This food soon failed, however, the blossom being over by the middle of August, when the larvæ are just hatching. The larvæ found on August 27th, 1895, were full-fed between September 9th-20th, at Carisbrooke; other larvæ taken on August 25th, 1899, were fullfed about September 10th (Prideaux). The young larva, on ivy, does not enter a flower-bud, but rests thereupon, its colour and position rendering it well-nigh undiscoverable; the colour of the newly-hatched larva is pale bright green, and it is covered with a number of whitish hairs which give it a soft greyish-green tone that exactly matches the colour of the ivy-bud, and the position that it selects, when resting, is the junction of the bud-stalk with the bud; the head and long neck are thrust into, or pressed closely against, the bud, and the remainder of the body, stretched along the stalk, is so pressed against it, that, when the bud is viewed from the top, the larva is so far hidden as to be practically invisible, whilst, when held up sideways, the resemblance to a slight thickening of the stalk, at its junction with the bud, is so complete that one would not suspect the presence of a larva without first being assured that one was there. Throughout its life the larva is very sluggish, seldom leaving the umbel on which it was hatched; in some few cases where the buds showed that they had been tenanted but the larva was absent, it was usually found on the back of one of the nearest ivy-leaves, and, apparently, in each case, in the act of moulting. The larva appears to feed only at night ; when doing so, its head is passed into the bud through a round hole eaten in the shell, large enough for the neck, but not for the following segment, to enter; this, consequently, presses closely upon the outside of the bud, whilst the head moves to and fro inside it. In the case of a large larva, the whole of the soft contents is devoured. The larval period, in August or September, in the St. Leonards' district, seems to last from four to six weeks (Adkin). On August 28th, 1905, Raynor found, at Hazeleigh, eighteen larvæ on the unexpanded flower-heads of a small-leaved variegated ivy; they were mostly full-fed, and frequented the flower-heads singly, except in two instances in which he found two half-grown larvæ on a flower-head. The larva conceals itself admirably, and clings very tightly to its foodplant. It seems very sluggish by day, and is possibly a nocturnal feeder; every one of these eighteen larvæ produced a healthy pupa. Chapman observes that, in July, 1903, larvæ were abundant at Moncayo, on heath, apparently *Erica arborea*, the larvæ being of a dove-colour, with brown markings, and no trace of green, and were very puzzling at first as to what they could be. Mathew says that from eggs laid August 15th-16th, 1906, larvæ hatched August 22nd, and immediately attacked the flower-buds of ivy. When about half-grown they ate large holes in the buds in which they sometimes half buried themselves. He adds that it is very easy to see where the larvæ have been feeding, for they make a little round hole in a bud and then move on to another and repeat the operation, and frequently every bud in a flower-head is thus marked, whilst when fullgrown they are rather conspicuous, as they sit on the buds quite exposed. As to the appearance of very late larvæ one may note—larvæ of *C. argiolus*, possibly those of a partial third brood, were received from Luff, on October 12th, 1893, having been taken a few days previously in Guernsey (Tutt). In 1906, Raynor took two *C. argiolus* larvæ, at Hazeleigh (on ivy flower-buds) on October 7th, and, in 1907, he took two on October 19th, and two more on October 20th; he regarded these as having resulted from ova laid by a late ♀ of the summer brood, especially as, in the latter year, he noticed imagines flying as late as September 4th. Larvæ were beaten from ivy at Bristol, on October 9th, 11th and 13th, 1869, all turned to pupæ from November 1st-3rd, and, in that state, passed the winter ; one died, the two others emerged in April, 1870; another, beaten from ivy at Norwich, in September, 1870, pupated in due course (Wheeler). Other dates noted are: Larvæ taken September 4th, 1899, at Chalford (Redmayne); during the first week of July, 1901, some 50 larvæ of various sizes were beaten from holly at Danbury, other larvæ were beaten, at Weston, Herts, from ivy, on September 10th, 1901 (Raynor); larvæ were found on ivy-buds, from September 1st-19th, 1901, at Bournemouth (Robertson); discovered a number of half-grown larvæ on ivy, at Ashford, on September 25th, 1901 (Wood) ; young larvæ were found at Dover, on September 23rd, 1902, whilst larvæ from the same place had all pupated, in 1901, by September 21st (Colthrup); larvæ found at Earl's Colne, on October 9th, 1902 (Dennis); larvæ were very late in 1902, *e.g.*, four halfgrown larvæ were beaten from a large ivy bush at Bradfield, near Dovercourt, on November 7th, 1902, three of which had not pupated by the 14th (Mathew); fullfed larvæ were found on *Rhamnus* in September, 1904, near Berlin (Dadd); whilst on August 25th, 1906, larvæ were taken on flower-buds of ivy, at Mucking (Burrows); larvæ found September 11th, 1907, at St. Cloud, pupated September 17th, one imago emerged October 15th, the rest of the pupæ overwintered (Oldaker). Hüttner's statement that larvæ were found on birch at Carlsbad needs confirmation. [For further notes on "Habits of Larva," see *anteà*, p. 408.]

Ontogeny of larva.—Chapman writes (*in litt.*): My notes show that *C. argiolus* has only three moults or four instars, and I believe this conclusion is correct. My doubts arise from the circumstance that some of my earlier notes reflect the belief that there should be four moults, and so give rise to some confusion, without affording any evidence that it is so. Again, Edwards, in his account of *C. pseudargiolus* (*Butts. Nth. Amer.*, vol. ii., and quoted *anteà* p. 409) gives four moults; but reading his account of the several instars, one sees that, careful observer as Edwards is, he gives no definite account or dates for four moults, and seems rather to have assumed five instars, and selected probable larvæ to illustrate them. On the other hand, it is quite possible that *C. argiolus* (and *C. pseudargiolus*) sometimes has three, and sometimes four, moults, possibly in spring and summer broods. My preserved specimens, not, however, too numerous, fall readily into four instars, without leaving any gap for an overlooked fifth one, and this is so whether measurements be taken of head, clypeus, jaws, true legs, or the hooks of the prolegs; the former enlarging at each moult by 50 per cent., the latter by 100 per cent. (linear)." Buckler also gives four moults, that is, five instars, but he describes only four, which leaves it possible that he, too, was not clear upon the point. The following are his short descriptions of the appearance in each instar:—

First instar:—Plump, hairy (something like that of an Anthrocerid larva in shape), body greenish-white, head dark, moderately large.

Second instar:—Stouter in figure, pale ochreous-green in colour, clothed with long, whitish, soft, silky hairs; when about a fortnight old, 4·75mm. long, of the usual Lycænid shape, skin smooth and glistening.

Third instar:—8mm. long, stout in proportion, showing a pale streak on the ridges of the back, thin double-slanting lines on the sides, and a margin of yellowish-white along the subspiracular region.

Final instar:—9·5mm. long, rather more when crawling. Variable in colour, with small, purplish-black, shiny head placed ventrally, and retractile in prothorax. The ventral surface flattened, the mesothorax swollen, the segments with deeply-cut segmental incisions; a slightly-developed double dorsal ridge, and a faintly-marked mediodorsal line. The mesothorax very broad and also the longest segment, is only slightly convex above, the others are arched on the back, the mesothoracic, metathoracic, and 1st abdominal segments the highest, whence they slope a very little to the 6th abdominal. These segments carry the double dorsal ridge of humps, between which lies a slightly sunken dorsal space broad and hollow on the meso- and metathorax, whence it flattens and narrows gradually to the 6th abdominal. The humped appearance of the ridges is due to the deeply-cleft segmental incisions, those of the 1st-3rd abdominals being bent forward laterally. The segments from the 7th abdominal to anus simply convex, sloping towards anal end, and the sides, although sloping outwards, become almost concave near the projecting, rounded, subspiracular ridge, which continues round the anal segment, overlapping all the short prolegs. The whole of the segments pitted with a vast number of exceedingly minute depressions, from every one of which arises a tiny hair. The spiracles excessively minute, whitish, with a well-developed marginal ridge. On either side of the median line in each segment is an oblique dash passing across the segment downwards from front to back, and rather paler than the ground-colour, whilst just above the spiracles is another straighter line. The

A

B

Photo. F. N. Clark.

Skin of larva of Celastrina argiolus (first instar) ×80.

A. Head. B. Anal end.

Plate XXIII.

(To be bound facing Plate XXIII.)

Skin of larva of Celastrina argiolus (first instar) $\times 80$.

Skin prepared by slitting the larva along the ventral line (as well as my rough technique can manage so delicate an operation) removing the interior and spreading out the skin as well as may be and mounting in balsam. The whole skin is very transparent, and the photograph, from which the plate is made, was touched up, to make certain hairs appear in this reproduction. These hairs are the pair immediately above the spiracle (iii), and the comparative coarseness of the result is easily detected in the plate, no attempt is made to bring out more clearly any other features. The plate may be compared with detailed description (p. 435). Down the centre is seen the prothoracic plate and the large hairs (i) of the dorsal crest, behind these those of ii, and then two lenticles (just like spiracles), one above the other, then the hairs (iii), reinforced as noted above, and then the spiracles, below each of these the three hairs of the lateral flange (iv, v); just below these the margin of the upper surface of the larva. The ventral portion comes out so poorly in the plate that it may be neglected, though traces of legs and prolegs are visible. The skin-points come out well enough to give a good idea of their number and distribution, so difficult to give in any description.

lateral edges of the segments are much crenulated, due to the depth of the incisions, and with a rather paler (yellowish) lateral line. The ventral surface is darker down the middle (between legs); it is also very flat, smoother and freer from hairs than the upper surface. The true legs are as pale as the ground-colour, as also are the prolegs; the hooks on the latter are reddish, and, though short, are fairly strong, and cling firmly (Buckler). The head almost globular, but slightly produced towards the mouth; it is very small, not being more than one-third as wide as prothorax, and entirely retractile within that segment at the pleasure of the larva; the body is of the shape of a Chiton; the divisions of the segments are decidedly marked; the prothorax has the anterior margin semicircular, and projecting over the head; the posterior margin of the metathorax and each following segment slightly projecting over the next following segment; there is a slight mediodorsal depression on all these segments, so that the back appears to have a double series of approximate humps, two on each segment, from the mesothorax to the 6th abdominal inclusive; the lateral margin of all the segments dilated; the entire dorsal surface is finely shagreened or sprinkled with approximate yellow glandular dots, in this respect the skin having the appearance of the glandular surface of the twigs or leaves of many plants, and being clothed with pale hairs. The head is black and highly glabrous; the body apple-green, with very oblique lines on each side of a darker green; these oblique lines are very indistinct; on the 6th abdominal segment is a diffused red spot, also indistinct; the ventral surface and claspers are apple-green; the legs are almost colourless and semitransparent (Newman). The fullgrown larva is also described by Prideaux (*Ent. Mo. Mag.*, xxxvii., p. 78), and ourselves (*Brit. Butterflies*, p. 190).

LARVA.—*First instar* (newly-hatched): The newly-hatched larva is a colourless scrap, faintly tinted, perhaps, of a yellowish-green, but of no pronounced colour till, having eaten, it becomes slightly greenish. The head is black, and the neck long and extensile, at least twice the length of the head. The total length of the larva is at first about 1·5mm. The neck consists of colourless and structureless membrane, the intersegmental membrane between the prothorax and the head, structureless of course only in the sense that it presents no skin-points, hairs or other appendages. How its extension is effected, is a matter about which I have been unable to learn anything, a difficulty that points rather strongly to its being secured by fluid contents being forced into it by pressure elsewhere. The extension is not required or used until the larva has eaten something, and requires to follow up the receding surface on which it is feeding, and consequently has obtained some contents that may be forced by pressure in different directions. For the structural details, arrangement of hairs, etc., see pl. xxiii. The disposition of hairs and lenticles agrees very much with that obtaining in *Polyommatus* (*icarus*, etc.), and differs very much from that of *Lampides* (*boeticus*). It has the hairs of tubercles i and ii; that of iii (?) is represented by the two clubbed hairs (as in *Polyommatus*), instead of the ordinary hair (as in *Lampides*), and the hairs are all spiculated (or perhaps rather serrated) as in the Polyommatid larva; the chief distinction from the latter is in the large size of the clubbed hairs of tubercle iii. In several of my specimens of mounted skin, the skin-points are very notable, and deserve some study in connection with the sculpture of the pupæ of the Polyommatids. In most larvæ with which I am familiar the skin is divided into cellular areas (pavement-epithelium actually, or in pattern), and the skin-points are projections, one in the centre of each of these. This arrangement is often well seen in pupæ, the intersegmental membrane being a beautifully tessellated pavement, and often each cell has a central darker point, and these graduate into ordinary skin-points as the ordinary segmental surface is reached. Here, in the larva of *C. argiolus*, in the first instar, the skin-points are minute rounded elevations connected with each other by very fine lines, forming a network with cells of 3, 4, or 5 sides. The pattern is, in fact, by no means very different from that on the egg of this species. Yet it is difficult to believe that these cells are not the same as those in the groups in which the skin-points occur, not at the angle but, in the centre of the cell. If this is so, the points themselves are not homologous with ordinary skin-points. In any case, either the lines or points do not correspond with those ordinarily observed. The resemblance to the pupal sculpture (in pattern) is certainly close, and also to the network with rosettes at the intersections on the pupæ, but, in the latter case, the scale is perhaps so much larger as to make a difficulty; nevertheless, there are many indications that the ribs forming the pupal network are only a selection of lines from a much finer reticulation, the other portions of which are usually obsolete. The points are about 0·01mm. apart. The long hairs of tubercle i are most conspicuous on the living larva, forming a tall flowing dorsal crest, each hair about 0·3mm. long, curving backwards; they arise from the 2nd and 3rd thoracic, and the 1st-8th abdominal, segments; on the mesothorax are apparently two, one in front of the other, both refeıable to this series; that on the 6th abdominal is perhaps the largest, nearly 0·4mm. The bases are large, tapered, about as high as broad (about 0·03mm. or 0·04mm.). The hairs are clothed with numerous points, very slightly raised, but with decurrent bases; ii carries a much smaller hair, half the length and thickness of that on i, placed a little outside and behind it; it is rather larger on the front segments, it exists on the 2nd and 3rd thoracic and on the 1st-6th abdominal segments; on the 7th its place is occupied by a lenticle (the upper of the two subdorsal ones). Not apparently on the mesothorax, but on the metathorax and on the 1st-7th abdominal segments there is a minute hair at the front margin of the segment, almost directly in front of ii. The supraspiracular hairs, near place of iii, one or other of which may represent the *seta* of that tubercle, are long and club-shaped; one only is present on the metathorax and the 7th abdominal, but both are present on the 1st-6th abdominal segments. As to position, the larger is in front and higher, the smaller is lower and directly above spiracle. [A line round the middle of the segment, or, rather, such a line pushed a little forwards dorsally, would pass through tubercle i, the two lenticles (not yet noticed), the posterior supraspiracular, the spiracle, and the middle of the three lateral hairs.] They are very similar in structure, very colourless and delicate, and difficult to see well either in the living, or prepared, larva; they are smallest where they arise from a little rounded base, gradually enlarge, and finish with a rounded end; they are faintly spicular like the other hairs, and have a considerable curvature; the longest, but least clubbed, is that on metathorax, about 0·09mm.; the shorter average about 0·03mm., the larger, 0·06mm., or 0·07mm. [On larva of *Polyommatus icarus* they are little more than 0·01mm.] The lateral hairs (iv and v (?) on the subspiracular-flange) are four on the 2nd and 3rd thoracic segments, three on the 1st-8th abdominal segments, possibly also on 9th, but these are not readily distinguished from those on the 10th; the middle one (already alluded to) is the longest, 0·16mm. or 0·17mm. long, the posterior, the shortest, about 0·07mm. long and is not produced to a point like the others, but has a rounded end and is very slightly clubbed, it is thickest at one-third of its length and narrow towards the end, but would be nearly as long as the middle hair, if, instead of being rounded off, it continued to a point. This different structure possibly separates this hair, as an accessory, from the other two, which would then be iv + v. Below these are two slender hairs, the longest about 0·1mm. a little towards front of segment (vi ?), and the smaller one, 0·04mm. or so, also very sharp and slender, a little above and in front of it. These are also present on the three thoracic segments at bases of legs. Two much smaller and finer hairs are found just outside prolegs. The lenticles on abdominal segments are two between tubercles i and iii, nearly in line with them, and about equally spaced, but the upper one a little in front of the exact line; they are nearly 0·02mm. in diameter with dotted lumen; the 1st abdominal has a rather smaller lenticle at front margin below spiracle, a little above iv + v; on the 2nd abdominal there is one between iv + v and vi in one specimen (but not in another), the 7th and 8th abdominal segments each have one in the same situation. The disposition on the more specialised segments differs, in the way usual in Lycænid larvæ, from that on the abdominal segments. The prothorax has a plate nearly square (but placed crosswise) with the front angle rounded (pl. xxv., fig. 1); it has a pair of hairs in the middle in front, outside each of which is a large lenticle; in the middle another pair of hairs a little further apart than those in front; these are very long (about 0·3mm.), and, near the posterior border, another pair, again further apart, so that these three hairs on each side are in lines diverging backwards; these posterior hairs are rather shorter than the middle hairs but larger than those in front; there is a shorter hair in each outer angle; on the segment, on each side, along the front border of the plate, are the usual three hairs, the front one rather short; a fourth, almost in line with these, is further back; in the front of the spiracle is a lenticle and three hairs; two fine ones are at base of legs. On the mesothorax are, on each side, two hairs (apparently) of tubercle i, one curved backwards, one forwards; a lenticle below the first one; then two hairs in line with tubercle ii, but a good deal larger than on the following segments (0·2mm.); then a long space, corresponding with the lenticles and tubercle iii of the following segments, before the four flange-hairs (0·12mm. to 0·14mm. long), the 2nd and 4th level, the 1st higher, and the 3rd lower, are reached. The metathorax is more like an abdominal segment—tubercles i and ii the same, only one lenticle, only one hair at iii, and four hairs on flange as on mesothorax. The 7th abdominal segment has no seta on ii; the upper lenticle rises up into its place; it has only one hair on iii, nearly in front of the other lenticle. The 8th abdominal has a hair on i, and a lenticle just outside it, then the spiracle, and three marginal hairs; the lenticle seems to be incorporated with the base of i, the same occurs (or all but occurs) on the 7th abdominal segment. The 9th abdominal seems unarmed above the three flange-hairs, but it is difficult to say precisely what is the 8th, 9th, or 10th abdominal, especially along the flange. The 10th abdominal has a large anal plate, about 0·08mm., without hair or lenticle, and a small plate on each side, about in line with spiracle, and hardly larger, faintly tinted with darker, like the anal plate; it is on the front margin of the 10th, or may, indeed, belong to the 9th;

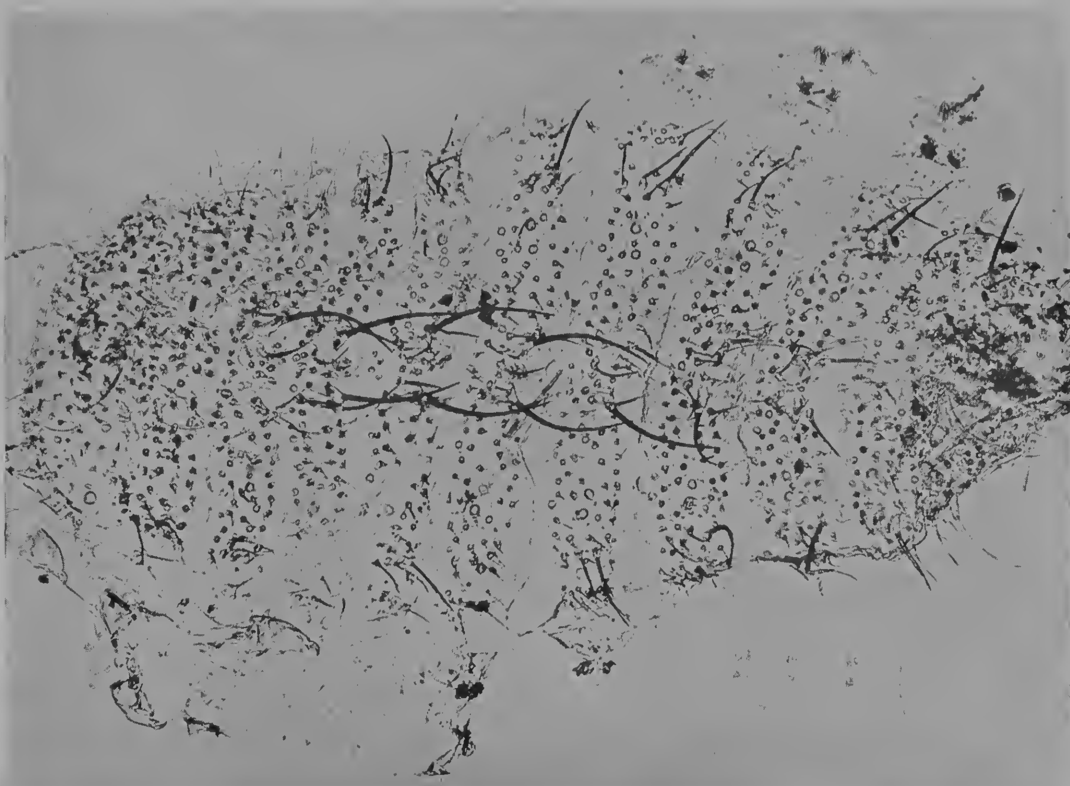
there are about six flange-hairs on each side, after allowing three for the 9th abdominal segment; the largest of these about 0·2mm.; below these are many sharp spicules, some of which look merely like skin-points, but many of the largest are hairs having the structure (jointed base) of hairs. The honey-gland of the 7th abdominal does not appear to exist, but the nature and arrangement of the skin-points differ a little at this spot. There seems to be no indication whatever of the eversible glands of the 8th abdominal segment. The spiracles are tinted, nearly 0·02mm. in diameter, much the same size as the dorsal lenticles, the first largest, and again larger posteriorly; the first, and several others, have marginal points, reminding one of the inserted lenticles on *Bithys quercûs*, or the coronetted lenticles of Polyommatids. The prolegs possess four hooks, an anterior and posterior pair; the anal claspers, two anterior, and one posterior, hook. The (palely tinted) true legs have a rather slender claw and the usual hairs. The head is too elaborate for description—it is dark, with pale mouth-parts and brown mandibles; the mandibles have six teeth, there are five ocelli in a curve with a sixth central one; over the clypeus are about a dozen, and on each side of the cranium about as many, hairs, very minute, broadly, but symmetrically, distributed. *Second instar* (May 12th, 1907): When just moulted for the first time, the colour is white, with a dirty look from the thick sprinkling of black hair-points. *May 14th:* Somewhat grown, nearly 3mm. long, perhaps 4mm. if stretched out; light whitish-green, but with some reddish-brown down the dorsal plane (furrow), decidedly broadest in front; dorsal ridges paler, emphasising the darker space between them. In this instar, the larva is fully 2mm. long when at rest, and is not quite 4mm. when extended (neck elongated, etc.). The head appears to differ from that of the first instar only in size, unless it be that the minute hairs are proportionally still more minute. The skin-surface is divided into cells by a delicate network of lines, that differ from those of the first instar by the spaces being less regular in size, the lines being somewhat waved, instead of straight from point to point, and by there being no raised points at the angles, only the fine lines. [For the structural details arrangement of hairs, etc., see pl. xxiv.] The hairs of the dorsal crest (i) are much as in the first instar. they are long (0·3mm.), curved backward, robust, and spiculated; their bases have little more than an indication of the stellate structure that is so remarkably developed in some of the other (secondary ?) hairs; tubercle ii is also very easily identified, about half the length of i; dorsal to i are eight or ten small hairs; between i and spiracle are fourteen or sixteen hairs and a number of lenticles; there are three or four longer hairs on the lateral flange; of these, the longest (0·2mm.) has, like the seta of i, a comparatively simple base. The prothoracic plate (see pl. xxv., fig. 1) is not very clearly marked out, but is flat under all circumstances, whilst the skin around may fold and pucker as it chooses, so that some idea of the plate is obtainable; it has two (one on each side), long (0·3mm. nearly), central hairs, with stellate bases, a large stellate lenticle (one on each side) in front, and a smaller hair towards each exterior angle; the rest of the prothorax is crowded with stellate-based hairs; lenticles are everywhere frequent, but abundant near the spiracles; on the metathorax is a rather large one, almost corresponding in situation with a spiracle. There is some structural modification at the site of the honey-gland on the 7th abdominal segment, a transverse area a little wrinkled, and

Plate XXIV.

(To be bound facing Plate XXIV.)

Skin of larva of Celastrina argiolus (second instar) × 60.

This shows the first stage of the transition from the few (nearly all primary) hairs of the first instar (pl. xxiii) to the dense, and but slightly differentiated, coating of the last skin. The large dorsal hairs of tubercle i are still distinct, one to each segment (except mesothorax); which hair represents tubercle ii may be doubtful amongst the several large hairs on the dorsal flanges; the three lateral hairs (belonging to tubercles iv and v) are accompanied by several others, whilst in the space between are numerous short hairs and lenticles; of the latter, one or two above the spiracles may represent the very definitely placed pair of the first instar (pl. xxiii). The legs (below to the left of fig.) and the prolegs (above to the right of fig.) are seen (the head is just outside the plate), but are not clear enough in the reproduction to do more than indicate the segments. For detailed description see pp. 438 *et seq*.



Skin of larva of Celastrina argiolus (second instar) ×60. Photo. F. N. Clark.

The Natural History of British Butterflies, etc., 1907.

bare of hairs, but an actual gland is not verified. The glands of the 8th abdominal are not detected. The abundant secondary hairs are about 0·06mm. long, longer in some cases when they approach i and ii or iv and v; they are very delicate, somewhat curved and clubbed, *i.e.*, narrowest at origin, and with some trace of the curious hacked scimitar form so marked in next instar (pl. xxvi., fig. 1); their bases have five or six long stellate processes, not spikes, standing out at an angle (approximately) of 45°, as on the bases of the primary hairs, but long (0·01mm. to 0·02mm.), with rounded ends, and horizontal, *i.e.*, parallel with the skin-surface below; the lenticles nearly all have lateral spikes, more or less intermediate, but more like those of the primary hairs than like those of the secondaries, and decidedly smaller; all the hairs are markedly spiculated. The prolegs have each two (anterior and posterior) pads each with four hooks. The hooks on the claspers are a little larger, but the posterior pad has only three hooks. When *ready for the second moult* (June 4th, 1907), two larvæ were 3·5mm. long, green in colour, slightly modified by numerous black dots on slopes, and paler colour of dorsal region, which is without dots, and has longish white hairs. The larva is broad and, especially, high; the dorsal ridges are rounded, but make a considerable approach to the form of the larva of *Ruralis betulae*, especially in the ridges separating on the thorax, so as to include a forward plane or slope; the lateral line is pale, hardly yellow, and there is some indication of lighter and darker green marking the oblique lines; the dark dots are small tubercles, those dorsally are larger and paler, but of quite the same structure; on one segment 30 are counted from the dorsal line to the spiracle on one side, and this distribution seems to be exceedingly uniform over the whole larva; the structure of these tubercles is remarkable; they consist of a short, thick, rough, almost clubbed, hair 0·06mm. long, bent backwards (tailwards) so as to lie parallel to the surface; their base is expanded into a barrel-shaped piece, from the sides of which project, like the spokes of a wheel, six or seven fine hairs, perhaps about 0·02mm. long, occasionally with one rather longer and stronger, not unlike the warts on certain plumes, *e.g.*, *Ovendenia septodactyla*. The approach of the larva to typical (by typical, meaning rather fully elaborated) Lycænid form, as in *Ruralis betulae*, combined with this curious armature, is striking. *Third instar* (June 5th): Two larvæ just moulted, and eaten their cast skins, are green, with black heads, and so densely felted with hairs that no details of them can be made out, but they appear to be of the same character as in previous skin. By June 10th the larvæ were laid up for the third moult, therefore, *fullgrown in third stadium*. The larva is very like its appearance in previous instar, except that it has a light red-brown dorsal band, broadest in front, and a reddish lateral line, and that the spiculate (white) hairs are more numerous. Along the dorsal ridges there are, on each segment, longer hairs, two about 0·35mm., two a little shorter, and, on each side, altogether, nearly twelve, more or less longer than the general surface hairs, which are about 0·08mm. long; these large dorsal hairs have naturally much larger basal cones than the others, the cones possess, also, the side-spicules, but the latter are not only proportionally, but are actually, shorter than on the smaller bases. There are, on abdominal segments, 70 to 80 hairs on one side from dorsum to level of spiracle. The skin-surface presents a fine network or tessellation. Laterally, there are also longer hairs, but not so long as on the back; all the hairs have a slight curve, and, though some are spiculated all round, the majority are so only along the convex margin; the spiculæ are short and blunt, more descriptively they are rather notches than spicules. In the neighbourhood of the spiracles are some lenticles, which show remarkably how closely related lenticles are to hairs, as the margins of the lenticular rings are produced into six or eight points, closely resembling the side-spines of the hair-bases. The membrane in their lumina is finely dotted. The width of a lenticle is about 0·1mm., more or less, according to whether spicules be measured in or no. Each of the two pads of the prolegs has seven or eight pale ochreous hooks, which vary much in size, some being twice as large as others, but they are not definitely in two rows. Head smooth, black. In this third (penultimate) instar, the hairs and lenticles are, at least, as abundant as in the second: 40 to 45 hairs may be counted between the dorsal set and the spiracle on the abdominal segments. There is still a double dorsal crest of hairs, of which the longest is about 0·3mm., much the same length as in the second instar, and which may be regarded as the seta of i, but, as several other hairs run it closely, the group, rather than any one hair, more probably represents tubercle i. Three of the lateral hairs are nearly as long. In this instar all, but especially the smaller, hairs show very strongly the peculiar character that was present in some degree in the second instar, and that seems to be quite wanting in the last, *viz.*, what I have called the hacked scimitar form; the bases still have the stellate form, the trunk and branches, though hardly longer than in the second instar, are decidedly thicker (pl. xxvi., fig. 1). The branches are nearly (here and there quite) as long as the hairs, but contrast by being smooth, cylindrical, and rounded at the ends; the scimitar hairs, curved so as soon to be nearly parallel with the skin, instead of at right angles to its surface, begin with a narrow neck, where much of the curvature is, then broaden out, sometimes to twice the width, and then narrow to a sharp point; the most striking peculiarity, however, is that the spicules are large and bold along the convex margin, making it something like a saw, and quite (or all but) wanting elsewhere, and the hair consequently looks (or perhaps is) somewhat flat and thin laterally, looking, in fact, just like a scimitar with the edge hacked (*à la* Falstaff). These hairs are very numerous, and there are intermediates between them and the more ordinary form, which are straighter, more club-like, and with more regularly distributed spicules. These hairs vary in length from 0·1mm. to 0·15mm. The longest hairs, however, even those of 0·3mm., have something of the scimitar character. The lenticles are nearly as abundant as in the previous skin; they often have three or four stellate processes nearly their own width in length, and are never quite without them. The honey-gland of the 7th abdominal segment is a transverse mark about 0·3mm. long, without hairs, etc., but with a special line of lenticles along its posterior border; the hairs close by are short, some very short, down to 0·03mm. and 0·05mm., and, in two or three cases, are hair-bases with rounded tops, but no hairs, difficult to class as hairs or lenticles. The bundle of fine, spiculated hairs, terminating the eversible glands of the 8th abdominal segment, may be seen at the site of this gland in a cast skin. The hairs of the under-surface are longer, straighter, and

Plate XXVI.

(To be bound facing Plate XXVI.)

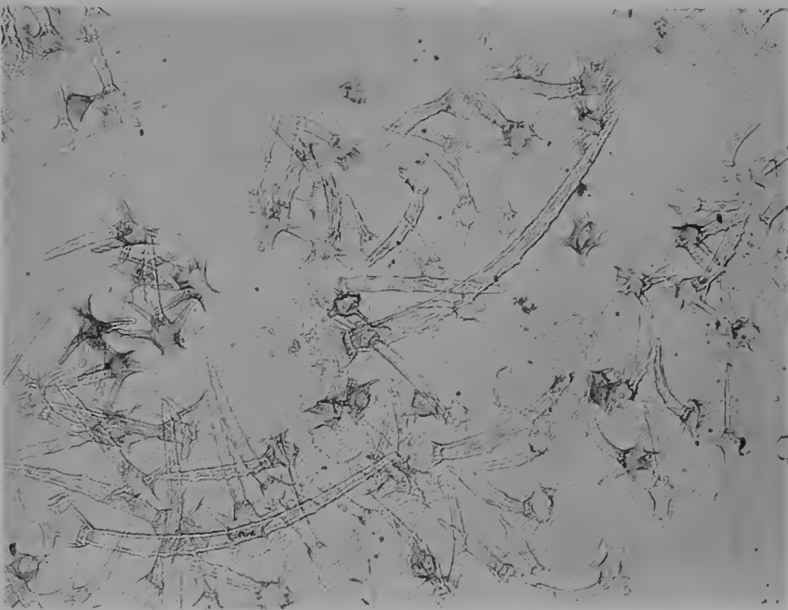
Comparison of larval hairs of Celastrina argiolus in third and fourth instars.

Fig. 1.—Hairs of larva in penultimate stage (cast skin at 3rd moult) × 150.

Two large subprimary hairs (representing i and ii) are very noticeable, also many secondary ones (scimitar and dagger hairs). The hairs and bases are actually, not merely comparatively, larger than in final skin (fig. 2, also pl. XXV., fig. 2). The rays of the hair-bases are more slender than in last stadium, but comparatively thick towards, and rounded at, the ends. The hairs are contracted towards the base, and are fusiform rather than tapering as in last instar; especially they are remarkably curved, and have the spicules very marked on, and often confined to, the convex margin, giving the "hacked scimitar" outline. Several lenticles with coronate margins also represented.

Fig. 2.—Portion of larval skin in final instar × 150 (see also pl. xxv., fig. 2).

Taken from the middle of a segment (with no subprimary hairs) (see pl. XXV., fig. 2). The ordinary hairs are shorter than in the preceding instar (see fig. 1), straight and tapering, no "scimitar" and "dagger" hairs; the hair-bases with short conical rays.



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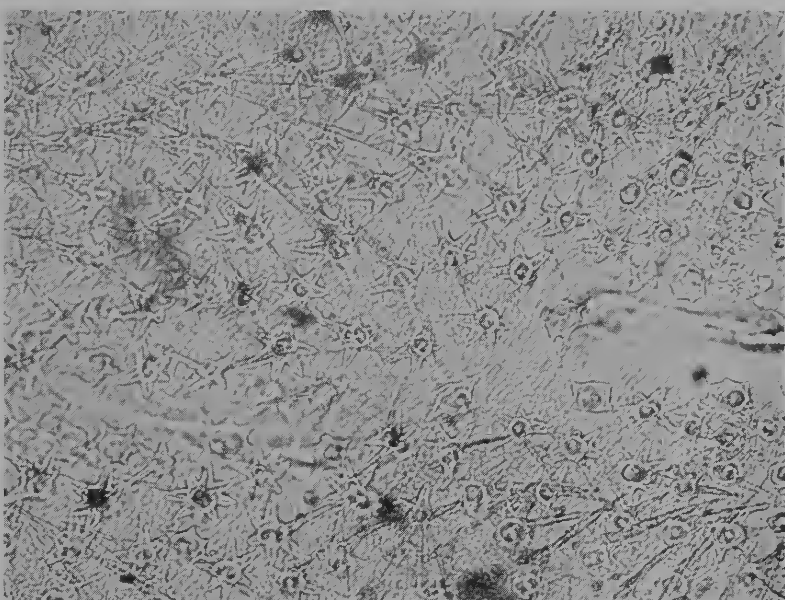

2. *Photo. F. N. Clark.*

Comparison of Larval hairs of Celastrina argiolus (1) in third, and (2) in fourth, instar.

simpler than those of the upper-surface; it requires close scrutiny to avoid describing them as unspiculated; their bases are usually simple cones (non-stellate); these hairs are often long, up to 0·35mm., these belong to the region of tubercle vi. The skin-surface is still reticulated, but the pattern consists of a number of circles (or approximate curves, ellipses, etc.) crowded together, but leaving angular spaces where three or more meet; near the bases of the (true) legs the circles are less visible, but a number of points are distinct, apparently at the spaces of intersection, but whether they are spicular depressions, or mere optical results of different densities, is not at all plain. Near the anal region are some unmistakable, very sharp, skin-points, on rounded bases, arranged in orderly rows; what, if any, relation these have to the circles of the reticulation is not determined. The spiracles, as seen in a cast skin, are remarkable structures; they rise as conical projections with very thick walls; these walls, however, are cellular, having what may be described as two or three horizontal floors (parallel with skin-surface), and about seven vertical ones, though it may be, owing to difficulty in interpreting appearances, that there are seven radiating pillars in a circle round the top, and others lower down; the skin envelops, but is distinct from, this chitinous framing. The pads of the prolegs each have six, seven, or eight hooks (varying), and they distinctly tend to be alternately larger and smaller; in the previous (2nd) instar this was only faintly indicated. *Fourth instar* (June 10th. Just moulted into last instar): Length, 7mm.; height, 2mm.; width, 2·4mm. Head black, shining. On dorsal view, the larva is of nearly equal width from mesothorax to 7th abdominal segment; the dorsal ridges are quite rounded, not very close to each other, and separating from 1st abdominal forwards; the interspace not hollowed; the width about one-fourth of slopes; the slopes hardly convex. On lateral view, the larva is highest about metathorax, and falls slightly to the 7th abdominal segment. The mesothorax markedly rises above prothorax; the mesothorax and the seven following segments have dorsal ridges, slightly humped; the 7th, 9th, and 10th abdominal segments slope backwards, and show little of dorsal ridges. The colour is dark green, relieved by the numerous golden hairs, and by a broad dorsal band of red-brown down the dorsal plain on the humped segments, the three forward ones having a central green spot, and the others green at their margins, dividing the band into a patch on each segment; there is also a pink suffusion along the lateral flange, darkened to almost black at the posterior margins of the 5th and 6th abdominal segments. [Larvæ taken at Moncayo, on heath, varied a good deal in the amount of colouring.] [The larva, under observation at the moment, was deprived (for mounting) of its cast-skin, and is now searching about the site of its silken pad most anxiously, doubtless looking for the skin with a view to eating it, which its fellow is now vigorously doing with his.] The red colouring affects hairs and hair-bases, as well as the skin proper. On the slopes are "oblique" lines; the outer sides of the dorsal ridges have some whitish coloration, wider at the posterior borders of segments; beneath this a faint ruddy tinge, and then a paler green shade on an oblique line, and lower, near spiracular level, another. Down the middle of each segment, on the "slope," is a subsegmental groove. The hairs, with their stellate bases, are packed together absolutely closely (to be further apart as larva grows); they are again longer down the dorsal crests and lateral flanges; the longest about 0·3mm. Dorsally the incisions seem deeply cut, but the dense coat of hairs certainly increases this appearance. The prothoracic plate (pl. xxv., fig. 1) is whitish, clothed with hairs as the rest of the surface, except that it has, on a dark base, an ordinary (*i.e.*, usual in structure, really extraordinary, see details below) hair at each outer angle; this hair is not spiculated; the width of the plate is 0·6mm. The dark hair-base forms a conspicuous black spot. Some of the hairs, at front and back, are about 0·4mm. long. There is no trace of a gland behind the 8th spiracle, but, on the 7th abdominal segment, is a transverse dorsal slit that opens and shuts occasionally, and has, at each end, some fine stellate spicules (hairs?), different from anything elsewhere. The spiracles are pale with shining white margins. On June 14th, the larva is still in its 4th (last) instar; 13mm.-14mm. long; head black, smooth; the dorsal plain red-brown, broadest in front; the dorsal ridges being round, not ridges, except theoretically; seen laterally they are flat at top, but the incisions are deep with rounded margins. The mesothorax rises high above the prothorax, but not so much as, say, in larvæ of *Callophrys rubi* or *Thestor ballus*. The 7th and following abdominal segments are without dorsal ridges, and slope backwards. The lateral line pink (a flesh-colour), toning into olive up to spiracles (light ochreous), the shade under the ridges and oblique lines yellow, but so overlaid with green as to obscure them; a subsegmental (?) double depression on slope. Under a lens, the spiracles are silvery and stems of hairs golden, on green ground; no gland is found in the 8th abdominal segment. In this last instar, the hairs are no longer than in the previous one, a few on the dorsal and lateral flanges, and again in the region of vi, reaching 0·3mm.; a few at the posterior margin 0·4mm., then others very much smaller; the mass about 0·05mm. long. The rays of the stellate hair-bases are now conical and pointed, and relatively rather shorter than in the previous instar. A large majority of the hairs are nearly straight, and, though some are somewhat curved and somewhat clubbed, none approach the scimitar-form so common in the penultimate stage. They are pointed and boldly spiculate (dentate or serrate?) (pl. xxv., fig. 2 and pl. xxvi., fig. 2). The skin is again very similar to that of stage 1—a fine reticulation of delicate lines, almost entirely in triangles, and with an appearance, at the decussations, as of a knob or elevation. These are, however, without any definite structure, and suggest that they are optical effects of a little different density of the cuticle at the angles. In my prepared skins the sites of the glands on the 7th and 8th abdominal segments are very evident, but no structural details are preserved; on the 8th abdominal, portions of skin without hairs or reticulations are seen at the site of the glands, and, on the 7th abdominal, the much larger area has many rather small lenticles crowded along its posterior margin and round the ends. The spiracles present the same structure as before, *viz.*, an outer and inner tube held apart by radial pillars (or plates?), of which ten or twelve may be counted in the upper layer; there is no trace of irregularity in the margin, which is smoothly curved (no lenticles attached as in those of some Theclid larvæ); they project less proportionately than in the previous skin. The hairs are everywhere abundant, but one can still distinguish the regions

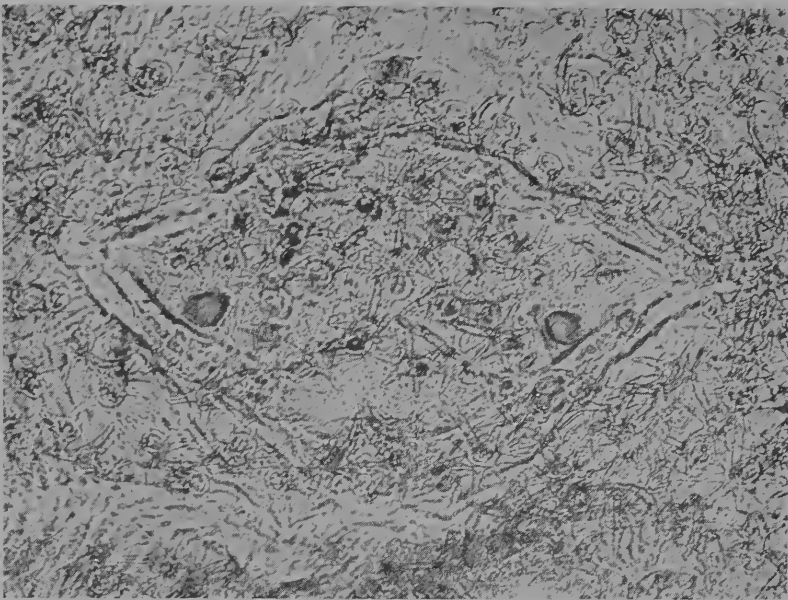

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Photo. F. N. Clark.

Structural details of larva of Celastrina argiolus.

Plate XXV.

(To be bound facing Plate XXV.)

Structural details of larva of Celastrina argiolus.

Fig. 1.—Prothoracic plate of *Celastrina argiolus* in penultimate instar $\times 150$.

The plate is outlined by folds, into which the skin around it has fallen in its preparation, the plate differing only from the surrounding skin by its greater density, and being indistinguishable therefrom in colour, armature of hairs, etc., except for a pair of hairs towards posterior border and outer angles (shown in fig. as two conspicuously dark circles, which are really bases of the hairs, and are round, smooth, large, and dark in colour, differing in these respects from any other hair-bases of the larva). The hairs themselves, which do not come out in the fig., are very long, flowing, slender, nearly uniform in thickness from end to end, and quite smooth and unspiculated, again quite unlike any other hair the larva possesses. These special hairs are most easily observed in penultimate skin. Little traces appear to have been noticed in larvæ of Chrysophanids and Ruralids (but are present in *Bithys quercûs*). They appear, however, to be present in all Lycænine larvæ, *e.g.*, *Lampides boeticus*, *Langia telicanus*, *Polyommatus icarus*, *Agriades bellargus*, *A. corydon*, etc.; in larva of *L. telicanus* especially conspicuous; in *A. bellargus* and *A. corydon* they are the centre of, but are somewhat lost in, a dark spot at the outer angle of prothoracic plate.

Fig. 2.—Portion of larval skin of *Celastrina argiolus* in last instar $\times 150$ (see also pl. xxvi., fig. 2).

Taken from near the dorsal margin of a segment. The longest hairs are those of dorsal crest (setæ of tubercles i and ii), the others are the very numerous skin-hairs. In spite of the crowding of hairs (and blurring due to reproduction), it shows the special character of these hairs as compared with stage 1 (pl. xxiii.), stage 2 (pl. xxiv.), and previous skin (pl. xxvi., fig. 1).

of tubercles i, iv+v, vi, and vii, in having them both rather more abundant and rather larger than in the regions between. The prolegs have the usual anterior and posterior pads, each of which has eight or nine large hooks (0·08mm., or 0·09mm. long), and nine or ten little more than half their length, alternating with them. The claspers are very similar, but the hooks are a little larger and the posterior set are more numerous (20 to 25 in different specimens) (Chapman).

Special prothoracic larval hairs.—We have, on the prothorax, most conspicuously in the last larval instar, a pair of hairs differing very much from all the others anywhere on the larva; each hair is nearly as obvious in the preceding (penultimate) instar, when found, but does not compel notice as in the last skin, and, tracing it back, it is found in the 2nd instar, and appears to correspond with one in the 1st instar, which, in examining that stage, attracted no attention; it is the smallest hair on the prothoracic plate, occupying its outer posterior corner. In this 1st instar, this hair is very slender, unspiculate, of uniform width from end to end, and, in length, about 0·1mm.; its base is not raised into the same cone as the others, but has a similarly darkened (the bases of the other hairs in the first stage are definitely marked off from both hair and skin by dark colouring) area on the flat of the plate, not sharply defined, but fading out at its margin, and the pale circle to which the hair is articulated is larger, four or five times the diameter of the hair instead of much the same as in the ordinary hair. In the second instar, this hair occupies the same position so far as the prothoracic plate can be defined, and has much the same character. It is small, slender, but enlarging a little upwards, and smooth; its base is remarkable in not being stellate, like that of all other hairs, but merely a dark rounded elevation of the plate itself, and not a separate structure, nevertheless, it is inconspicuous amongst the other hairs, chiefly owing to its small size. In the penultimate stage (pl. xxv., fig. 1), it is very conspicuous (when looked for) by its base being brown, the other hairs and bases being colourless. The hair is about 0·14mm. long, and the other characters are as already described in the second stadium. One may believe, taking these hairs as indications, that one sees the outline of the plate in this third stage, marked by a trifling difference in tone. In the last stage, they may be seen by aid of a hand-lens, as two brown dots 0·5mm. apart. Magnified, they look quite unrelated to the beautiful, nearly stellate, hair-bases that closely surround them. Instead of being superficial to the skin, and articulated to the surface, like the other hair-bases, this brown base is a hemispherical eminence beneath the skin, and the skin-points are seen regularly arranged, superficial to it, the central ones closer together than elsewhere, and tinted brown like the hair-bases, wanting only in a narrow circle round the central pale spot, from which the hair arises. The hair itself is very long and slender, colourless, 0·4mm. long, the hairs about it being at most 0·1mm. Towards the end, it expands into a spathulate process (or clublike and rounded during life ?) on which the very faintest traces of points are seen (or suspected ?), very different from the spiculæ of the ordinary short hairs. No trace of this very remarkable hair, or anything to represent it, can be found on the pupa (Chapman).

Variation of larva.—The larva varies very considerably in colour, and in the intensity and amount of markings; the adult larva, however, is usually dark green, with some whitish markings on the outer edges of the dorsal ridges, edged inferiorly with reddish, and with a broad dorsal band of red-brown occupying the raised area between the dorsal ridges, the band being more or less disturbed by a central green patch in the forward portion, and by intersegmental green lines on the hinder part; the red-brown colour affects the hair-bases and hairs as well as the skin; the oblique lateral lines, or shades, are usually pale green. Chapman observes that, in July, 1903, larvæ were abundant at Moncayo, on heath, apparently *Erica arborea*, but these larvæ were dove-coloured, with brown markings, and no trace of green. Schneider says that, in Upper Lusatia, the larvæ found on *Genista tinctoria* are yellow, those on *Rhamnus frangula* green. Adkin notes that, at Eastbourne, in September, 1896, on ivy, there were two distinct colour-forms, one purplish the other green. Buckler describes five forms (*Larvae Brit. Butts.*, i., pp. 97-99):—

1. Bright yellowish-green, with a pale streak on dorsal ridges; thin, double, slanting lines on sides, a margin of yellowish-white along subspiracular region. The head purplish-brown, an ochreous streak above mouth and at base of papillæ; the spiracles round and flesh-coloured; skin velvety, with its surface thickly covered with yellowish, warty granules, each having a minute, bristly hair.

2. Of the same yellowish-green ground colour; dashes of deep rose-pink on each humped ridge of the back, and in the dorsal channel continued to the anal end, and an additional dash on each side of the 1st abdominal; along the sides, fine, double lines of pale greenish-yellow, edged with darker, slanting backwards; the subspiracular ridge itself of a whitish flesh-colour, deepening above and below with a narrow border of full rose-pink, which again melts into the green ground colour.

3. Shows a very pretty mixture of green and black; the ground colour green as before, a transverse bar of black across the middle of the prothorax and beginning of mesothorax; a dorsal series of thick dashes from the mesothorax to the 6th abdominal; the 7th with a dash on either side enclosing the green ground colour as an interruption, with the dorsal marking again occurring on the 8th and 9th abdominals; on each ridge of the back is a row of roundish spots, and, a little lower on the side, a row of squarish spots, and, lower again, in the spiracular region, a row of roundish spots placed at the segmental divisions; on the 1st abdominal the upper markings are thicker and run together.

4. Olive-green, strongly marked with crimson on the dorsal region and along the sides, and deeply suffused with this colour on the thoracic segments; in the midst of this suffusion a pale yellowish-olive semilunar patch, situated transversely on the back at the hinder part of prothorax.

5. With deep rose-pink on the three thoracic and last three abdominal segments; the other segments of the body light green.

It should be noted that about four or five days before pupation the larvæ sometimes become of a dingy olivaceous-pink, or mouse-coloured.

The eversible and honey glands of Celastrina argiolus.—Guenée described, September 25th, 1867, some interesting structures observed by him in the larva of *Lampides boeticus* (see *anteà*, pp. 348-350). In July, 1869, Goossens observed similar structures in the larva of *C. argiolus*. This observer notes (*Bull. Soc. Ent. Fr.*, 4th ser., x., pp. 77-78) that he found five larvæ on "vigne vierge," in which he noticed the organs described by Guenée: (1) A sort of cushion on the 10th (7th abdominal) segment, whence a transparent hemispherical vesicle was extruded, which secreted freely a large drop of fluid that was renewed as soon as the former one was absorbed. (2) On the 11th (8th abdominal) segment, two openings (one on either side), from which a disturbed larva extruded a pyriform organ, the end of which bristled with small, fleshy, scale-like points. He was unable to make any suggestion as to the use of these structures. Edwards, however, later, worked out the structure and use of these organs at length; the eversible glands, he says, on the 8th abdominal segment, consist of white cylindrical tubes, of nearly even size, rounded at the top, and studded there with minute processes from which come the tentacles (*Butts. Nth. America*, ii., Lyc. pl. ii., fig. m^2). These are long, slender, and tapering, armed with fine filamentous spines disposed in whorls, and they stand out straight, making a white hemispherical dome over the cylinder, and none of them dip below the plane of the base of the dome. When the tube comes up, the rays are seen to rise in a close pencil, and, as the dome expands, they take position; on the contrary, when the tube is withdrawn, the top of the dome sinks first, and the rays come together (*op. cit.*, fig. m^1). The position of these organs is apparent in the younger larval stages, but, till after the second moult the larva appears to have no power to project the tubes, and not till the latter part of the same stage to emit the secretion. Ants, confined with larvæ in the first stage, treat them with indifference. . . . . Lintner described these organs as 'cylindrical, with barbed hairs.' Mack noted them as being similar to those of *Plebeius argus* and *Agriades corydon;* and added that they were placed on the penultimate segment (really they are on the 8th abdominal), outside and behind the stigmata, looking like two large white spots, each one of which evaginates a white membranous tube, just like the finger of a glove, the top of which is not entirely drawn out; . . . if the tube be blown on ever so little it is instantly invaginated. Edwards further figures (*op. cit.*, p. 14) a diagram by Mrs. Peart showing the position of these eversible glands, their appearance (1) when slightly protruded, and (2) when much further protruded. The honey-gland was first noted by Mack (Edwards' *Butts. Nth. America*, ii., Lyc. p. 11), who stated that it was placed on the antepenultimate (really it is on the 7th abdominal) segment, and that it formed a largish transversal opening behind and between the stigmata near the apical border, whilst it is described as looking like a closed mouth with its lips. Edwards observed that from these lips a dark green mammilloid membrane was protruded, and from the top of this a tiny drop of clear green fluid, which ants drink greedily, was exuded. The intervals between the appearance of the globule vary with the condition of the larva (see *infrà*). . . . Hunt states that he could find neither special glands beneath the membrane of the 'honey-gland,' nor an orifice on its surface, but he says that the fluid appeared to exude through minute pores all over the membrane; nor could he discover any connection between the eversible glands of the 8th, and the honey-gland of the 7th, abdominal segment. A diagram of the honey-gland by Mrs. Peart is given by Edwards (*Butts. Nth. America*, ii., Lyc. p. 14).

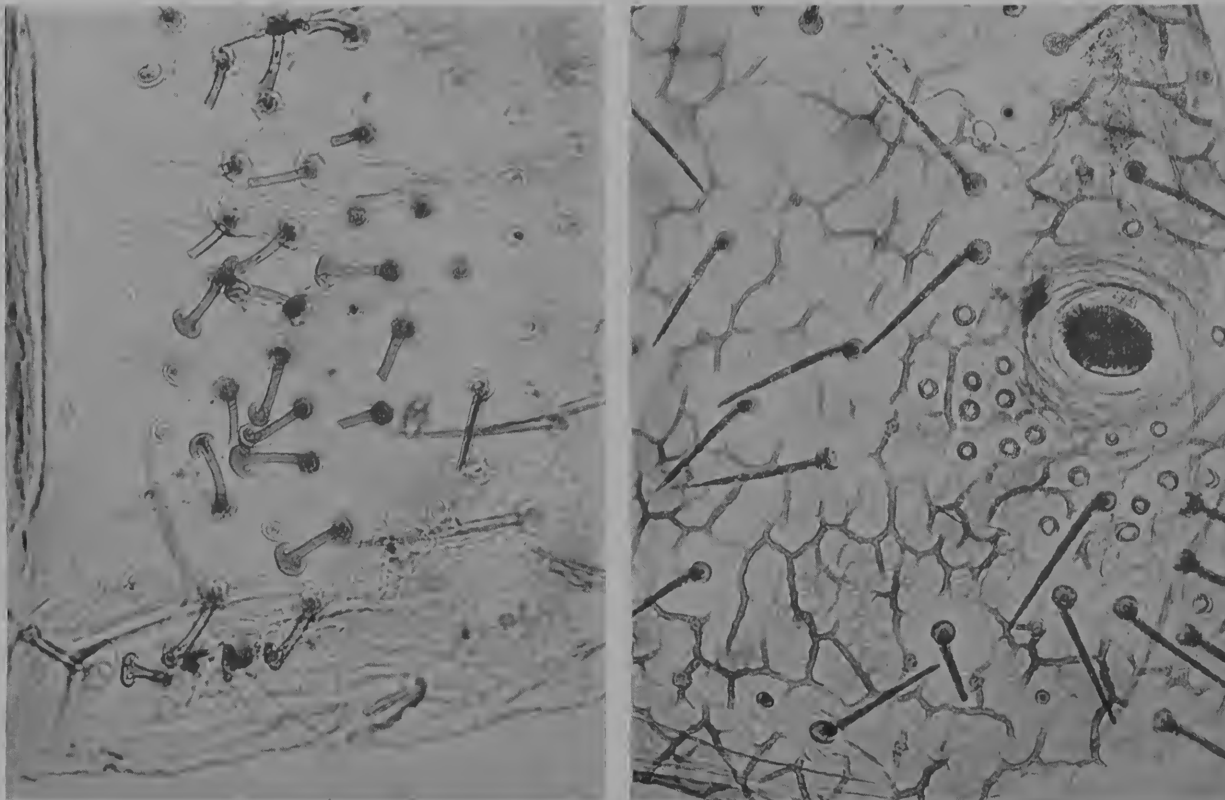
Connection between larvæ of Celastrina argiolus and ants.—On an ivy at Hazeleigh, with small variegated leaves and flowering towards the end of August, a search on the afternoon of August 31st, 1906, revealed two small black ants, *Lasius niger*, running backwards and forwards over a fullgrown larva of *C. argiolus*. Being left undisturbed, four ants were found attending it at 5.30 p.m.; there were no ants on nine other larvæ found the same day. On September 1st, at 11 a.m., a larva was found with two ants running over it, and stopping now and then to imbibe some sweet exudation. There were many of these ants on the ivy, especially at the tips of new shoots, where they were milking black aphides (Raynor, *Ent. Rec.*, xviii., p. 299). Edwards had, however, long before worked out in detail the connection between no fewer than four species of ants and the larva of the American form of this species. He states (*Butts. Nth. America*, ii., Lyc., pp. 10-12) that he observed, in 1877, the flower-spikes of *Cimicifuga racemosa*, on which larvæ of *C. pseudargiolus* were feeding, were much frequented by ants. It was soon evident that the ants were attracted by the larvæ, for they caressed them with their antennæ, running up and down their backs, the larvæ in no way resenting this familiarity, not even withdrawing their heads from the buds they were excavating; the ants seemed especially to linger about the last segments, particularly the 11th (7th abdominal). Lintner examined the larvæ and found the processes on the 8th segment, whilst Mack found in addition the honey-gland on the dorsum of the 7th abdominal. Between 1878 and 1883, observation was almost continuously kept on the larvæ, and it was noted that when ants were discovered on a stem, they were almost invariably on or near the larvæ. . . . . At first only two species of ants were observed, of medium size, but, later, Edwards noted that at least four, of which one is a very small species, not more than one-eighth of an inch long, accompanied these larvæ, operating in the same manner, and, in one case, six of these were busy over one larva, but the movements of all the species were similar. . . . . They run over the body, caressing incessantly with the antennæ, and undoubtedly with the object of persuading the larva to emit the fluid. . . . . Much of the caressing is done about the anterior segments, and while the ants are . . . . absent from the last segments, the tubes . . . . are almost constantly exposed to their full extent, and so remain without retracting, until the ants come tumbling along in great excitement, and put either foot or antenna directly upon, or close by, the tubes, when these are instantly withdrawn. The ants pay no heed to the tubes so far as touching them with intention, but at once turn to the median honey-gland, caress the back of that segment, put their mouths to the orifice, and show every sign of eager expectancy. With a lens, a movement becomes speedily apparent, and there protrudes a dark green mammilloid membrane, from the top of which exudes a tiny drop of clear green fluid. This the ants drink greedily, two or three of them perhaps standing guard over it. The demonstrations of the ants are of the most gentle nature, caressing, entreating, and, as the little creatures drink in the fluid, lifting their heads, as if to prolong the swallowing, there is a manifest satisfaction and delectation that is amusing to see. They lick away the last trace and stroke the back of the segment, and wait to see if their coaxing avails anything. If not, they run about . . . . but presently return, and the caressings go on as before. The intervals between the appearance of the globule vary with the condition of the larva. If exhausted by yielding to the frequent solicitations, some minutes may elapse, and the tubes meanwhile will remain concealed; but a fresh larva requires little urging; and the mere intimation of the presence of an ant in the vicinity is enough to cause the tubes to play rapidly, and one globule to follow another, sometimes without a retracting of the membrane, and before the near approach of the ants. I have counted six emissions in 75 seconds. The tubes are usually expanded when the ants are away from the last segments, and are retracted when they come near. I counted the length of these periods of complete and quiet expansion, 10, 20, 50, and to 80 seconds, the period always ending with the approach of the ants. I experimented, ... placing larvæ . . . . upon stems of the growing plants, where the ants had access to them. . . . . As soon as the ants discovered one of them, there was an immense excitement, and a rush for the last larval segments. The larva forthwith relieved itself by the execretion of the fluid, and the tubes stood out with tops expanded during the periods. If I placed a fresh larva on a stem on which were no ants, there was no excitement in the larva, no appearance of the tubes, and no movement in the median gland. If ants were now transferred to the stem, at once the larva changed its behaviour. The ants were only noticed as attending the larvæ in the later stages of the latter, and only observed in the case of summer-feeding larvæ. Edwards further notes (*op. cit.*, p. 13) that the ants, when confined with larvæ in the 1st instar, treated them with indifference. He introduced ants to larvæ in separate glass-tubes, some larvæ being at the middle, and some near the end of the second stage (*i.e.*, near the second moult); one of the larvæ was caressed several times but no tube appeared: another larva objected to the ant, thrashed its anterior segments about, and the ant left it. An ant introduced a day after the third moult . . . solicited as usual; the tubes appeared, and a drop of fluid came from the honey-gland, which the ant drank eagerly; it returned several times but obtained no more; on the same day an ant was introduced to two larvæ towards end of third stage (*i.e.*, just before third moult), there was a slight movement of the tubes in one larva, a mere point protruding, but no fluid from the honey-gland. The other larva did not respond at all, and the ant left both. An ant was introduced with another larva in its third stage, when the tubes were seen to play actively, but, though the ant held its mouth to the honey-gland for some seconds, no excretion was observed. It is in the last larval stage that the fluid flows freely at the solicitations of the ants. Edwards insists, however, that this only occurs with summer larvæ, on *Cimicifuga racemosa*, the flower of which is exceedingly sweet; he has not observed an ant on dogwood, and ants placed with larvæ feeding on dogwood soon became indifferent to them; similarly, ants attracted to autumn larvæ, feeding on *Actinomeris*, which has a flower bitter to the taste, have been noticed to turn away after investigation. Edwards considers that the tubes (on the 8th abdominal segment) serve as attraction signals to the honey-gland on the 7th abdominal. He has observed larvæ in the last stage, when no ants have been present, irregularly protrude the tubes, without any corresponding activity of the honey-gland; the presence of the ants, he says, seems necessary to produce this and the larvæ appeared only to emit the fluid when the ants were near. McCook informed Edwards that, in the spring of 1877, he saw a small green larva on *Cimicifuga racemosa*, and a black ant attending it, stroking the tail incessantly, moving away, and returning to go through the same process; he watched this for two hours, and saw that the purpose of the ant was at least friendly, although he was at a loss to explain these strange manipulations.

Foodplants.—Flowerbuds, young green berries and tender young leaves of *Ilex aquifolium*, flower-buds and young leaves of *Hedera helix*, (Buckler), flowers of *Rhamnus frangula* (De Geer), *Rhamnus catharticus*, (Krieghoff and Richter), *Frangula alnus* (Paul and Plötz), *Euonymus europaeus* (Harwood), flowers of *Cornus sanguinea* (Fletcher), flowers of *Escallonia* and *Laurustinus* (Mathew), vigne vierge (Goossens), flowers of *Rubus* (Mathew and Luff), of *Syringa* (Marshall), of *Erica vulgaris* (Freyer), of *Erica arborea* (Chapman), *Calluna vulgaris* (Paul, Plötz and Hofmann), *Spartium junceum* (Chapman), *Ulex europaeus* (Jefferys), *Dorycnium* (Stefanelli); flowers of *Clematis vitalba*, in confinement (Prideaux), ?rhododendron (Raynor); the flowers and tender shoots of a species of *Berberis* (at Gallipoli) (Mathew); flowers of *Lythrum ? salicaria* (Stange); black alder (Laplace); flower-buds of *Robinia pseudacacia* (Kranz and Steinert), *Genista tinctoria* (Schneider *teste* Schülze); the fruits of *Astragalus glyciphyllus* (*teste* Höfner). [The statement that the larva feeds on "young oak-leaves" (*Soc. Ent.*, xiv., p. 99) requires confirmation; so also does *Pyrus* (Himsl). Some of the old British textbooks give grass (see *Butt. Coll. Vade Mecum;* Ventris, *Ann. Mag. Nat. Hist.*, v., p. 205, 1832).] [For further list of "foodplants" see *anteà* p. 410.]

PARASITES.—Bird notes that the larvæ of this species were very ichneumoned in 1902 and 1903, in Sussex. Adkin observes that about half (15) of the larvæ of *Celastrina argiolus*, collected by him at Eastbourne in August-September, 1896, fixed themselves in the ordinary way as if for pupation, but, instead of becoming pupæ, remained affixed to the leaves for nearly a fortnight without changing, when a single yellowish-white dipterous larva, but little smaller than its host, came forth from each, and, where possible, made for the side of the cage, and, having crawled some 3 or 4 inches along it, leaving a slimy trail similar to that left by a slug, either attached itself to the side of the cage, or fell to the earth, and, within a few minutes, had assumed its pupal shape, but remained of the whitish larval colour for some hours, eventually turning to a deep brown. Mrs. Redmayne notes (*Ent. Rec.*, xii., p. 164) rearing, between April 27th-28th, 1900, *Listrodromus quinqueguttatus*, Grav. (*nycthemerus*, Grav.), from pupæ that had been derived from larvæ collected September 4th, 1899, at Chalford. Morley gives (*op. cit.*, pp. 186-187) an account of this insect and its emergence, and adds: "As far as I am at present aware, *Listrodromus quinqueguttatus* confines its parasitism to *C. argiolus*, since it has been bred thence by Marshall in August, from larvæ found on *Syringa* in July (*Ent. Mo. Mag.*, xxxiii., p. 235), by Bignell, Prideaux and Mrs. Redmayne. Raynor notes (*in litt.*) that, on June 25th, 1901, he beat 50 larvæ from holly at Danbury, many of which produced this same parasite. Weismann first suggested to Edwards the possibility of the evaginable tubes on the 8th abdominal segment and the honey-gland on the 7th segment being of use in attracting ants which would in turn drive away parasites, afraid of ants, from the larva. Of the parasites affecting the larva of the American form, Edwards writes that, there are four (1) A Tachinid, *Exorista theclarum*, which deposits its eggs on the larval skin in the 2nd stadium, and on the 2nd or 3rd segments; when the grubs hatch they eat their way through the skin, and emerge when fullgrown in the last larval stage, making for themselves a hard pupal case, from which in a few days the fly emerges. (2 and 3) *Apanteles cyaniridis* (nec *congregatus*, Say), and another minute hymenopterous species (? *Hemiteles lycaenae*). Both these lay their eggs singly, within the very young larvæ, the grub eating its way out when the larva is only halfgrown, proceeding to spin a cylindrical cocoon of yellow silk, from which in a few days the imago emerges. (4) A species of *Anomalon* (? *Angitia pseudargioli*), which appears to sting the larva only in the final stages. In this case the *Anomalon* larva feeds inside the attacked caterpillar, which pupates in due course, the hymenopterous parasite emerging from the pupa which it has, of course, destroyed. As bearing on Weismann's suggestion noted above, Edwards observes that, on June 20th, 1878, he saw in the woods a mature larva of *C. pseudargiolus*, and, on its back, facing the tail, a large ant. At less than two inches behind, on the stem, was an example of the *Anomalon* just noted, watching its chance to thrust its ovipositor into the larva. He continues: "I bent the stem, and held it horizontally before me without alarming either of the parties; the hymenopteron crawled a little nearer and rested, and again nearer, the ant standing motionless, but plainly alert and knowing of the danger. After several advances, the ichneumon turned its abdomen under and forward, thrust out the ovipositor, and strained itself to the utmost to reach its prey; the point was just about to strike the extreme end of the larva, when the ant made a dash at the ichneumon, which flew away, and, so long as I stood there, at least five minutes, did not return. The larva had been quiet all this time, its head buried in a flower-bud, but the moment the ant rushed, and the ichneumon fled, it seemed to become aware of the danger, and thrashed about the end of its body in great alarm. The ant saved the larva, and it is certain that ichneumons would in no case get an opportunity to sting, so long as such a vigilant guard was about. It seems that the advantage is mutual between the larvæ and ants, and that the former know their protectors, and take satisfaction in rewarding them. This was the only occasion which has fallen under my notice in which the actual attempt to sting was defeated, but, on June 16th, 1881, several larvæ and several ants were observed on a stem of *Cimicifuga racemosa* about which an *Anomalon* was hovering; it came very near one larva, but an ant, not standing upon the latter, ran at the fly, which then departed. On June 20th, 1879, another *Anomalon* was observed creeping along a stem on which was a halfgrown larva but no ant; the ichneumon moved up, put one leg on the larva, rested an instant, turned round, and, when apparently about to give the fatal thrust, hesitated, and, after standing quiet more than two minutes, flew away; the conclusion was reached that either the larva was too young for the purpose of the ichneumon, or the latter discovered that it had already been parasitised" (*Butts. North America*, ii., *Lyc.* pp. 14-15.)

Pupation.—When fullfed the larvæ change to a dull livid pink colour, this change being effected in the course of a few hours, when they show a disposition to descend the sprays of ivy, and it was found that a few ivy leaves, scattered over the bottom of the cage afforded them suitable conditions for pupation. The larva spins a small mat of silk in the concave side of an inverted ivy-leaf, a pretty strong silken girdle is made, which fits into the hollow between the pupal thorax and abdomen; this, with the anal support, secures it firmly, its face to the leaf; the pupa itself, of a rounded dumpy shape, reminds one somewhat of that of *Rumicia phlaeas*, and is of an ochreous tint dashed and blotched with brown. The pupal stage of one of these lasted only about a fortnight, of all the rest under observation about seven months (Prideaux). Buckler says that about four or five days before changing, the larva ceases to feed, spins a fair amount of silk as a foothold, and a stout thread as a cincture, crossing the front of the mesothorax, and strengthened near the base on either side, by two other short threads joining it, thus forming triple moorings. The operation of changing to a pupa brings away the cincture from its resting-place on the larva to below the thorax on the pupa, so that the thread, at first slanting forwards over the larva, now slants a little backwards over the pupa (Buckler). In some that we specially examined, however, the cincture passed up one side over the 1st abdominal, falling across the segmental incision between the metathorax and the 1st abdominal at the top of the dorsum, back over the side of the 1st abdominal on the other side. Adkin states that the fullfed larva quits the bud, and, having selected an adjacent leaf, attaches itself thereto by slender silken threads, and in three or four days becomes a pupa. Chapman notes that the pupa has a well-developed cremaster, and suspends itself with a girth, preferring some hard and solid place to which to attach itself, and not affecting leaves, etc. The girth divides at its attachment into three or four fine threads, but over the back is a single cable which sinks into the incision between the 1st and 2nd abdominal segments. Raynor states that the pupæ are brown in colour, but darker at each end, and, with the exception of one, which selected the northwest corner of a card-board box, the remainder of a brood, reared in confinement, attached themselves to the surface of ivy-leaves as follows: in four cases, a single pupa on the upperside of a leaf; in two cases, a single pupa on the underside of a leaf; in two cases, two pupæ on the underside of a leaf; in one case, three pupæ on the upperside of a leaf; in one case, one pupa on the upper- and two on the underside of the same leaf. On March 20th, 1897, a ♂ was observed drying its wings, at 9 a.m., under an ivy-covered wall, at Reigate (Prideaux); similarly, at Stroud, on more than one occasion, specimens have been met with, in April, drying their wings on grass-stems, at the foot of ivy-clad walls, suggesting that the larvæ had undergone pupation either among the herbage or on the surface of the soil (Davis). The pupal stage is said to average 11 days in summer, in Pomerania (Paul and Plötz), but the time varies considerably. [For further notes on "Pupation" see *anteà* p. 410.]

Pupa.—The form of the pupa is a fairly ordinary Lycænid one. The thorax is proportionally small, both in height and width. Compared with the few other Lycænid pupæ I know, it is unusually hairy. The pupa of *Everes argiades* has longer, but not quite so numerous, hairs. It is a rather small pupa, 9·0mm. long, 3mm. high at middle of mesothorax, 3·7mm. at 3rd abdominal segment, which is its highest point; these are respectively 2·0mm. and 5·0mm. from front. The ventral surface is nearly flat, projecting slightly at the first legs, and the ends of the wings; a little raised from surface on which it lies, at extreme front, and from first legs for some 2mm., opposite "waist" above. The front leaves the surface ventrally, not quite vertically, but sloping forwards for about 1mm., when the extreme front (dorsal head-piece) is about 0·5mm. in front of the ventral (flat) surface. The outline (now dorsal) then bends backward somewhat sharply, passing in a nearly straight line to the top of the metathorax; thence there is a trifling fall to the lowest point over the 1st abdominal segment, thence a fine regular curve, getting sharper as it proceeds, passes over the highest point, and reaches the attached surface by finally bending slightly forwards, the extreme posterior end of the pupa (apparently the middle of the 9th abdominal segment) being about 0·8mm. from attached surface and 0·2mm. beyond it. Viewed from above, the wing-spines project obviously as slight rounded elevations; the pupa is 2·4mm. wide across them, 1·4mm. from the front. In front of this the head and prothorax form a little more than a semicircle, being quite rounded; thence, the sides gradually diverge (along the wings) to 5·6mm. from front to the widest part of the pupa (nearly 4mm.) at 3rd-4th abdominal incision; thence again, the lines form a continuous elliptic curve round the posterior extremity. The markings are a dorsal series, a series halfway thence to spiracle, and another a little nearer spiracle, again just below spiracle, and another series a little more ventral. There is usually a dark mark at the end of the 1st abdominal segment; it belongs to the subdorsal series, but is present when these are wanting in next segment or two; there are others round the wing-spines. These marks vary much in different pupæ, both in size and intensity, but are not, as in many Lycænids, obviously aggregations of dots. The wings are more or less mottled with dark, the neuration often showing well as paler lines. "Poulton's line" is not well marked, but the margin beyond it slopes down to the surface of the 4th abdominal segment. The prothorax is about 1mm. long down the central suture, and from this to the pointed outer angle measures about 2mm.; the borders are parallel for half this distance, then they approach the posterior the more; it has also a curved hollow opposite the spiracle-cover of the mesothorax; it carries 60 or 70 hairs on either side, with some lenticles; attached to its anterior border, after dehiscence, as before, is the dorsal head-piece. Either half of the latter is less than 1mm. transversely, and about 0·2mm. from back to front at its broadest, and about 0·1mm. in the middle line; it has the ordinary lines of netting somewhat faintly marked, but no hairs or lenticles. The mesothorax is about 3·5mm. long in the middle line (suture), about 2·0mm. at the base of the wings, where the metathorax, as usual, arches up into it, the latter being about 1·3mm. long here, and about 0·25mm. in the middle line. The mesothorax has perhaps 140 to 150 hairs on either side, the metathorax about 35. In each case (in the pupa examined), some hairs have been broken off, and, without a minute study in each case, it is difficult to say whether the ring left is a hair-base or a lenticle. In each case, the hairs, etc., cease where the wings begin, these having only reticulations. The cover of the 1st spiracle is in the wing area, quite its own length from the ordinary surface area (with hairs, etc.); this spiracle-cover is about 0·5mm. long and 0·1mm. broad (from back to front); it is raised so as to be convex over its whole surface; the latter seems to be a pavement of polygonal cells, about 2000 or so in number, where, however, a view of the margin is obtained, each of these cells is seen to be the expanded top of an upright pillar, a structure identical with that observed in *Lampides boeticus*, except that here they all appear to be welded together in the pupa of *C. argiolus*, whilst, in that of *L. boeticus*, each little glassy pillar with its slightly cupped, nearly flat, top, appears to be unattached to its neighbours (*see* p. 355, pl. xxii., fig. 2). The 1st abdominal segment is about 3mm. across (side to side), 0·4mm. in length at the dorsal line. In the dorsal line, the 2nd abdominal segment is about 1·2mm. long, the 3rd 1·0mm., the 4th and 5th about the same, the 6th rather less, the 7th 0·7mm., the 8th 0·5mm., whilst the 9th and 10th together form approximately a circle of about 1·6mm. The head-piece has some 20 hairs in front, two at the base of the mandibles. The labrum and mandibles are both marked off by sutures. The mandibles meet in the middle line for about 0·08mm., and there is a minute square of labium, between them and the maxillæ. The labrum ends in a point, the apex of an angle of about 90°. The face projects with a more than usually sharp and pronounced angle, between the bases of maxillæ and first legs. The glazed eye is a dark line, with a broad, smooth, space outside it (the eye proper being marked by the points of the eye facets), and centrally (against antennæ and first leg) is a portion of ordinary surface carrying reticulations and 8 hairs, and three minute lenticles. The maxillæ are about 3·6mm. long (this pupa is rather a small one, and all dimensions are possibly below average); the basal, broad, portion is short, and the ends disappear by the antennæ meeting over them in middle line; the antennæ proceeding another 2·7mm. between the wings. The 1st legs are very broad (and curved) basally, 2·3mm. long, 0·6mm. broad (where broad), ending in a point between maxillæ and 2nd legs, and against antennæ for about 0·4mm. The 2nd legs are slender, about same length, and end in points at each end. The sculpturing of the surface is a network of raised ribs, generally darker than the area between them ; the ribbing is, however, rarely closed into a network over any considerable area, but the loose ends terminate in a somewhat dendritic way, branching into paler (and also smaller) ribs before fading into the general surface. In many places, however, a further structural element of the ribs is evident, these dendritic endings being continuous with a very small-celled netting that fills up the spaces between the larger ribs; this small netting is very much on the same scale as the network on the larval surface, and the inference is strong that it is the same structure. The large ribbing would then be certain lines of the larval network preserved and emphasised, the remainder disappearing except where, as here, some remnants of them are preserved. The points on the ribbing would correspond with the points at the angles of the network on the larva. The points on this pupa are comparatively few, and, though always on the network, do not occur solely at points of intersection, unless one carefully notes the minor fading branches; they are about three times as broad as the ribs, are round, and have a central bright point, and some indication of radial structure ; as a special peculiarity, they appear to be like buttons laid on the top of the ribs, instead of thickenings in the course of them, as they do in most Theclid pupæ. The hairs are everywhere of almost identical pattern and length, about 0·18mm. long, tapering regularly till near the end, then more rapidly, spiculated, but very faintly, till near the end, when the rapidly-thinning portion seems to dissipate itself in larger and more numerous spicules, nearly at right angles to the stem and often nearly as long as the stem is thick where they arise. Lenticles are sparsely scattered everywhere, and are very like (in size, etc.) hair-bases, but the finely dotted closing membrane at once distinguishes them. Hairs and lenticles, as in other Lycænid pupæ, occupy interspaces of the network, and are never on it. The wings and appendages are, as usual in allied pupæ, netted, but have no hairs, lenticles, or network points. There is the exception, however, that I now recognise, *viz.*, in



1. Pupal stucture of Celastrina argiolus. 2. *Photo. F. N. Clark.*

1.—Dorsal portion of cremastral area × 150. 2.—Spiracular area of second abdominal segment × 100.

Plate XXVII.

(To be bound facing Plate XXVII.)

Pupal structure of Celastrina argiolus.

Fig. 1.—The dorsal portion of cremastral area of the pupa $\times$ 150.

Nearly the whole of the dorsal portion is shown. At the outside of the fig. is the margin of the transverse suture that crosses the combined 9th and 10th abdominal segments; this suture is, perchance, the anal scar. The blurred portion (at lower part of fig.) is a fractured margin a little out of focus; beyond this fracture six more hooks exist, and rather more are excluded on opposite side (top) of fig. Hairs are seen towards dorsum (to right), and these are more abundant on the dorsal portion of conjoined segments; it is probable that, roughly, the haired portion is the 9th abdominal segment. The hooks have slightly bent stems, and the hooks themselves, on either side, are not in the same plane as the stem, but are twisted a little to one side. The darker spots are probably bases of hooks that have been broken off in removing silk, of which a scrap remains in the right lower middle of plate. The paler circles are abortive structures, but whether rosettes (of netting) or lenticles is doubtful.

Fig. 2.—Spiracular area of right side of 2nd abdominal segment $\times$ 100.

This shows the characteristic pupal hairs, though the spiculation is merely suggested in reproduction of photograph. Neither hairs nor lenticles (which are numerous near spiracle), have any trace of the radiated base, which is so striking a character in the larval hairs; the lumen of the lenticles being, as usual, dotted. The ribbing is obviously a special development of the minute skin tessellation. The hairs and lenticles have no relation to the ribbing. The rosettes at the angles of the skin-netting are well seen, presenting a convex disc divided by paler lines (? grooves) radiating from the centre into (usually five) sections.

the legs. The 1st legs have three lenticles and a rib-point on one leg, three lenticles on the other, apparently at the tibio-tarsal joint; the 2nd legs have a similar arrangement, except that the leg with the rib-point is on the opposite side; one of the 1st legs, and the 2nd on the opposite side have one odd lenticle lower down (on a tarsal articulation). On the 2nd, 3rd, 4th, 5th and 6th abdominal segments, there is a curious puckering, in the centre of the dark spot (upper of two) situated about halfway between the dorsum and the spiracle, on each side. This, probably, corresponds with the "upholstered" hollow on the side of each segment halfway up the "slope" of the larva. There is no indication, at all definite, of scars of prolegs. The spiracles are, as usual, accompanied by a little cloud of lenticles (pl. xxvii., fig. 2), that on the 4th abdominal has, for example, 25. The spiracles show a very narrow central slit, with a wide margin, with radiating structural lines; that of the 8th abdominal segment only obsolete, the 7th normal. The 9th and 10th abdominal segments are not distinguishable, and the 8th is narrowed to evanescence, and fused with the 9th in the ventral line (♀ pupa). The circle, representing the 9th and 10th, has a transverse suture, that one might take to be between dorsal and ventral plates of the 9th abdominal, with the 10th abdominal buried between them, but that, separate from it, at each end, is a short bit of suture that is, perhaps, more probably part of that between the 9th and 10th abdominals; the dorsal part of this circle carries 30 odd hairs. The cremaster is represented by a number of hooks dorsal to the transverse median suture, continued by a few hooks round the end of this, inside the scrap of suture, to a further portion along the front margin of the circle. If we assume all these hooks to be on the 10th abdominal segment, then the 9th, like the 8th, is evanescent ventrally, both being represented by a common projection, and the dorsal portion of the suture between the 9th-10th is smoothed out and non-existent. The cremastral hooks are about 50 in number on the dorsal portion (pl. xxvii., fig. 1), 25 on each side of the ventral; each hook has an anchor-shaped end, set on, however, in a plane oblique to that of the shaft; they are about 0·05mm. long. Examining a mounted pupa, for the curious hair noted on the metathorax of the pupa of *Lampides boeticus* (*anteà* p. 355), I find it on both mesothorax and metathorax, not far from the middle of each piece; it is not, however, after all, a hair; it looks like a short bit of twisted ribbon, and its length is about that of a hair; it is, however, on the *inside* of the pupal-shell, not the outside, and must represent the lining of some pore, drawn out on the emergence of the butterfly, just as tracheal-linings are. Except to note it as a remarkable structure previously unknown to me, I have as yet no further light to throw on it (Chapman). The pupa is about 8mm. long, 4·75mm. wide, of a dumpy figure, thickest at the middle of the abdomen, with the head and thorax rounded, and the latter very slightly keeled; a depression occurs between the thorax and abdomen where the cincture passes, and this holds it secure; thence the abdomen swells out full, and arched towards the bluntly rounded anal end; the wing-covers are long in proportion, but not at all projecting. In colour it is pale brownish-ochreous, with a blackish-brown thin dorsal line marking the thoracic keel, and, on the abdomen, a series of rather blotchy arrow-head dorsal dashes, and a subdorsal series of longer dark brown blotches, that nearest the thorax being the more conspicuous, owing to the next segment being without one. The thorax is marked with oblique rows of brown freckles, directed from the sides of the head towards the end of the keel at the depression; the eye-covers are blackish, the wing-covers pale greyish with rays of brown freckles, and outlined with a thin brown edging, their surface smooth, rather more glistening than the other parts, which are thickly studded with fine, short, brownish bristles (Buckler). [For further description of "pupa," see *anteà*, p. 410].

Dehiscence.—The dehiscence of the pupa of *C. argiolus* is by slitting dorsally down the dorsal head-piece and the whole thorax, and a separation in one piece of the front head-cover, with legs, antennæ, etc.; this, however, retains its hold, at its posterior extremity, to the wings and the 4th and 5th abdominal segments. The prothorax is also very apt to separate from the mesothorax, and is often carried away by the emerging insect and lost. There is, further, a good deal of loosening of many sutures, without actual opening. The thorax is thus all but separated from the 1st abdominal segment. The abdominal sutures seem to be loosened dorsally. It is noteworthy that, when opened, the membrane that still attaches the borders is colourless, and looks structureless, in nearly all the incisions, indicating that they do not admit of movement during life; the exception is the suture between the 5th and 6th abdominal segments, where there is, dorsally only, a portion of intersegmental membrane continuous with the 5th segment, tessellated and with raised skin-points; similar, but sharper, points exist on the front margin of the 6th abdominal segment; a similar, but less pronounced, condition exists between the 4th and 5th abdominal segments. It seems probable, therefore, that, at these points, some movement is possible during life. I do not know whether it has ever been observed, but one probably takes it too much for granted that these Lycænid pupæ are completely solid. Although the inner membranous dissepiments attach the legs, antennæ, etc., strongly, but loosely, to the ends of the wings, the head-piece easily separates from the appendages, the antennæ from the legs, etc., on slight violence, possibly a provision for the further freeing of the imago when it emerges, if an awkward position of the pupa prevents the normal splittings from opening widely enough (Chapman).

Time of appearance.—This species, in Britain, may be single-, partially double- or occasionally partially triple-brooded, *i.e.*, in some districts, *e.g.*, Ireland, Lancashire, etc., the species may be entirely single-brooded whatever the season, and, in cold backward seasons, this may be so in other districts, where, under more favourable conditions, the species is generally, at least, partially double-brooded, *e.g.*, Kent, etc., in 1888, whilst, in very favourable years, not only may there be a large second brood in July and early August, but a partial third brood later in the year. It is probable, however, that, even under the most favourable conditions, some pupæ of every brood (spring, summer and autumn) go over until the following year, and combine to make up the spring emergence of that year. Prideaux says that, of some pupæ that assumed this state in June, 1900, from larvæ from ova laid May 28th, 1900, all but five imagines emerged on July 17th, 1900, and subsequent days, and these five went successfully over the winter, and emerged in April, 1901; Joy states that, some pupæ that assumed that form in June, 1905, partly produced imagines in August of that year, the remainder going over the winter, and emerging in April, 1906; Prideaux further notes that he collected two dozen larvæ in the Isle of

Wight, in August, 1895, that these pupated in due course, one pupa producing an imago of the third brood, on September 30th, 1895, the rest of the pupæ going over until the following spring. Raynor states that some third brood imagines were reared, in September, 1906, from larvæ that pupated from August 28th onwards, at Hazeleigh, and that he found fullfed larvæ apparently of this brood from October 5th-7th. Burrows also reared third brood imagines on September 14th (♀), September 15th (♂), September 20th (♀), September 22nd (♂), 1906, from larvæ taken at Mucking, and that pupated August 28th, 1906, onwards. These records show distinctly that, in very favourable seasons, the species may be even partially triple-brooded. One suspects the same in Central France, for Oldaker bred, on October 17th, 1907, an imago from a pupa that was formed on September 17th, from a larva taken a few days before at St. Cloud, the rest overwintering. Dennis records that he found the species in all stages—egg, larva, pupa and imago—at Earl's Colne, Essex, on October 9th, 1902. Burrows, however, further notes that, even at Mucking, the species may be single-brooded, for, in April, 1906, he bred imagines from larvæ of April, 1905, none emerging in the autumn of the latter year. Of its probable single-broodedness in Ireland, Kane observes that he has not seen the second-brood in Ireland, but, as the species has been met with at Killarney, and in Wicklow, in early May, and in Ulster from the beginning of May to the beginning of June, there appears to be no reason why, after an early, genial, spring, an occasional second emergence should not take place in the autumn. In the north of England, Forsythe states that the species occurs at Witherslack by the end of May, but appears to be single-brooded there; similarly, Moss also thinks it is single-brooded in the Windermere and Kendal districts; in Sutton Park, in Warwickshire, Wainwright believes it is only single-brooded, and Bree asserts that it certainly is so at Allesley, yet, at Wolford, Wheeler says that both broods appeared in 1896. Tetley also observes that, although the spring brood was sometimes abundant in Montgomery, he never observed a specimen of the second-brood there, and Arkle affirms it to be single-brooded in Denbighshire. The occasional third brood examples obtained in this country appear to be a memory of its continuous-broodedness in its more southern haunts, for Walker says that imagines have been taken on the Rock at Gibraltar, as early as January 12th, resulting probably from the September-October (or even later) larvæ and pupæ (as third or fourth brood); these January imagines would lay eggs that would no doubt produce imagines, at latest, in March-April, *i.e.*, at about the same time as the over-wintering pupæ disclose their imagines on the French and Italian Riviera, and these, in turn, must be the parents of the very abundant brood, that Walker says occurs at Gibraltar in June and July. His actual dates for Gibraltar are: January 12th, 28th, 1888, near San Roque; March, 1887, June 23rd, 1887, July 6th, 1887, and on throughout the month, July 14th to August, 1888, and so on. The same observer also records the species as common throughout the summer, 1878, at Port Baklar, near Gallipoli; his dates are: April 28th, June 2nd-14th, July 20th (quite a fresh brood), whilst de la Garde says that it certainly occurs until October in Corfu; Walker also records it at Vigo in N.W. Spain, September 11th, 1878. Meade-Waldo's records for Morocco are not unlike those of Walker for Gibraltar, for he says that it first appears in February, then at intervals throughout the summer, *e.g.*, February 20th, 1901, at Tangier, June 26th, at Amsmiz, and August 28th-September, 1901, at Tangier, etc. Blackmore recorded it at Tangier in March and April, whilst Walker gives February 22nd, 1887, at Tangier and July 25th, 1888, at Esmir (Azmir), midway between Ceuta and Tetuan, and Mrs. Nicholl captured it in February in Algeria. Norris states that it occurred throughout the whole summer of 1892, up to September, in the Certosa di Pesio district, and the same facts are given for Tuscany (Stefanelli), and Lucca (Verity), etc. It appears to be double-brooded (probably triple-brooded in the south) in France, Belgium, April-May and July-August (Lambillion); Denmark, May and August (Aurivillius); the lowlands of Germany (Speyer); the lowlands of Switzerland, April-May and July-August (Frey); Hungary, mid-April-mid-June and July-August (Aigner-Abafi), Bulgaria, May and July (Elwes); very partially double-brooded in the Baltic Provinces, April-May and July (Nolcken); the government of Wiatka, May and occasionally in July (Kroulikowsky), etc. We have records that it is common in May throughout the Lebanon and Antilebanon, etc. (Nicholl); and in June on the Kerasdere, near Amasia (Fountaine); but one suspects that it is at least double-brooded throughout Asia Minor and Syria, as Graves gives mid-July for Ain Zahalta. In 1886, Weir propounded (*Ent.*, xix., pp. 51, 155) a theory that this species was double-brooded in England, in districts where the larva fed on ivy alone, or holly and ivy, but single-brooded where holly alone was found, but he brought forward no real evidence in support of this view, and his statement that, in the New Forest, the insect is single-brooded in many tracts where ivy is not found, was at once contradicted (*op. cit.*, xix., pp. 122-3), in addition to which Edwards notes (*op. cit.*, xix., p. 61) that he has beaten larvæ out of holly as well as ivy in October at Great Malvern; besides ivy and holly are only two of many foodplants for the species (see *anteà* pp. 447-448). The species fluctuates much in Britain. There are many years when specimens of either brood are hardly seen, there are others when one or other, or both broods, are unusually abundant, but, apart from this, there appears to be a rough unanimity in the records, that the western counties have comparatively small first, and comparatively large second, broods, whilst in the eastern counties the reverse is the case. One suspects, however, that this varies from year to year, and that statements of this kind often result from incomplete and haphazard observations spread over an altogether insufficient period of time, and that, for the same year, the abundance of the broods varies greatly locally. Harwood states that, "the species is double-brooded in Essex and Suffolk, but the first brood is usually much more numerous than the second, in favourable seasons extending its range, and in seasons with adverse climatic conditions, confined very much to headquarters." In Kent, we should report similarly, except that, in some exceptional seasons, we have seen the second-brood more abundant than the first, in fact Clifford does note that, in the Gravesend district, the second-brood is usually far inferior to the first in numbers, although we have seen the later brood quite abundant, flying over the ivied walls of Rochester Castle, only some six miles from Clifford's district. Sabine observes that, "in the Erith district, the species is invariably double-brooded, the first brood in April-May, nine-tenths of which appear to be ♂s, the second in August lasting into September (and once observed in early October), this later brood appearing to consist principally of ♀s." One suspects this observation is due to the fact that the ♀s of the spring brood are, in gardens and shrubberies, usually high-up (on the holly-trees) for oviposition, those of the ♀s of the autumn brood, comparatively low down (on ivy). Newman says that it is regularly double-brooded in the Dartford district, averaging April 24th-25th, and July 1st-2nd, for the first appearances of the respective broods. Grover notes that, at Guildford, in Surrey, the first brood was well out on April 10th, 1894, but not abundant till May 9th, in 1896, the second brood well out by July 15th, the ♀s of this latter brood scarce, quite 99 per cent. appeared to be ♂s. In 1897, the first brood rather scarce, the earliest specimens being seen on April 26th, the second brood much scarcer, and not till August 5th." Clark says that, "in Cornwall, the spring brood is always more plentiful than the autumn one, the latter not appearing at all in cold wet seasons, *e.g.*, 1903; in this latter year, near Newquay, not an example could be found in August, where hundreds had been seen the previous year." Mason observes that, "at Clevedon, the early brood was unusually abundant in April and May, 1896, after a mild winter, the spring brood being generally rare here, and the second-brood more abundant, yet Tetley says that, "in west Somerset, the species occurs sparingly in both broods, the second, however, occurring rarely." The following are years in which the species has been noted as having had particularly strong double-broods—the second-brood already very abundant on June 19th-20th, in the hot summer of 1868, at Taplow (A. H. Clarke); very abundant in August, 1872, in Sark (Luff); swarmed in August, 1878, at St. Austell (Hodge); second-brood common August 11th-August 20th, 1886, near Plymouth (Prideaux); second-brood abundant, August, 1887, at Brambletye Castle, near Forest Row (Blaber); abundant from July 16th, 1887, onwards, in South Devon (Prideaux); second-brood abundant, August, 1893, in Sark (Hodges), and in July, 1893, at Sandown (Prout), yet the second-brood was not seen at Dorking in 1893 (Prideaux); the second-brood abundant, August, 1895, at Carisbrooke, but very scarce in May, in the Isle of Wight (Prideaux); in 1896, a fairly numerous first-brood at Oxton, which appeared about a fortnight later than usual, and a very numerous second-brood the earliest examples of which were noticed on July 5th (Studd), the second-brood already well out July 8th, 1896, at Bude (Sheldon), extremely abundant, July, 1896, at Sandown (Prout), also in Suffolk, Ipswich, etc. (Burrows), Epping Forest, but the ♂s observed far outnumbered the ♀s (Garland); also exceptionally abundant, August and September, 1899, in Guernsey (Lowe); in 1900, first observed May 19th, at Harrow Weald, but, in the first week of August, both sexes were abundant and were observed flying in profusion on the road between Harefield and St. Giles (Rowland-Brown), both broods also very abundant in 1900, at Reigate, first-brood April 21st-June 9th, second-brood, July 23rd to August 29th (Prideaux), and very abundant in July, 1900, in Westcombe Park district (Tutt), as also at Hammersmith (Bird), at Dartmouth, in August, 1900 (Bankes), and at Pevensey and Hurstmonceux in September, 1900 (Adkin); first-brood common in Surrey, Reigate, etc., from April 22nd, 1901, second-brood from July 15th to August 22nd (Prideaux), also from July 20th onwards, at Dorking (Oldaker), and common in August, 1901, in the London district, Blackheath (Dannatt), Lee (Carr), Lewisham, the last week of July until August 12th (McLachlan), Margate, up to mid-September

(Barrett), at Weston-super-Mare (Whittaker), at Castle Moreton (Dobrée-Fox), and throughout August to the first week in September, 1901, in Essex —Southend, etc. (Whittle). The second brood was common in August, 1904, at Tintern and Llandogo (Bird); abundant in August, 1905, at Maldon, etc. (Raynor). As to its double-broodedness on the continent of Europe, we note that, in southern and central Finland, the species is not uncommon, but it occurs only in May and June (Federley), although in the Baltic Provinces it is at least partially double-brooded (Nolcken), as also in the Russian province of Wiatka (Kroulikowsky). In Germany, the species occurs almost exactly as in the British Islands; here and there an authority notes it as single-brooded, or as having a very rare and partial second-brood, but, generally speaking, the latter is noticed, and is said to vary considerably according to the season. The following notes show the records for the various States:—the first brood April-May, the second in July-August, in Brunswick (Heinemann), in Hesse (Rössler), in Thuringia (Krieghoff), in the province of Saxony (Stange), in the kingdom of Saxony (Steinert), in Brandenburg (Fuchs), in Silesia (Wocke), in Baden (Meess and Spuler); the first from the end of April to mid-June, the second from mid-July to mid-August in East and West Prussia (Speiser); mid-April (earliest date April 8th, 1862) and May, and again end of June and July in Mecklenburg (Stange); April-June, and again July-August in Hanover (Jordan); April (earliest date April 7th, 1862) to May, and July-August in the Rhine Provinces (Weymer); April (earliest date April 8th, 1862) to commencement of June, and then mid-July-August (Speyer); in May and again in August in Pomerania (Paul and Plötz); in May and then in July-August, in Holsatia, Hamburg and Schleswig (Boie); in early May and again at the end of July in Bavaria (Kranz). No doubt, in Austro-Hungary, the species is more or less early or late in the time of its appearance, and also more or less sparingly or abundantly double-brooded, according to elevation, although April and July are noted as general for the country by Höfner, *e.g.*, the broods are not distinguished in Moravia, imagines occurring from May to July, whilst, in Carinthia, three broods are evidently recognised, April to early June, then early June to mid-August (Höfner), also at St. Jakob, September (8th) to October (6th) (Fritsch); April-May and again July-August, in Bohemia (Hüttner and Fritsch), and in Upper Austria (Himsl); end of April-May and again in July in Lower Austria (Rossi); and April (13th) to May (11th), and again in August in the Tyrol (Fritsch). Gillmer notes that the second-brood is greater than the first in Mecklenburg, whilst Fuchs says that, in Hesse, the second-brood is much the rarer; the second-brood is also recorded as very rare in the Kingdom of Saxony. In the Baltic Provinces the insect is usually abundant in May (although Lienig once took it as early as April 11th), whilst it occurs again occasionally in July (Nolcken). The time of appearance of the species in North America is practically identical with that in Europe, the first-brood in the more northern States and Canada agreeing with the dates of Central Europe, *viz.*, April-May, the second-brood from early July until August, and are sometimes still to be seen in September, the second-brood being usually less abundant than the preceding. In the extreme north—Yukon river, Alaska, Anticosti, etc.—the species is single-brooded, or only an occasional specimen occurs as second-brood; this agrees with what also takes place in the White Mountains at considerable elevation.

The single-brood occurs in June and early July. In the more southern parts of the States, south of 40°N. lat., on the contrary, it becomes partially triple-brooded, the earliest and most abundant brood occurring in March and early April, the second in June, the third from the end of July until October, "but there is no general third brood" (Edwards). It is unfortunate that we know nothing of the lifehistory of the most southern Nearctic form, *gozora*, of Guatemala and Mexico, which, in appearance, has all the superficial characters of the subtropical Celastrinids, the discal area of wing in ♂ white, etc., and which is possibly almost continuously-brooded. The following dates will give a clue to the times of appearance in most parts of the Palæarctic area: Abroad — March 29th, 1844, at Messina (Zeller); April 7th, 1862, at Elberfeld (Weymer); April 8th, 1862, at Mecklenburg (Stange); April 8th, 1862, at Waldeck (Speyer); May, 1866, in Rome; May, 1866, in Capri (F. B. White); March, 1868, common at Tangier (Blackmore); May 1st, 1871, in Guernsey (Luff); June 24th-27th, 1872, at Florence; June 28th-July 3rd, 1872, at Lucca (Walker); August 8th, 1872, very abundant in Sark (Luff); August 19th, 1874, near Mahon, in Minorca (Walker); June, 1878, at Turin (Swinton); June 27th, 1878, at Aker (Elwes); April 25th, 1879, at Port Baklar, about twelve miles from Gallipoli (J. J. Walker); April 29th, 1880, near Cintra (Eaton); May 16th, 1882, at Phillipeville (Elwes); June 29th, 1883, at Kreuznach (Elwes coll.); June 2nd, 1884, in Finland (Elwes); July 6th, 1885, at Ou-pin, in Mongolia (Alphéraky); April 23rd, 1886, at Cintra (British Museum coll.); September, 1886, at Biarritz (Lemann); May 9th, 1887, between St. Maurice and Lavey (Hutchinson); May 28th, 1887, at Fermain Bay and Moulin Hoult Bay (F. A. Walker); May 30th, 1887, at Lugano (Jones); June 14th, 1887, at St. Peter's, Guernsey; June 18th, 1887, in Herm (Hawes); July 1st-4th, 1887, at Vernet, 2000ft-3000ft.; July 25th, 1887, at Biarritz (Elwes); May 3rd, 1888, at Carqueiranne (Jones); July, 1888, at Monte Generoso (Lemann); August, 1888, at Rochefort (Carlier); May 18th-20th, 1889, common at Hyères (Norris); June 1st-4th, 1890, in Sark (Hodges); June 5th, 1890, at Digne (Lemann); June 25th, 1890, in Jethou (Luff); July 2nd, 1890, at Marmarice; July 9th, 1890, at Navarino (de la Garde); first week in April, 1891, in the Cascine district of Florence (Rowland-Brown); July, 1891, at Digne (Lemann); July 9th, 1891, at Nauplia (de la Garde); June, 1892, at Budapest (Lemann); September, 1892, in Chusan Island (J. J. Walker); February 16th, 1893, at Nice (Bromilow); June 1st-20th, 1893, in Corsica, generally distributed and remarkably fine (Standen); June 6th, 1893, at Bocagnagno, Corsica (Yerbury); June 8th-21st, 1893, in the Budapest district (Nicholson); June 19th, 1893, and following days, at Corte (Jones); July 8th, 1893, at La Foce, Corsica (Yerbury); very common, August 15th, 1893, in Sark (Hodges); July, 1894, at Vernet (Lemann); July 28th-August 7th, 1894, at Courmayeur (Tutt); June 10th, 1895, at St. Petersburg (Elwes coll.); July 7th-24th, 1895, at Mendel (Lemann); May 25th-29th, 1896, at Goupont and Celles, in the Ardennes (Bath); ♀s common near Messina in June and July, 1896 (Fountaine); September 6th, 1896, at Malta; April 5th, 1897, at Villefranche, on the Riviera (Mathew); April 16th-23rd, 1897, at Digne (Tutt); May 5th, 1897, at Grenoble (Chapman); May 8th, 1897, one only at Costebelle (Buckmaster); June 12th-16th, 1897, abundant at Canea and Suda Bay (Mathew); June 21st and July 3rd, 1897, in the Pfynwald (Postans);

July 19th, 1897, at Wolfsberg (Lemann); August 1st-4th, 1897, at St. Michel de Maurienne; August 11th-20th, 1897, at Susa (Tutt); August 27th, 1897, at Venice (Mathew); March 18th-26th, 1898, at Hyères (Yerbury); April 5th, 1898, at Costebelle; June 23rd-30th, 1898, at Susa (Rowland-Brown); April 28th, 1898, in the Val d'Ombla, near Ragusa (Nicholl); two ♀s, June 18th, 1898, at Wei-Hai-Wei (Fletcher); June 20th-July 2nd, 1898, at Saeterstoen (Chapman); August 5th-12th, 1898, in the Courmayeur district (Tutt); September 1st, 1898, in Guernsey (Lowe); February 24th, 1899, at Cannes (Chapman); March 28th, 1899, at Bandol (Reverdin); April 5th, 1899, at Veytaux (Wheeler); June 12th, 1899, at Digne (Rowland-Brown); June 26th, 1899, in the Rilska Valley (Nicholl); June 28th-July 7th, 1899, at St. Martin Vésubie; July 9th-14th, 1899, at Vizzavona; July 18th-20th, 1899, at Digne (Lang); not uncommon, mid-July, 1899, at Kostenec (Elwes); July 27th, 1899, ♀s common at Fontainebleau; July 29th, 1899, in Guernsey (Lowe); March 6th, 1900, at Cannes, first of the year observed (Chapman); May 11th, 1900, at Bloudan (Nicholl); May, 1900, very abundant at Orta, also at Varallo (Lowe); June 18th-28th, 1900, at Saeterstoen (Morton); June 23rd-24th, 1900, on Mont Seny, near Catalonia (Nicholl); June 26th-28th, 1900, at Bechtesgaden; July 3rd-9th, 1900, at Budapest (Lang); July 31st-August 1st, 1900, at Lago di Loppio (Jones); February 6th, 1901, at Tangier; June 28th, 1901, at Amsmiz; August 28th, 1901, at Tangier (Meade-Waldo); May 18th, 1901, in Guernsey; June 20th-25th, 1901, at Bozen (Lowe); June 3rd, 1901, at Suda Bay, Crete (T. B. Fletcher); July, 1901, at Sépey (Lemann); July 16th-20th, 1901, at Florac (Jones); July 27th to August 3rd, 1901, at Villar, near Torre Pellice (Tutt); July 28th to August 6th, 1901, at Albarracin (Chapman); abundant in August and September, 1901, at Tangier (Meade-Waldo); October, 1901, at Corfu (de la Garde); February 6th, 1902, and following days, at Algiers (Nicholl); March 16th to May 3rd, 1902, in Andalusia (Lang); March 25th to April 2nd, 1902, at Le Trayas (Reverdin); March 31st, 1902, at the Pont du Gard, ♂s resting on the ilex leaves (Rowland-Brown); May 17th-22nd, 1902, at Hvalöerne, near Bolingshavn (Strand); May 26th to June 6th, 1902, at Montreux (Barraud); June 6th, 1902, at Faido (Chapman); June 26th to July 1st, 1902, near Sireosen (Strand); June 27th, 1902, between Martigny and Vernayaz (Sheldon); July 1st-12th, 1902, at Siredal (Strand); March 3rd, 1903, at Carqueiranne; March 28th-29th, 1903, at Hyères; April 6th-10th, 1903, at Auribeau; April 6th, 1903, abundant between Mouans-Sartoux and Pegomas; April 7th, 1903, in the Esterel above Le Trayas; April 8th, 1903, between Mougins and Auribeau; April 9th, 1903, abundant in the Esterel, in the Agay district; April 11th, 1903, between Agay and Le Trayas; April 12th-16th, 1903, at Alassio; April 13th, 1903, at Albenga; April 14th, 1903, at Laigueglia; April 20th, 1903, at Contra and Locarno (Tutt); April 3rd, 1903, at Philippeville (Walsingham); April 11th-20th, 1903, at Grandola, near Menaggio (Sich); April 22nd, 1903, at St. Maurice (Wheeler); May 22nd, 1903, in the Friedrichsthal Wood; May 25th, 1903, in the Werder Forest (Busack); June 27th to July 9th, 1903, at Canales; July 18th, 1903, at Moncayo (Chapman); July, 1903, at Sierre (Lemann); July 13th, 1903, between Martigny and Vernayaz (Sheldon); July 16th, 1903, between Vizzavona and Tattone; July

22nd, 1903, in the Tavignano Valley, near Corte; July 26th, 1903, at St. Martin Vésubie (Rowland-Brown); July 27th, 1903, between Roche and Yvonne (Tutt); July 29th, 1903, at Le Sépey (Jones); March 1st, 1904, at Anthéor (Reverdin); March 23rd-30th, 1904, at Hyères; April 24th, 1904, at Ste. Maxime (Chapman); April 20th, 1904, at Aigle (Sloper), April 24th, 1904, in the Werder Forest; May 13th, 1904, in the Friedrichsthal Wood (Busack); May 31st, 1904, at Niederneundorf, near Berlin (Dadd); July, 1904, at Innsbruck (Lemann); July 3rd to 22nd, 1904, at Puerto de Pajares (Chapman); July 7th, 1904, at the mouth of the Dog River, near Beyrout; July 10th-13th, 1904, at Ain Zahalta (Graves); July 12th-18th, 1904, at Mendel (Rowland-Brown); July 26th, 1904, at Friedrichsthal (Gillmer); April 24th-27th, 1905, in the Hyères district, already badly worn (Tutt); May 30th-31st, 1905, at Tibidabo, near Barcelona; June 17th-27th, 1905, at Vernet (Standen); June 18th-28th, 1905, at Vernet (A. H. Jones); July 7th, 1905, at Allevard (Reverdin); July 10th, 1905, in abundance at Le Vernet (Rowland-Brown); July 14th, 1905, above Domo d'Ossola (1900m.) (Blachier); July 15th, 1905, at Scalella, Corsica (Powell); July 15th-26th, 1905, between Aigle and Sépey (Moss); July 19th, 1905, at La Granja (Sheldon); July 22nd, 1905, at Grossmain, near Salzburg (Bentall); August 6th, 1905, at Crevola (Blachier); August 22nd, 1905, in the Val Anzasca (Tutt); March 11th, 1906, at Hyères (Reverdin); April 14th, 1906, at Valescure (Blachier); June 1st-10th, 1906, fairly common at Majorca (A. H. Jones); June 16th to July 8th, 1906, at Eclépens (Lowe); July 14th, 1906, in the Wörnitz on the border of the Mosigkauer Haide in Anhalt (Gillmer); August 4th, 6th and 19th, 1906, at Digne; August 24th, 1906, at Versoix (Tutt); May 12th-18th, 1907, at Digne (Rowland-Brown); May 21st, 1907, in the Lavey Woods; May 30th, at Sion, and May 31st, 1907, above Glion (Tetley); June 5th-8th, 1907, in the Tinière Valley, Villeneuve (Prideaux); June 19th, 1907, at St. Raphael; June 20th, 1907, at Agay; June 16th-21st, 1907, at Herculesbad (A. H. Jones); June 19th, 1907, freshly emerged at Digne (Gurney); July 19th to August 15th, 1907, at Glanon-sur-Saône (Rehfous); July 23rd, 1907, in the Val Maggia (Blachier); bred October 17th, 1907, from St. Cloud larva (Oldaker). British records: March 28th, 1830, at Allesley; July 29th, 1830, in the Isle of Wight (Bree); July 31st, 1830, at Cheddar (Dale); August 4th, 1831, between Dartford and Gravesend (Bree); March 13th, 1833, at Tiverton (Reed); May 9th, 1833, July 31st to August 12th, 1834, May 8th to June 6th, 1835, very abundant; and July 23rd to August 6th, 1835, at Kedington; May 7th, 1836, at Lavenham; in June, and again in September, 1841, at Lavenham (Gaze); April 9th, 1843, at Teignmouth (Jordan); May 11th, 1856, very abundant in Sutton Park (Meyer); July 21st, 1856, near Preston (Hodgkinson); first appearance for the year May 8th, 1857, in Blean Woods; June 2nd, 1857, in Blean Woods; May 22nd, 1857, at Faversham (Stowell); May 16th, 1857, at Southampton (Swinton); 40 examples, May 17th, 1857, in Crauklow Wood, near Sheffield (Laycock); June 22nd, 1857, and preceding days, near Birmingham (Campbell); July 21st-25th, 1857, at Bristol (Bingham); July 24th-31st, 1858, at Dawlish (Rawlinson); first seen March 19th, 1859, near Poole; April 19th, 1859, at Christchurch, at rest on an ivy-leaf (Green); April 13th, 1859, at Shorncliffe (Rogers); April 25th, 1859, at Taunton (Rawlinson); May, 1859, at Wetheral (Armstrong); May 13th, 1859, at Stoke in South Devon (Harvie); April, 1860, at Powerscourt (Barrett); August 25th, 1860, and following days, at Folkestone (Fereday); June 1st-9th, 1861, in the New Forest (Farren); May 20th, 1866, at Witherslack (Hodgkinson); May 22nd, 1866, at Chertsey (A. H. Clarke); ♂ July 18th, 1866, in the New Forest (Goss); July 21st, 1866, at Tilgate (Image); June 19th and 20th, 1868, second-brood, at Marlow (A. H. Clarke); ♂ July 2nd, ♀ July 17th, ♂ July 22nd, ♂ July 23rd, 1868, in the New Forest (Goss); July 11th, 1868, at Haslemere (Barrett); April 4th, 1869, at Hardwicke (Nash); April 20th-30th, 1869, at Castle Connell, Limerick (Marsden); ♂ July 15th, 1869, in the New Forest (Goss); April, 1870, flying freely at Gibside (Hedworth); April 16th and July 22nd, 1870, at Cranham; May 28th, 1870, worn specimen at Dursley (Watkins); April 16th, 1870, at Castle Cary (Macmillan); April 24th, 1870, at Hardwicke (Nash); April 25th, 1870, on Dartford Heath (Bower); ♀ July 12th, 1870, in the New Forest (Goss); July 30, 1870, May 5th, 1871, on Fork Common, near Sevenoaks (Raynor); April 5th-9th, 1871, at Castle Cary (Macmillan); April 26th and August 5th-30th, 1871, at Wanstead, bred July 11th, 1871 (indoors), from ova laid May 5th, hatched May 20th, larvæ fullfed June 20th, pupated June 24th (Burrows); May 25th, 1871, at Darenth (Bower); earliest date seen April 7th, 1872, at King's Mill (Watkins); April 12th-15th, 1872, at Castle Cary (Macmillan); April 9th, 1872, at Peterhouse; April 15th, 1872, August 12th, 1872, June 13th, 1873, at Danbury; August 25th, 1873, at Hazeleigh (Raynor); July, 1874, in the New Forest (Cooper); 2 ♀s August 3rd, 1874, in the New Forest (Goss); April 20th, 1875, at Shrewsbury (Adams); April 24th, and again July 16th, 1875, at Great Malvern (Edwards); May 16th, 1875, near Marlow (A. H. Clarke); July 30th-31st, 1875, in Chattenden Woods (Tugwell); April 30th and July 24th, 1876, in Abbott's Wood (Dale); June 3rd and 9th, 1877, at Chislehurst; June 10th, 1877, at Bexley (Bower); May 2nd 1878, abundant at Llanrwst (Bairstow); May 12th, 1878, at Chislehurst (Bower); April 26th, 1879, at Lee (Bower); June 30th, 1879, on the Cotswolds (Fox); from April 28th, 1880 onwards, abundant, near Babbacombe (Prideaux); May 1st-7th, 1880, in Merlin Park; May 24th-31st, 1880, at Rathmullan on the east shore of Lough Swilly (Walker); August 15th, 1880, at Bexley (Bower); April 17th, 1881, at Kingston-on-Thames (Frere); March 24th, 1882, at Templecombe (Macmillan); April 7th, 1882, first appearance of year in Sutton Park (Bath); May 13th, 1882, at Grange (Shuttleworth); May 15th, 1882, in the New Forest (Bull); July 23rd-31st, 1882, in the New Forest (Dobson); August, 1882, at Truro (Benson); August 9th-18th and 23rd, 1882, in the Isle of Purbeck (Bankes); May 12th, 1883, at Eltham (Bower); August 15th to September 16th, 1883, in the Mortehoe district (Riding); May 7th, 1884, first appearance of the year in Sutton Park (Bath); May 30th to June 1st, 1884, at Witherslack (Hodgkinson); May 3rd, 1885, at Greenhithe (Bower); July 18th to August 8th, 1885, near Beaulieu (Hawes); April 29th, 1886, at Brockenhurst (Jäger); May 6th, 1886, in the Isle of Purbeck (Bankes); May 7th, 1886, at Box Hill (Bower); August 11th, 1886, near Teignmouth, August 20th, 1886, common but worn at Plymouth (Prideaux); April 14th, 1887, at

Wimbledon; August 2nd, 1887, on Wimbledon Common (Whittle); May 11th-15th, July 25th, 1887, in the Isle of Purbeck (Bankes); June 4th, 1887, at Cuxton; August 8th, 1887, at Folkestone (Tutt); abundant in S. Devon from July 16th, 1887 (Prideaux); July 27th, 1887, at Darenth (Russell-James); August 5th, 1887, two out of condition at Greenhithe (Bower); mid-August, 1887, at Tenby (Jäger); May 10th, to June 12th, 1888, in Ashdown Forest, and near Groombridge; August 12th, 1888, in Boldre Wood (Blaber); August 23rd, 1888, at Gussage St. Michel (Ward); August 16th, 1888, at Darenth (Bower); September 13th, 1888, ♀ at Brentwood (Burrows); May 4th 1889, in the Isle of Purbeck (Bankes); May 1st, 1890, in the New Forest (Hewett); May 1st, 1890, just appearing in Epping Forest (Buckell); May 4th, 1890, in Epping Forest (Bayne); May 12th, 1890, in the Isle of Purbeck (Bankes); May 13th, 1890, in Epping Forest, common (Mackmurdo); May 24th, 1890, at Chislehurst (Fenn); June 6th, 1890, at Queensdown Warren (Tyrer); August 1st, 1890, and following days, at Egg Buckland (Briggs); August 2nd to September 6th, 1890, at Sidmouth (Wells); April 4th, 1891, at Stonehouse (White); August 7th to September 5th, 1891, at Sidmouth (Wells); a worn ♀ March 27th, 1892, the earliest date for the species at Oxton (Studd); April 21st, 1892, first example of the year at Guildford (Grover); June 2nd-12th 1892, in Abbott's Wood (Tugwell); August 4th-11th, 1892, in the New Forest (Blathwayt); the first seen March 25th, 1893, at Llandogo (Nesbitt); March 26th to April 17th, 1893, at Hereford (Chapman); March 27th, 1893, in co. Cork (McArthur); March 29th, 1893, near Hereford (Blathwayt); abundant in April, 1893, at Holmwood Common (T. B. Fletcher); April 1st, 1893, at Gloucester (Bassett); April 2nd, 1893, at Menabilly (Rashleigh); April 2nd-6th, 1893, at Hereford (Tutt); from April 2nd, 1893, at Dorking (Prideaux); April 3rd, 1893, at Stroud (Davis); April 6th, 1893, at Alton (Reid); April 10th, 1893, near Torpoint, Cornwall (Waldegrave); April 20th, 1893, at Instow (Hinchliff); April 20th, 1893, at Moreton (Jeffreys), April 20th, 1893, at Forest Row (Turner); April 21st, 1893, at Woodford; May 6th, 1893, in Epping Forest (Hunt); April 22nd-25th, 1893, in Sutton Park (Johnson); April 22nd, 1893, at Woking (S. G. C. Russell); May 8th, 1893, at Uckfield (Bower); May 8th, 1893, at the foot of the Twm Barlwyn Mts. (Knights); May 22nd, 1893, at Erwood (Vaughan); July 15th, 1893, at Sandown (Prout); August 1st-7th, 1893, at Ringwood (Fowler); March 26th, 1894, at Coolfin (Flemyng); April 2nd, 1894, at Winton, Hants (Hooker); April 7th, 1894, at Bidborough (Shepheard-Walwyn); April 8th, 1894, at Laugharne (Jeffreys); April 8th, 1894, first examples of year at Guildford (Grover); April 10th, 1894, at Box Hill (Bower); April 12th, 1894, at Tonbridge (Turner); April 15th, 1894, at Emsworth (Christy); April 22nd, 1894, at Dorking; August 11th, 1894, ♀ at Dorking; August 26th, 1894, at Clifton (Prideaux); common April 26th and 27th, 1894, on Holmwood Common (T. B. Fletcher); May 1st, 1894, at Chichester (Alderton); May 11th-15th, 1894, at Denny (Tremayne); June 8th-17th, 1894, worn in the New Forest (Wells); August 4th, 1894, at Tenby (Robertson); plentiful April and May 1895, at Oxton (Studd); common, very worn, May 9th, 1895, on Holmwood Common (T. B. Fletcher); May 16th, 1895, scarce, in the Isle of Wight; July 16th, 1895, at Sidmouth; a ♀ bred September 30th, 1895, from an Isle of Wight larva found in August (Prideaux); July 19th, 1895, on Box

Hill; August 8th, 1895, at Uckfield (Bower); bred from March 24th to April 22nd, 1896, sexes emerge simultaneously; April 8th, 1896, ♂ at Lymington; July 5th, 1896, ♂ at Clifton (Prideaux); March 25th to May 8th, 1896, at Ringwood (Fowler); March 30th, 1896, in South Devon (Green); April 5th-22nd, 1896, at Egg Buckland (Briggs); April 19th, 1896, first seen this year at Oxton; July 5th, 1896, and onwards, at Oxton (Studd); April 26th, 1896, at Greenhithe, July 19th and 29th, 1896, on Box Hill (Bower); May 1st-5th, 1896, in Epping Forest (J. A. Clark); May 4th and August 3rd, 1896, in West Somerset (Tetley); May 22nd to June 1st, 1896, at Lyndhurst (Wells); May 30th, 1896, at Tan-y-Bwlch (Blagg); July 12th, 1896, at Oxshott (Moore); July 8th, 1896, at Bude (Sheldon); July 12th, 1896, at Old Hall, Ipswich, very abundant in August, at Ipswich (Frost); July 13th, 1896, at Stroud (Davis); mid-July, 1896, in the New Forest (Bayne); July 19th, 1896, near Marlow (A. H. Clarke); July 20th, 1896, first seen in the garden at Chichester (Anderson); July 22nd, 1896, and the days preceding, very abundant at Sandown (Prout); July 28th, 1896, near St. John's Wood Station (Blandford); August 1st-20th, 1896, at Ryde (Sequeira); August 5th, 1896, at Bentley (Burrows); March 19th, 1897, at Tenby (Graves); first recorded appearance March 20th, 1897, ♂ at Reigate (Prideaux); March 25th, 1897, at Clevedon (Jefferys); April 13th, 1897, at Hammersmith; July 19th, 1897, at Harrow (J. F. Bird); May, 1897, near Ipswich (Pyett); April 16th-26th, 1897, at Waldringfield (Russell-James); May 1st, 1897, at Ashford (Wood); May 1st, 1897, Isle of Purbeck (Bankes); May 20th 1897, at Woodham Walter (Raynor); July 20th, 1897, at Bentley (Burrows); August 1st, 1897, five settled on ground at Chiswick Lane, one of which was drinking at a puddle (Bell-Marley); August 1st, 1897, at Painswick (Watkins); August 3rd, 4th, 5th, 1897, at Painswick (Stephens *teste* Watkins); August 3rd, 1897, in West Somerset (Tetley); between August 5th to September 9th, 1897, at Swanage (Hall); February 15th, 1898, at Dover (Webb); April 8th, 1898, in the Penzance district (Daws), April 16th-18th, 1898, and July 26th, 1898, at Mucking (Burrows); April 19th, 1898, in Monks Wood (Peed); May 1st-10th, 1898, swarmed on the road between Gwydyr Castle and Bettws-y-Coed (Bland); May 8th, 1898, at Maldon (Raynor); May 17th, 1898, at Box Hill (Bower); May 22nd, 1898, at Dorking (Prideaux); June 11th, 1898, at Reigate (Turner); July 2nd-6th, 1898, at Rye (Heitland); April 8th, 1899, and June 3rd, 1899, at Mucking (Burrows); April 30th, 1899, and following days at Chichester (Anderson); May 4th, 1899, at Oxton (Studd); May 8th, 1899, at Laleham; July 21st, 1899, at Hazeleigh (Raynor); May 10th, 1899, in the New Forest; May 18th, 1899, in Bournemouth Gardens (Robertson); May 14th, 1899, at Malvern; June 1st, 1899, at Lecky Hill (Peed); May 21st, 1899, at Hindhead; June 11th, 1899, at Dorking; August 8th, 1899, at Reigate (Prideaux); May 30th, 1899, at Sanderstead: June 1st, 1899, at Chislehurst (Bower); June 4th, 1899, at Bexley (Carr); June 9th, 1899, at Chattenden (James); June 14th-18th, 1899, at Westwell (J. E. Gardner); July 25th, 1899, in the Frensham district (Bingham-Newland); July 29th, 1899, near Marlow (A. H. Clarke); July 29th, 1899, Circus Road, Hampstead (H. H. Druce); July 31st, 1899, at Shipley (Bird); August 1st-10th, 1899, at Nunhead (Barrett); August 3rd, 1899, at Stroud (Davis); August 7th, 1899, at Otford (Battley); August 15th, 1899, at Kenton (Bower); ♂ April 6th, 1900, earliest bred one of the year; ♂ April 20th, 1900, earliest one caught of the year, at Chichester (Anderson); bred April 16th-27th, 1900, from Chalford larvæ (Redmayne); April 20th to May 7th, 1900, abundant at Lee (Bower); April 20th, 1900, at Sturminster Newton (Eaton); April 21st, 1900, at Sudbury (Ransom); from April 21st to June 9th, 1900, at Reigate, ova laid May 27th, 1900, hatched 29th, pupated June 25th, imago emerged July 12th, ♂; July 23rd to August 29th, in Surrey, a specimen in Moorfields, City, E.C., July 26th (Prideaux); April 21st and June 3rd-4th, 1900, at Westwell (J. E. Gardner); April 23rd and June 22nd, 1900, at Hazeleigh (Raynor); May 1st-28th, 1900, abundant on Blackheath (Dannatt); May 2nd, 1900, at Bromley; May 3rd and July 25th, 1900, at Lee; May 5th, 1900, at Chislehurst; June 11th, 1900, at Shoreham, Kent (Bower); May 12th, July 29th and August 4th, 1900, near Marlow (A. H. Clarke); May 19th, 1900, first observed at Pinner; August 1st-7th, 1900, between Harefield and Chalfont St. Giles (Rowland-Brown); May 20th-27th, 1900, at Bexley; July 21st-23rd, 1900, at Westcott, near Dorking; August 16th, 1900, at Ockham Pond and Wisley Lake; August 31st, 1900, at Chelsfield and Shoreham (Carr); May 24th, 1900, and following days, very abundant at Dover (Stockwell); June 1st, 1900, in Carmarthenshire (Jeffreys); June 4th-6th, 1900, at Newbury (Hopson); June 4th, 1900, at Aldbury Down; June 9th-14th, 1900, in the Farningham district (Barraud); June 16th, 1900, late examples of the first brood still out at Guildford; August 11th-27th, 1900, at Folkestone (Pickett); July 10th-19th, 1900, at Swanage (Alderson); bred July 17th, 1900, and subsequent days from larvæ that pupated June 23rd, the larvæ from eggs laid May 28th, 1900 (Prideaux); July 18th, 1900, at Sutton (Turner); abundant July 20th-28th, 1900, in Westcombe Park (Tutt); July 23rd-31st, 1900, at Hammersmith (Bird); July 24th, 1900, at Wareham; August 1900, near Dartmouth (Bankes); July 26th, 1900, at Isleworth; August 17th-21st, 1900, at Worcester Park (Kaye); July 31st to August 13th, 1900, at Upper Walmer (James); August 8th, 1900, at Torquay (Peed); August 9th-17th, 1900, at Weston-super-Mare, plentiful (Whittaker); August 11th, 1900, at Harringay Park (King); August 15th, 1900, at Stroud (Davis); August 16th, 1900, at Sheerness (Fletcher); August 21st, 1900, at Ashford (Wood); August 24th to September 10th, 1900, in South Devon (Porritt); September, 1900, exceedingly common at Pevensey, Hurstmonceux and Eastbourne (Adkin); latest date seen September 7th, 1900, at Clevedon (Watkins); April 22nd, 1901, in South Kensington (Mitford); April 22nd, also July 15th to August 22nd, 1901, common in Surrey (Prideaux); April 24th, May 10th and July 11th, 1901, at Hazeleigh (Raynor); April 25th, 1901, in West Kensington (McArthur); April 25th to May 20th and August 1st, 1901, at Cowfold (Bird); May 1st, 1901, first seen at Margate, abundant, second brood also abundant up to mid-September (Barrett); May 1st-15th, 1901, abundant; and again July 20th, 1901, and onwards, at Dorking (Oldaker); May 2nd, 1901, at Dover; May 3rd, 1901, between Kingsbury and Hendon (F. A. Walker); May 2nd to June 9th, 1901, at Lee, from July 24th, 1901, and onwards, common at Lee (Carr); very abundant in May, 1901, near Devizes (Sladen); May 2nd, 1901, at Chislehurst, May 24th, 1901, common at Riddlesdown, August 1st, 1901, at Shoreham (Bower); May 4th, 1901, in Epping Forest; May 5th, 1901, at West Wickham; May 19th, 1901, at Clapton (J. E. Gardner); May 10th, 1901, at Box Hill (Croker); May 10th-19th, 1901, at Oxton (Studd); May 16th, 1901, at Worcester (Peed); May 18th, July 26th, 31st, 1901, in the Isle of Purbeck (Bankes); May 19th, 1901, at Bushey Heath; May 25th, 1901, on Aldbury Down; May 27th, 1901, at Bricket Wood (Barraud); May 27th, 1901, and following days, July 16th to August 5th, 1901, at Lewisham (Adkin); June 1st, 1901, at Byfleet (Carr); June 22nd, 1901, at Mickleham (Ashdown); July 12th, 1901, in Pimlico; July 19th, 1901, at Belvedere (Adams); July 20th-23rd, 1901, at Carbis Bay (James); July 24th, 1901, in Bentley Wood (Pyett); common July 25th to August 12th, 1901, at Lewisham (McLachlan); August 1st-14th, 1901, at Watford (Arkle); August 3rd, 1901, at Mucking (Burrows); August 4th, 1901, at North Shoebury (Whittle); August 9th-19th, 1901, between Porlock and the Doone Valley (Carr); second week of August, 1901, in Arundel Street, Strand (Lang); April 19th, and August 22nd, 1902, at Mucking (Burrows); April 24th, and August 3rd, 1902, at Hazeleigh (Raynor); April 26th-30th, 1902, in the New Forest (Carr); first seen April 27th, 1902, at Dorking, August 15th, 1902, near St. Leonards (Oldaker); April 30th to June 25th, 1902, common in Surrey (Prideaux); May, 1902, numerous in the Harwich district, the summer brood was, however, somewhat scarce, and fresh-looking examples were seen up to September 17th (Mathew); May 3rd, 1902, at Chislehurst (Bower); bred May 14th, 1902, May 28th, 1902, at Cowfold (Bird); May 24th, 1902, at Reigate (Turner); May 25th, 26th, August 17th, 1902, in the Isle of Purbeck (Bankes); May 26th, 1902, at Loughton (Image); May 31st, 1902, at Clapton (J. E. Gardner); end of May and beginning of June, 1902, at Lee, second brood about mid-August (Carr); June 1st, 1902, at Eastwood (Whittle); July 5th, 1902, at Wisley (Lucas); July 23rd-25th, 1902, at Bentley Woods (Gibbs); August 5th-8th, 1902, at Harlech (Graves); August 10th-24th, 1902, at Deal (Browne); August 11th-29th, 1902, at Burgess Hill (Dollman); August 22nd, 1902, at Rotherhithe (Sweeting); August 26th-29th, 1902, on ivy, near Westminster Abbey (Spencer); September 3rd, 1902, at Hardwicke Heath (Norgate); imagines at Earl's Colne on October 9th, 1902 (Dennis); February 20th, 1903, at Worcester (Peed); April 10th, 1903, near Carmarthen (Barker); May 14th and August 21st, 1903, at Hazeleigh (Raynor); scarce May 19th, June 13th, one only; August 24th, 1903, in Surrey (Prideaux); May 29th, 1903, at Shoreham, Kent (Bower); June 5th, 1903, near Wilton, Salisbury (Carr); August 10th to September 7th, 1903, at Bentley (Burrows); May 14th, 1904, at Dorking; August 5th, 1904, at Brockenhurst (Oldaker); May 14th, 1904, at Mucking (Burrows); June 5th, 1904, at Blackheath (Tutt); July 29th, 1904, at Hazeleigh (Raynor); July 29th, 1904, at Morteboe (Longstaff); August 1st, 1904, in the New Forest (Baker); August 8th, 1904, at Torquay (Clutterbuck); August 10th, 1904, at Chislehurst (Bower); April 25th and May 29th, July 14th to August 10th, 1905, at Mucking (Burrows); May 5th, June 13th, July 14th, 1905, at Hazeleigh (Raynor); May 10th, 1905, at Chislehurst (Bower); July 17th, 1905, in the New Forest (Young); April 15th, 1906, at

Cockington; April 21st, 1906, at Torquay (Tutt); April 21st, 1906, at Abergele (Tyther); April 22nd, 1906, at Hampton Wick (H.P.R.); April 27th, 1906, at Wandsworth (Ransom); May 4th, 5th, 6th, 1906, at Hazeleigh (Raynor); May 17th, 1906, at Lewisham (J. Cochrane); June 5th, 1906, and again August 7th-20th, 1906, at Tintern (Bird); June 7th, 1906, at Pentwyn (Rait-Smith); bred September 15th-22nd, 1906, from larvæ that pupated August 25th, 1906, onwards, at Mucking (Burrows); March 31st, 1907, at Oxshott (Alderson); April 27th, 1907, at Haslemere (Oldaker); May 8th, 1907, at Sway (Raynor); May 11th, 1907, at St. John's Wood (Druce); May 11th, 1907, in Westcombe Park (F. M. Tutt); May 12th, 1907, at Halling (Ovenden); May 12th, 1907, on Paul's Cray Common (A. M. Cochrane); May 25th, 1907, in Correl Glen (Allen); May 19th, June 1st, June 8th, 1907, at the base of Minerva mtn. (Arkle); August 2nd, September 4th, 1907, at Hazeleigh (Raynor).

Habits.—This species differs in its general habits from all other British species of "blues." It flies high and restlessly, often for considerable distances before resting, and not, as a rule, over low herbage as do the other species of "blues," to be later noticed. Blachier says that it has a zigzag and hesitating flight which has some similarity to that of *Thecla ilicis*, or, still more, to that of *Pararge megaera;* it flies around bushes and hedges, passing freely from one side to the other, and so is not at all easy to capture. We have seen it careering wildly round holly bushes in the gardens around Hereford, Blackheath, Westcombe Park, and other surburban districts, as well as in the gardens of Rochester Castle, where also they fly round the topmost battlements of the ivy-covered keep, sometimes in great numbers in both broods. Far different are the open rides of the woods at Chattenden, the flowery openings of those topping the chalk-hills at Cuxton, or the wild ravines at Dinmore, where also they have been frequently observed, as well as on the outskirts of the thickets in Epping Forest. In the Kentish woods this is the first newly-emerged butterfly to appear; it comes with the bluebells, and, wherever there is a carpet of bluebells, there, on a hot sunny morning, *C. argiolus* will be found flitting about; the second brood of the species is, in these haunts, rare, only comparatively few specimens being seen in August and September flitting along the rides, or on the outskirts of the woods; but a few miles distant, as has already been noted, it is often quite abundant on the ivy-clad walls of Rochester Castle, whence it frequently extends its explorations into the streets of the city. Clifford remarks that, in the Gravesend district, he observed the tendency for the May imagines to haunt the buckthorn hedges, and supposed that it was that the ♀ s desired to oviposit on the buckthorn flowers, whilst the late summer imagines appeared to be partial to late bramble blossom, or still later in the year to ivy-bloom. In July, 1900, we observed the ♂ s of the summer emergence adopting a very different habit from those of the spring brood in Westcombe Park, for then many were observed flying about the waste ground at flowers, much like *Polyommatus icarus*. A. H. Clarke also records this difference of habit in the Marlow district, where, he says, the imagines of the spring brood fly at a considerable height from the ground and rarely settle, whilst those of the summer brood fly low, and rest on flowers. Studd also observes that, on July 12th-13th, 1896, a large number of

♀s were noticed at Oxton flying low over the gorse, and constantly settling on it as if seeking a place to oviposit. They seemed to have quite deserted the hollies, totally unlike the first brood, which kept up high among them, and rarely came within reach; far more ♀s than ♂s were seen in the second brood. Jäger states that the insect was in abundance at the end of April, 1886, at Brockenhurst, flying round the hollies and oaks, high up from tree to tree, and never before had he noticed it so abundant except in August, 1880, when it abounded on the ivy on Netley Abbey. Fowler further observes that, in the New Forest district—at Ringwood, etc.—he has observed the ♀s of the second brood feeding upon bramble-blossom, and has noticed that while the examples of the spring brood are rarely seen outside the Forest, those of the summer brood are scattered over all the district around. Harwood observes (*Ent.*, xix., p. 88) that, at Colchester, it appears to show extreme partiality for flowers of *Aucuba japonica* in the spring, and it has been suggested that the butterfly helps to fertilise the blossom, as the fruit comes to maturity here, but Harwood suspects the larvæ may feed thereon. Sabine notes (*op. cit.*) that, in the Erith district, the butterfly seems much attached to a particular spot, and describes one in a small shrubbery containing, among other trees and shrubs, laurustinus and candleberry myrtles but not any hollies; here he says that, provided the species was out and the weather suitable, he could always make sure of capturing them, although not noticed elsewhere, and that, by sitting down and waiting for them, he once captured seventeen in an hour, several of them off one particular sprig of candleberry myrtle, on which shrub, as well as on the laurustinus, they were very fond of settling. Grapes also notes that, in the Colchester district, it flits about the holly-hedges in May and August, and many examples of the spring brood have been netted whilst hovering over, or settling upon, the flowers of the old holly-trees on Donyland Heath and adjoining wood near Colchester; it also flits about hawthorn hedges, and occasionally settles on gooseberry-bushes in the garden, apparently only tending to prove that, in those localities where the insect is periodically plentiful, it occasionally wanders from its staple food to sip the sweets of the blossoms of other berry-bearing shrubs and trees. Biggs says that, in Epping Forest, the earliest imagines are often out in abundance before the holly has blossomed, although it later frequents the blossom, apparently for the purpose of feeding; here, too, the second brood is much less abundant than the early one. Jeffreys notes that, in the Clevedon district, the species is double-brooded, the spring examples flying over the holly when in bloom, and being also specially attracted by the blossoms of laurustinus, apparently, however, only for the sweets to be obtained therefrom; in August here, the females are to be seen flitting over the ivy, whilst in 1885 it was taken feeding on bramble-blossom; throughout the chalk district of Dorset it is also double-brooded. He further notes the species as particularly abundant in Carmarthen in April and May, 1896, and also in July, 1896, in Somersetshire; the second-brood being seen in town gardens, in lanes flying over hedges, and at bramble bloom, and on the outskirts of, and open spaces in, woods; a large number of ♀s also appeared to be flying over ivy and visiting the bramble-bloom, but, although those on the latter were carefully watched, they appeared only to be attracted by the sweets thereof.

Rait-Smith records it at flowers of holly, at Pentwyn, and Bath states that, in Sutton Park, the species chiefly flies about the hollies, but is occasionally to be seen settling on flowers of mountain-ash and crab-apple, the ♂s appearing to emerge before the ♀s, the former usually just following the flowering of the holly, and generally appear to exceed the ♀s in number, although, in 1888, the ♀s were the more abundant, and observed flying round the tops of the hollies, and remaining on the wing until 6.30 p.m., although most active just before noon. He adds that a striking protective resemblance may be noticed between the flowers of the holly and the butterfly when the latter alights upon them, the spots on the undersurface of the wings matching the little bunches of blossom. Clarke observes that, in the hot June of 1868, the imagines of *Polyommatus icarus* and *Celastrina argiolus*, evidently already the second-brood, were flying about, at Taplow, in as great abundance at 7 a.m. as they usually are at 11 a.m. This, of course, is exceptionally early for the butterfly to be active, and even in the glorious sunshine of lovely Provence, on the very borders of the Mediterranean, one rarely notices it at all in the morning before 8 a.m. Mason notes that, at Clevedon, the butterfly loves the flowers of *Ceanothus*, coming to and going from the blossoms of a plant climbing on a wall, during the whole time that the sun was shining between 9 a.m. and 4 p.m., the colour of the flowers of this beautiful plant being as nearly as possible that of the wings of *C. argiolus*. About noon on August 19th, 1906, several newly-emerged ♂s were observed flitting restlessly around the willows in the well-known glen at Digne, just beyond the Baths, or chasing each other assiduously, and only occasionally resting and sunning on the leaves. Later, in the afternoon, they appeared to be attracted by the flowers of *Eupatorium* on which they rested, with their wings closed, standing upright on the flowers, the whitish undersides making them very conspicuous when viewed sideways. Its habit of resting on leaves of bushes, and walking about them, has also been repeatedly recorded by German and Austrian lepidopterists. Of its soaring habits much has been noted. It may frequent the hollies for purposes connected with the food-supply of the next generation, but, in the Esterel, it flits unceasingly over the tall tree-like heaths, the oaks, and other trees and shrubs that cover the hillsides everywhere, whilst, at Digne, it haunts the shrubby brooms which clothe the slopes in spring almost to their summits in a cloud of golden beauty. In the British Isles it has been noted as flying over and around *Cedrus deodara* at Coolfin (Flemyng), yew-trees at Stonehouse (White), poplars in Westcombe Park (Tutt), the beeches at Aylesbury (Greene), chestnut-trees in Kensington (Mitford), lilac-trees also in Kensington (McArthur), lime-trees at Nunhead, and about plum-trees at Peckham (Barrett), whilst, in Jethou, it was observed flying over the tops of apple-trees in June, 1890 (Luff); both sexes sporting round the flowers of holly and sunning upon a neighbouring ilex at Harrow Weald (Rowland-Brown), etc. In its more northern habitats in England we read of it loving to fly over and around the tops of the highest hollies at Grange (Shuttleworth), abundant among hollies in the Borrowdale Road (F. H. Day), flying freely round, and resting upon, the hollies at Gibside in April, 1870 (Hedworth). It is further noted as being abundant at Llanrwst, flying about the holly-bushes, and keeping high up (Bairstow), abundant about the hollies on the north side of Epping Thicks (Elstowe), flying over holly-bushes near Beaulieu (Rowland-Brown), and in the holly-lanes throughout the Hall Green and Yardley districts, whilst it swarms among the hollies of Sutton Park (Imms); it flies over the hollies at Forest Row (Turner), and over the variegated hollies in a garden at Bidborough (Shepheard-Walwyn), and so on. At Allesley it is very partial to both holly and ivy, but is also fond of settling on Portugal laurel, rhododendron, and other evergreens, the species being particularly abundant in the gardens where these abound (Bree); it was also observed flying commonly around hollies and rhododendrons in the grounds of Dolforgan, Kerry (Tetley); is fond of settling on bushes of Portugal laurel and rhododendron in the garden at Hazeleigh (Raynor); also on the same plants at Cockington (Tutt); observed flitting commonly over bushes covered with clematis at Folkestone, in August, 1860 (Fereday), and over tall clematis-covered bushes near the baths at Digne in August, 1906 (Tutt). The butterfly has also been noted as abundant, flying over the bushes in a meadow on the Leuk side of the Pfynwald (Postans); flying freely over the flowering genistas and cistus on a waste piece of ground by the edge of a pinewood at Carqueiranne, and, indeed, over all the bush-covered slopes of the Hyères district (Tutt); observed flying around plane-trees in June, 1901, at Suda Bay, Crete (T. B. Fletcher); was observed in profusion flying around bay-trees in the Cascine district of Florence (Rowland-Brown), whilst we ourselves have seen it similarly flying over the tall bay-trees and laurustinus bushes at Torquay, and, after circling round the oaks, rest in the sun on the rhododendron leaves at Cockington. We have already noted its occasional abundance on the ivy-clad walls of Rochester Castle. It is similarly noted as flying in profusion on the ivied walls of Conway Castle (Harding); and as especially abundant in September, 1900, flying about the tall ivy-covered walls at Pevensey, at Hurstmonceux, in the afternoon sunshine, as well as about the patches of ivy in the town of Eastbourne (Adkin); also very abundant on the ivy covering the ruined walls of Brambletye Castle, near Forest Row (Blaber); swarmed in August, 1876, on an ivy-hedge bordering a wood at St. Austell (Hodge). It was also observed flying abundantly about the *Berberis* shrubs at Gallipoli (Mathew). We have already noted how, on some occasions, it is attracted to flowers, and, as bearing on the instance already noted, of many of these butterflies being attracted to the lovely blue flowers of *Ceanothus*, it would appear that blue is particularly attractive to *C. argiolus*, for we have ourselves more than once observed it in the wood-clearings hovering over and settling on the bluebell flowers at Cuxton and Chattenden, whilst Whittle notes one as toying with a wild hyacinth at Eastwood, and Thornewill says that it frequently settles on the blossoms of wild hyacinth at Burton-on-Trent, etc., whilst Raynor notes a ♀ attracted to flowers of borage, on June 13th, 1905, at Hazeleigh. We have also observed the spring specimens flying over and settling on the sloe-blossom at Digne, and Rowland-Brown records it as flying about the elder-flowers between Tattone and Vizzavona. At Digne and at Torre Pellice, in the autumn, the most attractive blossom is *Eupatorium cannabinum*, which Prideaux also notes as being attractive to the autumnal imagines near Carisbrooke.

Bramble and ivy blossom, too, are also favourites of autumnal imagines, apart from egg-laying possibilities, as we have already noted (*anteá* p. 468), *e.g.*, Rowlinson observes that the species is much attracted by bramble-blossom, of which it is very fond; and Becher says that it seems to have a special predilection for bramble in Spain, and Mathew that it was very abundant in June, 1897, upon and among bramble-blossom, at Canea and Suda Bay, etc. Watkins states that, on September 7th, 1900, he saw an imago on the flowers of verbena at Clevedon; Aigner-Abafi says that it is especially fond of *Ribes aureum* in spring, and *Sambucus ebulus* in summer. Dale states (*Ent. Mo. Mag.*, xlii., p. 42) that, in the first week of August, 1905, a ♂ was observed on board the steamboat going from Ryde to Stokes Bay, flying up and down the deck, and occasionally settling on the flowers that were on board. The imago loves the sun, but, in dull weather, hides beneath a protecting leaf, and there remains immovable. Blaber, in 1888, found the species common at Church Hatch, in Sussex, and, on a dull day, May 28th, 1888, although not a specimen was on the wing, a fine series was netted by beating the bushes with a stout stick, the sexes appearing to be in about equal numbers. Whenever, however, a gleam of sunshine occurred, they began immediately to fly largely round the tops of the hollies, but settled again as soon as the sky became clouded; some examples were observed at rest on the underside of the leaves, and others among the grass under the bushes. Sich says that, when sunning, both sexes move the lower wings, whether at rest on a leaf or flower, moving them vertically up and down like a lever works. The species is sometimes attracted to damp spots, but apparently never in the numbers that are reported by Edwards in West Virginia; Davis has observed it at Stroud basking in the sun on damp or oozy ground; and Bell-Marley records seeing five, settled on the ground, in Chiswick Lane, one of which was drinking at a puddle. We have occasionally seen a specimen at a damp spot in the French Riviera; Bower observed one drinking from a puddle in the road, at Sanderstead, and Barrett saw one in May, 1900, settling on the damp ground in a garden at Peckham, after the latter had been watered. In connection with this, Watkins once reported that many specimens were attracted by an open drain at Painswick, in July, 1870, sometimes alighting to sip the sewage, which they seemed to prefer to the flowers in the adjoining fields. It is recorded as often occurring in great numbers at the puddles in the villages of Alten-Ahr and Neuen-Ahr (Maassen); it also resorts to the wet places in the woods of Gera in Thuringia (*Ent. Verein Gera*), frequents wet spots on the sandy roads of the heath at Sprottau (Pfitzner), loves to rest on the wet places in the roads in Carinthia, where it may readily be distinguished from a distance by the white colour of its underside (Mann). Gosse, writing of this species, in America, says (*Can. Nat.*, p. 123) that "they are exceedingly playful, chasing each other through the air, and, though often alighting on the ground, remaining scarcely an instant before they are in flight again, flitting about over one particular spot, which they seem reluctant to leave, but, notwithstanding they are so restless, they are not difficult of approach and are easily caught." Edwards says (*Butts. Nth. Amer.*, i., p. 149, ii., p. 5) that, "on the Kanawha river, this is the earliest butterfly of the year, and, as soon as the stormy weather of March (usually about the

20th) is past, on the first sunny day, two or three of these little 'harbingers of spring' will be seen flitting about any moist sheltered spot on the road, out of reach of the wind, conspicuous from their charming colour, which in the sunlight is intense, and as near as may be like *Salvia patens* among flowers; by April 3rd or 4th, when occasional warm days send the mercury to 80° F., these little butterflies swarm along the sandy sides of the creeks, gathering in clusters as close as they can stand in favourite spots, motionless, with wings erect and closed, wholly intent on extracting from the sand some fluid no doubt delightful. With them will often be seen some of the smaller Hesperians, especially that sturdy little fellow *H. samoset*, Scud. (*nemoris*, Edw.), who has placed himself like a sentinel outside the throng, with wings half open, and suspicious antennæ ready to dart away for the least cause, frightening for a moment his busy associates. He will not return until the danger is past, but they, after fluttering about a little, settle down as before. These are all males, for the females do not appear till some days after, or about the 10th. By this time the peach-trees are in full bloom, and the females are especially attracted to them, but, as a general thing, this species is not partial to flowers." The first examples of early spring in West Virginia are of the form *violacea*, and they are generally abundant when the peach- and wild plum-trees are in blossom, varying a little as the season is early or late; this form is vastly more numerous in individuals than any of the later ones, and sometimes they may be seen by thousands in a morning's walk. Lintner also notes the species as occurring in swarms at Centre, New York; the air, he says, "has seemed blue from the myriads." Scudder says that the species flies with an uncertain, tremulous, wanton motion, never in a direct course, but hovering and quivering about one spot, never alighting without seeming to be very uncertain just where to go. If much alarmed, it will move off more rapidly, but still with the same wayward motion, rarely rising as high as one's head. The beats of its wings are much less frequent than those of species of *Incisalia*, in company with which it often occurs. They frequently congregate, especially the ♂s before the ♀s are out, in clusters around damp spots, extracting the moisture from the ground, wings erect and tightly shut; putrid or excrementitious animal matters, too, have great attractions for them. They are not at all timid, allowing one to approach close to them, and when disturbed circling about the spot, and speedily settling again. D'Urban tells of one that pitched on his hand and remained there for some time, while he was in a canoe by the shore of a lake. They have been known to fly at night to the electric light. When walking, the wings are placed back to back, the hind pair not concealing the lowest submarginal spot of the forewings; the antennæ diverge at right angles, and are bent slightly downward below the plane of the body; the front legs of the ♂ seem to be used in some sense as feelers, their movements being at least twice as rapid as those of the other legs. When resting, the wings are held in the same position, but, when moved by a breath of air, the forewings droop a little so as to bring the costal edge of the secondaries almost to the upper median nervule; the antennæ diverge at an angle of about 100°, and, viewed from above, are straight, but, from the side, they are seen to curve forward considerably close to the base, their main portion being parallel with the body, or raised at an angle of about 15°; the club is curved very slightly upward. At more complete rest, the forewings droop, bringing the costal edges of all the wings together; the body is then bent in such a way that, while the abdomen and lower edges of all the wings rest upon the surface, the thorax is elevated at an angle of 45°. The antennæ are depressed so that they are on a line with the outer half of the costal margin of the forewings; they divaricate, at the same time, at an angle of 80° or even as much as 110°. The appearance of this sedentary species at irregular periods in comparative abundance or rarity is very noticeable. In some recent years it has been unusually abundant in both broods, over most of the district it inhabits in England, *e.g.*, in 1896, 1900 and 1901. In 1903, 1904 and 1905, the species was hardly seen over large areas, in either brood, yet it was here and there locally abundant in both the latter years. That this uncertainty in appearance is due to direct climatological conditions, and that there appears to be no real foundation for the supposition that has been expressed that these periods of abundance and rarity take place in cycles, seem certain, for, after its abundance in 1900, increased abundance in 1901, and the comparative abundance of the first brood in 1902, scarcely a specimen was noticed in the cold, sunless summer and autumn of 1902, and it was equally scarce in both broods in the equally unfavourable season of 1903. Moreover, it sometimes happens that the species only fails locally, *e.g.*, it was exceedingly rare in 1905 in Surrey, whilst not at all uncommon in Essex. Bath notes the species as extremely abundant in Sutton Park, in the spring of 1889, but exceedingly scarce in 1890, and he attributes this scarcity to the almost complete failure of the holly-bloom in 1889. Bankes states that, in most seasons, the insect occurs sparingly in Dorset, that in other seasons it is hardly, if ever, seen. Blachier also remarks (*in litt.*) concerning its appearance at Geneva, that it is more abundant in some years than in others.

Habitats.—On Strood Hill, between the playground of the old school and the private garden of the adjoining house, a high wall covered with ivy, was, between 1866 and 1871, the rendezvous of bees and flies innumerable at the time that the ivy was in blossom. Amongst these were three other visitors, *Celastrina argiolus*, *Pyrameis atalanta* and *Aglais urticae*. The "blue" was a source of never-ending delight to one youngster, at least, and here he learned that whilst the ♂s appeared to join the bees, flies and butterflies, in extracting nectar from the expanded flowers, the ♀s selected the unopened heads for the purpose of egglaying. It is difficult to say just how much those "azure blue" butterflies had to do with making the writer a lepidopterist, but certainly some credit must be laid to their account. The habitats of this species in Britain differ considerably in spring and summer; in spring, the forests, woodlands, parks, gardens, shrubberies, plantations and hedgesides where holly abounds, are its chief haunts, while, in late summer, ivy-covered walls, whether on ruined castles, old buildings, or in gardens, are mostly selected for their restless, vapouring flight, for, in spite of the large number of occasional food-plants, one suspects that, in Britain at least, the early brood is confined largely to holly, buckthorn and dogwood for its egg-laying, whilst ivy is almost alone selected in the autumn. Distributed as the species is throughout the whole Palæarctic and Nearctic regions, circling the northern hemisphere, and entering the subtropical regions at Mexico and Guatemala in the New World, and India in the Old World, its habitats are varied enough, extending from the woodlands of the south of Lapland to the jungles of India and the desert-borders of Algeria and Morocco, from Ireland to Japan, from British Columbia to Labrador, and Yukon to Mexico and Guatemala. Scudder says that the species, in North America, haunts open deciduous woods, whether dry or swampy, at the borders of which, or in their open shade, or by the roadsides in their vicinity, it flutters in great numbers, for, wherever found, it appears to be abundant, possessing, as Edwards well puts it, the whole country. It settles about damp spots, and, in the west, is never found on the prairies, but at the bottom of the deep wooded ravines beside the streams. The Indian forms *coelestina* and *huegelii* are said to have exactly the same range and to be equally common, occurring throughout the outer ranges of the Western Himalayas, from Kashmir and Murree to Naini Tal, affecting the barberry-bushes. They are reported from as low as 3500 feet at Bagheswar, and as high as 12000 feet at Garbyan. The species is very rare on the heights of the Pamir (Fedtschenko), but common in many parts of China, *e.g.*, at Kiukiang, on the Yangtse river, about 500 miles from the sea (Leech). In the Lebanon and Antilebanon districts it is plentiful from 3000 feet to 5000 feet throughout, especially at Afka, and in deep bushy lanes near Bludan, a village 4850 feet above the sea, immediately below the Djebel Chekif, the highest point in the northern Antilebanon (Nicholl); it occurs at the mouth of the Dog river, some miles from Beyrout, at the foot of the hillside, covered with aromatic plants, mint, thyme, basil, etc. (Graves). Of its British habitats, there seems certainly to be some partiality exhibited for limestone and chalk districts. Kane says that, in Ireland, it is locally abundant in woodlands where holly is abundant, but not occurring, so far as has been noticed, in the unsheltered districts where holly occurs. There are no really satisfactory records of its occurrence in Scotland, and in Great Britain its most northerly points appear to be in Lancashire, Westmorland, Durham, and Cumberland where the species appears to be most plentiful in the limestone districts; it is common among hollies at Grange, becomes very thinly strewn at Windermere, and appears to be entirely absent in the Cumberland Lake district; only a single record or so appears for the Carlisle district, but in Northumberland it appears again, most frequently, too, in the limestone districts (Hodgkinson). Robson states that Hodgkinson later informed him that this Northumberland reference was an error. About five miles east of Cambridge, in a low meadow of coarse grass, adjoining a shrubbery, and bordered by a rivulet, the butterfly was, in the end of August, 1830, in great numbers; again, in the spring of 1831, in the same place, it was present, yet much less numerous, whilst in the autumn of that year none were observed (Ventris). In the Burton-on-Trent district the species occurs in woods where hollies attain their full growth (Thornewill). It is abundant in Sutton Park and in the lanes among the holly-hedges in Warwickshire. It occurs throughout the Malvern range, but is most abundant on the "Holly Bush Hill," where holly-trees grow luxuriantly, and here it is double-brooded, the examples of the second-brood flitting over bramble-blossom, etc. (Imms). In Somerset both broods abound in the gardens and woodland

(Mason), and in the lanes of Cornwall, the second-brood haunting the bramble-blossom with *Dryas paphia* (Bowles). In the New Forest the species is generally distributed, but particularly abundant about the holly-thickets in the spring, and more distributed by the hedgesides and in the gardens on the outskirts of the forest, in the autumn (Fowler). It is also very abundant along the undercliff at Niton, etc., in the Isle of Wight, in spring (Goss), and equally abundant both in the wooded portion of the undercliff and in the woodlands in the late summer (Prideaux), and, whilst it abounds throughout the large old gardens, as well as the hedges and woodlands of Devon, it also occurs on the open heaths on Dartmoor, at considerable distances from hedge or woodland (Prideaux). In Bucks it is particularly partial to the beech woods (Clarke), whilst in Sussex the species was most abundant at a spot called "Chuck Hatch," where holly plantations are numerous, the hollies in some cases growing to a great height; the immediate surroundings are wild and barren, there being nothing but moorland for miles around, with a solitary wild-crab or a yew-tree dotted here and there (Blaber). It occurs throughout Surrey and Kent, being generally distributed even throughout all the suburban gardens around London. In the Guildford district it appeared to be most abundant about a thick hedge which runs along the top of the chalk ridge east of Guildford; in July, 1896, and, when the imagines were not sipping nectar at the flowers of bramble, they appeared to choose the bushes of *Rhamnus catharticus* on which to rest (Grover), but at Reigate, Dorking, etc., it is also very generally distributed. In Kent, as already noted, it occurs almost everywhere, in the spring—in parks, gardens, the outskirts of shrubberies, woods, and by hedgesides, and, in the autumn, on old ivied walls. In the Epping district it is so far localised that, whilst not uncommon about the holly in some woods, it appears to be entirely absent on other clumps of holly at no great distance (Stockley); it is reported also that the second brood here is very rare; in the Colchester district it is confined to head-quarters in the holly-districts in seasons when the climatic or other conditions are adverse, being then rarely seen elsewhere, but, in favourable seasons, it is continually extending its range, being met with in gardens and lanes throughout the district, and even in the streets of the town, whilst it is periodically abundant about the ivy that grows upon Colchester Castle (Harwood). In Cambridgeshire it is noted as being abundant in the chalk-pits of the Gogmagog Hills near Cambridge (Lee). In Gloucestershire it is erratic in appearance, both broods occurring abundantly, however, in favourable years in woods and gardens (Watkins). On the continent of Europe its localities appear to be very similar. It occurs throughout France in localities similar to those of Britain, abounding in the French and Italian Riviera in gardens, by hedges, copses, etc.; swarming sometimes over the broom-covered slopes of the mountains of the Basses-Alpes and the Alpes-Maritimes, and in the gardens at Hyères; abundant on the bush-covered slopes of Hyères and Carqueiranne, the dells of the Esterel, the coppices of the Siagne, the gardens of Draguignan, the thyme-clad slopes on the outskirts of the woods around Alassio, etc. It is equally abundant among the partly-wood partly-garden slopes behind Locarno, etc., and Rowland-Brown notes it as particularly abundant by a lovely fountain in the chestnut-wood of the Tavignano Valley. In the late summer we have seen it flitting along the broad pathways of Fontainebleau Forest, soaring over the willows in the lovely glen beyond "the baths" at Digne, careering over the tree-tops in the woods between St. Michel-de-Maurienne and Valloire, and over the scrub on the slopes of the hills above Grésy-sur-Aix. In Piedmont we have taken it among the *Eupatorium*-thickets between Torre Pellice and Villar, here and there throughout the Val d'Aosta to 5000ft. at Courmayeur, whilst in Corsica it is common at the sunny corners of the Vivario road, both in the forest above Vizzavona and in the open towards Tattone. In Switzerland, Frey says that it is spread over the whole of the lowland parts, and is double-brooded, but that its vertical distribution is not great—above Leuk, at 2700ft., higher up in Sertigthal and Bergell, on the St. Gothard road above Göschenen at 3386ft., and at the Solothurn Weissenstein. We ourselves have taken it among the bushes that clothe the foot of the Grand Salève, near Geneva; flying over bush-covered slopes between Aigle and Villeneuve, and similar ground at Bregenz, on the slopes of the Pfander, whilst in the lovely Val Anzasca it was not at all infrequent in August, 1905, flying by the edge of the woods on the roadside a few miles above Piedemuliera. Tetley observes that it flies low about bushes in the Lavey Woods and in similar situations around Sion. Sheldon notes it as occurring in the copses between Martigny and Vernayaz. Bath records it as very abundant in the marshes in the neighbourhood of Lucerne during the end of July and beginning of August, 1888. In Holland it is generally distributed, but everywhere rare (Snellen), but in Belgium is distributed throughout, very common some years in the woods of Basse-Marlagne, etc.; it loves to fly around bushes of buckthorn in the clearings of woods, and it rests by choice on the ivy which covers the garden walls and rocks (Lambillion). In Germany it is generally distributed in parks, woods, and forests in Pomerania (Spormann); in woods and forests, especially in clearings and open rides, as well as in open meadows and exposed mosses in Mecklenburg (Gillmer and Tessmann); generally distributed, especially in places overgrown with *Spartium*, in Holsatia, Hamburg, and Schleswig (Boie); in woods and on heaths in Hanover (Glitz); and in gardens, meadows, woods (Weymer), as well as wood-clearings and on heaths in the Rhine Provinces (Rothke); on heaths, clearings in woods, meadows, mosses, and even in the gardens near the towns, in Hesse (Rössler and Koch); in the clearings and on the outskirts of woods in Waldeck (Speyer), and in similar places throughout the Province of Saxony (Wilde), also in the Kingdom of Saxony (Schütze); prefers the woods on mountain slopes in Thuringia (Knapp); in woods, forests, and the environs of towns in Brandenburg (Kretschmer); in the woods and forests of Posen (Schultz); especially in wood-clearings and on the outskirts of woods, in gardens and by roadsides, in meadows, etc., in the lowlands of Silesia (Möschler); and in the woods of the hills (up to 1700ft.) as well as those of the low country, sometimes affecting heaths and sandy roads, etc., in Silesia (Pfitzner); in the open parts of wood plantations, meadows on the outskirts of woods, and on wooded hillsides, in Bavaria (Schmid and Kolb), etc. In the Baltic Provinces it appears sparingly as the buckthorn comes into leaf, in open bushy places on the borders of woods and similar places (Nolcken). In Austria it occurs in wood-clearings in Bohemia (Nickerl); prefers bush-covered slopes, meadows on the outskirts of woods, and marshy spots in the neighbourhood of these in Salzburg (Richter), and by roadsides and woods throughout Carinthia (Höfner). In southeastern Europe, Walker notes it as common throughout the summer at Port Baklar, near Gallipoli, and Mathew records it from Boulair, on ground covered with bushes of *Berberis*. Homuzaki says that it is common throughout the summer on the slopes of the Cecina Mount, near Czernowitz, at an altitude of 400 mètres in the first half of June. In Spain it occurs very generally in all suitable localities. Walker says that it appears on the Rock at Gibraltar, as well as in the pinewoods near San Roque, whilst Sheldon records it in the La Granja district with *Lampides boeticus*, *Heodes virgaureae*, *Thecla ilicis*, *T. spini*, *Loweia gordius*, *Dryas pandora*, *Brenthis daphne*, and dozens of other species, in a wooded dell through which a stream flowed, and beyond which the trees thin out, and brooms and cistus are the prevailing plants. In Algeria it occurs in the copses behind Mustapha Supérieur, near Algiers (Nicholl).

British localities.—The range of this species in the British Isles is one of those things we cannot understand. It is abundant throughout England and Wales, becoming locally rare in Cumberland, Durham, and Westmorland, and apparently failing absolutely throughout Scotland, and yet generally abundant throughout Ireland. [Compare range of *Smerinthus ocellata* (*Brit. Lep.*, vol. iii., p. 445), *Mimas tiliae* (*op. cit.*, p. 420), *Malacosoma neustria* (*op. cit.*, vol. ii., p. 565), etc.]. Bedford: Bedford (Sharpin). Berks: common (Hamm), Reading (Holland), Newbury (Hopson). Brecknock: Builth (Vaughan). Bucks: Black Park (Stevens), Aylesbury (Greene), Drayton Beauchamp (Rothschild), Stony Stratford, rare (Foddy), Buckingham (Slade), near Marlow (A. H. Clarke), Burnham Beeches, Chalfont St. Giles (Rowland-Brown). Cambridge: Boxworth (Thornhill), Cambridge (Crisp), Peterhouse (Raynor), Gogmagog Hills, near Cambridge (Lee). Carmarthen: local, but distributed—Carmarthen (Barker), Laugharne (Jeffreys). Carnarvon: Bettws-y-Coed (Perkins), near Deganwy (Gardner), Conway Valley, between Gwydyr Castle and Bettws-y-Coed (Bland), Llanrwst (Bairstow), Conway Castle (Harding). Cheshire: Delamere (Harrison), north Cheshire (Greening), White Hall, near Tarporley (Stock), Eastham, Hooton (Harris *teste* Gregson). Cork (McArthur): Curriglass (Longfield). Cornwall: east and west Cornwall (Rollason), Penzance district (Daws), Bude (Sheldon), St. Austell (Hodge), Menabilly (Rashleigh), Carbis Bay (James), locally common from Kilkhampton and Whitsand Bay to Penzance—Newquay, common, etc. (Clark), Torpoint (Waldegrave). Cumberland: Keswick district—Lodore, the Borrowdale Road (Beadle), Wetheral (Armstrong), [one a few miles east of Carlisle (Hodgkinson), probably the Wetheral record (Routledge)], Keswick (Morson), Workington, uncertain and spasmodic (Wilkinson). Denbigh: near Wrexham, common, Colwyn Bay, sparingly (Newstead), near Ruthin (Gardner), Llanferres (Birch), Minerva mountain (Arkle). Derby: Repton (Garneys), Needwood Forest (Payne), Parson's Brake, near Burton-on-Trent (Thornewill), Kirk Langley (Fuller), Melbourne district (Corbett). Devon: south Devon (Green), Egg Buckland (Briggs), Cockington, Torquay (Tutt), Oxton (Studd), Teignmouth (Jordan), Woodbury (Kane), Barnstaple, Bideford, Braunton Burrows, Dartmouth, Plymouth, Instow (Mathew), Paignton (Goodale), Tiverton (Reed), Sidmouth (Wells), Kenton (Bower), Honiton district, abundant (Riding), Totnes (Swinton), Silverton, Torrington (Ward), Morteboe (Longstaff), Dawlish (Rawlinson), Stoke (Harvie), near Babbacombe (Prideaux). Donegal: at Rathmullan, on the east shore of Lough Swilly (Walker). Dorset: Swanage (Hall), Sturminster Newton (Eaton), Glanville's Wootton (Dale), Isle of Purbeck, Wareham (Bankes), Carne Wood, Preston Upton, Weymouth (Bogue), Sherborne (Douglas), Gussage St. Michael (Ward), near Poole (Green), Portland (Richardson). Dublin: rare (Kane). Down: abundant (Bristow), Donard demesne (Watts). Durham: formerly well distributed, but no record of its capture for 50 years (V.C.H.), Gibside, in 1870, *see* p. 468 (Hedworth), Sunderland, formerly common, no recent records (Corder), Derwent Valley, Ravensworth (Wailes), Gibside, Dilston, Winlaton Mill (Wailes), Shull, Darlington (Backhouse), Castle Eden Dene, near Durham (Ornsby), Chopwell (*teste* Maling). ESSEX: widely distributed—Colchester (Harwood), Hazeleigh, Danbury, Maldon, Woodham Ferris (Raynor), Earls Colne (Dennis), Harwich district, Bradfield, near Dovercourt (Mathew), Mucking, Brentwood, Rainham, Wanstead (Burrows), Buckhurst Hill (West), Southend, North Shoebury, Eastwood (Whittle), Witham (Burnell), Maldon (Fitch), Epping Forest (Sheldon), Loughton (Image), Epping Thicks (Elstowe), Monkswood, Epping Forest, High Beech (Rose), Stanstead (Spiller), Woodford (Hunt), Colchester (Harwood), Hale End (Simes). FERMANAGH: Correl Glen (Allen). FLINT: Bagillt (Walker), Halkyn, near Overton (Gardner), Overton (Perkins), Nant-y-ffrith (Newstead). GALWAY: Connemara (Birchall), Merlin Park (Walker). GLAMORGAN: Swansea district—Penllergare, Sketty (Robertson), Cardiff district—Curt-y-ralla (Ansaldo), Wenvoe, near Llandaff (Fowler). GLOUCESTER: common—Bristol, abundant (Griffiths), Cirencester (Harman), Newnham (Bingham), Hardwicke, Stonehouse, Forest of Dean, Standish (Nash), on the Cotswolds (Fox), Castle Moreton (Dobrée-Fox), Cheltenham (Robertson), near Bristol (Hudd), Chalford (Redmayne), Clifton (Prideaux), Dursley (Watkins), Cranham, Upton, Hempstead, Sandhurst, Matson, Grange Court, Highnam, Hartpury (Merrin), Painswick (Farn), Stroud (Stephens), Haresfield, Birdlip (Lifton), Micheldean (Searancke). HANTS: generally distributed—Isle of Wight—Niton, the undercliff about Shanklin, etc (Goss), Freshwater (Rothschild), Ventnor (Geldart), Sandown (Wood), Bullen, near Ryde (Jordan), Carisbrooke (Prideaux), Portsmouth district—Stokes, Gosport, etc. (Pearce), Frensham district (Bingham-Newland), Alton (Reid), Bournemouth (Robertson), Christchurch (Green), Winton (Hooker), Lymington (Prideaux), Winchester (Fisher), Southampton (Swinton), Emsworth (Christy), Fleet (S. G. C. Russell), Sway (Raynor), Beaulieu Abbey, throughout the New Forest (Goss), New Forest (Cooper), Denny (Tremayne), Brockenhurst (Oldaker), Lyndhurst (Wells), Ringwood (Fowler), Boldre Wood (Blaber), New Forest—Hinchelsea, Rhinefield, Sandys (Weir). HEREFORD: common (Bowell)—Leominster district (Lucas), Dinmore (Tutt), Hereford (Blathwayt), Moreton Jeffreys (Turner), Tarrington (Wood). HERTS: Sandridge (Griffith), Watford (Arkle), Haileybury (Bowyer), Hoddesdon (Harley), East Barnet (Gillum), Tring, abundant (Rothschild), Bricket Wood, Aldbury Down, Bushey Heath (Barraud), Norton Green Woods (Matthews), Cheshunt (Boyd), Bury Green and Bishop's Stortford (Mellows), Cassiobury Park (Rowland-Brown), Weston (Raynor), Waltham Cross (Bowles). HUNTS: St. Ives (Norris). KENT: common throughout—Rotherhithe (Sweeting), Blackheath, Westcombe Park, Rochester, Strood, Cuxton, Chattenden, Higham, Cliffe, etc. (Tutt), Bexley district (Newman), Chislehurst (Turner), Eltham (Jones), Belvedere (Adams), abundant, Lewisham (R. Adkin), Farnborough, Hayes (Alderson), Southend, Catford (A. Russell), Erith (Sabine), Farningham, Eynsford (Barraud), Ockham, Chelsfield, Shoreham, Westcott, Cudham, Lee (Carr), Hither Green (Cowham), Upper Walmer (James), Queensdown Warren (Tyrer), Ashford, Dover, Wingham (Wood), Chattenden Woods (Tugwell), Chatham district (Walker), between Dartford and Gravesend (Bree), Sheerness (Fletcher), throughout south-west Kent (Freke), Deal (Browne), Lower Fant, near Maidstone (Golding), Margate (Barrett), Dover (F. A. Walker), Darenth, West Wickham (West), Folkestone (Hills), near Herne Bay (Butler), Shorncliffe (Rogers), Sydenham (Swain), Ewell (Hall), Otford (Battley), Longfield, near Gravesend (Jennings), Tonbridge, Pembury (Cox), Bidborough (Shepheard-Walwyn), Faversham, Blean Woods (Stowell), Bromley, Greenhithe (Bower), Brasted (Prideaux), Fork Common, near Sevenoaks (Raynor), Westwell (J. E. Gardner), Paul's Cray Common (A. M. Cochrane), Thanet (Barrett). KERRY: Dolforgan (Tetley), Muckross, Upper Lake of Killarney, abundant (Kane). LANCS: not uncommon locally (Sharp)—Grange, Holker Moss (Crabtree), Carnforth (Murray), Silverdale (J.C.M.), Hale (Nixon *teste* Gregson), Arnside (Arkle), near Preston (Hodgkinson), Newton-in-Cartmel (Mason), Manchester district (Edleston), Grange-over-Sands (Joulty). LEICESTER: Leicester (Bates), Gumley (Matthews). LIMERICK: Castle Connell (Marsden). LINCOLN: Haverholme Priory, common 1902 (Coward). MERIONETH: Tan-y-Bwlch (Blagg), Harlech (Graves). MIDDLESEX: Ashford (Hawker), Hammersmith, Harrow (J. F. Bird), Chiswick Lane (Bell-Marley), Chiswick (Sich), Pimlico (Adams), South Kensington (Mitford), West Kensington (McArthur), between Kingsbury and Hendon (F. A. Walker), Bedford Park (Dollman), Ravenscourt Park (Image), Stamford Hill (Quail), Hagger Lane Forest (Prout), Southgate (Gates), Kentish Town (*Ent.*, xxxii., p. 236), Harrow Weald (Peers), Clapton (J. E. Gardner), near Westminster Abbey

(Spencer), St. John's Wood (Druce), Hampstead Heath (Godwin), Mill Hill (South), Laleham (Raynor), Wood Green (Dadd), Arundel St., Strand (Lang), Harringay Park (King), Canonbury Park, Pinner, Harefield (Rowland-Brown), Moorfields, City, E.C. (Prideaux), Harrow district (Prior). MONAGHAN: in woods about Favour Royal (Kane). MONMOUTH: Tintern and Llandogo (Bird), Abertillery district, Pentwyn, Llanhilleth (Rait-Smith), Pontnewydd (Conway), Wye Valley—below Builth (Vaughan), Monmouth (Palmer), Whitebrook (Rowland-Brown). MONTGOMERYSHIRE: Newtown (Tetley). NORFOLK: not common—Cawston, Booton, Thetford, Broome, Gillingham (Barrett), Norwich (Moss), Guestwick, common (Drane). NORTHAMPTON: throughout (Goss)—near Oundle (Bree). NOTTS: Sherwood Forest (Sterland) [Goss says that the species has not been noticed here for some years]. OXFORD: Watlington (Lucas), Oxford, common in the college gardens, 1901, Bagley Wood (Geldart), Chinnor district (Spiller), Henley (Carrington). PEMBROKE: not common—Castle Martin (Puckridge), Tenby (Graves), Pembroke (Barrett). RADNOR: Erwood (Vaughan). SHROPSHIRE: Shrewsbury (Adams). SOMERSET: common—Castle Cary, rare (Macmillan), Temple Combe, common (Griffiths), Clevedon, Bath (Jeffreys), Weston-super-Mare (Whittaker), Shepton Mallet district (Bogue), Quantock Hills, common, Taunton (Doidge), Cheddar (Dale), between Porlock and the Doone Valley (Carr). STAFFORD: not common—Mace Woods, between Stafford and Crewe, Maer, Burnt Wood (Daltry), Rugeley (Freer), east Stafford—Needwood Forest (Bath). SUFFOLK: local—Bury, Needham, Ipswich district, Leiston, Sotterley, Hemley, Wherstead (Bloomfield), Old Hall, Ipswich (Frost), Bentley Wood (Pyett), Lavenham (Gaze), Hardwicke Heath, Bury St. Edmund's (Norgate), Bentley (Burrows), Sudbury (Ransom), Waldringfield (Russell-James). SURREY: generally distributed—Holmwood Common, between Dorking and Leith Hill, Bookham Common, Weybridge, Claygate, Esher, Thames Ditton, Long Ditton, Surbiton, Wimbledon (V.C.L.), Kingston-on-Thames (Frere), Ranmore, Dorking (Oldaker), Westcott, near Dorking, Ockham Pond, Wisley Lake (Carr), Bagshot (Floersheim), Ashtead Common, Croydon, Box Hill (Sheldon), Sanderstead, Riddlesdown (Bower), Reigate, Hindhead (Prideaux), Haslemere (Barrett), Hayes Common (T. B. Fletcher), Chertsey (A. H. Clarke), Guildford (Grover), Oxshott (Moore), Dulwich district (Sellon), Peckham (Barrett), Sutton, East Dulwich, Keston, Purley, Hove (Turner), Worcester Park (Kaye). SUSSEX: widely distributed—Worthing (Fletcher), Forest Row (Turner), Pevensey, Hurstmonceux, Eastbourne (Adkin), Burgess Hill (Dollman), Brighton, Lewes, Abbott's Wood, Battle, Hastings (Jenner), Bognor (Lloyd), St. Leonard's (Oldaker), Ashdown Forest, Groombridge, Brambletye Castle (Blaber), Shipley, Cowfold (Bird), Chichester (Anderson), Hailsham (Sheldon), Rye (Heitland), Uckfield (Bower), Fairlight (Ford), Polegate (Hamlin). TYRONE: not very abundant (Kane), Tyrone, local (Greer). WARWICK: Sutton Park, Lickey, Knowle, Coventry (Blatch), Birmingham (Campbell), Allesley (Bree), Hall Green and Yardley Wood, Shirley, Coleshill (Imms), Warwick (Baly), Atherstone (Baker), Rugby, Chorley Wood (Rugby lists), Wolford (Wheeler). WATERFORD: Coolfin, Curraghmore (Flemyng). WESTMORLAND: Witherslack (Hodgkinson), Windermere, fairly common, Kendal district (Moss), Brigsten (West). WICKLOW: Deer Park, Powerscourt (Birchall), The Dargle (Kane), Shillelagh Wood, abundant (Bristow). WILTS: near Wilton, Salisbury (Carr), near Devizes (Sladen). WORCESTER: Great Malvern (Edwards), Worcester, Lecky Hill, Monk Wood (Peed), Midsummer Hill, Bilberry Hill (Fletcher), Bromsgrove (Blatch). YORKS: Thundercliffe Grange, near Rotherham (Brooks), Cauklow Wood, near Sheffield (Laycock), Huddersfield (Inchbald), Westbourne Avenue, Hull (Waller), Cudworth (Whitaker), Guyscliffe, near Pateley Bridge (Roebuck), Ledsham (Grassham), Leeds (Birchall), Richmond (Lang), Wakefield (Talbot), Ripon (Tyers), York (Sta., *Manual*), Scarborough (Rowntree).

DISTRIBUTION.—Throughout the whole of the Palæarctic and Nearctic areas, extending into the oriental region, in India and China, and the Neotropical in Central America to Panama. AFRICA: Morocco—Tangier, Amamiz (Meade-Waldo); Algeria—Algiers, Mustapha Supérieur (Nicholl), Guelma (Bethune-Baker), Collo (Oberthür), Phillipeville (Elwes). AMERICA: from Alaska to Panama, and the Pacific to Atlantic [see *anteà* pp. 410 *et seq.*]. ASIA: Asia Minor—Marmarice (de la Garde), Cilicia (Holtz), on the Kerasdere, near Amasia (Fountaine), Brussa (Dieckemann), Tokat (*teste* Rühl), Rhodes Island (Oken); Syria—Beyrout, mouth of Dog river (Graves), the Lebanon, common from 3000ft.-5000ft., near Bloudan at 4850ft. (Nicholl), Ain

Zahalta (Graves), Antioch (Sarkisian), Zebil Taurus (Brit. Mus. coll.); Persia—Irak district (Young); Transcaucasia—Gjas, Lenkoran, Meschedehr (*teste* Rühl); Turkestan and Thian-Shan (Alphéraky), Lepsa, Saisan, etc. (*teste* Rühl), Tarbagatai, Ala Tau (Haberhauer), south-western Altai (Kindermann); Kouldja district — Kounguesse-Thal, 4000ft.: the Pamir — Ferghana, very rare, Kasumkent, near Samarkand; Samarkand — Penjakent, Zarafshan Valley (Grum-Grshimailo); north-east Siberia, distributed — Udskoj, Ostrog Lena district, Transbaikal — Vitim and Vilui (Herz); Amurland, throughout —Nikolajewsk, etc. (Staudinger), the Schilka, Bureja mountains, Ema district, on the Ussuri (*teste* Rühl), Kentei district (Dorries); Manchuria (*teste* Rühl), Corea (Levett); Japan, local — Yamato, Ogasowara, Yokohama, Rynkyn (Pryer); Chiua — Mongolia, Ou-Pin, etc. (Alphéraky), Kiukiang, common (Leech), Isle of Askold (Oberthür), Chusan Islands (J. J. Walker); India—almost throughout, the Himalayas to Ceylon [see also *anteà* pp. 399-405]. EUROPE: throughout, except in the extreme north—AUSTRO-HUNGARY: Austria, throughout (Höfner); Bohemia — Prague, singly (Nickerl), Karlsbad district, everywhere common (Hüttner), Seuftenberg (Fritsch); Moravia—Brünn, frequeut (Schneider), Neutitschein (Fritsch), Mährisch-Trübau (Rühl); Upper Austria—Steyer, Wels, etc., nowhere rare (Brittinger), Linz (Fritsch); Lower Austria—Vienna, distributed (Rossi), Gresten (Schleicher), Hernstein, near Schwarzensee, not rare (Rogenhofer); Salzburg, in the plains and hills—the foot of the Kuhberg, Aigen, the foot of the Unterberg, between Glanegg and Fürstenbrunn, singly (Richter), Grossmain, near Salzburg (Bentall); Tyrol, up to 3000ft.—Bozen, Trient (Mann), near the Misurina Lake, Cortina (Mann and Rogenhofer); Mendel (Rowland-Brown), Innsbruck, abundant, Taufers Valley, rare (Weiler), Solsteinkette, Seiser Alp, Trafoi (Heller), Bregenz (Tutt); Croatia—Josefsthal (*teste* Rühl); Carinthia, distributed—Wolfsberg (Lemann), Lavantthal, Friesach, Pörtschach, St. Andrä, St. Paul (Höfner), St. Jakob (Fritsch); Upper Carnia—Wippach Valley (Mann); Dalmatia—Zara (*teste* Rühl), Ragusa (Nicholl), Isle of Losma (Schneider), Isle of Lacroma (Kempny), Isle of Lissa, and Lagosta, in the Macchien, common (Galvagni); Hungary, throughout, abundant — (Fountaine)—Bechtesgaden, Budapest (Lang), Nagyvárad, Debreczen, Eger, Parád, Pécs, Pápa, Szaár, Sopron, Verebély, Selmeczbánya, Rozsnyó, Kocsócz, Gölniczbánya, Igló, Eperjes, Kassa, Szádellö, Ungvár, Máramaros m., Fogaras, Nagyszeben, Nagyág, Mehadia, Orsova, Vinkovcze, Lipik, Josipdol, Fiume, etc. (Aigner-Abafi), Funfkirchen (*teste* Rühl), Herculesbad (A. H. Jones), Kaschau (*teste* Rühl); Poland—Cracow, Bielany, Czatkowice (Zebrawski); Galicia—W. Samborskiem, Stryjskiem, Lwowskiem, Dranczy (Nowicki), Bucovina (Hormuzaki). BELGIUM: throughout, very common (Lambillion)—the Ardennes—Goupont, Celles (Bath), Rochefort (Carlier), etc. BOSNIA AND HERCEGOVINA: very local and rare, extending up to 900m.—Dervent, Bosnatal, between Maglaj and Zenica (Hilf), Igman (Apfelbeck), Trebevic (Rebel), Jablanica, Velez (Hilf), Stolac (Winneguth), Val d'Ombla, near Ragusa (Nicholl). BULGARIA AND EAST ROUMELIA: distributed—Sophia (Rebel), Rilo district—Rilska Valley (Nicholl), Kostenec (Elwes), near Slivno (Haberhauer), near Rustschuk (Kowatschew), the Cecina mt., near Czernowitz (Hormuzaki). CHANNEL ISLANDS: Guernsey, Sark, Jethou, Jersey, not common (Luff), Herm (Hawes), Fermain Bay, Moulin Hoult Bay (F. A. Walker). CORSICA: throughout—Evisa (Fountaine), Corte (Jones), between Vizzavona and Tattone, in the Tavignano valley, etc. (Rowland-Brown), La Foce, Bocagnagno (Yerbury). DENMARK: Nord Sjaelland, Bellemose, Jaegersborg, Dyrehave, Rudehegn, Tikjöb Wood, Teglstrups Hegn, Hornbake Plantage, Slagelse, Lystskov, Moens Klint; Fyen, Jytland woods, Ry, Silkeborg (Bang-Haas). FINLAND: south and central, fairly common (Federley), Osterbotten (Lampa). FRANCE: Aisne (Dubus); Allier — Moulins (Peyerimhoff); Alpes-Maritimes—Vallon Obscur, Nice, St. Martin Vésubie (Bromilow), Antibes, Cannes, Vallauris, Auribeau, Grasse, Mouans-Sartoux, Pegomas, Mougius (Tutt), Villefrauche, near Beaulieu (Mathew), Aube (Jourdheuille), Aude, common (Mabille); Basses-Alpes—Digne, etc. (Tutt); Basses-Pyrénées, common — Biarritz, etc. (Elwes), Cambo (Hampson); Brittany, throughout (Griffith); Bouches-du-Rhône throughout—Aix (Fountaine); Calvados, common—Caen, etc. (Rowland-Brown); Charente-Inférieure—Royan (Salis); Cher—Sologne, St. Florent (Sand); Côte d'Or —Glanon-sur-Saône (Rehfous); Creuse—Guéret (Sand); Dordogne, common (Tarel); Doubs (Bruand); Eure—Pont de l'Arche (Dupont); Eure-et-Loire (Guenée); Finistère—Morlaix (Lauzanne); Gard—Nîmes, Pont du Gard (Tutt); Gironde, common (Robert Brown); Haute-Garonne (Caradja); Haute-Marne—Langres, Latrecy, Hortes (Frionnet); Hautes-Pyrénées, generally (Rondou); Haute-Savoie, Monnetier, Le Coin, Mont de Sion (Blachier); Haute-Vienne—Limoges (Samy); Ille-et-Vilaine—Rennes (Oberthür); Isère—Grenoble, St. Michel de Maurienne (Tutt), Allevard (Reverdin); Indre—Nohant (Sand); Indre-et-Loire—St. Avertin, near Tours (Meade-Waldo); Loir-et-Cher—forests of Blois and Russy, common (Chevillon): Lozère — Florac (Jones); Loire-Inférieure — Nantes, Savenay (Deberman-Roy); Maine-et-Loire, rather common (Delahaye); Manche—near Cherbourg (Nichollet); Marne—Rheims, very common (Demaison); Meurthe-et-Moselle—Wood of Vandœvre, near Nancy (Cantener); Nord, common, but local (Paux)—Phalempin, Mormal (la Roi); Oise (Pinard); Puy-de-Dôme, common (Sand); Pyrénées-Orientales—from 2000ft.-3000ft. (Elwes), Vernet (Rowland-Brown). Somède (Sprüngerts); Saône-et-Loire, common—Mâcon, etc. (André): Sarthe (Desportes); Savoie—Grésy-sur-Aix, Aix-les-Bains, Chambèry, etc. (Tutt); Seine—Paris, La Varenne, St. Maur (Ragonot); Seine-et-Marne—Fontainebleau (Walker); Seine-et-Oise—St. Cloud (Oldaker), St. Germain (Walker); Seine-Inférieure, common (Noel); Somme (Frionnet); Var — Hyères, Costebelle, Carqueiranne, Draguignan, St. Raphael, Valescure, the Esterel—Agay, Le Trayas, etc. (Tutt), Ste. Maxime (Chapman), Anthéor, Bandol (Reverdin). GERMANY: throughout the plain and hill region, usually abundant, but in some places scarce (Speyer)—east and west Prussia, common—Königsberg, Rastenburg, Insterburg, Braunsberg, Willenberg (Schmidt), Lübeck (Paul), Tilsit, Cranz, Rauschen, Warnicken, Fischausen, Capornsche Haide, Gross Raum, Löwenhagen, Gauleden, Tapiau, Wehlau, Darkehmen, Friedland, Domnau, Pr. Eylau Landsberg, Heiligenbeil, Braunsberg, Quittainen, Mohrungen, Osterode, Göttkendorf, Allenstein, Diwitten, Sorquitten, Angerburg, Goldap, Lyck, Arys, Neidenburg, Graudenz, Marienburg, Elbing, Danzig, Langfuhr, Löblau, Zoppot, Karthaus, Alt-Kischau, Jastrow (Speiser); Pomerania, throughout, but not common—Kieshof, Grubenhagen, Negast (Paul and Plötz), near Pennin, Crummenhagen, Divitz, the Hessenburg and Behrenshager woods at Damgarten, Stralsund, the Kniep Gate (Spormann); Mecklenburg, throughout—Neustrelitz, Rülow, Sülze, Wismar, Ludwigslust (Boll), Friedland (Stange), Schwerin, Waren, Friedrichsthal, Werderforst (Gillmer), Lübeck—Kuhbrook Moss, Wesloe Moss (Tessmann); Holsatia, Hamburg, Schleswig, common—Hamburg, Sachsenwald, Elbufer, Harburg (Zimmermann), Bahrenfeld, Schnelsen (Laplace), Heligoland (Selys-Longchamps); Hanover, not common — Lüneburg, frequent (Machleidt and Steinvorth), Bremen, rare, Schönebecker Holz, Hasbruch, Stenum, Stoteler Wald (Rehberg), Hanover, rather rare (Glitz), Osnabrück, Hameln, Göttingen, rare, Osterode (Jordan); Brunswick—Brunswick, Wolfenbüttel (Heinemann); Westphalia—Höxter (Jordan); Rhine Provinces, not rare—Crefeld, Uerdingen, rather scarce, Aachen, Bonn, Boppard, Bingen, not rare, Cologne, Elberfeld, infrequent (Stollwerck), Barmen, Hilden, Solingen (Weymer), Crefeld district, not rare, Hülserberg, Hülserbruch, Latumer Bruch, Forstwald, Friemersheimer Wald (Rothke), Alten-Ahr, Neuen-Ahr, frequent (Maassen); Hesse—throughout Hesse and Nassau (Koch), Oberursel (Fuchs), Hanau (Limpert and Röttelberg), Upper Hesse, everywhere, but singly, Giessen, Wiesbaden (Glaser), Frankfurt-on-Main, Kettenhof, Niederrad Moss, Bieber-Höhe, in the Taunus (Koch), Friedberg, in the Hinterland, Worms (Glaser), Homberg-on-Ohm (Schenck), Cassel district, in the Kaufunger, Stiftswald, and Habichtswald (Borgmann); Waldeck, infrequent (Speyer); Thuringia, not rare—Gotha, and throughout the Thuringian mountains (Knapp), Weimar, rare (Speyer), Mühlhausen, Rudolstadt (Jordan), Gera (Ver. Ent. Gera); Province of Saxony—Erfurt, singly (Keferstein and Werneburg), in the Steigerwald and Willroda Forest, infrequent (Ver. Ent. Erfurt), Zeitz district, at Ossig, Prössdorf (Wilde), Halle, in the Dölauer Haide (Stange), Dessau (Richter), the Wörnitz (Gillmer), the Mosigkauer Haide at Hirtenhau, Brambach, Brachmeierei, rare (Amelang), Wernigerode, rather rare (Fischer), Naumburg, Nordhausen, Quedlinburg, Kyffhäuser (Jordan); Brandenburg, distributed—Niederneundorf, near Berlin (Dadd), Frankfurt-on-Oder, singly, Dammvorstadt, Kornbusch, Cunersdorf and Boossen forests (Kretschmer); Posen—everywhere but not abundant—near Posen at Eichwald, Kobylepole, not rare (Schultz); Silesia, distributed and fairly common—the Trebnitz mountains (Nohr), Upper Lusatia, throughout (Wocke); Sprottau, Seufzen, Hochwald, near Wichelsdorf, etc. (Pfitzner), Schreiberhau 1700ft. (Standfuss); kingdom of Saxony, distributed, but not frequent—Dresden (Steinert), Freiberg (Fritsche), Saxon Upper Lusatia, throughout (Schütze), Chemnitz, not rare, Hilbersdorf (Pabst), Leipzig, Lausigk, Zwenkau, Rochlitzer Berg, Hainichen, Rosswein, not frequent, Leisnig, Rochsburg, frequent, Meissen, not frequent, Werdau, Crimmitschau, Limbach, Zwickau, Zschopau, Plauen, Langenfeld, Bad Elster, Schneeberg (*Ver. Iris*); Bavaria—Regensburg (Hofmann and Herrich-Schäffer), Munich (Kranz), Augsburg, Siebentischwald, rare (Freyer), Kempten, rare (Kolb), Kissingen, Ansbach (Rühl); Württemberg, throughout, but rare—Stuttgart, Tübingen, Reutlingen, etc. (Seyffer); Baden, throughout, not rare—Karlsruhe, on the Turmberg (Gauckler), Konstanz, Freiburg, Kaiserstuhl, frequent, Dinglingen, Heidelberg (Reutti), Lahr district, common (Keynes); Alsace—Strassburg (Rühl); the Palatinate—the Speyer Forlenwald (Bertram). Greece: throughout—Attica (Merlin Coll.), the Parnassus (*teste* Rühl), Nauplia, Navarino (de la Garde), Corfu, Crete, Suda Bay (Mathew), Morea, Vlasis (Rebel). Italy: Liguria—Alassio, Albenga, Laigueglia, etc. (Tutt); Piedmont—Turin, very abundant, especially in the hills (Rocci), Villar, near Torre Pellice, Susa, Courmayeur district, etc. (Tutt); Certosa di Pesio district, common (Norris), Monte Generoso (Lemann), Domo d'Ossola (Blachier), Val Anzasca (Tutt), Orta, Varallo (Lowe), Lugano (Jones), Grandola, near Menaggio (Sich); Lombardy—Lago de Loppio (Jones); Venetia—Venice (Mathew); Tuscany, common—Florence (F. B. Walker), the Cascine district of Florence (Rowland-Brown), the Tuscan Apennines, Vallombrosa, Pistoiese Apennines, Lucca district, etc. (Verity); Boscolungo (Norris); Campania—Isle of Capri, very common (Browne); Rome—Rome (Buchanan-White); Roman Campagna, Abruzzo (Calberla); Sicily, not common—Madonie, Polizzi, Etna, Valecorta, Palermo (Minà-Palumbo), Medda (Calberla), Osimo (Spada), Castelbuono (Giorni), Messina, Buon Retiro (Zeller). Netherlands: Friesland; not in South Holland (Snellen), Breda (Heylærts). Portugal: São Fiel (d'Azevedo), Setubal (Vieille-dent), Lisbon (Mathew), near Cintra (Eaton), Algarve (Elwes). Roumania: Braila, Laculetz (Fleck). Russia: White Russia—Gorki (*teste* Rühl), foothills of the Ural, near Tambow, Moscow, Casan (Eversmann), St. Petersburg govt. (Sievers); Baltic Provinces—throughout (Nolcken); Govt. Wiatka, rare throughout (Kroulikowsky), Russian Transcaucasia, everywhere (Romanoff). Bessarabia (Kroulikowsky), Novorossiisk (*teste* Rühl), Caucasus (*teste* Rühl). Sardinia: Alghera (Mathew). Scandinavia: Sweden—Skane to Helsingland (Lampa), Aker (Elwes); Norway, south and central, sparingly—Christiania, Odalen, Naes Vaerk, rare: Bergen, very common some years in the Obdal; Sarpsborg (Siebke), Loiten, St. Haus, Haugene (Rühl), Egeberg (Salvin), Saeterstöen (Morton), Bolkesjo, about 1700ft. (Standen), Smaalene, Akershus, Hedemarken, Buskerud, Bratsberg, Jarlsberg, Laurvik, Nedenaes, S. Bergenhus, Romsdal, S. Trondhjem (Schöyen), Vallö, Larkollen, Hvalöerne, Sireosen, Siredal (Strand). Spain: Leon—Picos de Europa (Nicholl); Beira—Valcarca, Murcia—San Genis, Garria (Martorell); Castile—Albarracin; Aragon—Moncayo, Canales (Chapman); Asturias—Puerto de Pajares (Chapman); Teruel district—Arroyofrio, Cañigral, Gea, Villar del Cobo, Rodenas, Virgen del Carmen, La Losilla, the plain of Albarracin (Zapater); Guadarrama Mts., La Granja (Sheldon); Catalonia—Mt. Seny (Nicholl), Calella (Martorell), Montserrat (Rambur), Tibidabo, near Barcelona (Standen); Andalusia—Granada (Rambur), Gibraltar (Walker); Galicia—Vigo (Walker); Vizcayo—Bilbao (Seebold); Balearic Isles—Majorca—Pollensa, Soller (Jones), Minorca, near Mahon (Walker). Switzerland: widely distributed, but rarely common—Geneva district—Veyrier, Sierne, Arzier, Bossey, foot of Mt. Saleve (Blachier); Rhone Valley district—Veytaux, Bouveret, very abundant (Wheeler); between Aigle and Sépey (Moss), Territet, Villeneuve, Roche, Yvonne (Tutt), Aigle (Tasker), Tinière Valley (Prideaux), Bex (Murray), Montreux (Barraud), Sépey (Jones), St. Maurice, Lavey (Hutchinson), above Glion (Tetley), Martigny, Vernayaz (Sheldon); very common—Fully, near Sion, Loeche (Favre), Pfynwald (Postans), Sierre (Lemann); the Juras—Weissenstein, near Soleure (Jaggi), Versoix (Tutt), Eclépens (Lowe); Bernese Oberland—Weissenburg, very common (Huguenin), Interlaken district (Renshaw); Ticino district—Faido (Chapman), Lugano, common (Jones), Monte Generoso (Lemann), Chiasso (Mayer), Locarno, Contra, etc. (Tutt), Val Maggia, Crevola (Blachier); Uri—Göschenen (Riggenbach-Stehlin), St. Gothard Pass (*teste* Rühl); Engadine—Val Bregaglia, Sertigthal (Killias), Zurich (*teste* Rühl). Turkey: Gallipoli (Mathew), Port Baklar (Walker).

ERRATA—CORRIGENDA et ADDENDA

Page 29, line 32.—After "of the" read "Argynnid and Brenthid larvæ."
Page 94, line 19.—For "forewings" read "four wings."
Page 120, line 42 *et seq.*—Callophrys rubi—Add "May 7th-16th, 1883, in Sutton Park (Bath); June 15th, 1884, in the Black Wood, Rannoch (A. H. Jones); June 21st, 1885, in Abbott's Wood, worn (Hawes); June 8th-25th, 1885, at Killarney (Kane)."
Page 121, line 41 *et seq.*—Add "May 8th, 1896, at Ringwood (Fowler); May 22nd to June 1st, 1896, at Lyndhurst (Wells); June 6th, 1900, May 18th, 1901, June 9th, 1902, at Marlow (A. H. Clarke)."
Page 122, line 11.—Delete "August 22nd, 1900, at Loughton" (*see* p. 308); also line 13.—Delete "five specimens (one ♂ and four ♀s) captured in a lane near Newtown in August, 1900" (*see* p. 308). Both these records refer to *Ruralis betulae*, and are recorded under *Callophrys rubi* in error.
Page 131, line 12.—For "Arishaig" read "Inverness: Arisaig (Gibbs)."
Page 131, lines 16 *et seq.*—Add: "Berks: Streatley, Dychwood Forest (Ball). Bucks: Marlow (Clarke), West Wycombe (Lang). Merioneth: Barmouth (Imms)."
Page 134, lines 14 *et seq.*—Add "Bouches-du-Rhône, throughout (Siepi): Haute-Vienne—Limoges (Samy); Loir-et-Cher—forest of Blois, forest of Russy (Chevillon); Oise (Pinard)."
Page 134, line 25.—For "Pas-du-Calais" read "Pas-de-Calais."
Page 142, line 26.—"Leechia" is preoccupied, *see* Leechia, South, "Trans. Ent. Soc. Lond.," 1901, p. 400. Leechia, Tutt (type *thalia*) is hereby renamed Strymonidia.
Page 142, line 37.—Edwardsia is preoccupied, *see* Edwardsia, Quatrefages (1842). Edwardsia, Tutt (type *w-album*) is hereby renamed Chattendenia.
Page 175, line 33.—Edwardsia w-album—Add: "July 12th, 1896, at Reading (Butler.)"
Page 183, line 43.—Add: "Berks: near Marlow, but in Berks (A. H. Clarke)."
Page 185, lines 36 *et seq.*—Add: "Bouches-du-Rhône—Aix, Septèmes, Gémenos St. Pons, most valleys near Marseilles (Siepi); Finistère, common (Lauzanne); Haute-Vienne—Limoges (Samy); Loir-et-Cher, rather common (Chevillon); Savoie—St. Michel-de-Maurienne (Tutt); Seine-Inférieure, common (Noel)—Orival (Martel); Var, La Verrerie (Millière)."
Page 185, line 54.—For "Montnori" read "Montnoir:" for "Lilleforts" read "Lille forts."
Page 185, lines 55-58.—For "Compiegne" read "Compiègne;" for "Lech" read "Leek;" for "Boulougne" read "Boulogne;" for "Puy-de-Dome" read "Puy-de-Dôme;" for "Sâone" read "Saône."
Page 219, line 43.—Strymon pruni—Add "June 12th, 1907, three miles from Geneva in direction of the Juras (Muschamp); June 20th, 1907, in the Bois de Bourlon, near Cambrai (Brabant)."
Page 225, lines 15 *et seq.*—Add "Aisne—near Laon, common (Sheldon), Seine-Inférieure, common (Noel); Nord—near Cambrai (Brabant)."
Page 260, line 51 *et seq.*—Bithys quercûs—Add: "July 24th, 1864, July 10th, 1865, July 28th, 1869, August 20th, 1892, at Chertsey (A. H. Clarke); June 29th to July 8th, 1896, in the New Forest (Nash); July 7th, 1901, at Marlow (A. H. Clarke)."
Page 263, line 32.—Add "On August 20th, 1907, imagines of *Bithys quercûs*, frequenting wild cherry-trees, appeared especially fond of settling on leaves curled-up by aphides. Watching with the aid of binocular glasses one was seen to be busily feeding on honey-dew. This is, perhaps, their principal food and probably explains the habit of species in frequenting the tops of various trees (*Ent. Rec.*, xix., p. 260)."
Page 269, line 4 *et seq.*—Add: "Bucks: Marlow (A. H. Clarke), Chalfont St. Peter (St. John). Dorset: Swanage (Hall). Essex: Witham, common (Burnell). Hants: Ringwood (Corbin). Lincoln: Kirton-in-Lindsey (Fyles). Monmouth: Pontnewydd, abundant (Conway). Surrey: St. Anne's Hill, Chertsey, abundant (A. H. Clarke)."
Page 269, line 15.—Add "Carlisle (Cartmel)."

Page 271, line 24, etc.—For "Pzér" read "Peér," for "Nagylévand" read "Nagylévárd," for "Selmeerzbánya" read "Selmeczbánya," for "Gaas" read "Gacs"; and "Kolozováa" read "Kolozzvár."

Page 271, lines 41 *et seq.*—Add "Bouches-du-Rhône, never common—Vallon de Toulouse, la Penne, Aglade, Valabre, Bar de l'Etoile, Val de Fabréjoules, St. Pons, Ste. Baume, wood of Notre Dame des Anges (Siepi); Haute-Vienne—Limoges (Samy); Gard, Finistère, Morlaix, common (Lauzanne); Ille-et-Vilaine (Bleuse); Loir-et-Cher—forest of Blois, forest of Russy, common (Chevillon); Seine-Inférieure, common—Orival (Martel)."

Page 273, line 1.—Add: "RUSSIA: Bessarabia (Kroulikowsky)."

Page 290, line 15.—RURALIS BETULÆ—Add "larvæ May 26th to June 13th, 1896, imagines commenced to appear on July 11th, 1896, and some dozens emerged on this and the following days, at Ringwood."

Page 299, line 14.—Add: "Westwood, however, notes that the pupa is placed lengthwise on a leaf without the silken band that usually characterises the pupæ of *Lycaenidae*" (*Ent. Mo. Mag.*, iii., p. 167).

Page 309, line 51.—Add: "Fowler says: 'At Ringwood, *betulae* usually appears in nature in August, it flies during the morning about midday, but must often be passed, as the ova are deposited on the very lowest sloe-bushes; I have observed them flying over oak-trees, yet never saw one settle low down.'"

Page 316, line 52.—Add "HANTS: Shedfield (Pearce)."

Page 318, lines 12 *et seq.*—Add "Bouches-du-Rhône, very local—Col de Bretagne, Val de Signore, Ste. Baume (Siepi); Finistère, rather rare (Lauzanne); Haute-Savoie—Chamonix (Walker), [Belfort (Frionnet)]; Haute-Garonne—La Croix Falgarde, larva once (Aubusson); Haute-Vienne—Limoges (Samy); Loir-et-Cher—Forest of Blois, rare (Chevillon); Oise (Pinard); Seine-Inférieure—Orival (Martel); Var—St. Zachaire, once (Siepi)."

Page 318, line 18.—For "Farques" read "Fargues"; line 26—after "(Paux)," add "Bourlon (Pagniez)"; line 32—for "Lucon" read "Luchon"; line 39—after "(Sand)" add "Thiers (Bellier)."

Page 331, line 31.—"LANGIA" is preoccupied, *see* LANGIA, Moore, "Proc. Zool. Soc. Lond.," 1872, p. 567. LANGIA, Tutt (type *telicanus*) is hereby renamed "RAYWARDIA."

Page 377, line 22.—LAMPIDES BŒTICUS—For "Bonches" read "Bouches;" after "(Frionnet)" add "in two generations—Vallon de Toulouse, wood of Mazargues, Marseilles (Siepi); line 26, for "Côtes" read "Côte;" line 32, for "fo" read "to;" line 41, transfer "Pyrénées-Orientales" to line 42 in front of "Vernet;" delete "Cannes (Chapman)," which is in Alpes-Maritimes.

Page 389, line 24.—CELASTRINA ARGIOLUS—The gynandromorphs numbered 1 and 2 refer to the same insect. It is in the collection at the Haslemere Museum, and carries the label "Left side ♀, right side ♂, from the 'Briggs' coll.,' obtained from Mr. Tuely of Wandsworth (*vide Entom.*, ii., p. 295)."

Page 448, line 39.—Add "This ichneumon emerges from summer pupæ in July and August; but from over-wintering pupæ in April (*see* Morley, *Brit. Ichneumons*, i., p. 3)."

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ARRANGEMENT OF PLATES—NOTICE TO BINDER.
